DOI: 10.1002/mar.21109

RESEARCH ARTICLE

WILEY Psychology & Marketing

The preference for scarcity: A developmental and comparative perspective

Maria John[1] | Alicia P. Melis[2] | Daniel Read[2] | Federico Rossano[3] | Michael Tomasello[4]

[1]Dr. Maria John Communications

[2]The University of Warwick

[3]University of California

[4]Duke University

Correspondence
Alicia P. Melis, Behavioural Science Group, Warwick Business School, The University of Warwick, Coventry, UK.
Email: Alicia.melis@wbs.ac.uk

Abstract

Human adults often show a preference for scarce over abundant goods. In this paper, we investigate whether this preference was shared by 4- and 6-year-old children as well as chimpanzees, humans' nearest primate relative. Neither chimpanzees nor 4-year-olds displayed a scarcity preference, but 6-year-olds did, especially in the presence of competitors. We conclude that scarcity preference is a human-unique preference that develops as humans increase their cognitive skills and social experiences with peers and competitors. We explore different potential psychological explanations for scarcity preference and conclude scarcity preference is based on children's fear of missing out an opportunity, especially when dealing with uncertainty or goods of unknown value in the presence of competitors. Furthermore, the results are in line with studies showing that supply-based scarcity increases the desirability of hedonic goods, suggesting that even as early as 6 years of age humans may use scarce goods to feel unique or special.

KEYWORDS

children, comparative psychology, scarcity, uniqueness theory

1 | INTRODUCTION

People often desire and value scarce products over abundant ones. This fact is exploited by marketers who promote products and services by emphasizing their limited availability and by artificially creating scarcity (Cialdini, 2001; Lindsey-Mullikin & Petty, 2011). A preference for scarcity in itself is often considered to be inconsistent with the standard account of economic rationality, which assumes preferences are based on the intrinsic attributes of a good itself, independent of such local and context dependent attributes as scarcity (Mittone & Savadori, 2009). To see why, imagine a consumer shopping for a car. After careful and thorough consideration, the consumer learns there are two cars that perfectly meet her needs, but she prefers A over B. She goes to the dealer to buy car A, and finds that although there are three models of car A available, there is only one model of car B. A pure preference for scarcity would be displayed if, without learning anything further about either car, she then buys car B.

Although ample research in psychology and marketing has demonstrated that adult humans display a scarcity preference (e.g., Aggarwal, Jun, & Huh, 2011; Inman, Peter, & Raghubir, 1997; Jang, Ko, Morris, & Chang, 2015; Lynn, 1991; Worchel, Lee, & Adewole, 1975), little is known about the origins of this preference. This paper examines what we can learn by taking a comparative and developmental approach. Comparative studies on closely related species can provide insight into the evolutionary origins and function of a specific behavior. Chimpanzees are human's closest living relatives, and therefore an important test-case for evolutionary theories about humans' preferences and cognitive biases. With respect to scarcity preference, if chimpanzees, our nearest evolutionary relative, display a scarcity preference it is more likely the preference evolved once during our common evolutionary history and has an important adaptive value. In addition, studies with children of different ages will provide insight into the developmental pattern of this human preference.

We address the following questions: (1) What are the possible explanations for scarcity preference? (2) Which of these explanations could apply to chimpanzees and young children? (3) Do we actually find a scarcity preference in chimpanzees and young children, or does the preference emerge only in humans as they mature? Our answers to question (3) will suggest which of the answers to question (1) are likely to be correct. We start by considering the range of possible answers to the first question.

2 | PSYCHOLOGICAL EXPLANATIONS FOR SCARCITY PREFERENCE

Proposed reasons for scarcity preference can be divided into three (not necessarily mutually exclusive) subcategories: (1) scarcity may be a valued feature or characteristic of a good in itself; (2) scarcity may be correlated with valuable option features so that scarcity preference is

a useful choice heuristic; or (3) scarcity preference may be due to fear of missing out in combination with the need to achieve variety in consumption or to guarantee the benefits from complementarity. It may be that scarcity preference is multiply determined.

Marketers are highly aware of the possibility that scarcity has intrinsic value (Brown, 2001), and that simply owning and using a "limited edition" car or piece of clothing can provide pleasure in itself. This can be for social reasons, as in displaying one's standing in society, but it can also be simply for personal reasons. Having a limited-edition LP can provide pleasure even to someone who never shows the disc to anyone else, and who already has access to the music in alternative (nonlimited edition) forms. A preference for some degree of uniqueness or distinctiveness could also be a fundamental human value, as proposed by Snyder and Fromkin (1980). Snyder (1992) argues that people derive satisfaction and have an intrinsic need to perceive themselves as distinct from "the masses," and that scarce products give rise to a valued sense of specialness or uniqueness. Other related explanations relate the possession of scarce goods to feelings of power or enhanced status (Emerson, 1962; Veblen, 1899/1965). Several empirical studies have found evidence supporting this explanation (e.g., Aggarwal et al., 2011; Gierl & Huettl, 2010; Jang et al., 2015). For example, Gierl and Huettl (2010) found that consumer's attitudes towards conspicuous goods were more positive when the goods were scarce, and scarcity was due to limited supply (as opposed to high demand). This is because individuals who possess goods in limited supply can signal high social status in interpersonal relationships.

Even if scarcity is not valued in itself, scarcity preference could be a valid choice heuristic (Cialdini, 2001; Lee, Oh, & Jung, 2014). This could work in different ways. One is through the relationship between scarcity and price (Lynn, 1989, 1992). Scarcity often predicts market price, in that what a marginal consumer will pay for a good is a function of the demand for the good, and its supply. To see this, imagine that for any good we can rank consumers by their willingness to pay. We release the good to the market one item at a time, and sell the item to the consumer willing to pay the largest amount (this could be done using an auction)[1]. With each subsequent item, the amount the next consumer is willing to pay will fall. If we stop releasing goods when there is still unfulfilled demand (at a price greater than $0), the price the next consumer will pay will be a function of the degree of unfulfilled demand. That price will also be the current market price (or market clearing price) for the good. This idea is at the heart of economic explanations for why scarce goods cost more than common ones, and is famously used to explain Adam Smith's (Smith, 1776, p. 172) "diamond–water" paradox: If water was as scarce as diamonds, it would cost much more; but because diamonds are scarce whereas water is abundant, diamonds demand a much higher price.

It is worth considering whether this consumer response to scarcity is "rational," meaning the scarce good is likely to be of higher quality than the common one. This will depend on whether scarcity is supply-based or demand-based. Supply-based scarcity occurs when a good is in relatively short supply, so few consumers can actually have one of the goods, whereas demand-based scarcity occurs when, even though the good is relatively abundant, the demand for it is so great it is hard to get. In the case of supply-based scarcity there is no rational reason to expect the scarce good to be of higher quality. An LP limited to 100 pressings is not better than one limited to 100,000 simply because of the quantity constraint, even if the marginal consumer will pay more for the first than the second. Demand-based scarcity, on the other hand, can indicate high valuation on the part of other consumers and therefore be a rational inference about quality (Cialdini, 2001). To see this, imagine two LPs are placed on the market at the same price, each having 100,000 pressings. One LP quickly becomes scarce, whereas the other remains abundant. This suggests stronger demand for the now-scarce LP than for the common one. A rational consumer could infer that the (now) scarce LP is better because other consumers have chosen it in favor of the other (Kardes, Posavac, & Cronley, 2004; van Herpen, Pieters, & Zeelenberg, 2009). Balachander, Liu, and Stock (2009) suggest marketers often deploy supply-based scarcity in hopes of deceiving consumers into making a response that by rights should be restricted to demand-based scarcity (see also van Herpen et al., 2009).

Somewhat ironically, demand-based scarcity can be an indicator of abundant ownership, as in the example of the scarce LP which is likely to be found in almost 100,000 homes. In this way, a preference for scarcity can arise due to a bandwagon effect, or a desire for conformity, with people wanting to "fit in" in to their group and preferring to do what others are doing (e.g., Bearden & Etzel, 1982; van Herpen et al., 2009).

Scarcity preference can also be understood as a strategy to acquire variety or to acquire complementary goods, with scarce goods being at greater threat of being lost (c.f., Sundie, Cialdini, Griskevicius, & Kenrick, 2012). One way is in the case of imperfect substitutes or complementary goods, with scarcity indicating diminishing supply of a good that cannot be simply replaced with another that serves the same function. Whenever it is beneficial to hold a variety or a set of goods, and if some types of good are in short supply and you can only take some of the goods now, it is better to take the scarce goods first and get the common ones later (e.g., Mittone, Savadori, & Rumiati, 2005). Otherwise, you might "miss out" on a good opportunity. For example, to turn to our LP example, if you want the complete Rolling Stones LPs and "Let It Bleed" is almost sold out, whereas "Sticky Fingers" is in abundant supply, you should buy "Let It Bleed" first, secure in the knowledge that you can always get "Sticky Fingers" later.

3 | EVOLUTIONARY AND ONTOGENETIC ORIGINS OF A SCARCITY PREFERENCE

Do humans have a biological predisposition or preexisting bias to prefer scarce goods (as suggested by both Lee et al., 2014 and Mittone et al., 2005), or does it develop as humans acquire the ability to reason, knowledge of social values, and an understanding of key economic principles? If scarcity preference depends on such high-level processes, we would expect it to emerge late in development. On the other hand, an evolutionary-based scarcity preference would likely emerge early and may even occur in other species. There is a precedent for this, with other economic "biases" being found in unexpected populations (e.g., Kanngiesser, Santos, Hood, & Call, 2011; Santos & Chen, 2009; Shafir, Waite, & Smith, 2002). For example, honeybees and gray

jays both display asymmetric dominance effects (Shafir et al., 2002), and some nonhuman primates display the endowment effect and loss aversion (Brosnan, Jones, Gardner, Lambeth, & Schapiro, 2012; Chen, Lakshminarayanan, & Santos, 2006; Santos & Rosati, 2015).

Whether humans and other closely related primates have a biological predisposition or preexisting bias toward scarcity preference will depend on whether it increases Darwinian fitness in natural environments. This can occur if scarcity is naturally a signal or index of the quality of a resource and if the environment can offer cues that are predictive of scarcity. We have already discussed how scarcity can signal quality, when it is demand-based and implies that others have chosen the (now) scarce good over the common one. This advantage of scarce over common goods will be particularly marked when there is intraspecies competition for resources so that scarcity can be due to the choices made by other conspecifics.

The presence of intraspecies competition can also render the scarce option the best option if variety or complementarity are sought. We already alluded to this in the choice of two Rolling Stones' LPs—it is competition from other consumers that urges the choice of the scarce "Let It Bleed" over its complement "Sticky Fingers" (remember, you want the whole set of LPs). More generally, suppose there are two goods of uncertain value available, but one is scarce whereas the other is abundant, and there is competition for goods. If you choose the scarce good, you can always come back for the other option. But if you take the abundant one, all the scarce ones may get swept up. If the lower risk of scarce options is combined with loss aversion, which is often held to be a rational response to risky environments when resources are limited (e.g., McDermott, Fowler, & Smirnov, 2008), it is easy to see how even nonhuman primates might show scarcity preference (and, indeed, even in honeybees and shrews). In our experiments, we included explicit competition conditions, in which choices between scarce and nonscarce options were made in the presence of someone who would get the next choice. This is the equivalent of being in the record store deciding which LP to purchase, with another shopper interested in the same LP standing right behind you waiting her turn.

Comparative and developmental research can help us disentangle the processes underlying scarcity preference. Some explanations predict they can occur in nonhuman primates and children, whereas others do not. By testing for the existence of scarcity preference in such populations, we can narrow the set of plausible explanations for that preference.

Exhibit 1 summarizes our reasoning with respect to each basis for scarcity preference. Children do not start caring for their own self-reputation until at least age 5 (Engelmann, Herrmann, & Tomasello, 2012)—and chimpanzees do not care about it at all—therefore it is unlikely that chimpanzees and young children will show scarcity preference due to "uniqueness" concerns. Moreover, chimpanzees and young children have no (or little) experience with the kinds of economic markets in which a scarcity/quality relationship is likely to occur, so our second reason (scarcity heuristic) is unlikely to apply to these groups. But it is plausible that young children and chimpanzees will acquire scarcity preference due to the fear of missing out combined with a desire for variety or complementarity, especially in competitive situations.

EXHIBIT 1 Psychological explanations for scarcity preference and following predictions regarding its occurrence in chimpanzees and humans

Psychological explanations	Chimpanzees	Young children	Older children	Human adults
(1) Scarcity is valued in itself due to desire for uniqueness or high status	Absent	Unlikely	Developing	Present
(2) Scarcity heuristic due to link between scarcity and quality	Unlikely	Unlikely	Developing	Present
(3) Fear of missing out combined with variety seeking, complementarity and uncertainty	Possible	Possible	Present	Present

Our first explanation for scarcity preference is based on the view that scarce goods are valued simply *because* of their scarcity, perhaps because they enable people to distinguish themselves from others, or perhaps simply because the consumption of scarce goods is pleasurable in itself. This is an inherently social and human explanation. We know of no evidence that chimpanzees care about standing out among their peers in terms of their possessions. Moreover, chimpanzees hold no property and do not even store food. Consequently, if this explanation is correct, scarcity preference will emerge only in humans, and only then as children become fully socialized and start caring about their position in society. Scarcity preference due to explanation (1) might therefore be observed in older children, but not the youngest children and definitely not in chimpanzees.

Our second explanation is that there is a scarcity heuristic, in which quality and value are inferred from scarcity. Such a heuristic makes sense in human societies, as in the record-purchase example above, because scarcity can arise from the interaction between high demand and limited supply. In nonhumans this heuristic is unlikely to evolve, because it is hard to imagine situations in which scarcity would correlate with quality. Even if there are such situations, they are likely to be uncommon, and therefore could not exert sufficient evolutionary pressure leading to an evolved predisposition for scarcity bias. Therefore, we expect that any scarcity heuristic will emerge as humans become more experienced with market forces, and therefore to be absent in chimpanzees and very young children.

The third explanation is that scarcity preference is due to variety seeking, and a desire for complementary goods and the fear of "missing out." Variety and complementary sets can most safely be obtained by starting with the scarce items in a set and then moving on to the common ones. This may be particularly pronounced in situations of high uncertainty about the value of the options and if there is a possibility of missing out on the best. To return to the record example, imagine two new records become available in different quantities—there is 1 copy of one, and 100 of the other. You do not know anything about the

records and will buy only one today. You should take the single record, because if you do not like it you can always come back and get the other, and you are unlikely to have a second opportunity if you turn it down now. As already discussed, underlying this account is the presence of competitors likely to purchase the lone record if you do not. Chimpanzees have been shown to be strategic in social interactions, when there is competition over resources (e.g., Hare, Call, & Tomasello, 2001; Hare, Call, Agnetta, & Tomasello, 2000; Kaminski, Call, & Tomasello, 2008). They take into consideration what others might choose or may have chosen to inform their own decisions. Children at 4 years of age also employ different social strategies to access limited resources (Green & Rechis, 2006). Therefore, this is the most likely explanation that could lead to scarcity preference in chimpanzees and young children.

Only two previous studies have investigated scarcity preference in children. One of these studies was designed to test reactance theory (Brehm, 1966), although it was interpreted by Cialdini (2001) as demonstrating scarcity preference. Brehm and Weintraub (1977) offered 2-year-olds two equally attractive toys, one besides a Plexiglas barrier and one behind. When the Plexiglas barrier was short and the toy behind it easy to access, children had no preference for either toy, but when the barrier was high and made one toy hard to reach, that was the toy they wanted. Although Brehm and Weintraub's study is important, it is not obvious that choice restriction is the same as scarcity. It may be that a common but restricted good could be preferable to a scarce but unrestricted one. For instance, if there were 100 identical toys behind a tall Plexiglas barrier the children might still have preferred one of those to a single toy beside the barrier.

The second study by Mittone et al. (2005) directly investigated children's reactions to "limited-number" scarcity. They allowed children to choose 1 teddy bear from an array of 18, in which 15 were of one color, and 3 of another. The youngest children (aged 9–10) were more likely to choose the rare bears. The authors interpreted this as evidence that scarcity preference is present early in development, and therefore it is an instinctive basic bias present not only in young children but possibly also in nonhuman animals (Mittone et al., 2005). The study does not rule out an alternative explanation that children were choosing the most salient item, rather than a scarce one. Furthermore, 9-year-olds have already accumulated enough economic experience to make more advanced inferences about price and/or quality, as anyone who has seen children bargaining over marbles and trading cards will know. Fox and Kehret-Ward (1985) found that at 9 years children could reason from a seller's perspective and even took relative scarcity into account. Leiser (1983) also found that 9-year-olds were quite sophisticated economically.

In the present study, we examined the ontogenetic and evolutionary roots of scarcity preference, by testing young children's and chimpanzees. We developed methods that isolated scarcity effects from those of salience, and also developed ways to test for scarcity preference in chimpanzees. We tested children aged 4 and 6 because in this age range they are not yet familiar with prices and the relationship between economic variables such as supply and demand (Fox & Kehret-Ward, 1985, 1990; John, 1999; Leiser, 2001).

4 | OVERVIEW OF EXPERIMENTS

We presented children and chimpanzees with choices between scarce and nonscarce items, which they could actually keep. Unlike previous studies, we investigated what we will call *pure* scarcity preference, in which the choice items were only distinguished at the moment of choice by their scarcity or abundance. The common option was chosen by the experimenter from a pile of identical wrapped goods, the rare option from a "pile" containing only a single wrapped good. At the point of choice, the participant saw only the two choice options. This method, unlike that of Mittone et al. (2005), allowed us to rule out salience effects.

In both experiments, we manipulated competition by conducting the study in a competitive or noncompetitive context. In the noncompetitive condition, the experimenter simply offered the participant a choice between the scarce and abundant reward. In the competitive condition, participants chose in the presence of two social partners who would be choosing immediately after them. Our prediction was that the competitive context would increase the urgency of choosing the lone (scarce) item so that scarcity preference due to the third explanation, "variety seeking and fear of missing out" would emerge more easily in the presence of competitors. Scarcity preference in the noncompetitive condition would indicate a role for the two other explanations, "uniqueness" and the "scarce-quality heuristic."

Participants were also tested in two additional matched control conditions (i.e., competitive and noncompetitive) but with known and identifiable items for which they had established preferences. In the case of chimpanzees, for instance, we offered them an abundant tasty food (e.g., banana) and a scarce boring food (e.g., carrot). We did not expect scarcity preference to emerge in these conditions because there was no uncertainty about the value of the goods and individuals always had clear preferences between the options. The primary rationale for these control conditions was that in the eventuality of not finding a scarcity preference in the treatment conditions, the control conditions would validate the method and demonstrate subjects do not choose randomly when they have clear preferences and are paying attention to the task.

We first report the experiment with chimpanzees and then the experiment with children. There were methodological differences between the two populations for two main reasons. First, we cannot give verbal instructions to chimpanzees and therefore a longer familiarization phase with the chimpanzees was necessary to make sure they understood the choice task rules when they started the test phase. Second, our sample size in the chimpanzee study was smaller and therefore we conducted more test trials with each chimpanzee participant. Importantly, both species received a familiarization phase, warm-up trials and test phase and the methods employed allowed us to guarantee that both species started the test phase understanding the task.

5 | EXPERIMENT 1: CHIMPANZEES

5.1 | Materials and methods

5.1.1 | Participants

Sixteen chimpanzees (M = 15.69 years, range = 11–22; 8 males, 8 females) participated. This is a common sample size for comparative studies. The chimpanzees were drawn from a social group of 42 from Ngamba Island Chimpanzee Sanctuary in Lake Victoria, Uganda (www.ngambaisland.com) established in 1998 to care for confiscated orphan chimpanzees. All participants were unrelated. One of the eight males and three additional males (M = 14.5 years, range = 13–17) participated as competitors. The chimpanzee participants were never food deprived and water was available ad libitum. They could choose to stop participating at any time by approaching the exit door of the testing room.

5.1.2 | Procedure and design

Participants were tested individually. They were given the choice between a scarce and an abundant item. There were four conditions in a 2 × 2 repeated measures design. The two factors were novel or familiar rewards and a competitive or noncompetitive decision environment.

The general procedure can best be understood by studying Figure 1. The participant sat in one room of the holding facility, where the chimpanzees normally spend the night. The choices were presented using a choosing board made of plastic (100 × 22.5 cm) placed outside the participant's room in the keepers' corridor. The rewards were placed on two square plastic dishes (21 × 21 × 2.5 cm) located on either side of the board. At first, participants saw all the contents of both dishes, i.e., the pile of five on one end of the board, and the single (scarce) item on the other end (Figure 1a). However, before allowing the chimpanzee to make a choice, the experimenter covered both dishes with an opaque cover (18 × 18 × 10 cm) and placed one item on top of each cover (Figure 1b). The actual choice the chimpanzee made was therefore between two single items, one of which had come from a small population (of one), and the other from a large population. This method therefore rules out saliency at the moment of choice, because there is only one item of each (scarce vs. abundant). By covering the two dishes before allowing the participants to choose, we also made it clear they would only obtain one item.

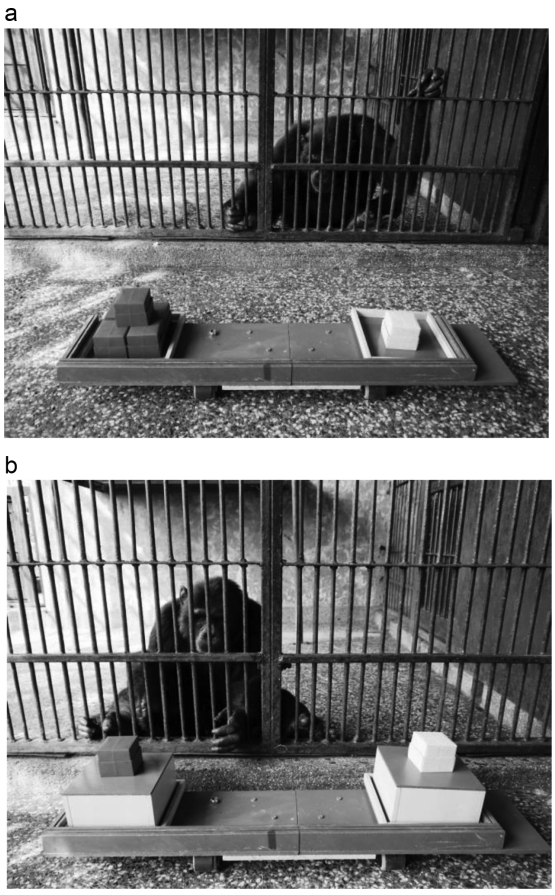

FIGURE 1 (a) Initial presentation of the rewards (Novel Condition). At first, the participant saw the total amount of containers (here: origami boxes with food rewards inside) from both piles (abundant and scarce). (b) Chimpanzee choosing the container from the abundant pile. At the moment of choice, they were confronted with two single items placed on top of their respective covered pile

Familiarization phase

Because this procedure was not initially familiar to the chimpanzees, and because we could not use verbal instructions, we conducted a familiarization pretest to acquaint them with the paradigm, and to ensure they understood that choosing an item extracted from the big pile did not translate into receiving the whole pile, as it would be in typical quantity discrimination studies (e.g., Hanus & Call, 2007). The goal of this pretest was to demonstrate to the chimpanzees that they would receive only one item for each choice, regardless of whether the item came from the abundant or scarce pile. This procedure was necessary because quantity discrimination studies have shown that chimpanzees prefer large over small quantities of food (e.g., Boysen & Berntson, 1989; Hanus & Call, 2007), and we could not verbally explain that they would not obtain the whole pile when choosing the food piece extracted from the abundant pile. However, this pretest could not interfere with the actual test, because in this pretest participants were presented with a choice between identical known visible items, whereas in the scarcity test they were confronted with different goods of unknown value.

In the familiarization pretest, participants chose between two pieces of the same food, such as a banana piece extracted from a pile of five pieces (abundant option) and an identical banana piece extracted from a dish with a "pile" of only one piece (scarce option). Following each choice, the experimenter removed all the food from the board and initiated a new trial with a new type of food. We performed eight trials per session with each type of food (banana, watermelon, cucumber, and eggplant) presented twice. Participants were expected to choose randomly because the options were identical (banana vs. banana) differing only in that one of the banana pieces came from the abundant pile and the other came from the scarce pile. Participants received as many sessions as needed until they chose randomly in two consecutive sessions (they should not have a preference for one or the other pile as assessed by a binomial test).

Test phase

Warm-up The pretest was followed by a warm-up phase to show the chimpanzees they would choose between different colored containers containing different quality food pieces. In this phase, they were also familiarized with the presence of two chimpanzee competitors, who would choose after them from the same set of options.

The warm-up phase was performed in a competitive environment to familiarize participants with the competitive conditions, and that they would encounter wrapped rewards from now on. They also learned there would be a high-quality reward in one container (watermelon or bananas) and a low-quality reward in the other (cucumber and eggplant). All chimpanzees, even from different populations, always prefer highly sugared fruits to watery or bitter ones. The variable of interest (scarcity vs. abundance) was not introduced until the actual test, because in the warm-up subjects were presented with two same-size piles.

The procedure was as follows: subjects chose between items from two same-size piles of containers (e.g., four black vs. four white wood boxes). In a given trial, the containers used for both options always had the same shape but different colors. Chimpanzees do not have established preferences regarding colors. The participant chose first, followed by the competitors who sat approximately two meters away from the participant in a facing room. The choosing board was moved from the participant to the first competitor, then to the second, and then came back to the participant, until all containers on the board had been chosen. There were six warm-up trials, administered in three different sessions (two trials per session). The side of the board and the colored container holding the high-quality food was counterbalanced within and across participants. The order in which the two types of container were presented was randomized across participants.

Test of scarcity preference All participants participated in four experimental conditions: Novel–Noncompetitive, Novel–Competitive, Familiar–Noncompetitive and Familiar–Competitive. To enhance competitiveness, before each trial of the competitive conditions each competitor was given, in full view of the participant, two items from each option (scarce and abundant). Although participants could see the competitors receiving the items, they could not see what was inside the containers.

The conditions unfolded as follows:

a. Novel–Noncompetitive: Using the choice procedure explained above (Figure 1), the chimpanzees were offered a choice between scarce (single item) and abundant (five item) containers that had high- and low-quality food inside. Within a trial, the containers were colored differently but had the same shape: they could be cardboard cones (pink, yellow, blue, green), metal bowls with striped colors (yellow, orange, green, dark blue), origami boxes (light blue, grey, red, violet), and plastic spheres (gold, lemon, dark green, rose) as containers. Each container contained one food item. To avoid an association between containers and rewards, the participant encountered any pair of containers only once. In each trial, the participants encountered two different colors of the same type of container. One container always contained a high-quality food (watermelon piece or banana slice), whereas the other always contained a low-quality food (cucumber or eggplant slice). After the chimpanzee had chosen, the experimenter extracted the food from the container and handed it to them. Although we were interested only in participants' first choice we allowed participants to continue choosing items until they were all gone, so that they were able to obtain six items per trial.

b. Novel–Competitive: This was like the condition (a) above, except that choices were made in a competitive context. After the initial choice, the board was transferred to the competitor's room, where each competitor chose once before the board was returned to the main participant. This continued until the board was empty, and the chooser and two competitors had each received two items.

In the "familiar" conditions, the rewards were not inside containers but presented openly.

c. Familiar–Noncompetitive: The participant chose between a visible high-quality food item (either from a scarce or abundant pile) and a low-quality food item (either from a scarce of abundant pile). As high-quality food, we used watermelon balls (diameter = 3 cm) and banana slices (thickness = 1 cm), and as low-quality food, cucumber as well as eggplant slices (thickness = 1 cm).

d. Familiar–Competitive: Participants were offered familiar food as in (c) but in a social context as in (b).

The position on the board (left vs. right) of the different food qualities (high vs. low) and quantities (abundant vs. scarce) was counterbalanced within participants. All participants received four trials per condition administered in eight sessions of two trials each. The order of conditions was counterbalanced within and across participants.

5.1.3 | Coding and data analysis

We coded only the first choice in each trial, because after the first choice, the scarce option could have disappeared already. A choice was defined as either extending a limb towards/through the bars of the respective side or putting the lips through the bars of the side closest to one of the options, accompanied by staring at the specific container or food item.

All trials were videotaped and interobserver reliability was determined for a randomly chosen 25% of the total data. The second coder was blind to the conditions and hypotheses being tested. There was a 100% agreement between both coders (Cohen's $\kappa = 1.00, p < .001$).

Although the data meets the assumption of independence and represents interval data, it violates normal distribution and homogeneity of variance and therefore does not meet all the assumptions needed for parametric testing. Thus, the data were analyzed using nonparametric methods. All *p*-values reported are two-tailed.

5.2 | Results and discussion

Thirteen out of 16 participants passed the familiarization pretest after two sessions, two subjects after three sessions and one subject after four sessions, showing that participants understood they would only

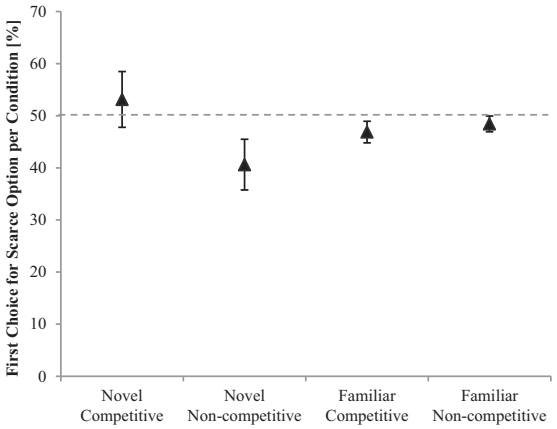

FIGURE 2 Results of Experiment 1 (N = 16). Percentage of trials in which the scarce option was chosen first, plotted per condition (four trials per condition). Novel–Competitive: Participants chose between differently colored containers which had food inside. Afterward, two competitors chose. Novel–Noncompetitive: Participants chose by themselves between differently colored containers which had food inside. Familiar–Competitive: Participants chose visible and familiar food directly. Afterward, two competitors chose. Familiar–Noncompetitive: Participants chose by themselves between two types of visible and familiar food. Error bars represent standard error of the mean. Dashed line represents chance level

obtain one reward regardless of which pile of items (scarce vs. abundant) the items were extracted from.

We compared the percentage of choices for the scarce option with a hypothetical mean representing chance level (50%) by using a Wilcoxon signed ranked test. There was no preference for scarce goods under any condition (Novel–Competitive: $Z = -0.54$, $p = .781$, $r = -.14$; Novel–Noncompetitive: $Z = -1.73$, $p = .148$, $r = -.43$; Familiar–Competitive: $Z = -1.41$, $p = .500$, $r = -.35$; Familiar–Noncompetitive: $Z = -1.00$, $p = 1.000$, $r = -.25$; Figure 2). Participants also did not differ in their choices for scarce goods across the four different conditions (Friedman test: $\chi^2(3) = 4.19$, $p = .251$).

Finally, we hypothesized that in the familiar (control) conditions, the chimpanzees would choose based on their established preferences. Therefore, we tested whether they preferentially chose high-quality (most liked) food rewards in the familiar conditions. As predicted, they did choose the high-quality food more often than as predicted by chance, both when competitors were present and when they were absent (Wilcoxon signed ranked test: Familiar–Competitive: $Z = -3.82$, $p < .001$, $r = -.95$; Familiar–Noncompetitive: $Z = -3.90$, $p < .001$, $r = -.98$). A direct comparison between these two conditions revealed no difference (Familiar–Competitive vs. –Noncompetitive: $Z = -0.58$, $p = 1.000$, $r = -.14$).

A post hoc analysis of the data revealed an effect of gender regarding the preference for scarce goods in the Novel–Competitive condition. Males chose the scarce option more often than females in this condition (Mann–Whitney test: $U = 12.00$, $Z = -2.42$, $p = .038$, $r = -.61$, Table 1). However, comparing both genders to a hypothetical mean representing chance level revealed no difference from chance (Novel–Competitive [females]: $Z = -1.34$, $p = .500$, $r = -.47$; Novel–Competitive [males]: $Z = -1.89$, $p = .125$, $r = -.67$).

Overall, the results were clear. There was no scarcity preference in chimpanzees, and this was not due to the chimpanzees not understanding the choice task or not being motivated to participate in the experiment, because they took the "best" option when given a choice between more and less desirable food. None of the analyses suggested that they had any preference or strategy when choosing either scarce or abundant novel items. It seems safe to conclude that scarcity does not increase the desirability of goods for chimpanzees, even in the presence of competitors. It remains to ask whether young humans display scarcity preference, and if so when does it emerge.

6 | EXPERIMENT 2: HUMAN CHILDREN

The methodology employed to test the children was as close as possible to that of Experiment 1. One difference was that children, who could be given verbal instructions, met the criterion in the familiarization phase after only four fixed trials (whereas chimpanzees received more sessions). Chimpanzees received six warm-up trials, whereas children received only two (again with the help of verbal explanations), and whereas chimpanzees received four trials per condition in the test phase, children received only two (we had 32 children per age group and only 16 chimpanzees). For the children, we used stickers as rewards because children are highly motivated to obtain them. A previous study that used both nonedible and edible rewards in children found no difference in children's behavior with regard to the different rewards (Warneken et al., 2011).

6.1 | Materials and methods

6.1.1 | Participants

Thirty-two 4-year-old children ($M = 4.24$ years, *range* = 4.01–4.50; 15 male, 17 female), and thirty-two 6-year-old children ($M = 6.88$ years, *range* = 6.76–7.02; 16 males, 16 females) participated. This is a common sample size used in developmental experiments.

The children were recruited from a database of Leipzig (Germany) daycare centers and primary school daycare. Their parents had agreed to have their children voluntarily participate in child-development studies. The participants belonged to mixed socioeconomic backgrounds.

6.1.2 | Procedure and design

As in Experiment 1, the children were tested individually in an object choice task. To determine their preferences over different stickers, we presented each child with sets of four different kinds of stickers: fish, owls, letters, and dots. The children were presented with four cards, each with one sticker type, and asked to choose the card with the sticker they liked most. Then the children chose the card they liked most from the remaining three cards and so on. This way, we determined two high-quality and two low-quality sticker types for each child by assessing the order of sticker likability.

As in Experiment 1, the general procedure was that children chose between two options: an item taken from an abundant pile, and a

TABLE 1 Percentage of trials in which the scarce option was chosen first in Experiments 1 and 2

	Experiment 1	Experiment 2	
Percentage of Trials	Chimpanzees	4-Year-old	6-Year-old
Scarce Option Chosen First			
Novel–Competitive	53.13 *(40.63/65.62)**	45.31 *(50.00/40.00)*	64.06* *(59.38/68.75)*
Novel–Noncompetitive	40.63 *(37.50/43.75)*	48.44 *(52.94/43.33)*	62.20 *(46.86/78.13*)**
Familiar–Competitive	46.89 *(43.75/50.00)*	53.13 *(52.94/53.33)*	53.13 *(50.00/56.25)*
Familiar–Noncompetitive	48.44 *(46.86/50.00)*	48.44 *(46.67/50.00)*	56.25 *(50.00/62.50)*
High-quality option chosen first			
Familiar–Competitive	96.88***	71.88**	96.88***
Familiar–Noncompetitive	98.44***	64.06*	68.75**

Note: Italicized values in parentheses represent the results for the different genders. First number in parentheses indicates the results for females; second number the results for males. Asterisks within parentheses indicate comparison against chance, asterisks outside the parentheses indicate comparison of the genders which each other.
*$p < .05$, **$p < .01$, ***$p < .001$

unique or scarce item. All participants participated in all four conditions of a 2 × 2 design, in which we varied the novelty and familiarity of the items as well as a competitive and noncompetitive decision environment.

Each child was tested in a room at the day care facilities. Throughout the test, the child sat at a table, opposite to the experimenter. The different choices were presented using a wooden board placed on the table between the child and the experimenter. The rewards were placed on two wooden dishes (21 × 21 × 2.5 cm) located on either side of the board. At first, children saw all the contents of both dishes, i.e., the abundant pile on one end of the board, and the scarce item on the other end. However, before allowing the child to make a choice, the experimenter covered both piles with an opaque cover (18 × 18 × 10 cm) and placed one of the respective items on top of each cover. By covering the two dishes before allowing the children to choose, we wanted to make clear that, as in the case of the chimpanzees, they would only obtain one item, even if they chose the item on top of the abundant pile. After obtaining the reward, the child was able to put it in a beaker in front of her/him.

As in Experiment 1, the children received a familiarization pretest, a warm-up and the test of scarcity preference. Children received all three parts of the experiment on one single day.

Familiarization phase

Children chose between two piles of the same sticker type. For example, they chose between an owl sticker taken from a pile of five owl stickers (abundant option) or an owl sticker taken from a dish with only one owl sticker (scarce option). After the child had chosen, the experimenter removed all the stickers from the board and initiated the next trial with a new type of sticker. Because we could verbally explain to the children that they would only obtain one sticker (independently of which pile the sticker was extracted from) we only performed four trials in total, so that each type of sticker (owl, fish, letters, and dots) was presented once. As with the chimpanzees, children were expected to choose randomly because they had to make a choice between two identical stickers.

Test phase

Warm-up The warm-up was performed as in Experiment 1 (although children were also told that one container would always contain a more preferred sticker than the other). Children chose between items from two same-size piles of containers (e.g., four flat vs. four round containers). One container contained a highly preferred sticker, whereas the other contained a less preferred sticker. We conducted two warm-up trials, and we varied the container color across trials. Therefore, in each trial, we used containers of the same color (e.g., violet) but different shapes, flat and round. As in Experiment 1, this phase was performed in a competitive environment. The children were told they could choose first, and that after them "Lola" and "Max" would also choose (Lola and Max were two puppets manipulated by a second experimenter) until all the containers had been chosen. Using puppets, instead of another child peer, is a common method used in developmental psychology (e.g., Kanngiesser & Warneken, 2012; Melis, Altrichter, & Tomasello, 2013). At these young ages, children play along and more easily treat the puppets as peers than if they were interacting with an adult experimenter. This method allows for controlled manipulations of the variables of interest.

The procedure was as follows: the child chose first, then the choosing board was moved to one puppet who chose, then to the other puppet, and then back to the child, with this repeating until all containers on the board had been chosen. The puppets chose randomly, and following each choice they stated which container they wanted (e.g., "I want the red square box"). The side of the board and the containers that contained the high-quality sticker were counterbalanced within and across participants. The order in which children were presented with the different sets of containers was randomized across participants. In the warm-up phase, children experienced the competitive aspect of the game (i.e., puppets chose after them potentially taking away what children did not choose right away).

Test of scarcity preference All children participated in all four conditions: Novel–Noncompetitive, Novel–Competitive, Familiar–Noncompetitive and Familiar–Competitive. Each child received two trials per condition resulting in eight trials overall (children did not

know how many trials there would be and how many choices they would be able to make). The order of the conditions was randomized within and across participants. Because children received all conditions on the same day, we did not conduct additional prelude trials prior to the competitive conditions (i.e., children had just experienced the socio-competitive context in the warm-up phase). In the competitive conditions, children were told that they would play with "Lola" and "Max," whereas in the noncompetitive conditions, they were told they would play by themselves because "Lola" and "Max" were outside doing something else.

The conditions were as follows:

a. **Novel–Noncompetitive**: The children made a choice in a nonsocial context, just by themselves. Children were offered a choice between scarce (single item) and abundant (five item) containers that had highly preferred and less preferred stickers inside. Each container was filled with a single sticker. The containers used were triangular and round wooden boxes in red (set one), green (set two), blue (set three), and yellow (set four). Each child encountered every container only once. In each trial, the participants faced one set (sets one, two, three, or four) of containers. Children were able to take the container and extract the sticker by themselves. Although we were interested only in children' first choice, we allowed them to continue choosing containers until they were all gone, so that they were able to obtain six stickers per trial.
b. **Novel–Competitive**: Like in (a) but the children had to make a choice in a competitive context. After choosing, the Experimenter moved the board on the table towards partner one on the left side of the child, from competitor one to competitor two on the right side of the child and then back to the participant, until all items on the board had been chosen. If children did not choose the scarce item, one of the competitive partners did. All participants were therefore able to obtain two items per trial.

In the control "familiar" conditions, the stickers were not inside containers but presented openly.

c. **Familiar–Noncompetitive**: The child was offered a choice between a visible high-quality sticker (either from a scarce or abundant pile) and a low-quality food item (either from a scarce of abundant pile).
d. **Familiar–Competitive**: The child was offered visible stickers as in (c) but in a competitive context as in (b).

If participants did not make a choice within 10 sec after the board had been moved towards them, they were encouraged to make a choice.

6.1.3 | Coding and data analysis

We coded only the first choice made by the child in each trial. A choice was made by either pointing or grabbing the desired item directly. If they just made a verbal decision, they were encouraged to take the item.

All trials were videotaped and interobserver reliability was determined for a randomly chosen 25% of the total data. The second coder was blind to the conditions and hypotheses being tested. There was a 100% agreement between both coders in regard to the choices made by the participants during the object choice task (Cohen's $\kappa = 1.00$, $p < .001$).

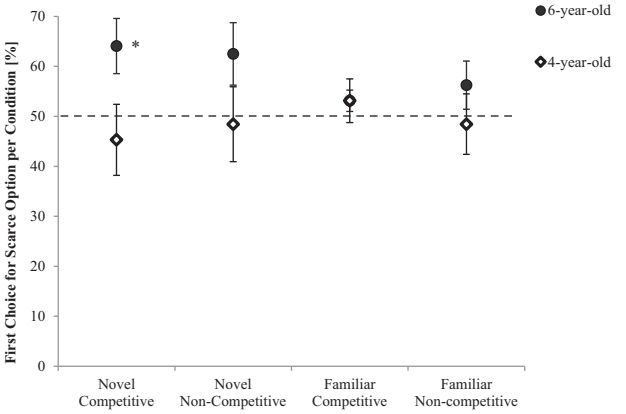

FIGURE 3 Results of Experiment 2 (N [4yo] = 32, N [6yo] = 32). Percentage of trials in which the scarce option was chosen first, plotted per condition (four trials per condition). Novel–Competitive: Participants chose between differently shaped containers which had stickers inside. Afterward, two competitors chose. Novel–Noncompetitive: Participants chose by themselves between differently shaped containers which had stickers inside. Familiar–Competitive: Participants chose visible and familiar stickers directly. Afterward, two stooges chose. Familiar–Noncompetitive: Participants chose by themselves visible and familiar stickers. Significance Codes: *p < .05, **p < .01, ***p < .001. Error bars represent standard error of the mean. Dashed line represents chance level

The data of the individual conditions did not meet all the assumptions for parametric testing. Therefore, comparisons against chance were performed using nonparametric methods. All *p*-values reported are two-tailed.

6.2 | Results and discussion

In the familiarization, pretest children chose randomly between identical items. A comparison between the percentage of choices for the abundant/scarce option with a hypothetical mean representing chance level (50%) revealed no preference for one or the other (Wilcoxon signed ranked test: 4-year-olds: $Z = -.354$, $p = .723$, $N = 32$; 6-year-olds: $Z = -1.725$, $p = .084$, $N = 32$) showing that children at both ages understood they would only obtain one reward regardless of which pile of items (scarce vs. abundant) the items were extracted from.

In the scarcity test, we found no preference for scarce goods for the 4-year-old children under any condition (Wilcoxon signed ranked test: Novel–Competitive: $Z = -0.66$, $p = .664$, $r = -.12$; Novel–Noncompetitive: $Z = -0.21$, $p = 1.000$, $r = -.04$; Familiar–Competitive: $Z = -0.71$, $p = .727$, $r = -.12$; Familiar–Noncompetitive: $Z = -0.26$, $p = 1.000$, $r = -.05$; Figure 3).

Among the 6-year-olds, on the other hand, we did we found a significant difference in the Novel–Competitive condition ($Z = -2.32$, $p = .035$, $r = -.41$) but not so clearly in the Novel–Noncompetitive condition ($Z = -1.89$, $p = .096$, $r = -.33$). There was no effect in either of the Familiar conditions (Familiar–Competitive: $Z = -1.41$, $p = .500$,

$r = -.25$; Familiar–Noncompetitive: $Z = -1.27$, $p = .344$, $r = -.22$). As can be seen in Figure 3, a direct comparison between the Novel–Competitive and the Novel–Noncompetitive revealed no difference between them (Wilcoxon signed ranked test: Novel–Competitive vs. Noncompetitive: $Z = -0.24$, $p = 1.000$, $r = -.04$).

Finally, as with the chimpanzees, we predicted that in the Familiar conditions children would go for the "best" options first. Therefore, we tested whether children preferentially chose their most preferable stickers in the familiar conditions. We found that 4-year-old children chose their most preferable stickers both in the presence of possible competitors (Familiar–Competitive [4yo]: $Z = -2.86$, $p = .007$, $r = -.51$) as well as in their absence (Familiar–Noncompetitive [4yo]: $Z = -2.18$, $p = .049$, $r = -.39$) when compared to a hypothetical mean representing chance level. A direct comparison between these two conditions revealed no statistical difference (Wilcoxon signed rank test: Familiar–Competitive vs. Noncompetitive [4yo]: $Z = -1.06$, $p = .311$, $r = -.19$; see Table 1).

Similarly, the 6-year-old participants preferred high-quality stickers in the presence of competitors as well as when choosing by themselves (Wilcoxon signed ranked test: Familiar–Competitive [6yo]: $Z = -5.48$, $p < .001$, $r = -.97$; Familiar–Noncompetitive [6yo]: $Z = -2.56$, $p = .017$, $r = -.45$) when compared to a hypothetical mean representing chance level. However, as shown in Table 1, in this case the competition aspect did affect the urge to choose preferred stickers, because 6-year-old children chose preferred stickers significantly more often in the Competitive than in the Noncompetitive–Familiar condition (Familiar–Competitive vs. Noncompetitive [6yo]: $Z = -3.218$, $p = .001$, $r = -.57$).

As with the chimpanzees, we conducted a post hoc analysis to see if there was potential effect of gender. Among the 4-year-olds, there was none. Among the 6-year-olds, however, we found that in the Noncompetitive condition boys showed a strong scarcity preferences (Novel–Noncompetitive [6yo, male]: $Z = -2.71$, $p = .012$, $r = -.69$), but girls did not (Novel–Noncompetitive [6yo, female]: $Z = -0.39$, $p = 1.000$, $r = -.09$). There were no other effects of gender. We suggest this is an interesting avenue for further research.

This experiment demonstrates a clear developmental difference in the scarcity effect. Younger children showed no scarcity preference, whereas older ones did. Specifically, the 6-year-olds exhibited a preference for the novel and scarce rewards in the presence of competitors. In the absence of competitors, the results were not as clear, because as a group their preference for scarce rewards was not significant, but when analyzing the genders separately, boys did choose the scarce option significantly more often than as predicted by chance.

As originally predicted when participants were familiar with the rewards and had a clear preference for one over the other, scarcity did not matter. That is, in the matched familiar conditions when confronted with familiar rewards, both groups of children chose the most preferred reward first.

Interestingly, 6-year-olds chose the highly preferred reward in the competitive condition at higher (almost ceiling) levels than in the non-competitive condition, which shows that they were being strategic trying to make sure that they do not lose their preferred reward when it is at risk of being taken by others. This is in line with our "fear of missing out" hypothesis, although here participants knew the value of the rewards and therefore went for the best one.

7 | GENERAL DISCUSSION

We found evidence for scarcity preference among 6-year-old humans, but not among chimpanzees or 4-year-old humans. We conclude that a preference for scarce goods develops in human ontogeny. We do not believe that we obtained our results because chimpanzees and 4-year-olds are incapable of keeping track of whether items are "unique" or "abundant." Both groups are very able to discriminate between different quantities, even in much more complex situations than we studied (e.g., Beran, 2004; Hanus & Call, 2007). Our control conditions with familiar items, in which subjects always chose their favourite rewards first, also demonstrate that both chimpanzees and 4-year-olds were motivated to play the game and were paying attention to the choices offered.

Among the 6-year-olds, scarcity preference appeared most clearly in the competitive condition, when the scarce item was at high risk of being taken by the competitors. The presence of competitive partners apparently increased the urgency to obtain the unique item (in the same way that it increased the urgency to obtain the preferred item in the familiar condition). Because participants were allowed to choose first (followed by the two competitors), they could assure themselves of obtaining one scarce and one abundant item by starting with the scarce item. It is not clear whether 6-year-olds exhibit scarcity preference in the absence of competitors as well. The boys in our study did but the girls did not. More focused studies with larger samples will be necessary to investigate this further.

Given that the presence of competitors was a key factor eliciting scarcity preference, the most likely explanation for it is that children did not want to miss out on an opportunity. Furthermore, choosing the scarce item first allowed children to maximize variety when the intrinsic value of the goods at stake was unclear. We had initially hypothesized that, if this explanation applies, chimpanzees and young children would possibly also exhibit the scarcity preference. However, the fact that 4-year-old children and chimpanzees do not behave in the same way suggests that cognitive skills that develop around 6 years of age in humans may be necessary for this. It is possible that scarcity preference relies on prospective planning skills and the capacity to picture a couple of moves ahead, something which neither chimpanzees nor 4-year-olds may be capable of.

Chimpanzees employ sophisticated behavioral strategies, incorporating knowledge about what others can and cannot see (or hear) to outwit competitors (Hare et al., 2000, 2001, 2006; Kaminski et al., 2008; Melis, Call, & Tomasello, 2006). For example, when a subordinate chimpanzee observes that a dominant individual can see the location of reward A, but not of reward B, she/he preferentially retrieves B, because taking A could lead to a fight with the dominant individual (Hare et al., 2000). On the contrary, dominant chimpanzees will go for the piece of food that both chimpanzees can see, i.e., the one that is "at risk" from competitors (Hare et al., 2000). The crucial difference between these competitive situations and the current study is that in

previous studies individuals were competing in the same turn, whereas in our set-up they have to think about future moves or "what will the competitor do after I have chosen?" which is cognitively more demanding. We know that prospective planning skills, imagining and linking present actions and future events are skills that in humans develop around 5 years of age (McCormack & Atance, 2011; Melis, Grocke, Kalbitz, & Tomasello, 2016). There is also some evidence for planning skills in chimpanzees, but these are very limited to individual tool-use situations and do not involve calculating social partners' most likely future responses (Kaminski et al., 2008; Melis et al., 2016; Mulcahy & Call, 2006). If chimpanzees and 4-year-olds cannot think about the competitors' future moves, then they may also not experience any fear of missing out an opportunity.

Given that we found that the scarcity preference emerges between 4 and 6 years of age in humans, are any of the remaining explanations for scarcity preference also likely to be correct?

At age 6, children have not obtained sophisticated knowledge of economic and market variables (Fox & Kehret-Ward, 1985; Leiser, 1983; Lynn, 1992). In our study, the source of scarcity was low supply (and not high demand). Furthermore, in the competitive condition participants were given the first choice, so their preference for the scarce goods could not be influenced by others' choices. Based on this, it is unlikely children were making inferences about others' preferences and choices, so we can rule out bandwagon effects or inferences about quality as the main explanation for scarcity preference in this study. Future studies could investigate young children's scarcity preference when the source of scarcity is high demand (or others' previous choices). Maybe scarcity that signals high demand also triggers quality inferences and positive attitudes towards goods in children at this age.

There is evidence showing that supply-based scarcity increases the desirability of hedonic goods, because possessing hedonic goods that almost nobody has can provide individuals with a feeling of being special (Ku, Kuo, Yang, & Chung, 2013). This is because individuals' purchasing motives are different depending on whether they are dealing with the acquisition of utilitarian or hedonic goods (Chernev, 2004; Rossiter, Percy, & Donovan, 1991). Whereas utilitarian goods accomplish a functional or practical goal (and therefore information about how others value the commodity can be very useful), hedonic goods accomplish a symbolic or self-expression function, so that having things that others do not have becomes highly attractive.

In this study, we used stickers as rewards for the children. Stickers can probably be characterized as hedonic goods because they do not have a functional or practical goal and are often collected by children and exhibited to their peers. In the experimental conditions, the stickers were inside small containers, so the children did not know the specific type of sticker they would obtain. However, they did know there were stickers inside the containers. By choosing the unique (sticker-containing) items, children could be trying to maximize variety as well as increasing the probability of obtaining a type of sticker that nobody else has. Therefore, the first explanation that argues that humans are attracted to scarce (hedonic) goods because it provides them with feelings of personal distinctiveness[2] and uniqueness (Snyder, 1992) could also apply here. Children could have chosen the unique item first, because they thought they would obtain a less common and more special type of sticker; a sticker which only they would have (in addition to the more abundant ones).

The uniqueness explanation did not make specific predictions regarding the competitiveness of the choice environment, because a preference for scarce goods, as a way of acquiring status and feelings of uniqueness, does not rely on clear direct competition. Interestingly, we found that only boys preferred the scarce items in the noncompetitive condition. Given we had no a priori predictions regarding the role of gender, one should be cautious regarding these results. However, if this gender difference replicates in future studies, one possibility is that the higher competitiveness typical of boys (e.g., Gneezy & Rustichini, 2004; Sutter & Rützler, 2010), also leads to a higher motivation to be "special," and therefore boys are attracted more generally to scarce products because that allows them to enhance a feeling of "uniqueness" or higher status (Snyder, 1992).

The two explanations, "desire for uniqueness" and "fear of missing out" are not mutually exclusive and it could be that both played a role in the current study. Future studies should also investigate children's preferences for scarce utilitarian goods. If the scarcity preference at this young age is solely based on the desire to feel special, advantaged, or unique, they should not exhibit such a scarcity preference for utilitarian and practical goods. However, if scarcity preference is mainly due to the fear of missing out and a tendency for variety seeking, these results should replicate when the goods at stake have utilitarian and practical value.

The goal of this research was twofold. One was to investigate the evolutionary and developmental origins of scarcity preference in humans, and a second was to draw conclusions about the most likely explanation for this preference. Our results suggest supply-based scarcity does not affect value attribution in chimpanzees, but it does in young children beginning at around school age and especially in competitive situations. Given these results, we cannot conclude that scarcity preference is a preexisting evolutionary bias. Because children at this age have already undergone extensive socialization and cognitive development, these results suggest they may learn from their social interactions with peers and adults, strategies to acquire resources and maximize variety in the presence of competitors. Thus, it seems safe to conclude that scarcity preference is unique to humans.

If preferences for scarcity are learned and not the result of evolutionary pressure, then they are likely to be malleable and context dependent. We should not expect to find a general preference for scarcity, but rather expect that it will emerge only if there are reasons for it to emerge. They can emerge when children or adults learn there is a relationship between scarcity and value, or they can emerge from education or marketing, or they can emerge due to competitive pressures. This fits how scarcity is often marketed, not simply as "rare" but as an opportunity to "get it while supplies last." Further investigations of scarcity preference should focus on the circumstances in which it emerges, and the kinds of goods and experiences which can produce such a preference. This will help marketers to target different audiences more successfully.

ACKNOWLEDGMENTS

The authors would like to thank the staff of CSWCT and the Ngamba Island Chimpanzee Sanctuary as well as the staff of the MPI EVA Childlab for supporting the execution of this study.

ENDNOTES

[1] Note that what the *marginal* consumer will pay reflects their marginal utility for the good. Because water is abundant, this marginal utility is low for the marginal consumer.

[2] Sundie, Cialdini, Griskevicius, and Kenrick (2012) suggest that scarcity preferences regarding nonessential or conspicuous resources could have evolved in the context of status hierarchies and mating strategies. The evolutionary argument here is that in addition to obtaining resources necessary for survival, humans navigate in a complex social world that requires individuals to acquire status, coalition partners, and mates. By incurring costs that others cannot bear or possessing resources that others do not have or cannot afford, individual humans excel in comparison to others, becoming potentially more attractive (mating) partners and increasing their biological fitness (Sundie et al., 2012, p. 142).

REFERENCES

Aggarwal, P., Jun, S. Y., & Huh, J. H. (2011). Scarcity messages. *Journal of Advertising*, *40*(3), 19–30.

Balachander, S., Liu, Y., & Stock, A. (2009). An empirical analysis of scarcity strategies in the automobile industry. *Management Science*, *55*(10), 1623–1637.

Bearden, W. O., & Etzel, M. J. (1982). Reference group influence on product and brand purchase decisions. *Journal of Consumer Research*, *9*(2), 183–194.

Beran, M. J. (2004). Chimpanzees (*Pan troglodytes*) respond to nonvisible sets after one-by-one addition and removal of items. *Journal of Comparative Psychology*, *118*(1), 25–36.

Boysen, S. T., & Berntson, G. G. (1989). Numerical competence in a chimpanzee (*Pan troglodytes*). *Journal of Comparative Psychology*, *103*(1), 23–31.

Brehm, J. W. (1966). *A* theory *of* psychological reactance. New York: Academic Press.

Brehm, S. S., & Weintraub, M. (1977). Physical barriers and psychological reactance. 2-yr-olds' responses to threats to freedom. *Journal of Personality and Social Psychology*, *35*(11), 830–836.

Brosnan, S. F., Jones, O. D., Gardner, M., Lambeth, S. P., & Schapiro, S. J. (2012). Evolution and the expression of biases: Situational value changes the endowment effect in chimpanzees. *Evolution and Human Behavior*, *33*(4), 378–386.

Brown, S. (2001). Torment your customers (they'll love it). *Harvard Business Review*, *79*(9), 82–88.

Chen, M. K., Lakshminarayanan, V., & Santos, L. R. (2006). How basic are behavioral biases? Evidence from capuchin monkey trading behavior. *Journal of Political Economy*, *114*(3), 517–537.

Chernev, A. (2004). Goal orientation and consumer preference for the status quo. *Journal of Consumer Research*, *31*(3), 557–565.

Cialdini, R. B. (2001). *Influence: Science and practice*. Glenview, IL: Scott Foresman.

Emerson, R. M. (1962). Power-dependence relations. *American Sociological Review*, *27*(1), 31–41.

Engelmann, J. M., Herrmann, E., & Tomasello, M. (2012). Five-year olds, but not chimpanzees, attempt to manage their reputations. *PLoS One*, *7*(10), e48433. https://doi.org/10.1371/journal.pone.0048433

Fox, K., & Kehret-Ward, T. (1985). Theories of value and understanding of price: A developmental perspective. *Advances in Consumer Research*, *12*, 79–84.

Fox, K. F., & Kehret-Ward, T. (1990). Naive theories of price: A developmental model. *Psychology & Marketing*, *7*(4), 311–329.

Gierl, H., & Huettl, V. (2010). Are scarce products always more attractive? The interaction of different types of scarcity signals with products' suitability for conspicuous consumption. *International Journal of Research in Marketing*, *27*(3), 225–235.

Gneezy, U., & Rustichini, A. (2004). Gender and competition at a young age. *The American Economic Review*, *94*(2), 377–381.

Green, V. A., & Rechis, R. (2006). Children's cooperative and competitive interactions in limited resource situations: A literature review. *Journal of Applied Developmental Psychology*, *27*(1), 42–59.

Hanus, D., & Call, J. (2007). Discrete quantity judgments in the great apes (*Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*): The effect of presenting whole sets versus item-by-item. *Journal of Comparative Psychology*, *121*(3), 241–249.

Hare, B., Call, J., Agnetta, B., & Tomasello, M. (2000). Chimpanzees know what conspecifics do and do not see. *Animal Behaviour*, *59*(4), 771–785.

Hare, B., Call, J., & Tomasello, M. (2001). Do chimpanzees know what conspecifics know? *Animal Behaviour*, *61*(1), 139–151.

Hare, B., Call, J., & Tomasello, M. (2006). Chimpanzees deceive a human competitor by hiding. *Cognition*, *101*(3), 495–514.

Inman, J., Peter, A. C., & Raghubir, P. (1997). Framing the deal: The role of restrictions in accentuating deal value. *Journal of Consumer Research*, *24*(1), 68–79.

Jang, W. E., Ko, Y. J., Morris, J. D., & Chang, Y. (2015). Scarcity message effects on consumption behavior: Limited edition product considerations. *Psychology & Marketing*, *32*(10), 989–1001.

John, D. R. (1999). Consumer socialization of children: A retrospective look at twenty-five years of research. *Journal of Consumer Research*, *26*(3), 183–213.

Kaminski, J., Call, J., & Tomasello, M. (2008). Chimpanzees know what others know, but not what they believe. *Cognition*, *109*(2), 224–234.

Kanngiesser, P., Santos, L. R., Hood, B. M., & Call, J. (2011). The limits of endowment effects in great apes (*Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*). *Journal of Comparative Psychology*, *125*(4), 436–445.

Kanngiesser, P., & Warneken, F. (2012). Young children consider merit when sharing resources with others. *PloS One*, *7*(8), e43979.

Kardes, F. R., Posavac, S. S., & Cronley, M. L. (2004). Consumer inference: A review of processes, bases, and judgment contexts. *Journal of Consumer Psychology*, *14*(3), 230–256.

Ku, H. H., Kuo, C. C., Yang, Y. T., & Chung, T. S. (2013). Decision-contextual and individual influences on scarcity effects. *European Journal of Marketing*, *47*(8), 1314–1332.

Lee, S. Y., Oh, S., & Jung, S. (2014). The effects of scarcity appeal on product evaluation: Consumers' cognitive resources and company reputation. *Social Behavior and Personality: An International Journal*, *42*(5), 743–756.

Leiser, D. (1983). Children's conceptions of economics–The constitution of a cognitive domain. *Journal of Economic Psychology*, *4*, 297–317.

Lindsey-Mullikin, J., & Petty, R. D. (2011). Marketing tactics discouraging price search: Deception and competition. *Journal of Business Research*, *64*(1), 67–73.

Lynn, M. (1989). Scarcity effects on value: Mediated by assumed expensiveness? *Journal of Economic Psychology*, *10*, 257–274.

Lynn, M. (1991). Scarcity effects on desirability: A quantitative review of the commodity theory literature. *Psychology & Marketing*, *8*, 43–57.

Lynn, M. (1992). Scarcity's enhancement of desirability: The role of naive economic theories. *Basic and Applied Social Psychology*, *13*(1), 67–78.

McCormack, T., & Atance, C. M. (2011). Planning in young children: A review and synthesis. *Developmental Review*, *31*(1), 1–31.

McDermott, R., Fowler, J. H., & Smirnov, O. (2008). On the evolutionary origin of prospect theory preferences. *The Journal of Politics*, *70*(2), 335–350.

Melis, A. P., Altrichter, K., & Tomasello, M. (2013). Allocation of resources to collaborators and free-riders in 3-year-olds. *Journal of Experimental Child Psychology*, *114*(2), 364–370.

Melis, A. P., Call, J., & Tomasello, M. (2006). Chimpanzees (*Pan troglodytes*) conceal visual and auditory information from others. *Journal of Comparative Psychology*, *120*, 154–162.

Melis, A. P., Grocke, P., Kalbitz, J., & Tomasello, M. (2016). One for you, one for me: Human's unique turn-taking skills. *Psychological Science*, *27*(7), 987–996.

Mittone, L., & Savadori, L. (2009). The scarcity bias. *Applied Psychology*, *58*(3), 453–468.

Mittone, L., Savadori, L., & Rumiati, R. (2005). Does scarcity matter in children's behavior? A developmental perspective of the basic scarcity bias (Working paper No. 0501). Cognitive and Experimental Economics Laboratory, Department of Economics, University of Trento, Italia.

Mulcahy, N. J., & Call, J. (2006). Apes save tools for future use. *Science*, *312*(5776), 1038–1040.

Rossiter, J. R., Percy, L., & Donovan, R. J. (1991). A better advertising planning grid. *Journal of Advertising Research*, *31*(5), 11–21.

Santos, L. R., & Chen, M. K. (2009). The evolution of rational and irrational economic behavior: Evidence and insight from a non-human primate species. In P. W. Glimcher, C. F. Camerer, E. Fehr, & R. A. Poldrack (Eds.), *Neuroeconomics: Decision making and the brain* (pp. 81–94). London: Elsevier.

Santos, L. R., & Rosati, A. G. (2015). The evolutionary roots of human decision making. *Annual Review of Psychology*, *66*, 321–347.

Shafir, S., Waite, T. A., & Smith, B. H. (2002). Context-dependent violations of rational choice in honeybees (*Apis mellifera*) and gray jays (*Perisoreus canadensis*). *Behavioral Ecology and Sociobiology*, *51*(2), 180–187.

Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations*. London: George Routledge and Sons.

Snyder, C. R. (1992). Product scarcity by need for uniqueness interaction: A consumer Catch-22 carousel? *Basic and Applied Social Psychology*, *13*(1), 9–24.

Snyder, C. R., & Fromkin, H. L. (1980). *Uniqueness: The human pursuit of difference*. New York: Plenum.

Sundie, J. M., Cialdini, R. B., Griskevicius, V., & Kenrick, D. T. (2012). The world's (truly) oldest profession: Social influence in evolutionary perspective. *Social Influence*, *7*(3), 134–153.

Sutter, M., & Rützler, D. (2010). Gender differences in competition emerge early in life. IZA Discussion Paper No. 5015. Available at SSRN: Retrieved from https://ssrn.com/abstract=1631480

van Herpen, E., Pieters, R., & Zeelenberg, M. (2009). When demand accelerates demand: Trailing the bandwagon. *Journal of Consumer Psychology*, *19*(3), 302–312.

Veblen, T. (1899/1965). *The theory of the leisure class*. New York: AM Kelley.

Warneken, F., Lohse, K., Melis, A. P., & Tomasello, M. (2011). Young children share the spoils after collaboration. *Psychological Science*, *22*(2), 267–273.

Worchel, S., Lee, J., & Adewole, A. (1975). Effects of supply and demand on ratings of object value. *Journal of Personality and Social Psychology*, *32*(5), 906–914.

How to cite this article: John M, Melis AP, Read D, Rossano F, Tomasello M. The preference for scarcity: A developmental and comparative perspective. *Psychol Mark*. 2018;35:603–615. https://doi.org/10.1002/mar.21109