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The Evolutionary Origins of Human Patience: Temporal Preferences in Chimpanzees, Bonobos, and Human Adults

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Summary

To make adaptive choices, individuals must sometimes exhibit patience, forgoing immediate benefits to acquire more valuable future rewards [1–3]. Although humans account for future consequences when making temporal decisions [4], many animal species wait only a few seconds for delayed benefits [5–10]. Current research thus suggests a phylogenetic gap between patient humans and impulsive, present-oriented animals [9, 11], a distinction with implications for our understanding of economic decision making [12] and the origins of human cooperation [13]. On the basis of a series of experimental results, we reject this conclusion. First, bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes*) exhibit a degree of patience not seen in other animals tested thus far. Second, humans are less willing to wait for food rewards than are chimpanzees. Third, humans are more willing to wait for monetary rewards than for food, and show the highest degree of patience only in response to decisions about money involving low opportunity costs. These findings suggest that core components of the capacity for future-oriented decisions evolved before the human lineage diverged from apes. Moreover, the different levels of patience that humans exhibit might be driven by fundamental differences in the mechanisms representing biological versus abstract rewards.

Results

When asked to decide between ten dollars in 30 days and 11 dollars in 31 days, people typically prefer the larger reward. However, when asked to choose between ten dollars now and 11 dollars tomorrow, people are more impulsive and prefer the immediate reward [3, 4]. These inconsistent preferences reveal that people often trade off between immediate and future benefits. Nonhuman animals must also make time-sensitive decisions about mating or foraging in their natural environments [1, 14]. Experiments with captive birds, rodents, and primates [5–10], however, show that many nonhuman species wait less than a minute (often only a few seconds) for a larger, delayed food reward when offered an immediate alternative. Relative to humans, who will frequently wait weeks or months for larger monetary rewards [4], animals thus appear to be impulsive over a radically reduced timescale.

These extreme differences between humans and nonhumans seem to provide powerful evidence that patience is a uniquely human trait (as suggested by [11, 12, 15]). But is this cognitive divide real? Some chimpanzees can wait several minutes in delay of gratification and exchange tasks [16–18], suggesting higher levels of patience in other hominoids. Two pieces of evidence are therefore required to test the uniqueness of human patience. First, if our species' temporal preferences originated in the human lineage, then our two closest phylogenetic relatives—bonobos and chimpanzees—should make impulsive decisions like other animals. Second, humans should wait longer than animals in directly comparable contexts—such as during decisions about food, a currency with more direct evolutionary relevance.

We provide a systematic test of these predictions by (1) comparing the temporal preferences of bonobos, chimpanzees, and humans in a food task, and (2) examining human temporal preferences across contexts—for iterated choices involving food or money, and in response to more typical discounting questionnaires. Our iterated task differed from standard economic tasks in several ways. First, subjects select between real rather than hypothetical (e.g., [19]) or partially realized (e.g., [20]) rewards. Second, subjects experience delays and pay an opportunity cost for waiting because they cannot concurrently engage in other activities or proceed to the next decision. Increasing evidence suggests that both the experience of delays [15, 21, 22] and variations in reward type [19, 23–26] can influence human preferences. Nonetheless, the majority of studies investigating human temporal choice involve low-cost choices about money, an evolutionarily novel reward that only humans are motivated to acquire [27]. In contrast, most animal studies necessarily involve biological rewards and higher opportunity costs. Thus, by letting human subjects make decisions about food rewards and experience delays, we offer a more appropriate methodology for comparison across species.

Study 1: Temporal Preferences in Bonobos and Chimpanzees

In the first study, we characterized the temporal preferences of chimpanzees and bonobos, determining the delay at which they chose equally between a smaller, immediate food reward, and larger, delayed food reward (as in [6, 8]; Figure 1). Bono-

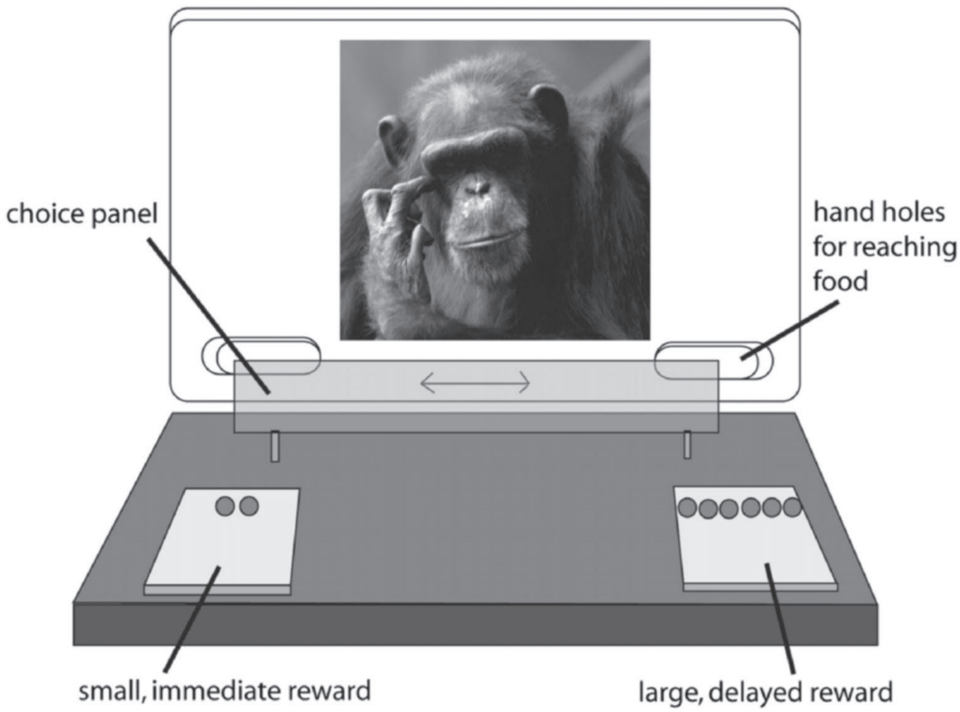

Figure 1. The Ape Discounting Apparatus Used in Studies 1 and 2

Subjects could choose between a small, immediate reward (two grape halves) and a large, delayed reward (six grape halves). Subjects faced the experimenter (E) through a Plexiglas panel; this panel had hand holes on either side so subjects could insert their fingers to make choices. E sat in front of a Table (75 × 40 × 50 cm) with two sliding platforms (9 × 12 cm) for food rewards (side assignment was counterbalanced within a session). Each trial started when E removed an occluder blocking access to the table; subjects then had 15 s to indicate a choice. Subjects indicated their preference by sliding the choice panel (70 cm wide, 9 cm tall, attached to the front of the table) to uncover either the left or right hole, and then could access their chosen food option when E slid the platform forward (immediately if subjects chose an immediate reward, but after a delay if they chose a delayed reward). E removed the forgone option after the subject made a choice. Subjects could take as long as they wanted to eat the food, and a trial ended when the subject placed the last piece of food in her mouth. E then replaced the occluder; the next trial began after a 30 s intertrial interval (ITI). Subjects in both studies completed no more than one session per day.

bos showed indifference when the larger reward was delayed by a mean of 74.4 s (standard error [SE] = ± 8.5 s), whereas chimpanzees waited a mean of 122.6 s (SE = ± 15.9 s), a significantly longer period [$t(8) = 2.68$, $p = 0.03$, two tailed]. Both species waited longer than did other animals previously tested in a similar manner [6, 8], including other primates (Figure 2). Finally, neither species' pattern of data can be explained by the short-term maximization of intake rate over repeated trials, a model that has been successfully applied to the choices of other nonhumans [5, 8]. This suggests that the apes made decisions over longer temporal horizons than did other animals. Accordingly, a long-term rate-maximizing currency [28], which is more farsighted than most species' patterns of choice (see [14] for a review), can account for the bonobos' preferences. However, chimpanzees are significantly more patient than expected by this model (see the Supplemental Data, following References). That is, chimpanzees and bonobos exhibit different temporal preferences than do other nonhumans examined thus far, and available models of choice cannot entirely account for this difference.

Study 2: Comparison of Patience in Humans and Chimpanzees

Although both ape species waited longer than other animals for food rewards, humans express a willingness to wait days or even years to acquire monetary rewards [4]. Consequently, here we provide the first direct comparison of chimpanzee ($n = 19$) and human ($n = 40$) temporal preferences; bonobos could not be included because of sample size limits. The two species made a series of choices between a smaller food reward (two pieces) and larger reward (six pieces): In the delay condition, the small reward was available immediately and the large reward was available only after a 2 min delay, whereas in the control condition, both options were available immediately. The control condition therefore measured subjects' baseline motivation to choose the larger reward, and assessed possible changes in motivation due to food consumption. Each human participant experienced one condition, whereas chimpanzees experienced both in a counterbalanced order.

We first compared the preferences of the human participants ($n = 20$ per condition) and the chimpanzees in their first test session (to ensure that prior experience did not influence chimpanzees; delay condition $n = 10$, control condition $n = 9$). Figure 3 shows that although both species strongly preferred the larger reward when available immediately (percent choice: chimpanzees = 88.9 ± 4.8%, humans = 77.5 ± 7.4%), only chimpanzees maintained this preference when required to wait two minutes (chimpanzees = 71.7 ± 6.6%, humans = 19.2 ± 4.4%; Figure 3). Condition [repeated-measures analysis of variance (ANOVA): $F(1, 55) = 29.16$, $p < 0.001$] and species [$F(1, 55) = 18.78$, $p < 0.001$] influenced choices, but not ses-

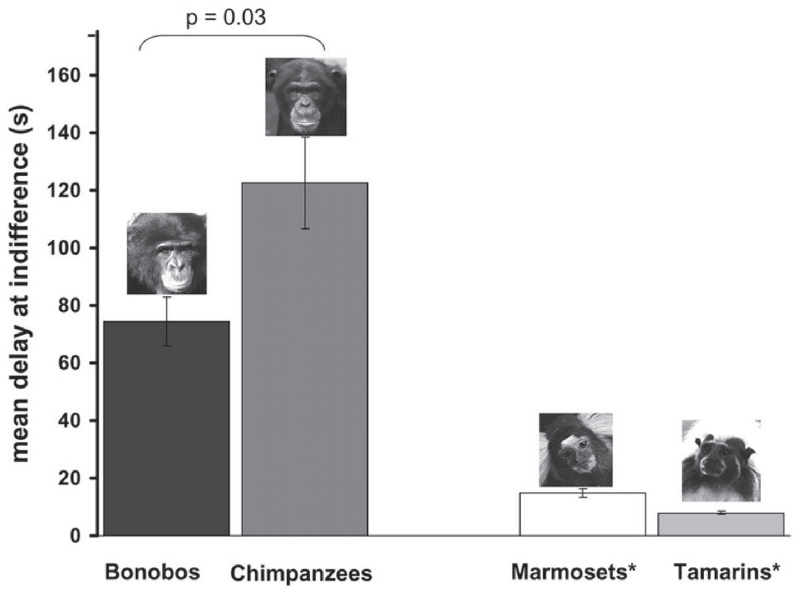

Figure 2. Delay at Indifference for Various Primate Species
In study 1, bonobos and chimpanzees chose between two pieces of food available immediately and six pieces of food available after some delay. Stevens et al. 2005 [8] found indifference points in a similar manner for common marmosets (*Callithrix jacchus*) and cotton-top tamarins (*Saguinus oedipus*). Error bars represent standard error of the mean indifference point for each species.

sion half [$F(1, 55) = 0.36$, $p = 0.55$]. An interaction between species and condition [$F(1, 55) = 8.73$, $p < 0.005$] showed that although the species did not differ in the control condition, humans chose the larger reward significantly less often in the delay condition than in the control condition, and less than chimpanzees overall (Tukey post-hoc tests; $p < 0.005$ for all significant cases).

To confirm that chimpanzees were sensitive to the delay, we next used a within-subjects analysis comparing individual chimpanzees' choices across both conditions. Overall, chimpanzees chose the large reward more in the control condition [control condition = 89.5 ± 3.2%, delay condition = 66.7 ± 4.8%; paired $t(18) = 4.10$, $p < 0.001$ two tailed]. Both species therefore made tradeoffs between rewards and time, although chimpanzees exhibited greater patience than did humans when required to wait for the larger payoff (Movies S1 and S2).

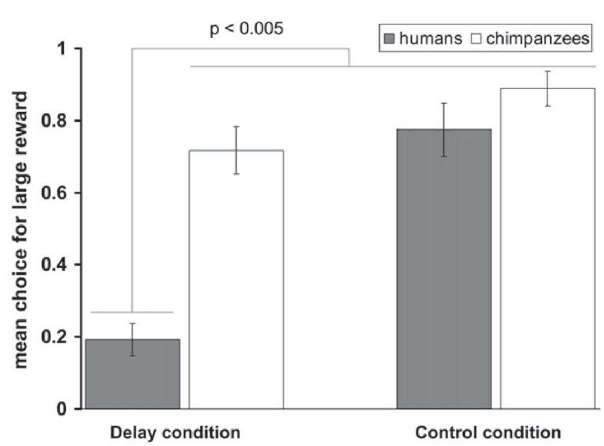

Figure 3. Human and Chimpanzee Preferences for Larger Food Rewards
In the delay condition (study 2), subjects chose between two food items available immediately and six food items available after 2 min, whereas in the control condition, both reward amounts were available immediately. Chimpanzee data is from their first test session. Error bars represent standard error of mean proportional choice for the larger reward.

Humans might not have waited in the delay condition because they did not wish to consume larger quantities of food. Three lines of evidence suggest this is not the case. First, both species strongly preferred the larger reward in the control condition—and whereas the chimpanzees' preference for the larger reward dropped by 19% in the delay condition, the human subjects' preference dropped by 75%. Second, neither species' preferences changed across sessions in either condition, indicating that the humans did not stop choosing the larger amount because they become satiated over repeated trials. Finally, an additional analysis indicates that their choices in the delay condition were not due to a lack of hunger (see the Supplemental Data).

Comparative analyses of cognition are notoriously difficult to conduct because of the inherent difficulty of equating methodologies across species. In the present study, chimpanzees and humans might not have faced identical waiting costs nor had an identical desire for the food. That said, neither species was food deprived, both could access food outside the test, and neither showed evidence of satiation. Altogether, these results suggest that humans and apes show comparable preferences when confronted with very similar temporal decisions.

Study 3: Human Patience and Reward Type

In study 2, human participants showed markedly different behavior in response to the iterated food problems than they do in more typical decisions involving money. We therefore conducted a third study to assess how reward type (money or food) and experiential context (real or hypothetical money and delays) impacts human decision making. A new group of human participants (n = 20) made iterated temporal decisions like those in study 2, but over small amounts of money (20 cents now versus 60 cents after 2 min). On average, participants waited on 56.7% of trials [SE = ± 8.8%]. Comparing these participants to those from the delayed food condition showed that people were more than three times as willing to wait for small amounts of money than for food [$t(38) = 3.839$, $p = 0.001$, two tailed] (Figure 4). Individual subject data shows

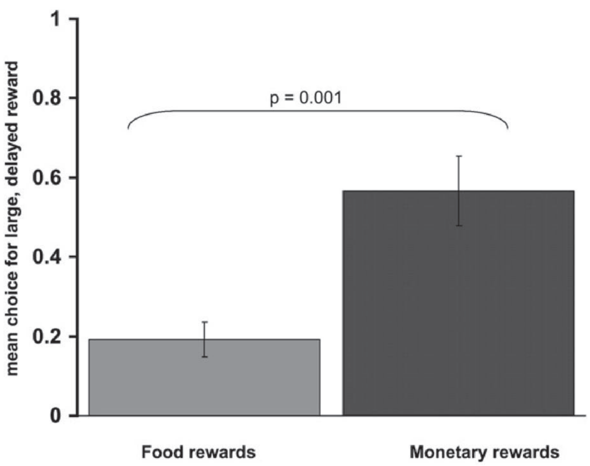

Figure 4. Human Preference for Delayed Food and Money
Subjects chose between a larger, delayed reward and a smaller, immediate alternative during an iterated, experiential discounting task involving either food rewards (delay condition, study 2) or monetary rewards (study 3). Error bars represent standard error of mean proportional choice for the delayed reward.

that whereas 40% of subjects in the delayed money condition waited *every* trial to receive an additional 40 cents, not a single subject did so to acquire more food. Critically, this result rules out the possibility that subjects in the delayed food condition did not wait because the paradigm was inherently aversive: Subjects in the delayed money condition faced an identical situation and opportunity costs, but were frequently willing to wait for more rewards.

As a final test, we examined all human participants' (n = 60) preferences on a hypothetical discounting questionnaire; such questionnaires carry low opportunity costs for choosing the larger reward. We used participants' responses over a series of ten questions (e.g., "Would you prefer to receive \$31 today or \$59 in 150 days?") to calculate the hyperbolic discounting factor (k), frequently used as an index of discounting levels in such contexts. Consistent with past findings, subjects exhibited a mean discount factor of k = 0.0116 (see the Supplemental Data). This value predicts that participants would be willing to wait up to 172 days for 60 dollars over an immediate 20 dollars—in contrast to their more impulsive preferences when required to actually wait 2 min delays to acquire food or money.

Discussion

Our results demonstrate that humans share similar levels of patience with bonobos and chimpanzees in some contexts. Both members of the *Pan* genus preferred to wait for larger delayed rewards, and did so for longer periods than other nonhuman animals tested thus far. Additionally, chimpanzees were actually more patient than humans when compared on similar temporal tasks. We conclude that a capacity for patience in the context of food rewards evolved before the human lineage split. Based on the comparative evidence, we also suggest that the last common ancestor of *Homo* and *Pan* possessed an extended temporal horizon for decisions about food. Because short temporal horizons could preclude the evolution of sophisticated capacities such as mental time travel [11] or reciprocal altruism [13], these findings imply that apes' abilities to plan for future activities [29, 30] or engage in flexible cooperative interactions [31, 32] might have arisen once the constraint of impulsivity was lifted.

Higher tolerance for delayed food rewards could have evolved as a foraging adaptation, and variation between closely related species might reflect differences in their natural ecology. For example, the varying levels of patience exhibited by callitrichid monkeys across contexts maps onto differences in their wild foraging patterns [8, 33]. Notably, chimpanzees inhabit environments characterized by small, unpredictable food patches with unstable fruit availability, whereas bonobos live in comparatively productive environments [34, 35]. Accordingly, variation in habitat has been proposed as a major selective force shaping the disparate social behaviors of *Pan* [36]. We suggest that ecology might also underlie differences in *Pan*'s nonsocial cognition: Chimpanzees may generally tolerate higher additional costs to procure food, such as increased work effort, longer travel distances, and the temporal costs explored here. Notably, there is extensive evidence for hunting and extractive tool technology in wild chimpanzees but not bonobos. Their respective temporal preferences might therefore promote optimal foraging rates in their different natural ecologies, although not necessarily in laboratory experiments (e.g [1, 14]).

Though we might share similar patience levels with apes during some kinds of choices, we appear to have evolved a greater capacity for patience in other contexts (as indicated by the questionnaire responses). Why this difference emerged is not entirely clear. As study 3 demonstrates, reward type is one factor that influences preferences, and monetary rewards have many properties that distinguish them from biologically central rewards like food: They are storable, can be convertible into other reward currencies, might not be immediately rewarding in the same way that biological currencies are, and can take on extremely large values. Most studies of economic decision making involve choices about much larger amounts than those used in the iterated task, and reward magnitude influences human patience [20, 37]. Importantly, the concrete rewards used in animal studies must necessarily be small, and it is unclear whether any rewards of relevance to nonhumans could take on such large values. Furthermore, some level of temporal impulsivity might be evolutionarily favored in foraging contexts so that it could be ensured that organisms maximize their rate of gain [1, 14, 28, 38], but rate might not be a relevant currency for all decisions. In particular, total gains could be more important when making decisions about money—especially if the opportunity costs associated with waiting for money are typically low relative to the costs incurred when actively foraging for food.

The human participants' increased willingness to wait for money over food in study 3 aligns with previous results [19, 23] despite the use of very different paradigms. This suggests that the contrast between decisions about abstract rewards—or "cognitive" rewards—and decisions about basic rewards [12, 26] may be quite robust. Notably, even limited exposure to money can systematically alter people's goals and behavior [39], and cognitive and basic rewards recruit overlapping [40] but possibly distinct [41] neural systems. As such, human preferences can differ depending on biological relevance: Decisions about money are not necessarily representative of all decisions. It is therefore essential to examine preferences across a wide range of contexts to fully understand both the evolutionary pressures shaping human choice and the cognitive mechanisms underlying decision making.

Experimental Procedures

Study 1: Temporal Preferences in Chimpanzees and Bonobos

Subjects

We tested five chimpanzees (8 to 30 years; three females and two males) and five bonobos (8 to 23 years; two females and three males), socially housed at the Wolfgang Köhler Primate Research Center in Leipzig, Germany. Apes had ad libitum access to water, were never food deprived, had access to food outside experimental contexts, and could stop participating at any time.

Procedure

Subjects chose between a small, immediate reward and a large, delayed reward (see Figure 1). Each session consisted of four introductory trials (forced choice with only one option available) for familiarization, and ten choice trials followed. The large rewards' delay was adjusted in a subsequent session according to a subject's preferences in the previous session (see the Supplemental Data). We determined each subject's indifference point by comparing the mean delay to large of their last five sessions with the mean delay to large of their previous five sessions (as in [6, 8]). Subjects were considered indifferent when these means differed by less than 10%. The mean delay of a subject's last five sessions was used as their estimated indifference point (see the Supplemental Data).

Study 2: Comparison of Patience in Humans and Chimpanzees

Subjects

We tested 19 chimpanzees (4 to 31 years; 13 females and six males) and 40 adult humans. Eighteen participants were from the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany (mean age: 27.7; eight females and ten males) and 22 were from Harvard University (mean age: 20.5; ten females and 12 males). These populations did not differ in an initial analysis (see the Supplemental Data), so they were combined.

Chimpanzee Procedure

Each chimpanzee completed three sessions per condition, with the same general procedure as study 1 (see Figure 1). For each condition, the first session consisted of 16 introductory trials. Subjects then completed two test sessions, each consisting of four introductory trials and then six choice trials. After approximately 1 week, subjects completed their second condition.

Human Procedure

Human participants completed one session, randomly assigned to condition. In advance, they were informed that the experiment would take up to 45 min, and asked to refrain from eating for the hour prior to the experiment if possible to ensure food motivation. After obtaining informed consent, the participant and experimenter (E) sat across from each other at a table. E read from a script (see the Supplemental Data), informing participants that they would first complete four "practice trials" (introductory trials), and then make a series of choices between the two options (six trials like the chimpanzees, although participants did not know how many in advance). Participants in the delay condition were not told the delay's duration, but experienced it in the practice period beforehand. Participants then selected their preferred food (raisins, peanuts, M&M's, Goldfish crackers, or popcorn). A glass of water was available throughout.

During introductory trials, E placed a cup on the table and asked how many items it contained (either two or six). In the control condition E said "You can now have the food" immediately after the participant responded. In the delay condition E said this immediately for the small reward, and after two minutes for the larger option. E moved 3 m away from the subject to another chair during the delay. In test trials, E placed two options on the table (counterbalanced for side assignment) and said "Do you prefer this cup or this cup?" As with the apes, E removed the forgone option after the choice, participants could take as long as they wanted to eat the food, and a 30 s intertrial interval (ITI) began when they placed the last piece in their mouth.

After the food task, participants completed a questionnaire (see the Supplemental Data) including hypothetical discounting questions [20] and scales assessing hunger and food preference [25]. Fourteen additional subjects reported that they were not hungry or did not like the food, and were excluded from the main analyses to ensure that the food was rewarding for the humans. However, these individuals did not affect the main results (see the Supplemental Data).

Study 3: Human Patience and Reward Type

Subjects and Procedure

We tested a naive group of 20 participants from the Max Planck Institute for Evolutionary Anthropology (mean age = 27.6 years; 12 females and eight males). Participants completed one session identical to the delayed food condition but involving choices about money (two 10 cent coins versus six 10 cent euro coins; see the Supplemental Data). Subjects knew they could keep all money from the experiment, and were requested to transfer the money into another cup after E said "You can now have the money." The next ITI began when the participant finished transferring the coins. Subjects completed a questionnaire after the main task as in study 2.

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Supplemental Data

Document S1. Experimental Procedures and Three Tables.

Movies S1 & S2. Study 2 Delay Condition, Parts 1 & 2. A chimpanzee forgoes a smaller reward he could receive immediately and chooses to wait two minutes to receive a larger alternative in Study 2. Movies S1 and S2 are consecutive halves of one trial.

Supplemental Data

The Evolutionary Origins of Human Patience: Temporal Preferences in Chimpanzees, Bonobos, and Human Adults

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Supplemental Experimental Procedures

Study 1: Temporal Preferences in Bonobos and Chimpanzees

Subjects

Ten adult and subadult chimpanzees and bonobos participated in this experiment (see Table S1). Subjects were socially housed at the Wolfgang Köhler Primate Research Center in the Leipzig Zoo, Germany. The chimpanzees lived in a group of 17 individuals. The bonobos lived in a group of six individuals (including one young infant). They spent the day in a 4000 m^2 outdoor area, and a 400 m^2 indoor area, both of which have climbing structures, enrichment items such as foraging boxes, and natural vegetation, water streams, and various other natural features. At night, they slept in a series of rooms approximately 47 m^2. Both species are fed various fruits, vegetables, and cereals several times per day independent of cognitive tests. Grapes are a regular component of the apes' daily diet in this facility, and are known to be a desirable food for both the chimpanzees and bonobos. A familiar experimenter tested subjects individually in familiar testing rooms (approximately 15 m^2); mothers with dependent offspring were tested with their child present in the testing room. All ten subjects were naive to discounting tasks.

Experimenter Behavior during Delays

If the subject chose the large reward, the experimenter removed the forgone option but did not push the food platform forward until the delay concluded; during this delay period, the experimenter sat looking down with her hands behind her back and did not socially interact with the subject.

Delay Adjustment Across Session

In the first session, both rewards were available immediately. If a subject demonstrated a preference for either reward during a given session, then the delay to receive the large reward was adjusted in their subsequent session (delays were always kept constant within a given session). Specifically, if subjects choose the large reward eight or more times, the delay to large was increased by 10 s; if they choose the small reward more than eight times, the delay was decreased by 10 s. Weaker preferences (six to seven choices) resulted in 5 s increments. If subjects had no preference, the delay to large remained the same.

Food Motivation Levels

In addition to the main analysis, we performed an additional statistical analysis to assess how subjects made choices within sessions. We arcsine, square-root transformed all proportional choices to normalize the data. We conducted a repeated-measures ANOVA comparing subjects' performance in the first half to the second half of all sessions, with species as a between-subjects factor. There was a significant effect of species [$F(1,8) = 14.39$, $p < 0.01$], but no effect of session half or interactions with session half. This indicates that subjects of both species had consistent choice strategies and retained constant levels of motivation to acquire the food over a given session.

Rate Maximization

We quantitatively assessed whether the two species' patterns of choice matched the predictions of a short-term rate-maximization model, as is the case in European starlings [S1] and cotton-top tamarins [S2]. This model predicts that foragers optimize gain in reward per unit time [S3]—that is, decision makers maximize the rate (R) of a choice, $R = A/(t + h)$, where A is the reward amount, t is the delay to receive the reward after a choice has been made, and h is the time required to process or handle the reward. Rate maximization thus predicts that individuals should be indifferent between the small and large rewards in this experiment when the intake rate of the small option (two grape halves) equals that of the large option (six grape halves): $A_2/(t_2 + h_2) = A_6/(t_6 + h_6)$.

Handling times (h_2 and h_6) for both species were estimated from measurements of the period between a subject's first reach for the grape halves once they became available, and when they placed the last grape half in their mouth. These measurements were obtained for six introductory small-reward trials and six introductory large-reward trials for each subject (Table S1). In addition, we coded 20 introductory small-reward trials (two per subject) to determine the length of time necessary for the experimenter to push the small food reward forward once the subject made a choice. On average, the experimenter took 1.6 s to push the reward forward so that the subject could access it. Measurements of handling time (see Table S1) indicate that bonobos took longer than chimpanzees to eat both the smaller and larger reward; on average the bonobos took 8.5 s to eat two pieces and 27.7 s to eat six pieces, whereas chimpanzees took 5.3 s to eat two pieces and 19.3 s to eat six pieces. Because animals discount future rewards more heavily when handling times are increased under some circumstances [S4], this could be one reason that bonobos did not wait as long as chimpanzees overall.

Using these handling times and 1.6 s as the delay estimate on the short reward, we calculated the predicted long delay at which subjects should be indifferent between the two rewards if they maximize intake rate in this way. Each species' indifference point prediction is a mean of individual subject's predicted indifference points. That is, we applied the rate-maximization equation to each subject rather than to the overall species means. If predicted indifference points were negative for a given subject, we used a time of 0 s (as in [S2]). The predicted average rate-maximizing indifference point of chimpanzees was 2.6 s, and the predicted indifference point for bonobos was 3.1 s. Chimpanzees and bonobos would thus have to exhibit very high levels of temporal impulsivity to maximize their rate of gain over the short term (see Table S2).

Because both species deviate extensively from these predictions, it is likely that bonobos and chimpanzees make choices over a longer temporal horizon than do other animals, accounting for more than just the period between making a decision and experiencing its consequences. For example, unlike other species examined thus far (see [S5] for a review), they might rate maximize over the long term, accounting for the entire duration of the experiment (including the duration between trials, or intertrial interval [ITI]). This long-term rate-maximization account (originally described in [S3]) would predict that subjects are indifferent when $A_2 / t_2 + h_2 + \mathrm{ITI}) = A_6/(t_6 + h_6 + \mathrm{ITI})$, where ITI in this case is 30 s. Including the ITI increases the average predicted rate-maximizing indifference point for chimpanzees to 61.3 s and the predicted indifference point for bonobos to 62.7 s. One-sample t tests comparing individual subject's observed indifference points to the average predicted indifference point for each species shows that although bonobos did not significantly differ from their long-term rate-maximization prediction [$t(4) = 1.374$, $p = 0.241$], chimpanzees waited longer than their long-rate maximization prediction [$t(4) = 3.862$, $p = 0.018$]. Thus, bonobos appear to maximize over the long term, but even examining choices over this longer temporal window cannot account for the chimpanzees' pattern of discounting preferences.

Study 2: Comparison of Patience in Human and Chimpanzees

Subjects

We tested 19 adult and subadult chimpanzees from the same population as study 1 (12 individuals were from the same social group as study 1; all individuals from a second social group of seven individuals were also tested). Five subjects participated in study 1 seven months previously; the other 14 subjects were naive (see Table S3).

In addition, we tested 40 adult humans. Eighteen participants were students from the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. These volunteers received no compensation for their participation other than the food. Twenty-two participants were undergraduates from Harvard University in Cambridge, Massachusetts, who received credit for a psychology course and the food in return for their involvement. Fourteen additional subjects were tested but excluded from the main analyses because they reported that they did not like the food or were not hungry in the questionnaire (see Exclusion Criteria below).

Human Procedure: Additional Details

Human participants were tested in a room either at the Max Planck Institute in Leipzig, Germany or at Harvard University in Cambridge, Massachusetts. Subject testing times ranged across the day: In Germany, all tests took place between 11:00 and 14:00, and in the U.S.A., testing took place between 12:00 and 18:00 (as mentioned in the main text, all subjects were informed beforehand that they would eat food in the session and were requested to refrain from eating for the hour proceeding the test if possible, to ensure food motivation). Although all sessions were conducted in English, there were minor variations between the instructions used in Germany and the instructions used in the U.S.A. because of different requirements for obtaining consent when testing human subjects. Once subjects had been informed of the complete procedure (see Appendix A for the script), they were asked to remove their watch if they were wearing one. They were then allowed to pick their preferred food from the set of options that were arrayed on a second table next to the test table. Once they indicated their preference, the experimenter retrieved a box containing the appropriate food rewards that had been portioned out into clear plastic cups prior to the subject's arrival; subjects could not see into this box because of an occluder attached to the box that blocked their view.

Experimenter Behavior during Delays in the Human Procedure

During delays in the delay condition, the experimenter moved to another chair approximately 3 m behind the experimenter's seat at the test table. The chair was perpendicular to the participant's line of sight; from this position the experimenter was visible to the participant, but not directly facing the participant. The experimenter sat in this location looking at her clipboard for the duration of the delay period, and the subject and the experimenter did not talk to each other or socially interact (as was the case with the chimpanzees, see above). Once the delay completed, the experimenter then told the subject that he/she could eat the food; while the participant ate, the experimenter returned to the main test table. While the subject ate his/her food rewards, the experimenter wrote on her clipboard and did not make eye contact with the subject. During the 30 s ITI, the experimenter continued to write on his/her clipboard as before.

Questionnaire

Once subjects completed the food test, they then completed a questionnaire with two parts (see Appendix B for the complete questionnaire). In part one, subjects (1) indicated their age and sex, (2) estimated the most recent time they had eaten prior to the test, (3) estimated the delay they had waited to receive the larger reward (if participating in the delay condition), and (4) were asked an open-ended question about why they made the choices they did. Individuals who participated in the test at Harvard were also asked to rate their level of hunger and the extent to which they liked the food they had eaten on 5 point scales (based on the hunger scales used previously in [S6]); for example, from 1, "Not at all hungry," to 5, "Very hungry." The second part of the questionnaire consisted of ten standard discounting questions about money (based on the discounting task used in [S7]). Subjects tested in Germany answered questions about euro monetary amounts; whereas subjects tested in the U.S.A. answered questions about dollar amounts. These questions were presented in random order across subjects.

Exclusion Criteria for Dropped Human Participants

As noted in the main text, we excluded human participants from Study 2 if their responses on the questionnaire indicated that they did not find the food items to be rewarding or desirable. This was done so that it could be ensured that that human subjects actually found the food to be rewarding because it is unlikely that individuals would wait longer to receive things they did not like or want to have (and indeed might have found it aversive to eat food they did not want). The chimpanzees have extensive experience with grapes both during daily feeding and in other experimental contexts, and it is a preferred food for these test subjects. In contrast, the human subjects might have had less direct experience or knowledge about their chosen food prior to the experiment, or discovered that they disliked it only once the experiment began. Furthermore, unlike chimpanzees, human subjects who were not hungry or discovered that they disliked their choice might have continued to eat it only out of social obligation to complete the experiment. Human participants were therefore excluded from main analyses if they met any of the following five criteria: (1) If the subject explicitly wrote on the open-ended portion of their questionnaire that they made their choices because they were not hungry, (2) if they explicitly wrote that they did not like or want to eat the food they were provided with in the experiment, (3) if they said they made the choices they did because they were on a diet, (4) if they answered "not hungry" (scale points 1 or 2) on the hunger scale, or (5) if they answered "did not like food" on the food-desirability scale. Fourteen of the total 54 participants tested met one or more of these criteria. However, the inclusion of these additional subjects does not influence the main results (see below).

Statistical Analyses

We arcsine, square-root transformed all proportional choices of both species.

Differences between Human Populations

In addition to the main analyses, we performed three further analyses of the human choice data. First, we examined all 54 tested participants (including those that met the exclusion criteria) by performing a 2 (condition) × 2 (human population) ANOVA to examine how all participants responded to the delay manipulation, as well as whether those tested in Germany or the United States differed in their discounting preferences. This ANOVA revealed a main effect of condition [subjects choose the larger reward more often in the control condition; $F(1, 50) = 14.889$, $p < .001$] but no effect of population [$F(1, 50) = 0.518$, $p = 0.4750$] nor any interactions. Consequently, we combined both subject populations for all other statistical analyses.

Table S1. Individual Characteristics and Performance of Subjects from Study 1

Subject	Species	Sex	Age (Years)	Handling Time, Two Pieces (s)	Handling Time, Six Pieces (s)	Observed Indifference Point (s)
Joey	Bonobo	M	23	9.5	32.0	92
Kuno	Bonobo	M	9	6.2	25.2	80
Limbuko	Bonobo	M	10	11.3	29.1	59
Ulindi	Bonobo	F*	12	6.7	20.9	91
Yasa	Bonobo	F	8	9.0	31.3	50
Bonobo Average				8.5	27.7	74.4
Dorien	Chimpanzee	F	26	2.9	16.7	162
Fraukje	Chimpanzee	F*	30	3.4	12.8	106
Patrick	Chimpanzee	M	8	5.6	18.7	108
Robert	Chimpanzee	M	31	5.4	24.6	157
Sandra	Chimpanzee	F	12	9.0	23.7	80
Chimpanzee Average				5.3	19.3	122.6

"*" indicates a female with dependent offspring present in the testing room during sessions.

Table S2. Summary of Amounts, Delays, Indifference Points, and Rate-Maximization Predictions for Both Ape Species

Rate Maximization Summary	Bonobos	Chimpanzees
Small reward amount (A_2)	2 pieces	2 pieces
Large reward amount (A_6)	6 pieces	6 pieces
Short delay (t_2)	1.6 s	1.6 s
Small reward handling time (h_2)	8.5 s	5.3 s
Large reward handling time (h_6)	27.7 s	19.3 s
Intertrial interval (ITI)	30 s	30 s
Average predicted indifference point: short-term rate maximization	3.1 s	2.6 s
Average predicted indifference point: long-term rate maximization	62.7 s	61.3 s
Average observed indifference point	74.4 s	122.6 s

Performance of Excluded Subjects

Second, we reanalyzed the main human-chimpanzee comparison from study 2, but included the additional 14 human subjects who originally met the exclusion criteria (for a total of 19 chimpanzees and 54 humans). The chimpanzee data was identical with that in the comparison reported in the main text. Subjects in this expanded human subject pool choose the larger reward on an average of 62.7 ± 4.5 percent of trials in the control condition (compared to 77.5% of trials when these additional subjects are excluded as reported in the main analysis), and an average of 19.5 ± 3.9 percent of trials in the delay condition (as compared to 19.2% of trials when these additional subjects are excluded as reported in the main analysis). Thus, humans' preference for the larger reward therefore decreased by 69% when they were required to wait to receive it in the delay condition compared to when they could receive it immediately in the control condition (compared with 19% with the chimpanzees, as described in the main text).

As in the main text, a repeated-measures ANOVA with session half as a within-subjects factor and species and condition as between-subjects factors revealed main effects of condition [$F(1, 69) = 14.292$, $p < 0.001$] and species [$F(1, 69) = 22.352$, $p < 0.001$], with both species preferring the large reward less in the control condition, and humans preferring the large reward less in both conditions. There was no effect of session half, and the species × condition interaction reported in the main text drops to only a trend when the additional subjects are included [$F(1, 69) = 2.707$, $p = 0.104$]. This analysis indicates that the human subjects' preference for the larger reward drops more in the delay condition than it does for chimpanzees regardless of the inclusion of these subjects. Rather, the main effect of the exclusion criteria was to remove human subjects that did not find the food to be rewarding regardless of waiting.

Role of Hunger in Human Choice

Third, we performed an analysis designed to assess the influence of hunger or food motivation on the humans' choices. This analysis also included participants who were originally excluded because they reported that they were not hungry; participants who were excluded for other reasons (i.e., they said they did not like the food or were on a diet) were not included in this analysis. Based on the hunger scale and subjects' written responses, we had information about the hunger state of 37 participants. These participants were given a composite hunger score; a composite hunger score of 1 indicates that subjects were not hungry when they completed the test (i.e., subjects rated their hunger as 1 or 2 on the scale or explicitly wrote that they were not hungry), a composite hunger score of 2 indicated that subjects were neutral (i.e., subjects rated their hunger as 3 on the scale or explicitly wrote that they were neutral), and a composite hunger score of 3 indicated that subjects were hungry (i.e., subjects rated their hunger as 4 or 5 on the scale or explicitly wrote that they were hungry).

A 2 (condition) × 3 (hunger score) ANOVA revealed a main effect of condition [$F(1, 31) = 10.51$, $p = 0.003$], a main effect of hunger score [$F(2, 31) = 4.84$, $p = 0.015$], and interaction between hunger and condition [$F(2, 31) = 7.64$, $p = 0.002$]. A post-hoc Tukey test indicated that in the control condition, hungry subjects (hunger score = 3) picked the large reward more than nonhungry subjects did (hunger score = 1; $p = 0.001$), and hungry subjects in the control condition picked the large reward more than all subjects in the delay condition ($p < 0.04$ for all cases). However, there were no significant

Table S3. Individual Chimpanzee Subject Characteristics and Results from Study 2

Subject	Sex	Age(Years)	Condition Order	Previous Discounting Experience?	Control Condition, Proportion Choice for Large Reward	Delay Condition, Proportion Choice for Large Reward
Alex	M	5	2	No	0.92	0.83
Alexandra	F	6	2	No	1.00	0.83
Annett	F	6	1	No	1.00	0.92
Corrie	F*	30	2	No	0.83	0.67
Dorien	F	26	1	Study 1	0.92	0.50
Fifi	F	12	1	No	1.00	0.58
Fraukje	F*	30	2	Study 1	1.00	0.50
Frodo	M	12	1	No	0.92	0.83
Jahaga	F	13	2	No	1.00	0.75
Lome	M	4	1	No	0.83	0.75
Natascha	F	27	1	No	0.58	0.83
Patrick	M	8	1	Study 1	1.00	0.08
Pia	F	6	2	No	1.00	0.50
Riet	F*	29	2	No	0.58	0.75
Robert	M	31	2	Study 1	0.83	0.58
Sandra	F	12	1	Study 1	1.00	0.50
Swela	F	10	1	No	0.67	0.83
Trudi	F	12	2	No	1.00	0.92
Unyoro	M	9	2	No	0.92	0.50

Condition order 1 indicates that subjects completed the control first, and condition order 2 indicates that they completed the delay first. Proportional choices represent average over both test sessions per condition. All data was used for the within-chimpanzee comparison, whereas only each individual's first test session was used for the human comparison. "*" indicates a female with dependent offspring present in the testing room during sessions.

differences in the delay condition. That is, although participants picked the large reward less frequently in the control condition if they were not hungry at the time of testing, participants in the delay condition were not willing to wait for the larger reward regardless of their level of hunger.

Effect of Food Type on Human Choice

To address whether the human subjects' food option had any impact on their performance, we performed an additional analysis of the human data with session half as a within-subjects factor and condition as a between-subjects factor as before, but added chosen food option (i.e., M&M's, crackers, popcorn, peanuts, or raisins) as a covariate. There was no influence of chosen food [F (1, 37) = 0.083, p = 0.775], and, as before, there was a main effect of condition [F (1, 37 = 44.185, p < 0.001] but no effect of session half [F (1, 37) = 0.145, p = 0.313] and no significant interactions. This indicates that subjects tested with different foods did not differ in their choices and were not more likely to become satiated over trials.

Effect of Past Discounting Experience on Chimpanzee Choice

Although all ape subjects in study 1 were naive to discounting tasks, five of nineteen chimpanzees in study 2 had participated in study 1 seven months prior. To ensure that the inclusion of these nonnaive subjects did not affect the results of study 2, we performed the second (within-subjects) analysis of chimpanzees from study 2 with only naive subjects. The main result reported previously, i.e., the difference between the delay and control conditions, holds [paired t(14) = 2.802, p = 0.015], indicating that the inclusion of these experienced subjects did not substantially influence the results.

Response Times for Humans and Chimpanzees

We coded two additional indexes of motivation for chimpanzees and humans: response latency (latency to make a choice) and food retrieval latency (latency to begin eating the food once it was available). For humans, choice latency was the period from when the experimenter finished saying "Do you prefer this cup, or this cup?" to when the subject indicated a choice, and food retrieval latency was from when E said "You can now have the food" to when the subject first touched the food cup. For chimpanzees, response latency was the period from when E removed the occluder to when the subject slide the choice panel; and food retrieval latency was the duration between when the food platform reached the front of the table and the subject first touched the food through the hand hole. In all cases, durations were coded as 0 s if, for example, subjects touched the cup before the experimenter finished the sentence (humans) or put their hands through the hole before the experimenter finished sliding the platform forward (chimpanzees). For each subject, we coded one choice trial for response latency, and another choice trial for food retrieval latency, both counterbalanced for trial number across subjects. Only 38 our of 40 human subjects could be assessed because of damage to one of the tapes.

Choice latencies and latencies to retrieve the food were normally only a few seconds for both species. Humans took an average of 1.3 s to make a choice, and average of 0.9 s to touch the food once it was available. Chimpanzees took and average of 2.8 s to make a choice, and an average of 1.0 s to touch the food once it was available. Because humans and chimpanzees do not radically differ in these measures, it suggests similar motivation levels for the food: For example, if humans did not particularly want the food, they might have had high response latencies (reflecting uncertainty or lack of desire to begin eating the food). It is important to note, however, that these measures are not directly comparable across species because of the necessary differences in their respective paradigms.

Study 3: Patience and Reward Type

Subjects

We tested subjects from the same population of students at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany tested in study 2, but did not retest any subjects. All tests took place in a room at the institute and occurred between 10:00 and 17:00. See Appendix A for the experimenter's script.

Questionnaire

Once subjects completed the money test, they then completed a questionnaire with two parts (see Appendix B for the questionnaire). In part one, subjects (1) indicated their age and sex, (2) estimated the delay they had waited to receive the larger reward, and (3) responded to an open-ended question about why they made the choices they did. The second part of the questionnaire consisted of ten standard discounting questions used in study 2.

Statistical Analyses

All proportional choices were arcsine square-root transformed. As reported in the main text, we performed an independent-samples t test with condition (delayed money or delayed food) as a between-subjects factor. Because the assumption of equal variances was not met (Levene's test, p < 0.001), the significance we report did not assume equal variances.

Analysis of Discounting Questionnaire Responses in Studies 2 and 3

Subjects chose the delayed reward a mean of 61.2% [SE = ± 3.5%]. By using participants' reponses over the ten questions, we calculated *k* values with the method developed by Kirby and Marakovic [S7] that creates a consistency index of possible discounting rates on the basis of each subject's pattern of responses; the most consistent value (or the geometric mean of multiple equally likely values) is taken as the *k* for that particular subject. Though we did not assess whether the hyperbolic model (from which *k* is derived) fits our data, this model fits most human monetary discounting data better than alternative models, such as exponential discounting [S8, S9]. A one-way ANOVA of *k* values indicated that on the questionnaire, preferences did not differ across the food control, food delay, or money delay conditions [F(2, 57) = 0.100, p = 0.905]. The *k* value seen in our study is comparable to that seen in other studies (for example, a similar experiment [S7] found average *k*s ranging from 0.0113 and 0.0047, depending on whether the questions involved small or large amounts of money; our questionnaire included questions falling across this spectrum; see Appendix B).

Correlation between Task Responses and Questionnaire Responses

In addition, we assessed whether subjects' responses in the experiential tasks (the delayed food condition from study 2 and the delayed money condition in study 3) were related to their responses in the questionnaires. As with previous analyses, proportional choices were arcsine square-root transformed. A partial correlation controlling for reward type (food versus money) between proportional choice for the larger rewards in the delayed tasks and proportional choice for the larger rewards in the questionnaire revealed a positive relationship (correlation coefficient = 0.334, 2-tailed p = 0.038). Thus, individuals who are more patient in the experiential discounting tasks used here are also more patient in standard discounting questionnaires, although the length of time they are willing to wait varies dramatically.

Appendix A: Experimenter Instructions for Human Participants in Studies 2 and 3

Study 2 Instructions for the Food Task

Italicized text appears only in the control condition; text inside parentheses appears only in the delay condition.

This is an experiment about decision-making, and will take no longer than 45 min. In the experiment you are going to be able to make a series of choices about food, and after each decision you can eat the food you choose. How much you receive will depend on the decisions that you make. This part of the experiment will take no longer than 31 min. At the end of the experiment you will be asked to complete a questionnaire. This questionnaire will take about 10 min to complete. Do you have any questions at this point?

In the test, you get to choose between two pieces of food, and six pieces of food. I will ask you which of the options you prefer, and you can then answer verbally or by pointing at your choice. *Once you have indicated your choice, I will say "You can now have the food," and you can then eat the option you have chosen.* (Once I say "You can now have the food," you can then eat the option you have chosen.) Specifically what will happen is that both options will be in cups like this. I will ask you which cup you want, and once you answer I will remove the other one*. Then I will say right away, "You can now have the food."* (If you pick the two pieces I am allowed to give it to you immediately. However, if you choose the six pieces I am not allowed to give it to you until after a set period of time has passed. That is, if you chose the cup with two pieces, I will say right away, “You can now have the food.” But if you choose the cup with six, you will have to wait before I say “You can now have the food.”)

Each trial will consist of just one choice like this. The total number of trials was randomly predetermined, so the test could stop after any number of trials. Therefore just choose according to your preferences when I actually ask you. There is no right or wrong way to do this task. Before we start the experiment there will be a practice period where you get to see how the procedure works and experience both options (receiving the two pieces right away, and waiting for the six pieces). This practice period can then guide your decisions when you chose between the two options. Do you have any questions at this point?

Throughout the test, you must eat all of the food before you can proceed to the next trial—that is, you have to eat it here during the test, and cannot take the food out of the test or save it for later. You can take as long as you’d like to eat the food and eat it in any way you’d like. (Throughout the test, the two pieces of food will always be available immediately, and the six pieces will always be associated with the same delay.) That’s a glass of water that you should feel free to drink throughout the test if you get thirsty. Do you have any questions at this point? (If you choose the six pieces of food, during the delay period I will sit at that table over there, and we are not allowed to talk to each other. Then when the delay finishes you can eat the food.)

Before the actual test begins, if you are wearing a watch it could you please remove it. Thank you. Now for the actual test, you will be eating the same food throughout the test. However you can choose beforehand what type of food you would like to eat. You can choose from chocolate, popcorn, raisins, peanuts, and goldfish crackers. Feel free to try these options before you decide.

Ok great. Now there’s going to be the practice period where you get to experience each option two times each. In this practice period I am going to set just one cup in front of you, and then ask you how many items are in the cup. *Once you answer I will immediately say “You can now have the food,” and then you can consume your choice.* (If the cup has two pieces of food in it, once you answer I will immediately say “You can now have the food.” But if the cup has six pieces, there will be a delay before I say you can eat it.) Once you have experienced each option twice, I will tell you that the practice period is over and the actual test will begin. Do you have any questions at this point?

Then we will begin with the practice period.

Study 3 Instructions for the Money Task

This is an experiment about decision-making, and will take no longer than 45 min. In the experiment you are going to be able to make a series of choices about money, and after each decision you will receive the money you choose, which you can keep when the experiment is finished. How much money you receive will depend on the decisions that you make. This part of the experiment will take no longer than 30 min. At the end of the experiment you will asked to complete a questionnaire. This questionnaire will take about 10 min to complete. Do you have any questions at this point?

In the test, you get to choose between different numbers of coins. Specifically, you can choose between two 10 cent coins—that is, 20 cents—and six 10 cent coins, or 60 cents. I will ask you which of the options you prefer, and you can then answer verbally or by pointing at your choice. Once I say “You can now have the money,” you can then take the option you have chosen and put it in your cup here to keep. Specifically what will happen is both options will be in cups like this. I will ask you which cup you want, and once you answer I will remove the other one. If you pick the two coins I am allowed to give them to you immediately. However, if you choose the six coins I am not allowed to give them to you until after a set period of time has passed. That is, if you chose the cup with two coins, I will say right away, “You can now have the money.” But if you choose the cup with six, you will have to wait before I say “You can now have the money.”

Each trial will consist of one choice like this. The total number of trials was randomly predetermined, so the test could stop after any number of trials. Therefore just choose according to your preferences when I actually ask you. There is no right or wrong way to do this task. Before we start the experiment there will be a practice period where you get to see how the procedure works and experience both options: receiving the two coins right away, and waiting for the six coins. You get to keep the money you receive during this practice period, and the practice period can then guide your decisions when you chose between the two options. Do you have any questions at this point?

Throughout the test, you get to keep all of the money you choose. After every trial, you can put your chosen amount in this cup here. When the test is over, you can trade in the coins for larger bills if you prefer. Throughout the test, the two coins will always be available immediately, and the six coins will always be associated with the same delay. Additionally, that’s a glass of water that you should feel free to drink throughout the test if you get thirsty. Do you have any questions at this point?

If you choose the six coins, then during the delay period I will sit at that table over there, and we are not allowed to talk to each other. Then when the delay finishes you can have the money and put it in your cup. Before the actual test begins, if you are wearing a watch it could you please remove it. Thank you.

Ok great. Now there’s going to be the practice period where you get to experience each option two times each. In this practice period I am going to set one cup in front of you, and then ask you how many items are in the cup. If the cup has two coins in it, once you answer I will immediately say “You can now have the money.” But if the cup has six coins, there will be a delay before I say you can have it. Once you have experienced each option twice, the actual test will begin. Do you have any questions at this point? Great. Now we will begin with the practice period.

Studies 2 and 3: Questionnaire Instructions

Part I: The first part of the questionnaire consists of some basic information about yourself as well as a question about the decisions you made in the previous test. Once you have completed this part of the questionnaire, I will then give you a series of questions about money and time.

Part II: Items 5-14 [or 7-16 depending on condition] are a series of questions about money and time. For each question, you can indicate your preference between two options: a smaller amount of money that that you could have today, or a larger amount that you could have after some delay. Although you will not receive the options that you chose, please make your choices as though they will actually be paid to you. I will present these questions to you one at a time, and you can mark the option you prefer on the sheet. Once you have completed a question you can return it to me and I will give you the next question.

Appendix B: Sample Questionnaire Used in Studies 2 and 3

“*” indicates questions that were administered only to subjects from study 2 tested at Harvard University. “**” indicates a question administered only to subjects in the delay conditions in studies 2 and 3.

Part I

1. What is your sex? M_____ F_____
2. What is your age (in years)? ______
3. Please estimate the most recent time you ate something today prior to the test: _______

*4. Please rate how hungry you were before the test started:

1 2 3 4 5

Not at all hungry Neutral Very Hungry

*5. Please rate how much you liked the type of food you ate in the test:

1 2 3 4 5

Disliked strongly Neutral Like strongly

**6. Please estimate the length of the delay associated with the six pieces (in minutes) to the best of your ability: ______

7. Please briefly explain why you chose the number of options (2 versus 6) that you did in the test:

Part II

8. Would you prefer to receive $27 today or $69 in 90 days?
____$27 ____$69
9. Would you prefer to receive $15 today or $50 in 45 days?
____$15 ____$50

10. Would you prefer to receive $17 today or $52 in 220 days?
____$17 ____$52
11. Would you prefer to receive $22 today or $70 in 20 days?
____$22 ____$70
12. Would you prefer to receive $35 today or $55 in 100 days?
____$35 ____$55
12. Would you prefer to receive $31 today or $59 in 150 days?
____$31 ____$59
14. Would you prefer to receive $33 today or $60 in 110 days?
____$33 ____$60
15. Would you prefer to receive $24 today or $63 in 50 days?
____$24 ____$63
16. Would you prefer to receive $29 today or $59 in 275 days?
____$29 ____$59
17. Would you prefer to receive $34 today or $51 in 195 days?
____$34 ____$51

[Subjects who completed the test at the Max Plank Institute answered identical questions, but the monetary unit was the euro].

Supplemental References

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