Cognition 126 (2013) 109–114

Contents lists available at SciVerse ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/COGNIT

Brief article

Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability

Celeste Kidd [a,*], Holly Palmeri [a], Richard N. Aslin [a,b]

[a] Brain & Cognitive Sciences, University of Rochester, Meliora Hall, Rochester, NY 14627-0268, United States
[b] Center for Visual Science, University of Rochester, Meliora Hall, Rochester, NY 14627-0268, United States

ARTICLE INFO

Article history:
Received 3 March 2012
Revised 27 June 2012
Accepted 15 August 2012
Available online 9 October 2012

Keywords:
Child learning
Decision-making
Rational analysis
Delay of gratification
Marshmallow task

ABSTRACT

Children are notoriously bad at delaying gratification to achieve later, greater rewards (e.g., Piaget, 1970)—and some are worse at waiting than others. Individual differences in the ability-to-wait have been attributed to self-control, in part because of evidence that long-delayers are more successful in later life (e.g., Shoda, Mischel, & Peake, 1990). Here we provide evidence that, in addition to self-control, children's wait-times are modulated by an implicit, rational decision-making process that considers environmental reliability. We tested children ($M = 4;6$, $N = 28$) using a classic paradigm—the marshmallow task (Mischel, 1974)—in an environment demonstrated to be either *unreliable* or *reliable*. Children in the *reliable* condition waited significantly longer than those in the *unreliable* condition ($p < 0.0005$), suggesting that children's wait-times reflected reasoned beliefs about whether waiting would ultimately pay off. Thus, wait-times on sustained delay-of-gratification tasks (e.g., the marshmallow task) may not only reflect differences in self-control abilities, but also beliefs about the stability of the world.

1. Introduction

When children draw on walls, reject daily baths, or leave the house wearing no pants and a tutu, caretakers may reasonably doubt their capacity for rational decision-making. However, recent evidence suggests that even very young children possess sophisticated decision-making capabilities for reasoning about physical causality (e.g., Gopnik et al., 2004; Gweon & Schulz, 2011), social behavior (e.g., Gergely, Bekkering, & Király, 2002), future events (e.g., Denison & Xu, 2010; Kidd, Piantadosi, & Aslin, 2012; Téglás et al., 2011), concepts and categories (e.g., Piantadosi, Tenenbaum, & Goodman, 2012; Xu, Dewar, & Perfors, 2009), and word meanings (e.g., Xu & Tenenbaum, 2007). Here we demonstrate that young children also use their rational decision-making abilities in a domain of behavioral inhibition: a sustained delay-of-gratification task.

Decision-making is said to be rational if it maximizes benefit or utility (Anderson, 1991; Anderson & Milson, 1989; Marr, 1982), yet young children's decisions during delay-of-gratification tasks often appear to do just the opposite (e.g., Mischel & Ebbesen, 1970). When asked to resist the temptation of an immediately available low-value reward to obtain one of high-value after a temporal delay, 75% of children failed to do so, succumbing to their desire after an average of 5.72 min. The cause of these apparent failures of rationality, however, is not fully understood. While children's failures to wait are likely the result of a combination of many genetic and environmental variables, two potentially important factors are *self-control capacity* and *established beliefs*.

* Corresponding author. Address: BCS, Meliora Hall, Box 270268, University of Rochester, Rochester, NY 14627-0268, United States. Tel.: +1 585 275 6281; fax: +1 585 442 9216.
E-mail addresses: ckidd@bcs.rochester.edu (C. Kidd), hpalmeri@bcs.rochester.edu (H. Palmeri), aslin@cvs.rochester.edu (R.N. Aslin).

0010-0277/$ - see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.cognition.2012.08.004

1.1. Deficient capacity hypothesis

One possible explanation for failing to wait for a larger reward is a deficiency in *self-control*; some children are simply incapable of inhibiting their immediate-response tendency to seek gratification. Young infants, for example, have not yet developed the executive functions necessary for inhibitory control (e.g., Piaget, 1970), as evidenced by the perseveration errors made by up to 2-year-old children in A-Not-B tasks (e.g., Marcovitch & Zelazo, 1999; Piaget, 1954). As predicted by this theory, children's ability to delay gratification improves with maturation (e.g., Mischel & Metzner, 1962). Maturational changes, however, are insufficient to account for all of the variance in task performance (e.g., Romer, Duckworth, Sznitzman, & Park, 2010). *Individual differences* in children's capacities for self-control may account for the remaining variance.

Self-control has been implicated as a major causal factor in a child's later life successes (or failures). Mischel, Shoda, and Peake (1988) analyzed data from adolescents who, many years earlier, had been presented with a laboratory choice-task: eat a single marshmallow immediately, or resist the temptation during a sustained delay to receive two marshmallows. With no means of distracting themselves from a treat left in view, the majority of children failed to wait for the maximum delay (15 or 20 min) before eating the marshmallow, with a mean wait-time of 6 min and 5 s. Importantly, longer wait-times among children were correlated with greater self-confidence and better interpersonal skills, according to parental report. Longer wait-times also correlated with higher SAT scores (Shoda et al., 1990), less likelihood of substance abuse (Ayduk et al., 2000), and many other positive life outcomes (e.g., Mischel, Shoda, & Rodriguez, 1989). Based on these findings, the marshmallow task was argued to be a powerful diagnostic tool for predicting personal well-being and later-life achievement—"an early indicator of an apparently long-term personal quality" (Mischel et al., 1988). The logic of the claim is that a child who possesses more self-control can resist fleeting temptations to pursue difficult goals; in contrast, children with less self-control fail to persist toward these goals and thus achieve less. To be clear, the evidence for poor self-control in young children (e.g., Baumeister, Heatherton, & Tice, 1994; Goleman, 1995), in a wide variety of tasks and contexts, is undeniable. At issue is the *origin of failure* of delay-of-gratification in laboratory tests like the marshmallow task, which has remained largely speculative (Mischel et al., 1989, p. 936).

1.2. Rational decision-making hypothesis

Another possibility is that the variance in children's performance may be due to differences in children's expectations and beliefs (Mahrer, 1956; Mischel, 1961; Mischel & Staub, 1965). Under this theory, children engage in rational decision-making about whether to wait for the second marshmallow. This implicit process of making rational decisions is based upon beliefs that the child acquired before entering the testing room. The basis for this theory centers on what it means to be rational *in the context* of the marshmallow task. Waiting is only the rational choice if you believe that a second marshmallow is likely to actually appear after a reasonably short delay—and that the marshmallow currently in your possession is not at risk of being taken away. This presumption may not apply equally to all children. Consider the mindset of a 4-year-old living in a crowded shelter, surrounded by older children with little adult supervision. For a child accustomed to stolen possessions and broken promises, the only guaranteed treats are the ones you have already swallowed. At the other extreme, consider the mindset of an only-child in a stable home whose parents reliably promise and deliver small motivational treats for good behavior. From this child's perspective, the rare injustice of a stolen object or broken promise may be so startlingly unfamiliar that it prompts an outburst of tears. The critical point of the foregoing vignette is that rational behavior is inferred by understanding the goals and expectations of the agent (Anderson, 1991; Anderson & Milson, 1989; Marr, 1982). Relevant to this hypothesis is the fact that children with absent fathers more often prefer immediate, lesser rewards over delayed, more valuable ones (Mischel, 1961). Also, children's willingness to wait is negatively impacted by uncertainty about the likelihood, value, or temporal availability of the future reward (Fawcett, McNamara, & Houston, 2012; Mahrer, 1956; McGuire & Kable, 2012; Mischel, 1974; Lowenstein, Read, & Baumeister, 2003). These effects are consistent with the idea that children may be capable of engaging in a rational process when deciding whether or not to wait.

In support of this second hypothesis, we present evidence that the reliability of the experimenter in the testing environment influences children's wait-times during the marshmallow task. Half of the children observed evidence that the researcher was *reliable* in advance of the marshmallow task, while half observed evidence that she was *unreliable*. If children employ a rational process in deciding whether or not to eat the first marshmallow, we expect children in the reliable condition to be significantly more likely to wait than those in the unreliable condition. Our experiment provides a fundamental test of this perspective on children's rational behavior and provides compelling evidence that young children are indeed capable of delaying gratification in the face of temptation when provided with evidence that waiting will pay off.

2. Materials and methods

2.1. Participants

Twenty-eight caretakers volunteered their children (ages 3;6 – 5;10) for the study. The children were all healthy, had not recently visited the lab (within 2 months), and had not interacted with researchers running the study since infancy. These precautions ensured children had minimal prior expectations specific to the lab or researcher's reliability before this study. Children were randomly assigned to one of two experimental conditions—*unreliable* and *reliable*—such that each group was gender and age balanced (nine males, five females, and $M = 4;6$). Participants received a small treat bag and $10 as compensation.