Chapter 2
Delay of Gratification: Explorations of How and Why Children Wait and Its Linkages to Outcomes Over the Life Course

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Introduction

The ability to delay gratification, to forgo immediately available rewards in pursuit of more preferred but distal goals, is a hallmark of adaptive functioning across the life course. Delaying gratification is a behavioral manifestation of the larger umbrella construct of self-control (Moffitt et al. 2011) and is implicated in a wide range of self-regulatory regimens including maintaining a healthy diet (Herman and Polivy 2003), exercising effectively (Unkelbach et al. 2009), and doing well in school (Bembenutty and Karabenick 2013; Bindman et al. 2015) to name just a few. Inability to delay, on the other hand, has been linked to numerous maladaptive outcomes including obesity (Caleza et al. 2016), substance use (Abikoye and Adekoya 2010; Rossiter et al. 2012), relational difficulties (Ayduk et al. 2000), gambling (Callan et al. 2011), and clinical symptomatology (Ayduk et al. 2008; Campbell and von Stauffenberg 2009). Given the scope of life outcomes to which delay of gratification is linked, it is not surprising that the ability to wait for more desired outcomes is a vibrant field of inquiry within psychology (Tobin and Graziano 2010).

Although there a number of alternative operationalizations of delay of gratification, the paradigm developed by Walter Mischel and his students nearly 50 years ago has captivated both empirical and popular considerations of the topic. In the self-imposed delay of gratification paradigm, a 3–5-year-old child is brought to a "game room" by a familiar adult and asked to indicate a preference between, for instance, one small treat or two. Not surprisingly, children invariably opt for the larger of the two options. The preschooler is then told the adult needs to leave the room and that in order to get the preferred treats, the child will need to wait quietly for the adult to return. Should they decide they no longer want to wait, the child is

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given the option to ring a small desk bell to signal the adult to return at any time. However, if the child terminates the wait, they only get the single treat. Although numerous types of treats (marshmallows, pretzels, M & Ms, mints, etc.) have been used in this research, the experimental paradigm has become popularly labeled simply as the "Marshmallow Test."

Originally designed during the late 1960s, the self-imposed delay of gratification paradigm became the methodological foundation for a decade-long experimental exploration of the cognitive and contextual factors that influence children's ability to wait (Mischel et al. 1989). The number of seconds children waited in those original experiments subsequently became the predictive base for a longitudinal research program that now spans four decades (Mischel et al. 2011). The research program that has evolved around the Marshmallow Test is widely recognized as contributing critical insights into the empirical understanding of childhood waiting and especially its connections to later life outcomes. Mischel et al. (1988) first reported that children who delayed gratification during preschool were perceived by their parents as adolescents who were more cognitively competent, socially competent, and able to cope with stress than their counterparts who did not wait. Subsequent research has extended these longitudinal findings to academic outcomes (Shoda et al. 1990), early adult interpersonal difficulties (aggression, peer rejection) and adaptive functioning (low self-worth, drug use) (Ayduk et al. 2000), borderline personality features (Ayduk et al. 2008), adult body mass (Schlam et al. 2013), and adult differences in neural functioning during impulse control tasks (Casey et al. 2011; Berman et al. 2013).

In popular culture, the Marshmallow Test has assumed a life of its own. The research was thrust into the public consciousness when Dan Goleman offered it as evidence for the importance of "impulse control" in his popular trade book on "emotional intelligence" (Goleman 1995). While there are serious empirical questions about whether delay of gratification is even a component of emotional intelligence (Mayer and Salovey 1997), Goleman captured widespread media and public attention by pitting the Marshmallow Test against traditional IQ tests as a predictor of "success" in later life. Although these claims have also been questioned (Amelang and Steinmayr 2006; Di Fabio and Palazzeschi 2009), they are rarely scrutinized in the popular portrayals of the research. Instead, the research findings are commonly reduced to the simple claim that terminating waiting in the Marshmallow Test portends all manner of later life challenges. These reductions are often buttressed by incredibly compelling, cute, and humorous depictions of children as they grapple with staged enactments of the Marshmallow Test. In outlets ranging from Sesame Street to Oprah, the virtues of impulse control are consistently extolled. The self-help industry has stepped in with numerous books cautioning parents about the fate foretold by early impulsivity. Through Internet blogs, TED Talks, and the like, the virtual life of the Marshmallow Test continues to grow largely unchecked. And like many things within this sphere, as hyperbole builds on hyperbole, complexity and nuance give way to simplistic reductions. Sadly, many academic and popular renditions of the lessons to be learned from this program of

research run counter to the conceptual intent, empirical findings, and explicitly stated precautions of the published research.

What should we make of a child ringing a bell to summon the researcher to return during a Marshmallow Test? The direct answer to this question is that the child chose not to wait. In many scholarly and popular portrayals, however, terminating the wait is seen as an act of "impulsivity," the focal point of these conference proceedings. While the label impulsivity is descriptively convenient, it encourages inference about underlying process that may not be fully warranted. It implies more than that the child opted not to wait, and it suggests a reason for that choice. As an explanatory construct, impulsivity implies "acting on impulse" and is commonly defined as acting on emotion, without forethought or careful consideration of risks and consequences. For this reason, impulsive acts are often characterized as irrational, reflexive and stimulus bound. But is ringing a bell to summon an adult back to the room an act of impulsivity? Is the preschooler "acting on emotion, without forethought or careful consideration of risks and consequences"? Is terminating the delay and opting for the lesser reward an "irrational, reflexive, and stimulus bound response"? Labeling the termination of the wait as impulsivity both implicates an underlying process that may not be warranted, suggests that the root cause of stopping is dispositionally rooted in the child, and detracts from other prospective processes that might be implicated in the child's choice.

On the other side of this bipolarity, what should we make of the child who sticks it out, doesn't ring the bell, and waits in order to get the second treat? As noted above, effectively delaying gratification is commonly cast as an act of impulse control or "willpower" (Goleman 1995, pp. 80–82). Especially problematic in this labeling is the suggestion that differences in waiting time derive the individual's "self-control strength," an inferred limited resource subject to depletion under stress (Baumeister and Tierney 2011). Willpower also implies that the path to effective waiting involves "gritting it out" until one attains the desired outcome. Framed within this impulsivity/willpower dichotomy, individuals are viewed as navigating a continuing battle where the temptation to follow irrational impulses must be overcome by "willing" their way to more desired, reasoned choices. Rather than inferring that waiting is the product of willpower or impulse control and all that those terms imply, it is important to ask what children actually do to facilitate delay of gratification. It turns out that existing research provides rich and somewhat unexpected clues about these processes.

As the empirical span of this research program closes in on nearly half a decade, it seems timely to review the history of the Marshmallow Test from its early experimental roots through its various longitudinal forays. In the context of the current volume, any full consideration of impulsivity should rightfully include a review of this foundational research. The review offered here presents an historically annotated and purposely critical overview of what the original research program revealed about waiting, what the follow-up research has documented to date, and what those various explorations tell us about what might be guiding children's behavior as they navigate the challenge. The research reviewed will then be used to evaluate different factors that are commonly offered as explanations for why

children wait and to explore academic and popular claims that are commonly attached to the Marshmallow Test.

Experimental Studies of Delay of Gratification (1967–1973)

Background and Setting

The series of experimental studies that constitute the empirical base of the Marshmallow Test evolved from the collective efforts of Mischel and a dedicated group of students during the latter part of the 1960s and continuing through the early 1970s. A number of theoretical and operational influences converged at that time that guided this program of research. Several of these are worth special consideration.

First, Mischel's interest in delay of gratification predated the Marshmallow Test by over a decade. Beginning with anthropological collaborations with his brother in Trinidad and Grenada that were initiated in 1955, Mischel conducted a series of investigations of preferences for delayed outcomes (Mischel 1958, 1961; Mischel and Gilligan 1964; Bandura and Mischel 1965; Mischel and Staub 1965; Mischel and Grusec 1967; Mischel et al. 1969). Throughout this line of research, the key dependent measure was the individual's choice between a small, but immediately available reward (one cent candy now) and a temporally delayed but larger reward (ten cent candy in one week). The expressed preferences were labeled as measures of "delay choice." The Marshmallow Test was designed with the recognition that expressed preferences for delayed outcomes are not always born out when people actually face the challenge of the wait itself. One only needs to think of the considerable challenges people confront holding to New Year's resolutions to understand this important distinction. People can express all manner of preferences for desirable distal outcomes only to see those preferences melt away when faced with the sacrifices and challenges of staying on a diet, maintaining an exercise regimen, or forgoing alcohol or cigarettes. Mischel and his students recognized the distinction between expressed preferences for delayed outcomes (delay choice) and the ability to actually maintain delay (delay maintenance) and focused the design of the Marshmallow Test directly on the latter.

The discrepancy that often exists between delay choices and delay maintenance was aligned with the then emerging literature on the differences that characterize people's attitudes and their actual behavior in other spheres (Fishbein and Ajzen 1972) and continues to be recognized as an important distinction in understanding self-control and impulsivity. Much of the current work on temporal discounting that is linked to the study of impulsivity, although impressively refined and operationalized over the early offerings of Mischel and others (Mahrer 1956), focuses almost exclusively on people's delay preferences despite reminders of the important distinction between those choices and delay behavior itself (Reynolds and

Schiffbauer 2005; Addessi et al. 2013). Although the term delay of gratification is often confusingly used to refer to either delay choices or delay maintenance, a key distinction between the two is that while self-reported preferences (and the discounting functions associated with them) yield static assessments of the person's desires, maintaining delay is a dynamic process that is defined by individual's option to defect from those choices as the waiting progresses (Young and McCoy 2015).

It is worth noting that children participating in the standard delay of gratification paradigm do state a preference between the two outcomes that are offered. Typically, this choice is between different quantities of the same treat (e.g., one marshmallow vs. two marshmallows) although it is not uncommon to use mixes (e.g., one pretzel vs. two marshmallows). When this preference is first expressed within the experimental paradigm, it is in the form of a straight choice (Mischel 1958) and is distinguished from a delay choice by the absence of a temporal element (e.g., one marshmallow now vs. two marshmallows in 15 min). Children are simply asked whether they would prefer one reward option or the other. The element of time is only introduced when it is later explained to the child that they must wait for the more preferred outcome, but even here the actual length of the wait is not specified. Indeed, one of the defining features of the Marshmallow Test is the child's uncertainty about how long they will need to wait. Preschoolers are only told that the experimenter needs to leave the room and that they must wait for the experimenter to return in order to receive the more preferred reward. Children might reasonably infer that the wait will be minutes versus hours or days, etc., but it is deliberately unclear whether the absence might be just a few seconds, a few minutes, or longer. One thing that is clear is that waiting alone to the required criterion time, which ranged from 10 to 30 min in the original experiments, is typically an unusual and challenging experience for preschoolers. Needless to say, subjective expectations about how long the wait might be are likely shifting as the experience unfolds (McGuire and Kable 2013). These shifting expectations contribute to the dynamic of most self-control situations where the individuals must continually re-evaluate whether the desired outcome is indeed worth enduring the wait and forgoing immediately available options. As in many real-life self-control scenarios, earnestly expressed preferences become subject to reappraisal and defection as the child sizes up the challenge, uncertainty, and experience of the task at hand.

A second major influence on the development and implementation of the experiments on children's waiting was undoubtedly the publication of *Personality and Assessment*, the classic critique of the field of personality theory and testing (Mischel 1969). In *Personality and Assessment*, Mischel provided a review of several lines of research that challenged key assumptions that had historically guided theory and research on the nature of personality. First, with the exception of some cognitive and intellectual measures, people show less consistency in their behavior across situations than was suggested by traditional dispositional approaches. Although people often demonstrate impressive stability in their behavior over time when observed in the same situation, observations taken across different

contexts suggest that behavior is highly sensitive to contextual variation. Second, Mischel noted that efforts to predict how people behave in real-life situations based on static trait-based assessments of personality typically demonstrated modest efficacy. From these observations, Mischel questioned the utility of both conceptualizing and measuring personality using highly generalized dispositions such as impulsivity and willpower. Instead, Mischel challenged personality researchers to shift their focus to units of analysis that might more closely embody the observed contextual sensitivity of behavior. Rather than being driven by generalized dispositions, Mischel suggested that people's behavior is highly discriminative. People navigate the complexities of their social worlds actively processing situational cues that trigger sets of expectancies, goal systems, and competencies that guide their ongoing behavior.

The shift away from global, dispositional units to more contextualized, process-oriented constructs can even be seen in the very early work on delay choice. Rather than viewing these preferences as generalized traits, this research focused on identifying contextual and experiential factors that influence delay choices. In work based on Rotter's early social learning theory, Mahrer (1956) showed that children's experimentally manipulated expectancies that they will receive the preferred reward (e.g., their "trust" that the reward will in fact be delivered) powerfully impacts children's delay choices. Mischel (1958, 1961) similarly demonstrated that the trust-based expectancies that underlie delay choices can derive from children's cultural and familial history with agents who deliver rewards. Mischel and Metzner (1962) showed that delay choices varied in relation to age, intelligence, and the length of the wait. Also working within a social learning framework, Bandura and Mischel (1965) demonstrated that exposure to live and symbolic model's delay preferences produced sustainable shifts in children's delay choices. Mischel and Staub (1965) showed that when a work element was added to the requirements for attaining the desired outcome, delay choices were influenced by the child's expectancies of succeeding on the task. Additionally, Mischel and Grusec (1967) demonstrated that delay choices are related to beliefs about temporal delay and trust (probability of delivery) for both future rewards and punishments. This line of research illustrates the shift away from viewing delay choices as highly generalized dispositions to one where preferences are seen as the products of children sizing up the circumstances they face and using those contextual cues to guide their choices. From this perspective, delay preferences were not seen as fixed and enduring, but flexible and adaptive. Similarly, and importantly for the current review, children's delay choices were not seen as primarily reflecting of the child's impulsivity. The child expressing a preference for an immediate reward was not viewed as "acting on emotion, without forethought or careful consideration of risks and consequences." Instead, delay choices were seen as reflecting a reasoned evaluation of the current circumstances in light of child's beliefs, values, and expectancies regarding the proposed outcomes.

Similarly, as Mischel and his students shifted their focus of study from delay choice to delay maintenance, the child's ability to wait was not viewed as a fixed and enduring disposition, but as a competence that was likely influenced by an array

of contextual and cognitive factors. The program of experiments that utilized the Marshmallow Test set out to identify and explore those factors. In the review that follows, the methods and key findings of each of the published experiments in that program are briefly described. Experiments are reviewed in the chronological order of their publication, which largely overlaps with the order in which they were conducted. It is important to note that the experiments employing the Marshmallow Test were but one part of a larger research program that explored different facets of children's self-control including children's generalized control beliefs (Mischel et al. 1974), coping plans (Mischel and Patterson 1976; Patterson and Mischel 1976), and knowledge of waiting strategies (Yates and Mischel 1979; Mischel and Mischel 1983). In addition, some experimental conditions that were part of the studies discussed here are not included in this review. Although all of this research informs our broader understanding children's self-control, these programmatic components do not employ an experimental variation of the Marshmallow Test or do so in examining something other than passive waiting (e.g., delay while working) and hence are not included in the longitudinal database to be discussed subsequently.

Reward Presence: Mischel and Ebbesen (1970)

The initial rendition of the Marshmallow Test was designed to address a straightforward but consequential question regarding the factors that might influence children's ability wait. It explored the impact of the physical presence of the rewards during the waiting period in research carried out by Ebbe Ebbesen at the Bing Nursery School during the summer of 1967. Mischel and Ebbesen introduced a new delay of gratification paradigm where preschoolers, typically 4–5 years of age, were asked to indicate a straight choice preference between either five 2-inch pretzels or two animal cookies (yes, the original "Marshmallow Test" did not include any marshmallows). After the child had indicated a preference, the experimenter explained they would need to leave the room and that the child would need to wait for the experimenter to return to receive the preferred reward. Unlike later versions of the paradigm, there was no bell in this first study. Instead, children were taught to consume a small ½-inch pretzel as a signal to the experimenter that they wanted to terminate the delay.

The key manipulation in this paradigm was which rewards were left in the room while the child attempted to wait. All combinations were included: both rewards, the delayed (preferred) reward, the immediate (less preferred) reward, or neither of the rewards. Mischel and Ebbesen reasoned that leaving different combinations of rewards in the room would allow children to focus attention on the rewards while they waited, and hence, this was offered as a manipulation of the child's attention to rewards. While it is clearly the case that children will pay more attention to rewards when they are physically present, it is not the child's attention per se that is being manipulated in this experiment but the physical presence or absence of the rewards.

Mischel and Ebbesen noted and subsequent research has since demonstrated that even with rewards physically available for attention, there are substantial differences in children's tendency to actually focus attention on the rewards (Peake et al. 2002).

The key finding of this research was that leaving the rewards physically present (and hence available for the child to attend to) was quite detrimental to waiting. Children facing both rewards during the delay period managed to wait on average just over 1 of the possible 15 min (Fig. 2.1). In contrast, when both rewards were removed, children waited on average over 11 min. If either one of the rewards (delayed or immediate) was left with the child, intermediate waits averaging around 5 min were observed. These findings demonstrate that having any reward present while waiting makes the delay more challenging, but having both rewards present makes waiting especially difficult. This indicates that the presence of both rewards encourages active comparison of the two outcomes that might encourage reappraisal and earlier defections from the desired path. It is one of the first empirical signs that children are actively processing and re-evaluating possible outcomes as the wait progresses.

In discussing the impact of reward presence, it is common to find the difference between the 1- and 11-min average waits highlighted (Mischel et al. 1989, 2011). However, Mischel and Ebbesen recognized that it was problematic in this paradigm for the "signal" to terminate delay (eating a small pretzel) to be so similar to one of the potential rewards. For this reason, in a section of the paper referred to as "follow-up data," they report a replication study where they introduced a small desk bell for children to use to signal the experimenter to return. This substitution eliminated the confounding of the signal to return with the desired outcome and became the standard procedure for all subsequent work in this paradigm. Interestingly, although average delay times remain significantly shorter when rewards are present than absent when using the bell as a signal (3 min vs. 9 min, see Fig. 2.1), they are no longer the extremely short times evidenced when pretzels

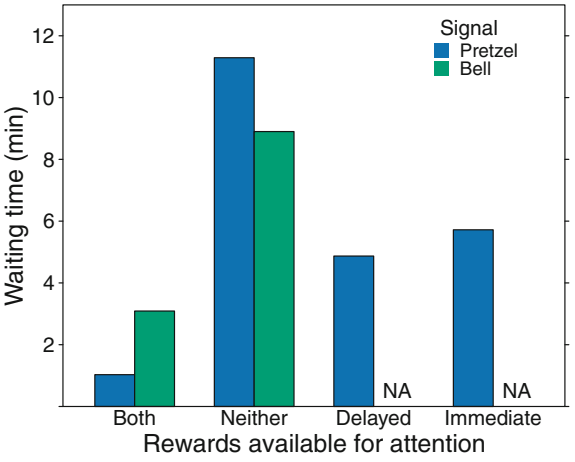

Fig. 2.1 Waiting time as a function of reward presence using either consuming pretzel or ringing bell as signal for experimenter to return. Adapted from Mischel and Ebbesen (1970)

were used as signals. This might again attest to the contextual sensitivity of delay behavior, but some caution is warranted here since sample sizes are quite small in most of these conditions (typically around $N = 10$ in any experimental condition), and hence, condition means can contain a substantial error component. It is worth noting that while reward presence almost always yields significantly shorter average wait times within a particular experiment, there is nonetheless sizable variation in the average wait time with rewards present across studies.

In retrospect, many suggest that it is obvious that leaving rewards present during the delay period should be detrimental to effective waiting. At the time, however, there were several compelling theoretical accounts that suggested just the opposite. Psychoanalysts, including Freud (1911), had suggested that the key to bridging time in pursuit of a blocked gratification involved constructing mental images of the desired but blocked object (see also Rappaport 1967). Working from a very different theoretical slant, social psychologists also weighed in on this issue suggesting that effective impulse control centered on self-instructional processes that increase the salience of delayed outcomes, thus facilitating "time-binding." From this perspective, any cognitive or contextual factors that increase the salience of the reward should make waiting easier (Jones and Gerard 1967). To this day, it is not uncommon to see self-help guides that steer individuals to repeatedly focus or remind themselves of desired outcomes. Within the empirical literature, there are still important questions regarding those circumstances where attention to rewards might facilitate performance (Peake et al. 2002). Whether obvious or not, the impact of reward presence remains one of the most robust and conceptually important findings in this program of research.

Distractions from Rewards: Mischel et al. (1972)

In discussing their findings, Mischel and Ebbesen commented on the activities of the children while they waited with the following:

> One of the most striking delay strategies used by some subjects was exceedingly simple and effective. These children seemed to facilitate their waiting by converting the aversive waiting situation into a more pleasant non-waiting one. They devised elaborate self-distraction techniques through which they spent their time psychologically doing something (almost anything) other than waiting. Instead of focusing prolonged attention on the objects for which they were waiting, they avoided looking at them. Some children covered their eyes with their hands, rested their heads on their arms, and found other similar techniques for averting their eyes from the reward objects. Many seemed to try to reduce the frustration of delay of reward by generating their own diversions: they talked to themselves, sang, invented games with their hands and feet, and even tried to fall asleep—as one child successfully did (1970, p. 335).

Mischel and Ebbesen saw these efforts as testimony to how frustrating waiting alone is for preschoolers. They noted that there were likely two components contributing to this frustration. First, merely waiting alone in a room with nothing to do

is quite difficult and unusual for young children. The waiting task is boring, a quality shared with many self-control tasks. Children must invent ways to engage themselves during this monotonous period. Second, the presence of the rewards may increase the anticipation of the reward, adding to the frustration of the situation. The antics of the children as they attempt to wait, while often seemingly haphazard and quite amusing, were seen as strategic attempts to divert attention from these aversive components of the wait.

Working off this observation, Mischel and Ebbesen were joined in the spring of 1968 by Antonette Zeiss, then an undergraduate studying at Stanford, to explore the impact of providing children with different types of distraction during the delay period. In a series of three separate experiments, Mischel et al. (1972) explored the impact of both physical and cognitive distractions when rewards were either present (Experiments 1 and 2) or absent (Experiment 3) during the wait. In all three experiments, children indicated a preference for either one small marshmallow or one pretzel. Physical distraction was provided by allowing the child to play with a slinky toy. Cognitive distraction was provided by instructing the child to either think about fun things, about sad things, or about the rewards themselves during the wait depending on the experiment.

Mischel, Ebbesen, and Zeiss replicated the impact of reward presence in the absence of any distraction instructions with children showing very short delays when facing the both rewards (Fig. 2.2). Interestingly, when children had the opportunity to play with a slinky toy, a form of physical distraction, delay times were nearly 9 min despite the fact that the rewards remained available for attention. Thinking fun things, a form of cognitive distraction, was especially helpful, producing lengthy delays regardless of whether rewards were present or absent. In contrast, thinking sad thoughts, a cognitive distraction that children might be less likely to actually do or maintain, provided modest gains in waiting times.

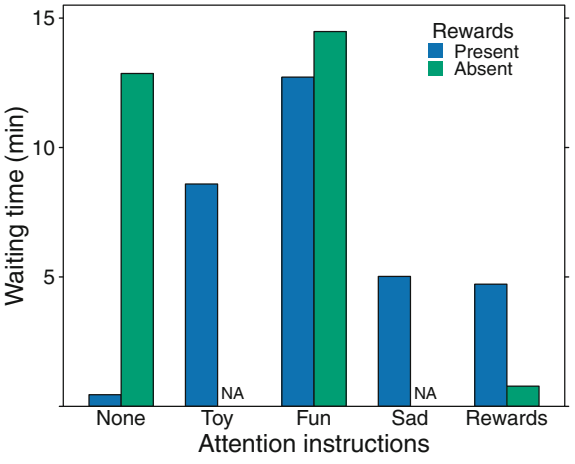

Fig. 2.2 Waiting time as a function of reward presence and type of attentional instruction provided. Results collapsed across three experiments. In replicated conditions, means across experiments are shown here. Adapted from Mischel et al. (1972)

In addition to demonstrating that physical and cognitive distractions during the wait period facilitate waiting, one of the more important findings in this work was seen when children are instructed to focus their attention on the rewards themselves. When the rewards are present, reward-directed attention yielded average delays somewhat but not significantly longer than when children were given no instructions, suggesting that in the absence of instructions to do something else, children were likely spontaneously engaging in reward-directed attention. Interestingly, when rewards were absent, asking children to think about the rewards had the same detrimental effect as placing the rewards directly in front of the child with no instructions. This finding suggested to the researchers that the cognitive representation of the rewards is as important as the physical stimulus itself. This is a theme that is born out throughout the remaining research program with the Marshmallow Test.

Symbolic Rewards: Mischel and Moore (1973)

Recognizing that distracting, irrelevant activities like playing with a slinky toy or thinking fun thoughts enabled waiting even in the presence of rewards, the research next focused more directly on reward representation during the delay period. During the time that he completed his graduate studies with Mischel, Burt Moore conducted a series of experiments examining the impact of symbolic versus real presentations of the rewards on waiting. The first of these experiments was initiated by Moore at the Bing School in the fall of 1970. Working off the prior finding that thinking about rewards in their absence was detrimental to waiting, Mischel and Moore sought to explore aspects of children's ideation about rewards while waiting. Even though the physical presence of rewards had been shown to debilitate rather than facilitate delay as previously theorized, Mischel and Moore noted that most theoretical accounts of delay of gratification made reference to people's thoughts and images while waiting, not their direct perceptions. Most waiting situations do not involve the actual physical presence of the rewards, so what mattered was how individuals thought or imagined the rewards in their absence during the waiting period.

Recognizing that children's cognitive activity was largely inaccessible during a waiting task, Mischel and Moore attempted to manipulate the child's cognitive representations by displaying symbolic presentations of the rewards while the child waited. This was accomplished by showing the child pictures of the rewards with a slide projector. In this first study, half of the children were asked to express a straight preference for either two marshmallows or one pretzel, while the other half selected between two pennies or a token. The reward pair for which the child expressed this preference was referred to as the "relevant rewards," while the other reward pair was referred to as the "irrelevant rewards." Using a crossover design, children observed slides of the relevant rewards, the irrelevant rewards, a blank slide, or no slide at all. For half of the children, the slide content was shown

continuously, while for the rest the slide was shown "periodically" (5 s at 30-s intervals). This scheduling variation was intended to test the notion that periodic reminders of the goal might better serve the child than continuous exposure.

Contrary to the prior findings involving direct exposure to the rewards, Mischel and Moore found that exposure to symbolic representations of the reward did indeed facilitate waiting (Fig. 2.3). In both periodic and continuous presentation conditions, preschoolers exposed to symbolic representations of relevant rewards waited close to the maximum wait of 10 min utilized in this experiment. This is in stark contrast to both how children responded to irrelevant rewards in this study, and real and physically present rewards in prior experiments. There were only minor differences connected to whether the slides were continuously or periodically presented, and the research once again replicated the prior finding that when rewards were absent and children were given no instructions (no slide condition), children were able to demonstrate lengthy waiting capacity.

In interpreting the obtained pattern of findings, Mischel and Moore embraced Berlyne's (1960) distinction between two cueing functions that a reward might serve (see also Estes 1972). On the one hand, rewards can provide an arousal or motivational cue that stimulates the individual's desire for the outcomes. Second, rewards can provide an informational cue, reminding the child about properties of what they are striving to attain. Mischel and Moore speculated that the physical presence of the rewards likely served to cue arousal in the child, increasing the challenge of waiting. In contrast, symbolic representations of the rewards are less loaded with arousing physical cues and may serve mainly an informational function. This distinction about the different ways that children might cognitively process rewards lays the foundation for much of the theoretical formulations about delay that eventually evolved from this program of research (Metcalfe and Mischel 1999; Mischel et al. 2011).

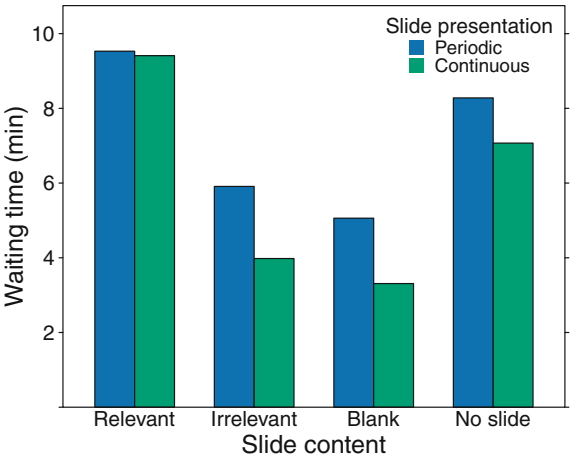

Fig. 2.3 Waiting time as a function of slide content for symbolically presented rewards. Rewards physically absent in all conditions. Adapted from Mischel and Moore (1973)

Beliefs About Instrumental Thinking: Mischel and Underwood (1974)

With the completion of Mischel and Moore's first exploration of symbolic presentation of rewards, Bill Underwood, another of Mischel's graduate students at Stanford, initiated a project in the spring of 1971 to examine instrumental ideation while children waited. Framed as a study to shift the research program from waiting to working situations, the "work" in Mischel and Underwood (1974) only involved children's beliefs about the instrumentality of what they are thinking as they wait. The research was an extended replication of the paradigm used by Mischel and Moore where preschoolers were exposed to either symbolic (slides) or real rewards that were either relevant or not. In this experiment, all rewards were presented continuously. To that core design, Mischel and Underwood added an instruction to make children believe that thinking about the rewards would make the experimenter return sooner. All children were told that they could think about the rewards while they waited if they wanted to, but those in the instrumental ideation condition were made to believe there was a contingency between this thinking and the return of the experimenter.

Mischel and Underwood found that making children believe there was an instrumental connection between thinking about the relevant rewards facilitated delay time regardless of whether the rewards were real or symbolic (Fig. 2.4). Similar but less lengthy delays were evidenced when children thought instrumentally about irrelevant rewards. Finally, delay times were modest across conditions without the aid of instrumental instruction. The most significant finding from this work is seen in the lengthy delays for children provided with instrumental instructions when rewards were real and relevant. This stands in stark contrast to all prior research conditions where rewards were present and children were not provided with instructions about how to think about them (including the "non-instrumental–relevant–real" condition of this experiment). Mischel and Underwood speculated that the instrumental instructions shift the child's reward focus to the informational properties of the reward and away from the arousing cues that they likely gravitate toward without instruction. In this way, the findings of Mischel and Underwood provide further indirect insight into what children might

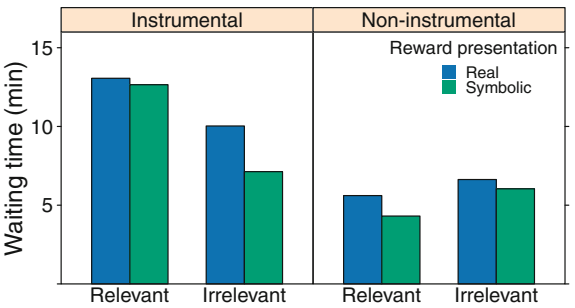

Fig. 2.4 Waiting time as a function of child's belief about instrumentality of thinking about real or symbolic rewards that are either relevant or irrelevant. Adapted from Mischel and Underwood (1974)

be doing spontaneously when trying to wait in the presence of the reward. It is noteworthy that delays are modest in all non-instrumental conditions.

Consummatory and Non-consummatory Ideation: Mischel and Baker (1975)

As the research program on delay of gratification progressed, a theoretical formulation was evolving. That formulation recognized first that the physical presence of the rewards made waiting difficult. However, the research also demonstrated that *how* children thought about the rewards could override the impact of their mere physical presence. The idea that rewards could function as either an arousing or an informational cue was evolving and supported, albeit indirectly, in the research. Mischel and Moore speculated that presenting rewards symbolically might be directing children's attention away for the salient motivational properties of real rewards. Similarly, Mischel and Underwood suggested that instructing children to think instrumentally about the rewards was also leading to an informational focus. These experiments demonstrated that shifting the form (mode of presentation) and function (instrumentality) of rewards altered their impact on children, but did not explore specifically how children cognitively represent rewards themselves while waiting. It was not until Nancy Baker, then an undergraduate at Stanford, tested children at the Bing School in the spring of 1971 that an experiment looked directly at the consequences of having children focus on the arousing properties of rewards while they waited.

Mischel and Baker (1975) employed a rewards physically present crossover design where children were exposed to and instructed to think about either relevant rewards or irrelevant rewards during the wait period that was lasted a maximum of 20 min. The rewards used were either 1 versus 2 marshmallows or 1 versus 2 pretzels. Children were told to focus on either consummatory (arousing) properties or non-consummatory (transformational) properties of the rewards. In the consummatory conditions, children were told to think about the how the marshmallows were "sweet and chewy and soft" or how the pretzels were "crunchy and salty." In the non-consummatory conditions, children were instructed to think about how marshmallows are "white and puffy … like clouds" and "round and white … like the moon" or how the pretzels were "long, thin, and brown … like logs."

Mischel and Baker found that instructing children to focus on the consummatory properties of relevant rewards made waiting very difficult for children (Fig. 2.5). Conversely, focus on non-consummatory properties leads to lengthy delays. Interestingly, when children were asked to focus on the consummatory versus non-consummatory properties of irrelevant reward, this effect was reversed. Mischel and Baker speculated that a focus on consummatory properties of irrelevant reward might provide distraction from the frustration typically associated with waiting with rewards present, but it is not conceptually obvious why transforming

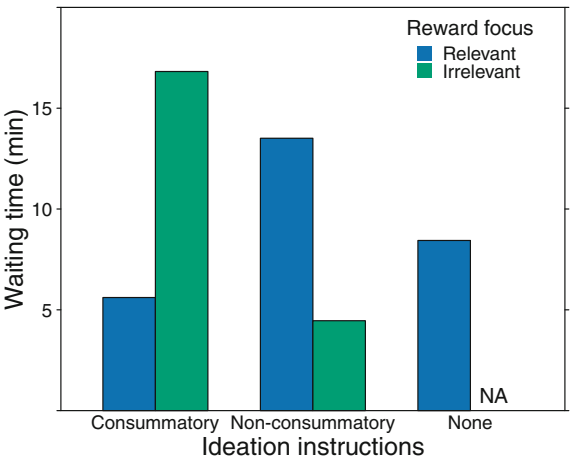

Fig. 2.5 Waiting time as a function of instructions to think about consummatory or non-consummatory properties of rewards. "None" represents a control condition where children are not provided with any instruction. Adapted from Mischel and Baker (1975)

an irrelevant reward would lead to shortened waiting times. Needless to say, these types of focus on irrelevant rewards, while experimentally convenient, do not have many real-life analogs. The key takeaway from this pivotal work is that the impact of physically present rewards can be either accentuated or attenuated by instructions that influence *how* children cognitively represent the rewards.

Transforming Real and Symbolic Rewards: Moore et al. (1976)

Mischel and Baker demonstrated that children could be instructed to cognitively transform rewards so as to focus on their less arousing properties. In work conducted in the summer of 1973, Moore et al. (1976) asked whether the prior findings obtained by Mischel and Moore (1973) concerning the impact of symbolically presented rewards using slide presentations would hold if children were asked to cognitively transform real rewards into symbolic ones, in this case pictures. During the 20-min delay period, children waited with either a picture of the rewards (two marshmallows vs. one pretzel), the real rewards, or no rewards physically present. Some children were instructed to look and think about the rewards that were in front of them (real or pictures). Other children were instructed to cognitively transform the rewards as they were presented. Hence, children who faced the real rewards were asked to imagine a color picture of the rewards in their head and then "put a frame around it." They were then asked to pretend that the picture was on a screen and that they could see it. Children who faced the picture of the rewards were asked to cognitively transform them to imagine that they were real and setting on the table in front of them.

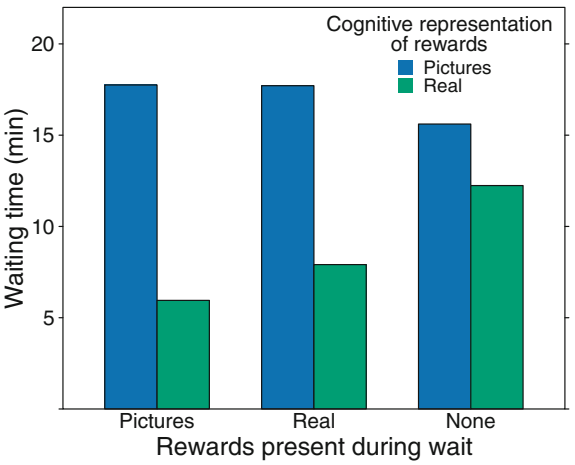

Fig. 2.6 Waiting time as a function of cognitive representation of reward and their actual physical presence during the delay period. Adapted from Moore et al. (1976)

Moore, Mischel, and Zeiss showed that having children imagine the rewards as pictures facilitated delay regardless of which rewards were physically present as the child waited (Fig. 2.6). In contrast, representing rewards as real yielded shorter delay times regardless of whether the child was facing real rewards or their symbolic representations. When rewards were not present in any form, children once again showed the ability to wait. The findings of Moore, Mischel, and Zeiss not only replicate Moore and Mischel's prior finding about how symbolic representations impact waiting, but more critically demonstrate that this impact can be obtained using just the child's imagination. Having a child "put a frame" around the real rewards transforms them in a manner that they have the same impact as actual pictures, bolstering the view that what really matters is the child's representation of the rewards.

Consummatory Focus on Symbolic Rewards: Mischel and Moore (1980)

In the final published experiment containing data that are included in the longitudinal follow-ups of the Marshmallow Test, Mischel and Moore (1980) once again examined the impact of symbolically presented rewards but now with a focus on how children were instructed to ideate about the slide content. Using a crossover design modeled after Mischel and Moore (1973), children waited while viewing continuously presented slides that pictured either relevant rewards, irrelevant rewards, or no rewards. Children were also instructed to think about the consummatory qualities of the relevant rewards, the irrelevant rewards, or neither. Children initially indicated their preference for either 2 marshmallows versus a pretzel or 2 candy mints versus a graham cracker. The reward pair employed in this choice was

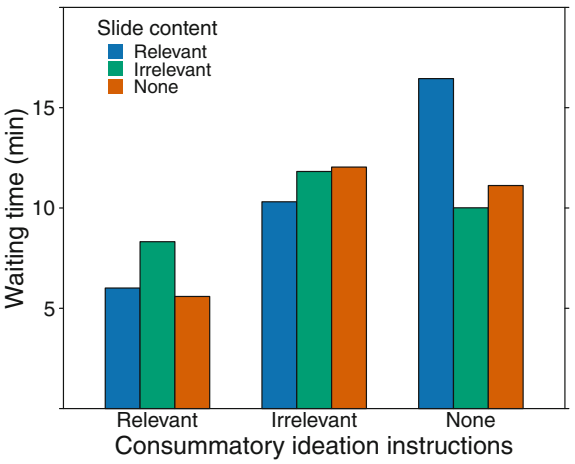

Fig. 2.7 Waiting time as a function of consummatory ideation instructions and type of slide content presented during the delay period. Adapted from Mischel and Moore (1980)

labeled the relevant rewards, and the other was referred to as the irrelevant rewards. If a child had chosen between the marshmallows and pretzels and was assigned to engage in the consummatory ideation for the relevant rewards, they were asked to think about how marshmallows are "sweet and chewy." If, on the other hand, they were assigned to the think about the irrelevant rewards while waiting, they would be asked to think about how mints are "sweet and melt in your mouth." As with Mischel and Moore (1973), real rewards were absent in all conditions of this experiment.

Mischel and Moore (1980) replicated Mischel and Moore's (1973) finding that symbolic presentations of rewards tend to facilitate delay as compared to exposure to real reward (Fig. 2.7). However, when children were asked to focus on the consummatory properties of the relevant reward, delay times resembled those obtained when the rewards were physically present and children had no instructions. Moreover, thinking about the consummatory properties of irrelevant rewards facilitated delay regardless of the slide content. These findings buttressed Mischel and Moore's prior claim that symbolic presentation of rewards (without instruction) leads children to focus away for the arousing properties of rewards and focus on their informational cues. Directing children's attention back to the arousing, consummatory cues debilitates their ability to wait.

Experimental Studies: Takeaways and Caveats

The experimental investigations utilizing the Marshmallow Test reviewed here paint a compelling picture of the capacities of preschoolers to wait for desired outcomes. The first general finding of this work is that a child's ability to delay gratification depends very much on the situation they face. A manipulation as subtle

as covering or removing the rewards during the delay period powerfully impacted children's ability to wait. That said, children were not solely under the stimulus control of the reward. Children were successfully instructed to distract themselves from the rewards with a physical activity as simple as playing with a slinky toy or a cognitive activity like thinking fun thoughts. Presenting the rewards symbolically as slides made waiting much easier, indicating that physically present rewards might be providing more arousing, motivational cues compared to their informative symbolic counterparts. Leading children to believe that thinking about the rewards will be instrumental in making the wait shorter was also an effective way to make waiting easier and may also involve a similar shift in attentional focus toward informational cues. Having children think about the arousing, consummatory properties of rewards produced delay times that resemble those that occur when children are left to their own spontaneous coping strategies, suggesting that a consummatory focus might reflect how children spontaneously process physically present rewards. Instructions that ask children to transform the rewards by focusing on their non-consummatory properties, on the other hand, greatly facilitated waiting. Children proved to be remarkably adept at cognitively transforming rewards creating representations of real rewards as if they were pictures and pictures as if they were real rewards. In both cases, the impact of the rewards on waiting was driven by the cognitively transformed versions. Finally, even though symbolically presented rewards facilitated waiting, those gains quickly dissipated when children are asked to focus on the consummatory properties of the slide presentations.

The picture that emerges from this line of research is not one of children primarily driven by a general disposition like impulsivity or willpower. Rather, children are facile in their responsiveness to contextual cues and can readily adapt to instructional sets that assist (or debilitate) their coping efforts. Even those children who terminate the delay do not seem irrational, reflexive, and stimulus bound. Instead, they appear to be making reasoned choices that reflect both qualities of the challenge presented to them and how they come to represent that challenge cognitively.

All that said, it should be noted that the typical child left to wait in the presence of rewards found the task challenging. In many reports, the very short (less than one minute) delay times of some studies (Mischel and Ebbesen 1970; Mischel et al. 1972) are emphasized implying that virtually no child can cope long at this challenge. The research reviewed here suggests that these extremely short average wait times are not typical. Average wait time with rewards present varies from study to study, and it is difficult to make cross-study comparisons since the maximum delay time varies across studies and minor adjustments were made to the paradigm as the research progressed. Nonetheless, it can be said that wait times with rewards present typically averaged around 4–5 min and these delays were reliably significantly less than when children were waiting with the rewards removed or covered. Moreover, the average wait time of 4–5 min with rewards present is consistent with more recent research using the paradigm (Peake et al. 2002) with preschoolers including a large-scale testing of nearly a thousand children in the paradigm as part of the National Institute of Child Health and Development (NICHD) Study of Early Child

Care and Youth Development (SECCYD; https://secc.rti.org/) (for a descriptive summary, see Duckworth et al. 2013).

Recognizing that waiting with rewards present is generally challenging, there were nonetheless substantial individual differences in how long children actually waited in this experimental setting. Some children opted out and rang the bell within the first few minutes of the session, while others stuck out the wait and received the preferred rewards. The experiments reviewed here provide indirect insight into how children might typically process the experience and the types of strategies that might contribute to the observed individual differences. The consistent message across all the research reviewed here is that any experimental instructions that moved children's attentional focus away from the variously labeled arousing, consummatory, or motivational properties of rewards facilitated delay. In contrast, instructions that focused attention toward these properties increased the challenge of the wait. Collectively, the findings suggest that in the absence of experimental instructions on what to think or do while waiting, preschool children will tend to focus attention of the "hot" properties of rewards. Individual differences in waiting, then, are most likely connected to children differentially engaging in activities and cognitions that divert attentional focus away from the rewards (Metcalfe and Mischel 1999).

It is important to note, however, that the inferences offered here all derive from experiments focused on group differences. None of the original Marshmallow Test experiments examined individual differences in what children were doing while they waited. The strategies that the children might have been spontaneously deploying were neither directly observed nor measured. Informal direct observation of children in the delay situation raises important questions about whether the captivating behaviors they commonly display (singing, clapping, staring away), behaviors that seem to distract attention away from the rewards and task at hand, are actually deliberate and strategic attempts at coping or if children are merely emitting behaviors some of which happen to be helpful and others less so. If the former were the case, the resulting individual differences in waiting might be meaningful and connect with other aspects of the child's adaptive functioning. Alternatively, if children are just randomly stumbling across more or less effective strategies, the observed individual differences should not be especially meaningful or predictive. This key question is at the core of the Bing Longitudinal Study, a project that has now followed the lives of the participants in these experiments for over 35 years.

Longitudinal Explorations of Delay of Gratification (1981–2016)

Background

Data collection for the last of the experimental investigations reported above was completed in the summer of 1973. While completion of the published manuscripts

for that work continued, Antonette Zeiss along with her husband Bob initiated a new project that they called the Bing Consistency Study. Recall that Mischel had previously raised important questions about the consistency of behavior, and Zeiss set out to explore the consistency of children's behavior on the Marshmallow Test. With the ambitious research program that was conducted at the Bing School from 1967 to 1973, many children found their way into the experimental game room on more than one occasion. In a typical scenario, a child might be tested in one experimental paradigm and then be brought back to participate in a pretest for subsequent research. This allowed the research team to explore modifications to the design and/or new manipulations without using previously untested children, a valuable commodity in such an active program. The purpose of the Bing Consistency Study was to organize all the data collected in connection with this research program in hopes of examining issues such as the stability and consistency of children's waiting in different experimental settings.

Mischel had conscientiously maintained the data sheets from the original experiments, and Zeiss initiated efforts to consolidate those data. It is important to recall that at the time of the original experiments, computers were only beginning to become utilized in academic settings, and they were large, expensive, and not easily accessible. Data from the experiments were all collected and recorded on large "green sheets," the paper-and-pencil forerunner of the modern spreadsheet. Interestingly, all data reduction and statistical calculation were also completed by hand, recorded on similar green sheets, and stored in crudely labeled file folders. To accommodate the sheer amount of data, Zeiss taped green sheets together to provide more columns and rows. Unfortunately, these early organizational efforts were not completed before Zeiss left for graduate school, and the resulting summary sheets were filed away with all the other data in Mischel's back office.

In 1978, I arrived at Stanford with no real interest in delay of gratification and fully intending to study the consistency of behavior. Powerfully influenced by reading *Personality and Assessment* as an undergraduate at Carleton College, I had initiated a major investigation into the consistency of student behavior along with my mentor Neil Lutsky and fellow student Linda Wray. Modeled after the seminal work of Bem and Allen (1974), the Carleton Consistency Study yielded boxes and boxes of data that I transported to Stanford hoping that it would form the basis of my dissertation work. The Carleton project was ambitious, and my early meetings with Mischel made clear that I needed to find a more manageable project that could be completed during my first year in Palo Alto to fulfill the entry requirements of the Ph.D. program.

After several false starts, we resolved on a delay of gratification project that examined Bem and Funder's (1978) template matching approach to understanding the personality of situations. Bem and Funder obtained parental ratings of children using Block's California Child Q-Set (Q-Set), an omnibus assessment that required sorting of 100 personality descriptions tailored toward the children's personalities and then correlated these ratings with children's behavior in two delay of gratification situations. One of these was a modification of the Marshmallow Test where the experimenter stayed in the room while the child waited. The second was a "gift

delay" measure developed by Block (1977). In the gift delay, a child is told they can have a small colorfully decorated box after they complete a challenging puzzle. The child's behavior is recorded both during the process of completing the puzzle and upon its completion to see how long the child will wait to grab and open the gift. Although these are both putative measures of delay of gratification, they tap into conceptually distinct psychological processes, and this is what Bem and Funder's results seemed to show. A full discussion of the follow-up work on this project can be found in Mischel and Peake (1982).

While dutifully filing away copies of the data sheets from this work in Mischel's back office, a folder labeled simply "Bing Consistency Data" captured my attention. It contained Zeiss' prior efforts to organize the data from the experiments employing the Marshmallow Test for a consistency analysis. Calling this to his attention, Mischel agreed this might be a nice match for my interests, so I set about what would become a sizable effort to reorganize the original experimental data into a form that could be examined using the then rapidly improving computer systems at Stanford. Examination of these files led to the quick realization that many of the children who had participated in the delay experiments had familiar names. They were, indeed, the now teenage children of many Stanford professors. Aware of efforts to examine the longitudinal correlates of Block's operationalizations of delay of gratification including the gift delay (Funder et al. 1983), a similar longitudinal follow-up involving children in the Marshmallow Test seemed compelling. On proposing this idea to Mischel, the Bing Longitudinal Study was born. In the beginning, the research was viewed as relatively inexpensive and quick way to see whether connections might exist between preschool delay and adaptive functioning in adolescence. We had a hunch there might be linkages, but given the simplicity of the initial assessment and the complexities of developing lives, there was no strong conviction about what we might find. We certainly never anticipated that we were initiating what has now become a 35-year longitudinal exploration.

The pages that follow summarize all of the published results of the longitudinal explorations of the Marshmallow Test to date. Like the summary of the experimental studies, the review is organized around discussion of each publication that taps into the evolving Bing Longitudinal Study data set. The review focuses separately on those studies that explore direct correlations between early waiting and later functioning, those that explore delay as a moderator of relations to subsequent life outcomes, and those that incorporate preschool delay to examine the behavioral and neural correlates of different life course self-regulation trajectories.

Delay as a Direct Predictor

Relations to Adolescent Functioning: Mischel et al. (1988)

During the summer of 1981, phone books from around the San Francisco Bay Area were scrutinized in an attempt to locate the parents of children who had participated

in the original delay experiments. Packets that included a California Child Q-Set and a brief competency questionnaire that was devised with the assistance of Antonette Zeiss were sent to those who were located. The Q-Set was included because it contains a comprehensive set of personality and behavior descriptors appropriate for young children and because this would allow comparisons with our own and prior research that had employed this assessment device. The competency questionnaire was an intentionally brief questionnaire that asked parents to rate their child's academic competence, social competence, frequency of problems, and ability to cope with problems, all included as general markers of self-regulation in adolescence. In the end, 95 parents responded to our request, and their Q-Set ratings and questionnaires became the first wave of data collected as part of the Bing Longitudinal Study.

One of the first analytic problems faced was to determine exactly what the predictor variable would be for these parental responses. Recall that the children were observed in numerous different experimental settings, many of which had powerful effects on the child's behavior. Because of this, the child's raw delay time was not a good candidate. By the time, the first wave of parental responses arrived at Stanford, so had a new graduate student, Yuichi Shoda. With Shoda's capable assistance, we classified different experimental conditions according to the type of objects available for attention (e.g., rewards, slides, and nothing) and the types of ideational instructions provided (e.g., think about the consummatory aspects of the rewards, think about the consummatory aspects of other objects not in the contingency, and think about fun events, no instructions). A delay deviation score was then calculated by computing the difference between a child's wait time and the average delay for all children who waited under similar circumstances. This delay deviation score is the standard index of the child's ability to wait that has been used consistently in all subsequent longitudinal explorations.

We first examined the correlations between preschool waiting and parental ratings of the adolescent's competencies (Table 2.1). Children who were able to wait as preschoolers were more likely to be seen by their parents as teenagers with more academic competence and more social competence. While they were not seen as experiencing problems in life more frequently, when they did experience

Table 2.1 Correlations between parental ratings of adolescent competencies and preschool self-imposed delay

Adolescent rating	*r*
Academic competence	0.24*
Social competence	0.35**
Frequency of problems	0.03
Coping competence	0.23*

Note Adapted from Mischel et al. (1988, p. 691). Copyright 1988 by the American Psychological Association

$N = 87$; all p-values are two-tailed

*$p < 0.05$; **$p < 0.01$

challenges, parent's reported that they coped with those challenges more effectively. This general pattern of surprising connections was consistent for both boys and girls. To obtain a broader picture of what these teenagers were like, we next explored the California Child Q-Set ratings that parents had provided (Table 2.2). Consistent with the competency profile, the positive correlates in the top portion of

Table 2.2 Correlations between parental California Child Q-Set ratings in adolescence and preschool self-imposed delay

Q-Set item	*r*
Positive correlates	
Is verbally fluent	0.47***
Is attentive and able to concentrate	0.44***
Uses and responds to reason	0.42***
Is competent and skillful	0.41***
Is planful and thinks ahead	0.40***
Becomes strongly involved in what he/she does	0.34**
Is self-reliant, confident, and trusts own judgment	0.33**
Is resourceful in initiating activities	0.32**
Is curious, exploring, and eager to learn	0.27*
Is self-assertive	0.26*
Is persistent in activities and does not give up	0.25*
Can be trusted and is dependable	0.23†
Is an interesting, arresting child	0.23†
Negative correlates	
Tends to go to pieces under stress	−0.43***
Is shy and reserved	−0.42***
Appears to feel unworthy and thinks of self as bad	−0.38**
Reverts to immature behavior under stress	−0.34**
Teases other children	−0.29*
Tends to be indecisive and vacillating	−0.29*
Is stubborn	−0.25*
Is inhibited and constricted	−0.24†
Tends to be sulky or whiny	−0.24†
Shows specific mannerisms or behavioral rituals	−0.23†
Is jealous and envious of others	−0.23†
Tends to become immobilized under stress	−0.23†
Tends to be suspicious of others	−0.22†
Has a readiness to feel guilty	−0.21†
Is unable to delay gratification	−0.20†

Note Adapted from Mischel et al. (1988, p. 692). Copyright 1988 by the American Psychological Association

$N = 67$; all p-values are two-tailed

$^{\dagger}p < 0.10$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Table 2.2 suggest that children who waited longer on the delay task were seen as teenagers who were bright, adaptive, planful, etc. In contrast, the lower panel of Table 2.2 portrays children who terminated the delay as generally more challenged teens. Perhaps, most noteworthy in this profile is the array of items indicating that short delays in preschool signal adolescents who struggled significantly coping with stress.

The reporting format of these early reports was adopted to allow comparison with the work of other research examining delay of gratification (Funder et al. 1983). Consistent with much of Block's work using the Q-Set, lists of correlations are presented to allow one to surmise the general patterning and profiling of correlates, not to highlight the relation to any individual item. As an alternative to this atheoretical listing, Block and Block (1980) conceptualized delay of gratification as being fundamentally related to the underlying constructs of ego-control and ego-resiliency. Ego-control relates to the permeability of psychological subsystems and finds expression behaviorally in a spectrum of behavior that consists of impulsivity (undercontrol) at one extreme and excessive constraint and inhibition (overcontrol) at the other. According to the Block's conceptualization, the general tendency toward impulsivity represented by the construct of ego-control can be situationally modulated at times by one's ego-resilience, a reflection of elasticity of the psychological subsystems. Ego-resilience is seen as manifesting itself temporarily to increase ego-control in response to situational constraints and expresses itself as competence, intelligence, resourcefulness, and adaptability under stress. Funder et al. (1983) used Q-Set items to derive indices of ego-control and ego-resiliency and then showed that delay of gratification, measured in part by the Block gift delay task, was linked to ego-control for boys but ego-resiliency for girls.

Noting that we had found different patterns of relation of the Marshmallow Test to ego-control and ego-resiliency in prior work (Mischel and Peake 1982), we examined the relations of self-imposed preschool waiting to these Q-Set derived indices (Table 2.3) in the Bing Longitudinal Study sample. Interestingly, preschool waiting as measured by the Marshmallow Test was powerfully related to ego-resiliency and showed virtually no relation to ego-control. This was true for both boys and girls. This finding is provocative not only because of the strength of the longitudinal ties, but also because it sheds more light on what might be governing children's ability at the delay task. It suggests that the child's ability to be flexible and adaptive to the challenge is far more important than their dispositional impulsivity. This message is remarkably consistent with the message from the experimental research which showed that it is not so much the physical presence of

Table 2.3 Correlations between California Child Q-Set indices of ego-resiliency and ego-control and preschool delay

Sex	Ego-resiliency	Ego-control
Girls (n = 35)	0.56**	0.11
Boys (n = 32)	0.49**	−0.22
Combined (N = 67)	0.53***	−0.09

Note Adapted from Mischel et al. (1988)
**$p < 0.01$; ***$p < 0.001$

the reward stimulus that regulates waiting. Rather, delay maintenance derives from how the child adapts to the situation through the strategies they use to distract their attention or transform the features of the task to make it less challenging.

Diagnostic Experimental Settings: Shoda et al. (1990)

The interesting linkages between preschool waiting and adolescent well-being captured our curiosity. First, it was impressive to see that a single assessment of the child's waiting at age 4 was correlated with psychological functioning over 10 years later. It is also curious because these correlations are calculated using a delay index that includes waiting in not just one but many different experimental conditions. The calculation of deviation scores within waiting situations was one tactic to eliminate the impact of experimental variations. But even with this centering around conditional means, the remaining variance in the scores should not have the same psychological meaning. First, individual differences in waiting should be meaningful, and hence "diagnostic," only in those situations that are psychologically challenging. In the case of the delay of gratification experiments, the differences in wait times should be most meaningful when the rewards were present. Second, in most of the experimental conditions, children were provided with instructions about how to cope with the situation at hand. They were told to play with toys, think happy thoughts, transform marshmallows into clouds, etc. Enduring individual differences should most likely be tapped in those situations where children are not provided with any instruction and hence are left to their own spontaneous coping strategies. Unfortunately, the sample size of the first outreach in the Bing Longitudinal Study was not sufficient to allow these comparisons.

During this period of the research, Mischel accepted a new position at Columbia University and Shoda opted to follow him there. Working with our conscientious assistant, Rhea Cabin, and the aid of the Stanford Alumnae Association, the search for more Bing children pressed on at Stanford. The second mailing to this expanded sample of parents included requests for information about the child's demographic, academic, and vocational history, an expanded survey of self-regulatory capacities referred to as the Adolescent Coping Questionnaire, and the California Child Q-Set, now presented simply as a questionnaire instead of the traditional sorting packet. Responding to complaints from parents about the sorting task, we were swayed by a personal communication from Lee J. Cronbach and the analysis of Green (1980), both of which asserted the functional equivalence of the complex sorting procedure and standard questionnaire methodology. The returns from this mailing were gathered at Stanford and shipped off to Columbia just as I left for a new appointment at Smith College.

Using data from this expanded sample, we first looked at the correlations between preschool delay and parent provided Q-Set ratings of the teenagers. In this analysis, we first divided participants into groups that represented the type of experimental setting to which they were exposed at preschoolers. Experimental settings were classified both according to whether rewards were present versus

absent during the delay and according to whether children were provided with instructions about what to do or think about during the wait period or not. Our hypothesis was that meaningful individual differences should only be found in "diagnostic" conditions where children were exposed to the rewards (e.g., the task was challenging) and were not provided with instructions about what to do during the wait (e.g., were left to their own spontaneous coping strategies). The respective correlates for these four groups are presented in Table 2.4. Two main themes are clearly evident. First, most of the conceptually meaningful longitudinal correlates were found in the predicted diagnostic condition. When rewards were absent or children were provided with instructions about what to do, fewer correlates were detected and they made less conceptual sense. Second, the correlates found for children in the diagnostic condition were basically consistent with the portrait of delay that emerged in earlier studies with positive correlations indicating bright,

Table 2.4 Correlations between parental California Child Q-Set ratings in adolescence and preschool self-imposed delay in different diagnostic settings

Q-sort item	Spontaneous ideation		Suggested ideation	
	Rewards Present (n = 48)	Rewards Absent (n = 51)	Rewards Present (n = 32)	Rewards Absent (n = 35)
Positive correlates				
Has high standards of performance for self	0.44**			
Uses and responds to reason	0.43**			
Is attentive and able to concentrate	0.39**			
Is competent and skillful	0.37**			0.34*
Is planful and thinks ahead	0.36**			
Develops genuine and close relationships	0.36**	−0.36**		
Appears to have high intellectual capacity	0.34*			
Is verbally fluent	0.32*			
Tends to be proud of accomplishments	0.30*			
Is talkative	0.29*			
Is vital, energetic, and lively	0.28*			
Can be trusted and is dependable		0.26†		0.30†
Recognizes the feelings of others	0.25†			
Is suspicious and distrustful of others		0.32*		
Daydreams and tends to get lost in reverie		0.26†		
Becomes strongly involved in activities			0.42*	
Is persistent in activities			0.30†	
Is fearful and anxious				0.28†
Is aggressive (physically or verbally)				0.28†

(continued)

Table 2.4 (continued)

Q-sort item	Spontaneous ideation		Suggested ideation	
	Rewards Present (n = 48)	Rewards Absent (n = 51)	Rewards Present (n = 32)	Rewards Absent (n = 35)
Negative correlates				
Feels unworthy and thinks of self as "bad"	−0.39**			
Tends to imitate those he/she admires	−0.38**			
Tends to go to pieces under stress	−0.34**			
Is unable to delay gratification	−0.34*			
Tends to dramatize or exaggerate mishaps	−0.30*			
Is calm and relaxed and easygoing	−0.28†			
Has an active fantasy life	−0.27†	0.28†		
Prefers nonverbal communication	−0.25†			
Shows mannerisms or behavioral rituals	−0.25†			
Tends to arouse liking and acceptance in elders		−0.28*		
Is jealous and envious of others			−0.32†	−0.28†
Tends to brood, ruminate, and worry			−0.31†	0.32†
Reverts to immature behavior under stress				−0.51***
Is easily offended and sensitive to ridicule				−0.44**
Is afraid of being deprived				−0.38*
Overreacts to minor frustrations				−0.38*
Tends to be sulky or whiny				−0.35*
Looks to adults for help and direction				−0.34*
Tends to be judgmental of others				−0.30†

Note Adapted and expanded from Shoda et al. (1990)
$^{\dagger}p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

planful, and resourceful adolescents were linked to preschool waiting, whereas teens challenged in coping with stress had shorter delay times in preschool. This pattern was even more dramatic when focusing in directly at coping competencies that are implicated in self-regulation (Table 2.5). Here, virtually all statistically significant relations were found only when children were exposed to the rewards and left to their own coping strategies to work through the challenge. Finally, as part of this report, we examined the relation of preschool waiting to scores on the Scholastic Aptitude Test (SAT) (Table 2.6). Once again, predictive linkages were found to both verbal and quantitative components of the test but only for children who participated in the hypothesized diagnostic condition. These relations were especially powerful for females.

Table 2.5 Correlations between adolescence coping questionnaire and preschool self-imposed delay in different diagnostic settings

Coping questionnaire item	Spontaneous ideation		Spontaneous ideation	
	Rewards	Rewards	Rewards	Rewards
	Present	Absent	Present	Absent
	(n = 42)	(n = 42)	(n = 21)	(n = 28)
Gets sidetracked by minor setbacks	−0.30*			
Shows self-control when frustrated	0.58***			
Copes with important problems	0.31*			
Capable of doing well academically	0.37*			
Yields to temptation	−0.50***			
Settles for immediate gratifications	−0.32*			
Pursue goals when motivated	0.38*			
Is intelligent	0.42**			
Exhibits self-control when tempted	0.36*	−0.32*		0.39*
Skilled at maintaining friendships				
Is distractable when trying to concentrate	−0.41**			
Capable of self-control when frustrated	0.40**			0.38*
Effectively pursues goals				
Diverts attention from desired rewards	0.32*			

Note Adapted from Shoda et al. (1990)
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2.6 Correlations between SAT scores and preschool self-imposed delay in different diagnostic settings

Measure	Spontaneous ideation		Suggested ideation	
	Rewards	Rewards	Rewards	Rewards
	Present	Absent	Present	Absent
	(n = 35)	(n = 33)	(n = 14)	(n = 12)
SAT verbal	0.42*	−0.12	−0.40	−0.21
SAT quantitative	0.57***	−0.33	−0.26	−0.23

Note Adapted from Shoda et al. (1990)
*$p < 0.05$; ***$p < 0.001$

Body Mass: Schlam et al. (2013)

The most recent research to look at a direct relation between preschool waiting and a later life outcome examined linkages to a self-reported body mass index (BMI) in adulthood. Schlam et al. (2013) tapped into data collected as part of the midlife follow-up of the Bing Longitudinal Study participants that was organized by Ozlem Ayduk at Columbia between 2002 and 2004. Respondents to this survey were 39 years of age on average. Since this follow-up consisted of two parts separated by about one year and each questionnaire asked for information about weight and

height, BMI [weight in kg/(height in m)^2] was calculated separately for each assessment and then averaged. Because sex is known to correlate with BMI (women report lower BMI scores than men), Schlam et al. first entered sex into a hierarchical regression and found that this variable alone accounted for 13% of the variance in scores. Preschool delay was then shown to account for 4% of the variance over and above sex. Although the precise factors driving this relation are not clear, it is noteworthy that the number of seconds children waited for rewards at age 4 showed linkages to this general metric of physical well-being 35 years later. It is noteworthy that the relation between preschool delay of gratification on the Marshmallow Test and body mass have been replicated outside the Bing Longitudinal Study by examining BMI at age 11 for children who participated in the NICHD Study of Early Child Care and Youth Development (Seeyave et al. 2009).

Delay as a Direct Predictor: Takeaways and Caveats

The pattern of correlates between preschool delay and later life outcomes is both surprising and revealing. They are surprising in that a single assessment of a child in preschool at a task where the child's behavior is surely being impacted by numerous factors demonstrates useful predictive efficacy over the time frames examined. This suggests that the delay task is tapping into some fundamentally important psychological processes that have important lifelong consequences. Those processes appear to be connected to the ability to be flexible and adaptive in responding to contextual demands, to be cognitively competent in developing plans and strategies, and to be generally adept at coping with stress.

While much has been made of the longitudinal correlates of delay reported here, there are some necessary precautions that are often neglected in their popular portrayals. On the one hand, these are correlations and their causal implications should not be overstated. Far too frequently, popular presentations of the findings suggest that the Marshmallow Test foretells one's fate. "Failing" the test portends a life of struggle; "passing" the test foreshadows all kinds of good fortune. Despite the rather obvious fact that one cannot pass or fail the Marshmallow Test since it is not and never has been a "test," the number of seconds a child waits at the task in preschool is not determinative of anything later in life. It is safe to say that on most any follow-up measure, some children who did not wait will do quite well. On that same measure, some children who did wait will struggle. The correlations reported simply tell us that children who waited tend to also perform better on average in the longitudinal assessments. It is a basic but easily forgotten statistical truism.

Nonetheless, parents all around the world are subjecting their children to home versions of the Marshmallow Test and then fretting or celebrating their child's prospects. We strongly discourage this practice. First, be reminded again about the contextual sensitivity of the testing procedure itself. It is doubtful home versions of the Marshmallow Test could ever replicate the laboratory conditions structured into the original research. For example, it is not uncommon to hear of parents setting their child at the kitchen table and watching as they attempt to navigate the

challenge. But, prior research in the laboratory has shown that merely leaving the experimenter in the room during the wait totally changes the dynamic of waiting situation and disrupts the diagnostic utility of the task (Mischel and Peake 1982). Staged demonstrations of the Marshmallow Test commonly found across the Internet are rarely faithful to the original procedures, and it is hard to imagine that a home test could do much better.

In reports that tout the predictive prowess of the Marshmallow Test, it is not uncommon to find specific correlates singled out and highlighted. For example, relations between preschool waiting and performance on the SAT have become a particular favorite in popular accounts (see, e.g., Goleman 1995). This is not advisable both due to the inherent unreliability of single assessments and due to the prospect of capitalizing on chance when calculating multiple individual correlations. There is much to be learned from the patterning of correlates documented to date, but it is not advisable to focus on or emphasize any single relationship. This is as true of SAT and BMI scores as it is for the ratings obtained using the Q-Set. And, as always, caution needs to be observed when making reference to correlates based on relatively small samples of individuals, an issue that is especially important in analyses where partitioning by diagnostic conditions constrains sample size. The findings from the Bing Longitudinal Study can only shed light on prospective relations that require replication and refinement before they are treated as fact.

Although the longitudinal correlates of preschool delay are commonly featured in presentations of this research, in terms of conceptual significance, the identification of diagnostic conditions by Shoda et al. (1990) may be one of the most important findings in the program. The fact that children's delay scores are only longitudinally predictive when they are tested in settings that are challenging and where they must use their own coping strategies speaks again to the contextual specificity of delay behavior. Subtle changes in the physical setting (e.g., removing the rewards) fundamentally shift the psychological dynamic of the experience. This is expressed not only in group differences as was documented in the experimental findings, but in the meaningfulness of the individual differences remaining once the group difference is removed. Second, the diagnostic value of reward presence tells us something more about the factors that are contributing to the longitudinal findings. Recall that one of the components of the waiting situations is the sheer boredom of the self-control task. This is a central aspect of many self-control situations and one aspect, independent of striving for desired rewards, that the child must cope with during delay. The diagnosticity findings demonstrate that coping with boredom does not account for the longitudinal linkages. Waiting without rewards present is also an extremely boring task, yet individual differences in waiting in these situations do not relate to adolescent outcomes, even when children are left to their own coping strategies. This suggests that the presence of the rewards is a defining feature of situations that tap into preschool competencies with longitudinal consequence.

Finally, the finding that conceptually meaningful longitudinal correlates are almost exclusively connected to situations where children are not provided coping instructions is critically important. This indicates that the behaviors that children

spontaneously emit while waiting—playing with their hair, looking around the room, singing songs, etc.—are not simply random acts that happen to help the child endure the wait. These spontaneously generated activities reflect early differences in coping that may provide children with a head start toward later self-regulatory competence. Those behaviors that people find so cute and amusing when watching re-enactments of the Marshmallow Test are the child's self-generated strategies to temper and endure the challenge. It is noteworthy that the long-term individual differences are not found when the strategies employed result from experimental instructions that are not the child's own construction. This raises an extremely important question about what preschoolers actually do while they wait. What are the typical strategies that preschoolers spontaneously deploy in their efforts to delay gratification?

Delay as a Moderator

Rejection Sensitivity and Adolescent Life Outcomes: Ayduk et al. (2000)

The 1990s were a period of great transition for the Bing Longitudinal Study with its key partners now relocated to the East Coast. With the first round of publications on the longitudinal correlates of delay, Mischel and Shoda turned their attention back to issues of the consistency and stability of behavior. This effort was driven by Shoda's dissertation work on person-situation profiles that conceptualized personality as sets of conditionally sensitive "if-then" propositions (Shoda et al. 1993, 1994). This research laid the groundwork for the presentation of the cognitive affective processing system (CAPS), which was offered as an alternative to disposition-based approaches to personality (Mischel and Shoda 1995). Quite separately, work on the Bing Longitudinal Study continued at Smith College where a follow-up of a further expanded sample of now young adults was initiated in collaboration with Mark Lepper at Stanford.

During this period, Ozlem Ayduk, along with her partner Rudy Mendoza-Denton, was beginning their graduate training at Columbia, both working with Mischel. Ayduk also developed a working collaboration with Geraldine Downey, who had pioneered investigations into the construct of rejection sensitivity (Downey and Feldman 1996; Feldman and Downey 1994). Rejection sensitivity (RS) reflects an interpersonal vulnerability that leads individuals to anxiously expect rejection in relationships, to quickly see others' behavior as rejecting, and to overreact to those perceptions. Downey and her students and collaborators documented that persons high in RS were more likely to experience aggression, bullying, and violence in relationships, were more likely to experience loneliness, social anxiety, and depression, have a diminished sense of self-worth, and have an increased likelihood of substance abuse (see Pietrzak et al. 2005 for review). The Columbia University collaborators saw RS as a good example of the type of conceptual unit proposed in the CAPS framework where aspects of the

interpersonal situation trigger a set of interconnected expectations, encodings, and emotions that lead to intense reactions. In this way, they conceptualized RS as a "cognitive affective mediator that links situational features to psychological processes operating in interpersonal relationships" (Ayduk et al. 2000, p. 777).

Ayduk tapped into the early adult data that had just been collected at Smith to explore whether self-regulatory capabilities might moderate the relation between RS and maladaptive outcomes. Specifically, she developed a proxy measure of RS using self-rated Q-Set responses from participants and then examined whether preschool waiting moderated the relationship between RS and a set of conceptually predicted life outcomes. These included measures of self (and parent)-rated positive functioning, as well as behavioral reports of educational attainments and substance (cocaine–crack) use. Positive functioning was indexed by compositing self-ratings of self-esteem, self-worth, and coping with stress into one measure so as to maximize reliability. Each of these component measures had been shown in prior work to be negatively correlated with RS. Ayduk et al. showed that preschool waiting moderated this relation such that the deleterious impact of increasing RS is only seen in those children who were not able to wait in preschool (Fig. 2.8a). From this vantage, the self-regulatory processes tapped by preschool waiting served to buffer the impact of RS. Ayduk et al. went on to show that this buffering effect applied additionally to educational attainments (Fig. 2.8b) and substance use (Fig. 2.8c). Related to the prior findings of Mischel et al. (1988) that preschool delay correlates strongly with the Block's construct of ego-resilience, Ayduk et al. also showed that the relationship between RS and ego-resilience in young adults is also moderated by preschool waiting. This result seems to follow since the ego-resilience measure derived from Q-Set ratings and the positive functioning rating derived from other personality scales are quite highly correlated.

After reporting these findings as they pertained to preschool delay and the Bing Longitudinal data, Ayduk et al. reported similar findings in a project that involved children from an inner-city school in the Bronx, New York. Assessments using the delay task were first performed when children averaged about 11 years of age. Follow-up assessments two years later showed once again that delay of gratification moderated the impact of RS for both self-worth and interpersonal functioning (peer acceptance and aggression [inversely scored]). These findings are noteworthy because they replicate the pattern of findings found with the Bing sample when working in a population that is both older (late elementary school) and far more economically challenged, partially allaying concerns about the generality of findings obtained at the Bing School to the privileged demographics of the original sample.

Rejection Sensitivity and Borderline Personality: Ayduk et al. (2008)

Following on the findings of Ayduk et al. (2000) that RS and preschool delay interacted in the prediction of metrics of early adult adaptive functioning, Ayduk et al. (2008) extended this analysis to explore behaviors in the clinical realm.

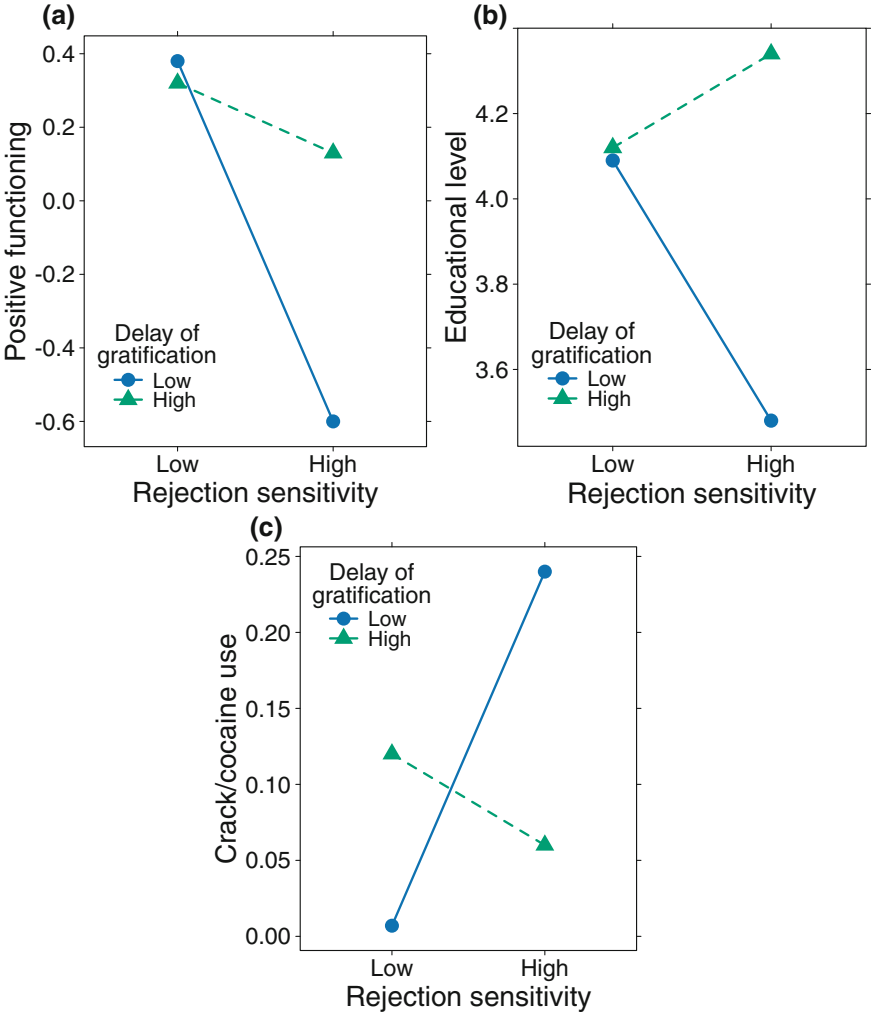

Fig. 2.8 Interaction of preschool delay of gratification and rejection sensitivity. **a** Impact of rejection sensitivity on early adult positive functioning is moderated by preschool delay of gratification. **b** Impact of rejection sensitivity on early adult educational attainment is moderated by preschool delay of gratification. **c** Impact of rejection sensitivity on early adult substance use is moderated by preschool delay of gratification. Adapted from Ayduk et al. (2000)

Specifically, they recognized the close parallels between some aspects of RS and the clinical features that define borderline personality disorder (BP). Specifically, RS and BP share common patterns of interpersonal interaction where individuals amplify and overpersonalize minor disagreements that can rapidly turn into personal attacks and outright aggression. The two syndromes also share common life outcomes including difficulty maintaining relationships and jobs, increased

substance abuse, and low self-worth. The striking descriptive parallels between RS and BP led Ayduk et al. (2008) to explore the relationship between these two variables. It is important to note that in examining BP, Ayduk et al. were not looking at clinically diagnosed samples, but rather individual differences in the tendency to display borderline features within a normally functioning sample.

In a first study, Ayduk et al. utilized the self-reports of college students to examine both RS and executive control (EC) as joint predictors of BP. EC is conceptualized as the "ability to override habitual, automatic responses in favor of less dominant but situation appropriate responses in a voluntary and effortful manner" (Ayduk et al. 2008, p. 153). Ayduk et al. offered EC as a proxy variable for delay of gratification suggesting that preschool delay times effectively "tap into" EC. The researchers then showed that the relation between RS and BP was moderated by EC. Basically, people who were low in EC showed increasing BP features with increasing RS. This pattern was not found in college students high in EC. Following on this finding, Ayduk et al. examined the same relation using data from participants in the Bing Longitudinal Study sample. RS, EC, and BP measures were all collected as part of a Bing follow-up coordinated by Ayduk at Columbia between 2002 and 2004. Using data from participants who were now midlife adults (average age of 39 years), Ayduk et al. replicated the EC moderation of the relation between RS and BP found using college student self-reports. In an effort to extend these self-report findings to behavioral data, the researchers then conducted a similar analysis, substituting delay times from preschool for self-reported EC. Ayduk et al. found that, indeed, the relation between RS and BP was moderated by preschool waiting (Fig. 2.9). Adults who were unable to delay gratification as preschoolers were far more prone to show borderline personality features with increasing rejection sensitivity. This relation between RS and BP was attenuated for adults who were able to wait as children. The researchers offered that this relation was evidenced because waiting as a preschooler taps into basic psychological processes that form the foundation of executive control in adults.

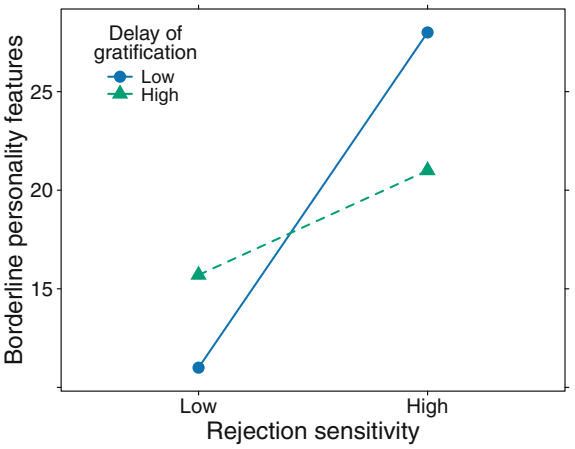

Fig. 2.9 Impact of rejection sensitivity on adult borderline personality features is moderated by preschool delay of gratification. Adapted from Ayduk et al. (2008)

Delay as a Moderator: Takeaways and Caveats

The repeated demonstration that delay ability during preschool buffers the impact of rejection sensitivity on a host of self-regulatory ratings and outcomes over the life course is provocative. Mischel (2014) has written that the finding that self-control as measured through the Marshmallow Test serves to protect individuals from the impact of other life-changing vulnerabilities is a far more important finding than the direct correlations that receive so much attention in the literature and in the popular press. The finding that the self-regulatory capacities that are reflected in waiting times on the Marshmallow Test buffer people from undesirable outcomes suggests a set of skills that might have more generality than is implied by direct correlates. To date, the work of Ayduk and colleagues elegantly demonstrates how this plays out in the realm of one interpersonal vulnerability: rejection sensitivity. One imagines that the interaction demonstrated here might accrue to many other variables impacted by RS. More importantly, the findings open up the prospect that self-regulatory capacities might similarly buffer people in other realms and with other vulnerabilities. The specification of those types of relations is one rich with conceptual and empirical possibilities for further investigation.

Self-control Trajectories and Neural Processes

Cognitive Control: Casey et al. (2011)

Behavior in the delay task appears to tap into a set of basic underlying skills, competencies, and/or processes that form the foundation for self-regulatory competence later in life. There are, of course, many possibilities, and it is likely that how preschool waiting links to later life outcomes is idiosyncratically organized. Nonetheless, the longitudinal findings indicate that some common processes are engaged. In the most recent phases of the Bing Longitudinal Study, teams of cognitive and neuroscientists have joined in the exploration searching for links between patterns of delay and basic cognitive and neural processes. Data collection for these efforts took place from 2008 through 2011 and consisted of two sets of activities. In one, laptop computers were sent to Bing participants and they were asked to complete a set of computer-driven cognitive assessments. In a second, a subset of the original Bing participants returned to Stanford where fMRI imaging was conducted as they completed different self-control-related tasks.

In the first of these studies, Casey et al. (2011) examined the relationship between life patterns of self-control and measures of cognitive control. Cognitive control (CC), a behavioral analog for the self-reported assessment of executive control previously used by Ayduk et al. (2008), refers to "the ability to suppress competing inappropriate thoughts and actions in favor of appropriate ones" (2011, p. 14999) and, as such, is a measure of one aspect of how individuals control attention. Since directing attention played such as pivotal role in the experimental

studies with preschoolers, perhaps differences in CC in adulthood would relate to individual differences in the Marshmallow Test. Prior research with a different sample had demonstrated linkages between what preschoolers looked at while waiting (attentional focus), but not how long they waited, and CC during adolescence as assessed by performance on a go/no-go task (Eigsti et al. 2006). Casey et al. sought to examine whether differences in CC might be found in Bing Longitudinal Study participants nearly 40 years after the original experiments.

To examine this idea, Casey et al. first targeted subgroups of Bing participants who were classified as either high or low "delayers." Recall that over the course of the Bing Longitudinal Study assessments, participants were asked to repeatedly complete ratings of their personality using the California Q-Set. Using a subset of items from the Q-Set, Casey et al. created measures of the participants' self-reported self-control when they were in their 20 s and then again 10 years later. Participants who scored above the median in preschool waiting time and both of the subsequent self-control reports were labeled as "high delayers." Participants who scored consistently below the median on these three measures were labeled as "low delayers." In a first study, Casey et al. examined CC using two variations of a go/no-go task for 59 Bing Longitudinal Study participants. In one task, reaction time and accuracy were assessed as participants made "go" (press a button) or "no-go" (do not press button) judgments about emotionally neutral target images, the faces of males versus females. In a second variation of the task, participants made go/no-go button presses for more emotionally laden targets, faces that were either fearful (or not) or happy (or not). Casey et al. found no differences between low delayers and high delayers in reaction times or accuracy for go trials for either of the different target stimuli. Similarly, no differences were detected in the accuracy of no-go trials when the target stimuli were emotionally neutral. However, when the target stimuli were emotionally laden, low delayers showed far more false alarms, pressing the button to indicate the presence of a target when it was absent (Fig. 2.10). This decline in

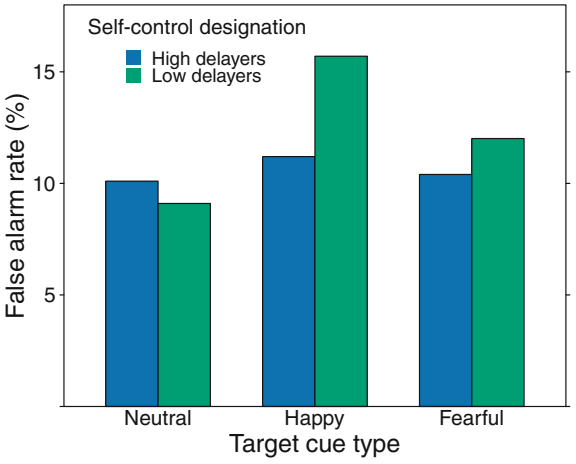

Fig. 2.10 No-go false alarms as a function of the emotional cue of target and lifelong self-control designation. Adapted from Casey et al. (2011)

accuracy of no-go target responding is a classic critical indicator of the inability to inhibit a prepotent response and hence a deficit in CC.

In a second study conducted nearly two years later, 26 of the participants from the prior study came to Stanford and were tested on a similar go/no-go task while having their brains scanned in an fMRI. In this follow-up, participants completed only the emotion-laden (happy and fearful faces) stimuli. The pattern of findings was similar to the first study with low delayers showing a trend toward increased false alarms in the no-go trials. Analysis of the fMRI scans revealed that accuracy at the task was supported by the ventral frontostriatal circuitry. Specifically, low delayers generally showed less polarization of the inferior frontal gyrus in response to no-go as compared to go trials, indicating less activity in this portion of the prefrontal cortex when trying to engage in CC. Additionally, low delayers showed greater activity in the ventral striatum when trying to suppress a no-go response, particularly when target stimulus was a positive cue (happy face). This indicates that this reward center within the limbic system may be activated by positive cues in a manner that interferes with the higher cognitive control systems ability to appropriately modulate reactions to emotionally laden stimuli.

In summary, Casey et al. identified behavioral differences in response to a go/no-go task administered in adulthood between groups of Bing participants who were selected because they showed patterns of self-control that were either stably high or low over the life course. False alarms to no-go tasks were not generalized over different types of stimuli, but were cue specific, only appearing when the cue was positively socially rewarding (happy faces). Follow-up brain scans of a subset of these participants on a similar task implicated two regions of the brain, both part of the frontostriatal circuitry, to account for the behavioral differences. High delayers showed more activation of the inferior frontal gyrus, an area commonly associated with CC, when required to make any no-go responses. Low delayers showed cue-specific activation for positive stimuli in the ventral striatum when required to suppress a no-go response. Together, the findings draw a picture of contextually specified, reward-oriented activation within the limbic system that is paired with attenuated prefrontal cognitive control as low delayers attempt to suppress a prepotent response.

Brain Network Dimensionality for Working Memory: Berman et al. (2013)

Berman et al. (2013) examined the hypothesis that controlling the contents of working memory is linked to lifelong patterns of self-control. Utilizing the same subgroup of high- and low-delaying Bing participants as Casey et al. (2011), Berman et al. conducted behavioral and imaging analysis while participants engaged in a different continuous performance task. In the directed forgetting task, participants were first asked to memorize a group of six words. Three words were presented with blue letters and the remaining three with teal letters. Participants were then presented with a cue instructing them to forget all of the words of one

color. For example, they might be cued to forget all the blue words and hence remember the teal words. Over a series of trials, a single probe word was presented and participants pressed a "yes" key if the word was one of the words they were instructed to remember and "no" if it was not. Among the no trials were control words that were not part of the target array and that rarely occurred over trials and lure words that were drawn from the set of to-be-forgotten words on the current trial. Response time and accuracy were recorded on each trial, and the overall difference in these assessments between control and lure trials was used as an index of control over working memory.

Berman et al. found slower and less accurate performance on lure trials for both high- and low-delaying participants. Although the interaction between the two groups and trial type was not significant, a trend was observed where low delayers were less accurate and took longer to respond to lure trials. According to Berman et al. (2013, p. 3), "… these results hint at the possibility that low delay participants find it more difficult … to resolve interference between relevant and irrelevant material." Despite the behavioral performance similarities between the two groups, Berman et al. did document robust differences in the neural engagement. Low delayers recruited neural networks far less efficiently than high delayers. Using linear discriminant analysis to identify the optimal number of principal components required to achieve maximum classification between lure and control trials, Berman et al. document that high delayers recruited lower level neural networks (fewer principal components) and showed more homogeneity as a group in this recruitment (Fig. 2.11). Compared to low delayers, high delayers showed consistently more efficient recruitment of cortical networks in order to obtain similar outcomes on the working memory task. This led Berman et al. to conclude that neural dimensionality might serve as a key biologic marker of self-control ability.

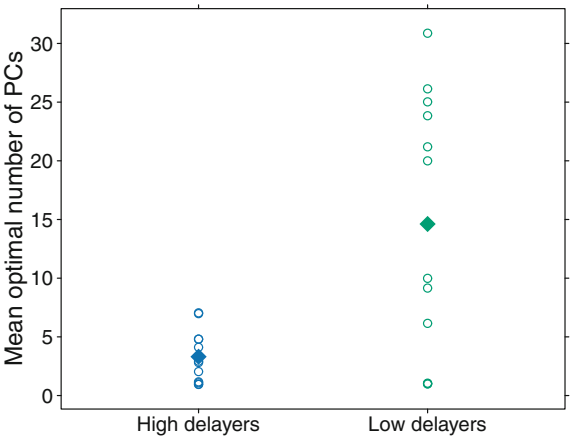

Fig. 2.11 Efficiency of working memory represented as mean number of linear discriminant principal component (PC) required to achieve maximum classification between lure and control trials for high- and low-delaying participants. Adapted from Berman et al. (2013)

Self-control Trajectories and Neural Processes: Takeaways and Caveats

The detection of differences in behavior and neural processing between groups labeled as low and high delayers provides a provocative glimpse of the cognitive and neural processes that might support individual differences in self-control. The work of Casey et al. (2011) and Berman et al. (2013) implicates two different neural systems. The involvement of the ventral frontostriatal circuitry by Casey et al. is consistent with other research examining performance on go/no-go tasks, suggesting that observed differences in self-control over the life course may derive from individual differences in cognitive control and the attentional processes required to suppress competing inappropriate responses in pursuit of a goal. These findings also map nicely onto Metcalfe and Mischel's (1999) hot/cool processing framework (and other dual-process models similar to it—see Rahimi-Golkhandan et al. and Bickel et al., this volume), which posits that effective self-control requires the suppression of hot, fast, limbic based response tendencies by cool, slow, prefrontal processes. In this case, the limbic processes are localized in the ventral striatum, whereas the competing "cooling" mechanism is localized in the inferior frontal gyrus. Casey et al. also suggest that the contextual specificity of the finding for emotion-laden stimuli illustrates how important it is that the stimuli in question be "hot" and hence provocative for the participant. Berman et al., in contrast, implicate a different system that is commonly associated with executive functions, namely working memory. Effective working memory is posited as essential for keeping long-term goals in mind during delay, and this research points to marked differences in the efficiency of this system between low and high delayers. Collectively, the two findings hint that individual differences in self-control can be mapped onto distinct neural processes that may maintain across the life course.

While the findings of these two studies are offered as evidence of the biologic underpinnings of self-control generally and the Marshmallow Test specifically, they might be more conservatively seen as preliminary explorations of the neural processes that support adaptive self-regulation. Interpretive caution is warranted on a number of fronts. The first of these traces to the classification of individuals in the research as either low or high delayers. While it is technically true that the groups compared differed in their tendency to wait as preschoolers, the additional selection criteria requiring participants to consistently report as being either high or low in self-control over the life course cloud the interpretation of this classification. So, for instance, there are many high delayer preschoolers who were not included in this research because they did not consistently report high self-control over the life course. A similar issue exists for those classified as low delayers. One might just as easily label these two groups as consistently high versus low in self-reported self-control. From that vantage, it is not nearly so impressive that people who self-classify as being high versus low in self-control perform differently on continuous performance go/no-go-like tasks and that those differences map onto neural processes that have been previously linked to these tasks.

A key focus of the ongoing work with the Bing Longitudinal Study is to examine different life course trajectories of self-control. The full examination of

these trajectories will include not only those who remain consistently high or low (an important first step), but also those that change over the life course. It will include, for instance, participants who waited as children but report challenges with self-control later in life and participants who did not wait in the Marshmallow Test but who report adaptive self-regulation as adults. In a full consideration of the different trajectories, we will be better able to isolate which aspects of adult behavioral and neural functioning are uniquely linked to preschool waiting. The substantial costs and time connected with doing this type of investigation led to a focus on just two trajectories in the research of Casey et al. and Berman et al. These promising initial findings suggest that a full exploration of the different life course trajectories is warranted.

The work of Casey et al. and Berman et al. flags another important issue in investigating the behavioral and neural correlates of self-control. This involves the extensive reliance on continuous performance go/no-go-like tasks as the measurement tool for identifying differences in neural processing. Note that both the go/no-go task employed by Casey et al. and the directed forgetting task of Berman et al. are cognitive tasks the involve quick choices among competing options that are presented in a rapidly paced serial decision-making format where target stimuli are interspersed among presumably habituating non-target stimuli. These types of tasks are well suited to fMRI scanning studies and provide a valuable and convenient way to measure one form of impulsive responding, the ability to quickly override a seemingly automatic or habituated response. It is likely that this capacity is implicated and supportive of children's efforts to wait when faced with the Marshmallow Test. But it is important to note that this type of task does not capture the essence of what children appear to be doing while they wait. That behavior is far more deliberate, reasoned, and strategic. Children actively struggle with a decision about what the best course of action might be given what is unfolding in front of them. As such, children are making choices among competing responses, but these choices play out in a manner that appears slow (not quick), singular (not serial), and among two choices where the more immediate option, while tempting, is neither automatic nor habituated.

The findings of Casey et al. and Berman et al. also raise important questions for future work on the neural underpinnings of self-control. For example, Casey et al. document the contextual specificity of go/no-go responding and link this to "hot" responding connected to emotionally laden stimuli. In the original experimental investigations of delay and the conceptual integration provided by Metcalfe and Mischel, "hot" responding made reference to a focus on consummatory and appetitive features of the rewards being pursued. Casey et al. detect individual differences in neural responding by cuing emotion-laden stimuli (happy vs. fearful faces) that do not seem to share this consummatory/appetitive quality. While this is offered as a demonstration of the contextual specificity of the individual difference, it raises critical questions about the generality of "hot" stimuli. Are the cognitive and neural processes connected with a child's desire for a tempting food reward parallel to those engendered by an adult viewing faces that vary in affective tone (hence socially rewarding)? Is the mere "positivity" of the cue sufficient to engage

the underlying cognitive processes? These are important questions that speak to the specificity of the neural processes that support self-control.

The work of Berman et al. raises similar important issues. For example, Berman et al. document profound individual differences in the efficiency of engagement of working memory among those labeled as low and high delayers. These differences in neural efficiency do not translate, however, into powerful performance differences in the directed forgetting task that presumably provoked them. This might simply be a reflection of task difficulty, but it raises important questions about the behavioral domain where one might expect observable behavioral differences linked to the efficiency of engagement of working memory. Where and how might these foundational differences in neural functioning play out in the behavior of those labeled as low and high delayers? Would it be evidenced in a more challenging directed forgetting task? More critically, how might these inefficiencies undermine effective self-control in more complex behavioral realms like those involving delay of gratification?

How and Why Children Wait: Lessons from the Marshmallow Test

The research reviewed here provides a critical and comprehensive summary of all findings published to date connected to the original experiments and the ongoing Bing Longitudinal Study. Although the findings reviewed are impressive, they are not as extensive as the exaggerated network of connections often represented in popular portrayals of the work. Caution should be observed when taking such claims at face value. Not everything you read on the Internet is true! Nonetheless, the findings reviewed here do allow some insight into the factors that impact a child's ability to wait. The concluding section of this paper will evaluate the factors that are commonly offered to explain how and why children wait.

Impulsivity and Willpower

As discussed throughout this presentation, the results of the Marshmallow Test and the Bing Longitudinal Study are frequently offered as a marker for the importance of impulse control and willpower over the life course. While it is true that the research documents correlations between preschool waiting and later life outcomes, the attribution of these links to impulse control, while descriptively convenient, appears misplaced. On the one hand, such representations imply that the key to effective waiting lies in a dispositional quality that involves controlling impulses. Children who do not wait are labeled as impulsive. Preschoolers who do wait are

suggested to possess willpower. Neither of these dispositional labels fit well with the actual findings of the research.

On the one hand, there are serious questions about whether children's delay of gratification is dispositionally organized at all, regardless of label applied to it. First, the experimental investigations reviewed here demonstrate that the ability to wait is highly contextualized. Subtle changes or shifts in the experimental setting or instructions can change the task from one that is quite challenging for preschoolers to one where children are quite capable of lengthy waits. These findings led Mischel and his students to conclude that delay of gratification is best viewed not as a generalized and decontextualized disposition (like impulsivity or willpower), but as a capability that can be weakened or enhanced by the prevailing circumstances or by the strategies a child is provided to cope with the challenge.

More critically, the documented longitudinal linkages to ego-control and ego-resilience suggest that dispositional impulsivity is not empirically connected to childhood delay. Although often framed as a measure of impulsivity, these findings suggest preschool waiting on the Marshmallow Test is not enduringly related to ego-control and hence dispositional impulsivity. In contrast, the ability to adapt to situational constraints and be flexible does appear to be strongly predicted by preschool delay. Hence, a child's tendency to yield to the temptations, their "impulse" to terminate the wait and take the immediate reward, is far less important than the child's ability to adaptively adjust to the task.

These same findings also call into question the appropriateness of the label willpower. The correlates indicate that the child is not "willing" their way to the end of the wait. They are not "gritting" it out or more generally demonstrating "effortful self-control." They are instead adjusting to the situation as it unfolds, devising strategies to distract from its challenge, and making reasoned choices regarding the values of continuing given their current appraisal of the situation. Hence, the "power" in willpower is far more likely connected to flexibility and strategically deployed distraction than it is to self-control strength or sheer grit. In this manner, the findings of the Bing Longitudinal Study are entirely consistent with recent findings that suggest that the pathway to goal attainment in adults is better served by efforts to avoid temptations than it is to exert willpower over them (Milyavskaya and Inzlicht in press). At the very least, the pattern of findings for this research suggests that it might be time for researchers to find better labels to describe a child's decision to terminate a delay or wait for a desired reward. Impulsivity and willpower convey too much inferential load to be useful descriptions of children's behavior in the Marshmallow Test.

Strategic Attention Deployment

An often unappreciated but central finding of the longitudinal research is that long-term linkages to preschool waiting are almost exclusively limited to those experimental settings where children must face the rewards and are left to their own

spontaneous coping strategies during the wait. Longitudinal relations are absent when rewards are not present or if children are provided with instructions on what to do while waiting. The identification of these diagnostic settings illustrates the importance of context not only in explaining variance across experimental conditions but also in organizing individual variation within settings. The significance of this finding cannot be understated. Long-term and consequential individual differences are only revealed when children are tested in settings that are challenging and that require them to rely on their own spontaneous coping strategies to address the challenge. But what are those coping strategies? Since the experimental research strongly suggests that left to their own devices children will tend to focus attention on the consummatory features of rewards, individual differences in waiting in these diagnostic settings may be tied to the child's tendency to spontaneously deploy strategies that distract attention away from the rewards and otherwise reduce the frustration connected to waiting. The longitudinal linkages documented in these diagnostic conditions demonstrate that the oft times cute and captivating activities displayed while waiting are not just happenstance but represent the child's strategic attempts to adapt to the challenge at hand.

Whether children actually strategically deploy attention while waiting, although implied by much of this research, is not addressable directly within the Bing Longitudinal Study sample because no video recordings were made of the original experiments. However, research involving a diverse set of other samples consistently demonstrates linkages between how children deploy attention and their ability to wait. In the most direct and intensive investigation of these attentional strategies, Peake et al. (2002) demonstrated that attention to rewards is detrimental to preschool delay in both waiting and working situations. This research used second-by-second codings of attention deployment to show that when children focus more attention on rewards, delay times are shorter. Conversely, moving attention away from rewards facilitates delay. Peake et al. further demonstrated that one attentional activity, "fixing" attention on rewards at any point during the delay session, is highly predictive of the termination of waiting. A number of investigations using modified assessments of attention deployment have yielded similar results. Rodriguez et al. (1989) showed that attention diversion, measured as the proportion of time children spent looking away from rewards, was highly predictive of waiting time on the Marshmallow Test for older children with social adjustment problems. These researchers also demonstrated that patterns of attention deployment differed substantially near the end of the waiting period, with children who terminate the wait spending significantly more time focusing attention on the rewards. Ayduk et al. (2007) document linkages between attention deployment strategies on the Marshmallow Test and delay time on the task as well as separate measures of verbal and physical aggression in two samples of older children. Sethi et al. (2000) demonstrated that differences in strategic attention deployment recorded in toddlers were subsequently predictive of waiting on the Marshmallow Test when the children were 4 years of age. Most recently, Luerssen et al. (2015) demonstrated that differences in attention deployment strategies during the Marshmallow Test were linked to increased functional coupling between a limbic

region (the nucleus accumbens) and cortical structures that foster self-control when children subsequently engaged in a modified Marshmallow Test during fMRI imaging. Taken collectively, these results buttress the notion that children's strategic attention deployment plays a key role in their ability to wait. Several of these studies demonstrate that assessments of attentional strategies might serve as an alternative robust predictor of subsequent life outcomes, perhaps even more robust than the delay time itself. As this work progresses, research energies need to focus on the how to operationalize strategic attention deployment more consistently across studies and to specify the variety of forms these strategies might take as a child engages in goal-directed pursuits.

Tracking children's attention deployment as they wait provides an observable behavioral marker of one strategy that children might be using to adaptively cope while waiting. The early experimental work used instructional sets that directed children toward many other possible strategies: thinking happy thoughts, symbolically representing rewards, focusing on non-consummatory properties of rewards, etc. Mischel (2014) offers these findings as evidence that children can be taught effective self-control strategies. It might be inferred, then, that individual differences in preschool waiting might also be connected to children's spontaneous use of these more complex cognitive strategies. This, of course, is a more challenging empirical question since what children are thinking and how they are representing rewards while they wait are not directly observable. There is an important distinction, however, between what preschoolers can be told to do and what they might actually do spontaneously while they wait. Zimmer-Gembeck and Skinner (2011) present a meta-analysis of children's coping strategies demonstrating that while preschoolers commonly perform simple forms of behavioral distraction and withdrawal, more complex cognitive forms of coping are not typically deployed until middle childhood. Even though preschoolers may successfully follow instructions to execute these cognitive strategies, it is questionable whether they are spontaneously generating these strategies to aid their efforts to wait. It is possible that preschoolers will struggle to learn these more complex strategies.

These questions drive an evolving line of research being conducted by my students at Smith College that focuses on the training of coping strategies in service of facilitating delay of gratification. Our preliminary findings suggest that preschoolers show substantial individual differences in their understanding of strategies for waiting. Preschoolers appear to be capable of acquiring strategies involving simple forms of distraction, and once these are acquired, children wait longer on the Marshmallow Test. These same children show substantially less understanding of more complex cognitive strategies and struggle to acquire those understandings with training. This buttresses the idea that even though preschoolers may be able to be told to use a complex strategy through an experimental instruction, they may not actually be incorporating that strategy into their repertoire of coping techniques. While children appear to be capable of acquiring self-control strategies, intervention directed at training those strategies might need to be keenly sensitive to their natural developmental progression in children.

Executive Functions: Cognitive Control and Working Memory

Attempts to explain why children wait, or even why children might differ behaviorally in how they deploy attention while waiting, increasingly point to the role of the executive functions. Executive functioning is an umbrella label that includes a set of neurocognitive processes implicated in the "conscious control of emotions, thoughts, and behaviors, including working memory, inhibitory control, and set shifting" (Lee and Carlson 2015, p. 1435). Mischel (2014) builds the argument that the Marshmallow Test reveals individual differences in the early development of the executive functions. For Mischel, the executive functions map nicely onto the "cooling" strategies proposed in the hot/cool dual-process system that he uses to understand childhood waiting (Metcalfe and Mischel 1999). The argument that the executive functions may contribute to individual differences in preschool waiting is compelling. First, the Marshmallow Test contains many of the elements of situations where the executive functions are proposed to be engaged (Norman and Shallice 1986). For a preschooler, the delay paradigm is a novel situation that involves planning, decision making, and resisting temptation. Second, the longitudinal correlates documented in the Bing research paint a picture of the children who wait that maps nicely onto the description of adaptive executive functions. Long delaying preschoolers are described later in life as planful, verbally fluent, attentive, responsive to reason, and able to cope with stress, all hallmarks of engaged executive functioning. Third, two specific components of the executive functions, cognitive control and working memory, have been shown empirically to have both behavioral and neural links to waiting in the Marshmallow Test (Ayduk et al. 2008; Berman et al. 2013; Casey et al. 2011; Luerssen et al. 2015).

Despite the compelling and growing argument for the relationship of executive functioning to preschool waiting, the understanding of that linkage is far from complete. The provocative findings of Casey et al. (2011) regarding cognitive control and Berman et al. (2013) regarding working memory both suggest links to the Marshmallow Test but are difficult to interpret due to the grouping criteria that required participants to show lifelong patterns of self-control. That lifelong patterns of self-reported self-control relate to cognitive control and working memory is a significant finding in and of itself, but the direct linkages to preschool waiting are still unclear. Ayduk et al. offer that the ability to wait on the Marshmallow Test is "an early behavioral precursor" of cognitive control in adulthood (2008, p. 151), but then report that empirically these two variables are not correlated. Luerssen et al. (2015) document the most direct and impressive investigation to date of the links between the Marshmallow Test and an aspect of executive functioning (attentional focus away from the rewards). But, even here, the links were documented in older children (aged 7–9) where the functional significance of rewards present seems to have passed, at least with respect to how long children waited. Mean waiting time in the presence of rewards was over 22 min in a paradigm where the maximum wait

was 25 min. It is encouraging, nonetheless, that strategic attention deployment (labeled in this study as "cool focus") still demonstrates predictive prowess.

Converging evidence from research not directly connected to the Bing Longitudinal Study also raises important questions about the inferred connection of preschool waiting and executive functioning. Lee and Carlson review findings documenting that "delay of gratification tasks often do not relate to or load on the same factors as typical executive function tasks" (2015, p. 1435). In addition, Diamond and Lee (2011) show that interventions that improve executive functioning in children do not demonstrate corresponding impact on delay of gratification in those same children. Given the expansive scope of definition of executive functioning, there will clearly be some linkages to preschool waiting. However, the specification of which executive functions are involved, how they are involved, and the extent of their impact are questions ripe for further empirical scrutiny. For example, Lee and Carlson (2015) illustrate the importance of "set shifting," the ability to respond adaptively and flexibly to different contexts, for delay choice and savings behavior. That sort of emphasis is entirely consistent with the picture of the effectively delayer that emerges in the current review where the emphasis is placed on the child's ability to rationally adapt and flexibly respond to the changes challenges in the situations they confront.

Trust

Recently, a considerable amount of attention has been given in both academic and popular circles to the role of trust in delay of gratification. Both Kidd et al. (2013) and Michaelson and Munakata (2016) present findings indicating that a child's "trust" that they will receive a promised delayed reward critically impacts waiting in a modified version of the original Marshmallow Test. In Kidd et al., trust was manipulated by having an experimenter either make good or not on the promise to deliver a more desired outcome if the child was willing to wait in two preliminary waiting scenarios. Children then participated in an experimental variation of the Marshmallow Test conducted by the same experimenter. Kidd et al. found that children who worked with a "reliable" experimenter were much more likely to wait than children exposed to an "unreliable" experimenter. Michaelson and Munakata refined this paradigm so that the child observed the experimenter being "untrustworthy" with another adult on a task that did not involve direct delivery of a promise. Children subsequently working with a "trustworthy" experimenter delayed significantly longer than children working with an adult who had been observed to be "untrustworthy." Both sets of researchers suggest that their findings offer an alternative explanation of why children wait, one focused on rational decision making concerning the likelihood of the receipt of the reward, and they raise questions about what might be contributing to the individual differences documented in the Bing Longitudinal Study.

To begin, even the very earliest investigators of delay choice and delay maintenance fully appreciated the important role of children's trust expectations about the delivery of rewards. As reviewed previously, early investigations of delay choice did not conceptualize these choices as the products of some generalized tendency to demonstrate self-control (or impulse control), but contextually driven decisions that children made as they sized up the task they faced. Trust was explicitly manipulated by Mahrer (1956) and implicitly inferred from cultural and familial interactions by Mischel (1958, 1961). Both showed the powerful impact of trust expectations on children's delay choices.

In shifting the research emphasis from delay choice to delay maintenance, the designers of the Marshmallow Test were keenly aware of how trust expectations might influence children's waiting and took steps to explicitly address this in developing the paradigm. Although rarely discussed, experimenters participating in the early Marshmallow studies were required to make repeated visits to the child's classroom for several weeks prior to the beginning of research. Researchers participated in class activities and played with the children in order to build familiarity, rapport, and trust with the children. In designing the task, at least three features of the paradigm were explicitly structured into the task to establish trust. The first of these was the process of having the child ring the bell in order to signal the experimenter to return. It is important to note that this procedure was practiced repeatedly at the outset of the instructions both so the child would understand how to use the signal and so the child would trust the experimenter will actually return. Second, in all experimental settings where rewards were left in the room (except those that were explicitly testing the impact of having either the immediate or delayed reward alone), both rewards were left on the table directly facing the child. In this manner, there was little room for doubt in the child's mind that they would receive the preferred reward if they waited. The desired reward was within their reach the entire time. Finally, the contingencies for waiting were rehearsed repeatedly with the child before the delay period began. Again, the purpose of this rehearsal was to assure that the child understood the contingency and to build trust in what would happen should the child opt to wait or terminate the delay.

As with the early experimental reports from Mischel and his students, it is difficult to discern whether Kidd et al. or Michaelson and Munakata required researchers to spend time establishing rapport with children prior to beginning testing. However, the modified Marshmallow Test used by these researchers systematically eliminated all those procedures that Mischel and his students built into the paradigm to build trust. In the modified paradigm, children were presented with one marshmallow and told that they could either eat it right now or wait for the experimenter to go get more marshmallows. They were promised that if they had not eaten the marshmallow when the experimenter returned, they would get two marshmallows. Missing from this paradigm was the bell and its rehearsal as a signal for the researcher to come back. Kidd et al. acknowledge this was deliberate since the training connected with the bell would "… provide additional information about the experimenter's reliability." That is true, and it is one of the key reasons that the bell and its training were included in the original paradigm. The elimination of the

signaling bell also creates a confusing scenario where the child's consumption of the marshmallow means that the child will not get the additional treat but has no particular significance to ending the waiting period. This means that a defining element of the Marshmallow Test, the contingency between opting for the less preferred reward and terminating the wait, is omitted in this revised paradigm. Neither Kidd et al. nor Michaelson and Munakata acknowledge or address the absence of the preferred reward or the rehearsal of contingencies as central features of the Marshmallow Test, but these are likely also important omissions that impact the child's trust. Instead, Kidd et al. claim that all the "major features" of the delay situation they employed were "identical" to those of the original Marshmallow Test and then later suggest that their modified paradigm included only "small procedural differences" (2013, p. 6). Suffice it to say, these small procedural differences fundamentally change the dynamic of waiting situation in many important ways.

If there is a single lesson to be learned from the experiments reviewed previously, it is that small alternations of the experimental setting can have dramatic impact on children's experience of the wait. Those differences can find expression in both group differences across conditions and the meaning of individual differences within settings. Both Mischel and his students were fully aware of the role that trust expectations might play in the Marshmallow Test and took explicit steps to buttress the child's trust and hence reduce individual differences on this variable. There is no doubt that some individual differences in trust were still impacting children's choices, but they should have been small compared to those expressed in the modified paradigm used in the trust research. The findings of Kidd et al. and Michaelson and Munakata provide a useful reminder of the role that trust expectations might play in children's waiting, but they have no bearing on the evaluation of the findings of the Bing Longitudinal Study where children were tested under conditions deliberately structured to minimize the impact of individual differences in trust expectations.

It is interesting to note that the findings of Kidd et al. and Michaelson and Munakata are offered as an example of how children's waiting can be guided by rational decision making, in this case the expectancy that the experimenter will deliver the more desired reward. Both sets of researchers pit this rational decision-making perspective against what appears to be a seemingly irrational, impulsive explanation of children's behavior. For Kidd et al., the contrast is to explanations that invoke children's self-control. For Michaelson and Munakata, the seemingly irrational counterpart are explanations pointing to cognitive control. Such pitting reflects a fundamental misunderstanding of the meaning of findings reviewed in this paper. Far from ascribing children's waiting to irrational and impulsive components, the recurring message throughout this review is that children's behavior, even the decision not to wait, is rational, flexible, adaptive, and responsive to changing circumstances that they face. It is curious that even processes like cognitive control are cast as somehow irrational. If the executive functions are shown to play a substantive role in delay of gratification, the entire of point of those functions is to facilitate better decision making! Far from offering an different view of the factors that impact children's ability to wait, the findings of

Kidd et al. and Michaelson and Munakata buttress the perspective offered here that children in waiting situations are actively processing the contextual cues and strategically adapting their behavior to make choices about whether to continue.

Concluding Comments

The number of seconds a child waits before summoning an experimenter to return during the Marshmallow Test is commonly used a marker of the child's self-control (Duckworth et al. 2013). In both popular and academic treatments, short waits are attached to constructs like impulsivity, while opting to not ring the bell is seen as a sign of the child's willpower. While such ascriptions are descriptively convenient, they carry with them inferential load about how and why children wait that is consequential. In popular treatments, those inferences frequently imply a dispositional tendency toward the control of impulses that is set in place early in life (Goleman 1995). In academic treatments, ascriptions to self-control or more specific processes like cognitive control are taken to imply that the factors driving children's waiting are not "rational" (Kidd et al. 2013; McGuire and Kable 2013; Michaelson and Munakata 2016). The research reviewed here suggests a very different picture of how and why children wait. On the one hand, the experimental studies tell us that children participating in the self-imposed delay of gratification paradigm are keenly responsive to contextual cues and highly adaptive in adopting suggested strategies to facilitate waiting. Individual differences in a narrow range of predictable "diagnostic" experimental settings tap into core psychological processes with enduring longitudinal consequences that are expressed both in direct relations to adaptive functioning and through buffering people from other adult vulnerabilities. Those psychological processes are tied closely to the way children use attention flexibly while waiting and are seen behaviorally in the various coping antics displayed by children as they wait. Collectively, the research points to children differentially and deliberately deploying age-appropriate attentional coping strategies to make a decision about what to do in a novel and continually unfolding situation.

The Marshmallow Test was offered by Mischel and his students as an operationalization of delay of gratification intended to move research in the field beyond the static assessment of delay choices and preferences. The research team sought to devise a paradigm for examining the cognitive and contextual factors that influence the dynamic process of maintaining delay once a preference has been expressed. In its inception, no one knew how the research might unfold or what it might reveal. No one envisioned that this simple framework for engaging preschoolers would evolve into a research program that now spans a half-century. Most certainly, none of the principal researchers anticipated that enormous growth of public interest in the work.

The investigations of children's delay of gratification, conducted by Mischel and his students at the Bing Nursery School nearly 50 years ago, launched a program of

research that remains vital to this day. Our current work includes explorations of linkages to economic outcomes in the Bing participants' lives, studies of training children on effective strategies for delay, and examination of different life course self-regulatory trajectories to name just a few. As with any programmatic research, the Bing Longitudinal Study continues to raise challenging questions about the nature of self-regulation as it plays out over the life course. Because the Bing Longitudinal Study was in part accidental in its inception, it was not designed or structured to answer many of the questions that it has raised. It is encouraging to see that active research programs utilizing more tailored designs are emerging to clarify issues raised and lessons learned by this work. The accurate portrayal of what investigations utilizing the Marshmallow Test have revealed to date should assist these continuing efforts to understand how and why children wait and the linkages of early delay of gratification to outcomes over the life course.

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