Nebraska Symposium on Motivation 64

Jeffrey R. Stevens *Editor*

Impulsivity

How Time and Risk Influence Decision Making

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Debra A. Hope, Lincoln, NE, USA

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How Time and Risk Influence Decision Making

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Series Preface

We are pleased to offer this volume from the 64th Nebraska Symposium on Motivation.

This year the volume editor is Jeffrey Stevens. In addition to overseeing this book, the volume editor coordinated the 64th Symposium, including selecting and inviting the contributors. I would like to express my appreciation to Prof. Stevens and the contributors for a stimulating meeting and an excellent series of papers on impulsivity, an important factor in many behavioral problems.

This symposium series is supported by funds provided by the Chancellor of the University of Nebraska–Lincoln, Harvey Perlman, and by funds given in memory of Professor Harry K. Wolfe to the University of Nebraska Foundation by the late Professor Cora L. Friedline. Given Chancellor Perlman's retirement in 2016, we honored his long-standing generous support by naming the poster session and reception in his honor. We are also grateful for the University of Nebraska Foundation's support via the Friedline bequest. This symposium volume, like those in the recent past, is dedicated in memory of Professor Wolfe, who brought psychology to the University of Nebraska. After studying with Professor Wilhelm Wundt in Germany, Professor Wolfe returned to his native state, to establish the first undergraduate laboratory in psychology in the nation. As a student at Nebraska, Professor Friedline studied psychology under Professor Wolfe.

Lincoln, USA — Debra A. Hope

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Chapter 1
The Many Faces of Impulsivity

Jeffrey R. Stevens

Introduction

Can you resist the dessert tray when eating out at restaurants? Do you enjoy the thrill of pulling the arm on a slot machine in anticipation of the results? Do you succumb to purchasing candy or magazines in the checkout line of the grocery store? Have you ever bungee jumped or skydived? Have you ever blurted out something that you wish you would not have said? These questions all address *impulsivity*, a multifaceted concept that typically captures an inability to wait, a preference for risky outcomes, a tendency to act without forethought, an insensitivity to consequences, and/or an inability to inhibit inappropriate behaviors (Evenden 1999; Reynolds et al. 2006). Because it touches on so many different aspects of behavior, impulsivity connects to a number of other concepts including patience, self-control, delay of gratification, intertemporal choice, discounting, risky choice, risk taking, inhibitory control, and sensation seeking. So, when different researchers refer to impulsivity, do they mean the same thing? Is impulsivity a single construct across all of these usages?

A Taxonomy of Impulsivity

The shear breadth of behavioral phenomena labeled "impulsivity" already implies an answer to this question. It seems unlikely that impulsivity is a unitary construct that applies to such a diverse range of behaviors. In fact, researchers have created a

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taxonomy that carves up the concept into different types of impulsivity. A primary distinction divides impulsivity into impulsive choice (or decision making) and impulsive action (or disinhibition) based on both behavioral correlates across tasks and neural mechanisms (Evenden 1999; Reynolds et al. 2006; Dalley et al. 2011; Robbins and Dalley, this volume).

Impulsive Choice

Many cases of impulsivity involve making a choice: a choice between rewards with different costs. These costs can result from time delays to receiving the reward, probabilities of receiving the reward, or effort required to receive the reward. These choices typically involve a trade-off between a smaller reward with a smaller cost and a larger reward with a larger cost.

For *intertemporal choices*, the cost is a time delay to receiving a reward—individuals must choose between rewards that are available after different delays (Read 2004; Stevens 2010). Researchers often investigate explicit *delay choices* between a smaller, sooner option and a larger, later option (see Barack and Platt, Bickel et al., Mitchell, Rahimi-Golkhanden et al., Robbins and Dalley, Tucker, this volume). Choosing the smaller, sooner option is often labeled impulsive, whereas choosing the larger, later option signals self-control or patience. Psychologists and economists have proposed temporal (or delay) discounting as the mechanism generating delay choices—that is, they assume that decision makers subjectively devalue future rewards. Individuals who highly discount the future will show a strong preference for sooner rewards.

In addition to delay choice, other intertemporal choice paradigms explore *delay maintenance*, in which individuals must maintain a choice for a delayed reward in the face of alternatives (Mischel and Ebbesen 1970; Toner et al. 1977). Rather than making a single choice, delay maintenance requires making a constant stream of choices for the larger, later option. Walter Mischel's Marshmallow Test investigates the notion of delay of (or delayed) gratification by using delay maintenance tasks (see Peake, this volume). Though they are both measures of intertemporal choice, performance on delay choice and delay maintenance tasks are not strongly correlated (Toner et al. 1977), suggesting that even within intertemporal choices, levels of impulsivity are dissociated between making and sustaining choices.

For *risky choices*, the cost is the probability of receiving the reward, with the receipt of the small reward more certain than receipt of the larger reward. Impulsivity in this context refers to the willingness to take risks (Barack and Platt, Bickel et al., Rahimi-Golkhanden et al., Robbins and Dalley, Tucker, this volume). This ranges from gambling in games of chance to engaging in risky behaviors such as having unprotected sex. Conceptually, risky choices are analogous to intertemporal choices, and researchers refer to probability discounting as an analogous mechanism to temporal discounting.

Rewards can also be costly in terms of the effort need to obtain them. Increasing the effort or distance required to obtain a reward will reduce choices for that reward (Mitchell, this volume). So, like temporal and probability discounting, investigators can also measure effort and distance (or spatial) discounting, with impulsivity referring to choosing the option with the least effort/distance. Effort and distance preferences are not as well studied as time and risk preferences, but some evidence suggests that they are decoupled from time preferences (Mühlhoff et al. 2011; Mitchell, this volume), though they share some neural substrates (Mitchell, this volume).

Impulsive Action

Impulsive action refers to a failure of inhibition or the inability to withhold from making a response (Winstanley et al. 2006). This often involves acting without forethought, ignoring consequences of actions, and failing to inhibit inappropriate behaviors. Impulsive action can be divided into "waiting impulsivity" and "stopping impulsivity" (Dalley et al. 2011). Waiting impulsivity refers to situations in which individuals cannot wait and prematurely respond to a situation—for example, when drivers anticipate a traffic signal changing but accelerate before the signal actually changes. Stopping impulsivity refers to situations in which individuals fail to stop an action when required—for example, when a child is reaching to touch a forbidden object and fails to stop reaching when told not to touch the object. Robbins and Dalley (this volume) describe how different neural circuits underlie these two subcategories of impulsivity.

Scope of Impulsivity

Due to the many different varieties of impulsivity, this concept is wide in scope. It is of relevance to a large number of fields, including psychology, economics, biology, neuroscience, anthropology, nutrition, finance, and environmental sciences. Studying impulsivity requires investigation across a broad range of levels. Early work in this area began by focusing on the behavioral level of individuals. But impulsivity has important implications for society in terms of both differences across cultures (Tucker, this volume) and applications to critical societal problems such as physical health (Bickel et al., Mitchell, this volume), mental health (Barack and Platt, Bickel et al., Mitchell, Robbins and Dalley, this volume), financial well-being (Laibson et al. 1998), and environmental sustainability (Stern 2008). Given its potentially negative societal implications, interventions and nudges could be designed to reduce impulsivity. This raises interesting questions about whether

impulsivity is a trait that people have or whether it is a response to the decision-making context (Peake, this volume). Therefore, investigating its cognitive mechanisms (Bickel et al., Mitchell, Peake, Rahimi-Golkhanded et al., this volume) could provide fruitful insights into impulsivity. Taking this a step further by exploring the biological mechanisms (e.g., neural circuits and neurotransmitters: Barack and Platt, Robbins and Dalley, this volume) can yield therapies to treat pathological impulsivity. Therefore, impulsivity connects numerous fields across many levels of analysis and has critical applications to human (and nonhuman) societies.

Due to this breadth, the current volume reflects the scope of impulsivity by including contributors from a wide range of fields who work at different levels of analysis. The volume begins with Philip Peake's review of the foundational work on the Marshmallow Test—a famous (and perhaps infamous) series of studies on delay of gratification in children (Chap. 2). This work has captured the public's interest in impulsivity by demonstrating important connections between the ability to wait for delayed rewards at a young age and life outcomes in adolescence and adulthood. It also highlights the underappreciated emphasis on how cognitive and contextual factors influence delay of gratification.

Bram Tucker then takes us on a bit of an adventure by describing the difficulties of and insights from studying questions of impulsivity in small-scale societies (Chap. 3). We learn that serious attention must be paid to cultural differences when translating the experimental paradigms used in Western populations to that of other cultures. These studies yield interesting insights into culturally specific contextual factors that shape understanding of risky outcomes.

Shahin Rahimi-Golkhandan, David Garavito, Bertrand Reyna-Brainerd, and Valerie Reyna provide an outside-of-the-box theory of memory, judgment, and decision making that challenges established models of risk and temporal preferences (Chap. 4). Fuzzy Trace Theory explores the social and cognitive mechanisms of these preferences by proposing that people use two different types of mental representations of the rewards, risky probabilities, and time delays inherent in these preferences: The gist representations give a "fuzzy," overall meaning of information (e.g., "now" vs. "later") in contrast to the precise verbatim representation (e.g., in 10 min vs. in 7 days). Incorporating this component of cognition captures many aspects of contextual effects on choice across the life span, with implications for the malleability of impulsivity and delay of gratification.

Suzanne Mitchell connects impulsivity in temporal discounting to psychopathology but also highlights an understudied form of discounting: effort discounting (Chap. 5). Though effort discounting shares some characteristics and neural circuitry with temporal discounting, it is distinct in many ways, as well. Given its potential effects on psychopathology such as depression and attention-deficit/hyperactivity disorder, effort discounting could provide a valuable tool to further understand impulsivity.

David Barack and Michael Platt provide a comprehensive review of the neural circuitry underlying time and risk preferences in foraging (Chap. 6). Foraging offers a decision domain critical to survival for all animals that combines both time and risk.

These authors describe a process model of foraging that incorporates both behavioral and neural data in humans and other species to implicate dysregulated neural circuitry for foraging as a key contributor to impulsive choice.

Trevor Robbins and Jeffrey Dalley synthesize behavioral and neural data in humans and other species to fractionate impulsivity into different subtypes (Chap. 7). Importantly, waiting impulsivity and stopping impulsivity show distinct neural circuits. Understanding the neural basis for the different types of impulsivity can translate into treatments for neuropsychiatric disorders such as substance abuse disorders, attention-deficit/hyperactivity disorder, Parkinson's disease, and other impulse control disorders.

Warren Bickel, Jeffrey Stein, Lara Moody, Sarah Snider, Alexandra Mellis, and Amanda Quisenberry introduce a novel approach to studying impulsivity with direct applications to physical and mental health (Chap. 8). Narrative theory is a framework that taps the power of storytelling to develop interventions for maladaptive health behavior, including addiction, overeating, and risky sexual behavior. Thus, narrative theory provides potential interventions for impulsivity in both temporal and risk preferences.

From neurons to societies, from mice to humans, from children to adults, these chapters cover a broad range of questions we can ask about impulsivity. Understanding the many faces of impulsivity requires continued integration across levels of analysis, species, and timescales. I am very grateful to the contributors to this volume for their participation in the Nebraska Symposium on Motivation and for their continued work to advance our understanding of impulsivity.

Acknowledgements Organizing the 64th annual Nebraska Symposium on Motivation was a joy and a privilege. But the success of the symposium relied on the goodwill and hard work of many people. I am grateful for the financial support from the University of Nebraska-Lincoln Chancellor Harvey Perlman and from the late Professor Cora L. Friedline's bequest to the University of Nebraska Foundation in memory of Professor Harry K. Wolfe. The symposium would not be possible without their generous gifts. I would also like to thank Professor Debra A. Hope, the symposium series editor, for shepherding me through the process of organizing the symposium—from advice on inviting speakers to help picking out the dessert tray. Finally, the symposium went off without a hitch, primarily due to the superb organization of Pam Waldvogel and the assistance of Emily Johnson and Juan Duque. Thank you for your time and hard work.

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

Philip K. Peake

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

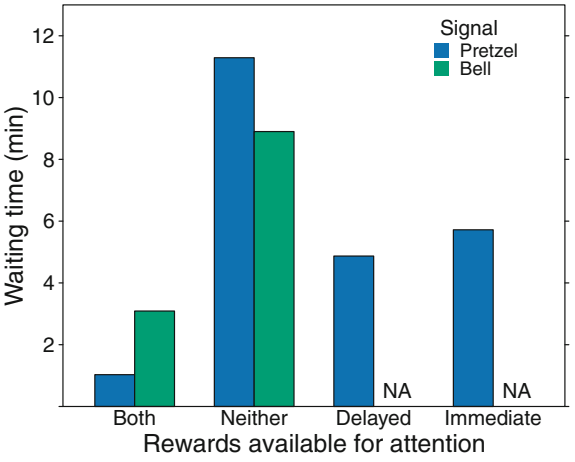

Fig. 2.1 Waiting time as a function of reward presence using either consuming pretzel or ringing bell as signal for experimenter to return. Adapted from Mischel and Ebbesen (1970)

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.

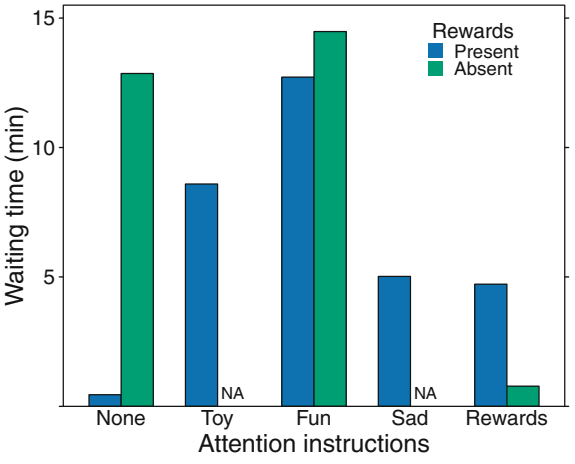

Fig. 2.2 Waiting time as a function of reward presence and type of attentional instruction provided. Results collapsed across three experiments. In replicated conditions, means across experiments are shown here. Adapted from Mischel et al. (1972)

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).

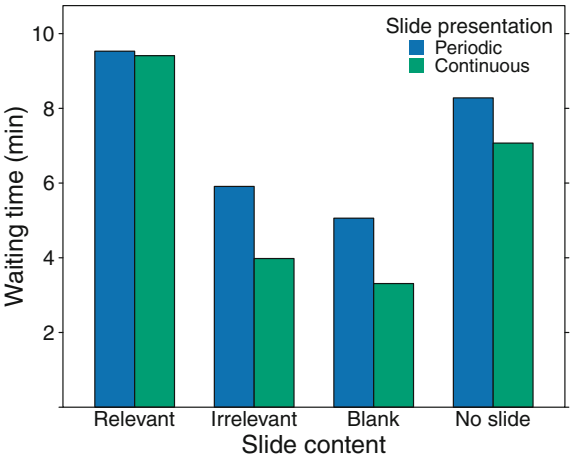

Fig. 2.3 Waiting time as a function of slide content for symbolically presented rewards. Rewards physically absent in all conditions. Adapted from Mischel and Moore (1973)

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

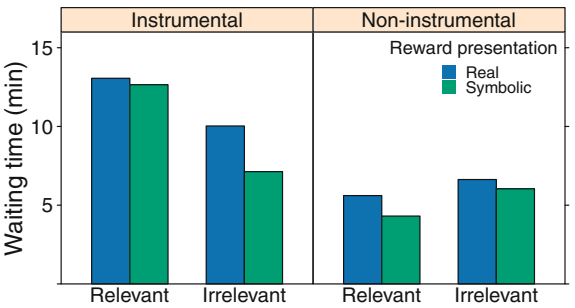

Fig. 2.4 Waiting time as a function of child's belief about instrumentality of thinking about real or symbolic rewards that are either relevant or irrelevant. Adapted from Mischel and Underwood (1974)