

The Many Faces of Impulsivity

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## The Many Faces of Impulsivity

### Abstract

Impulsivity is a multi-faceted concept that 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. 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. Therefore, researchers have created a 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. Due to the many different varieties of impulsivity, this concept is of relevance to a large number of fields, including psychology, economics, biology, neuroscience, anthropology, nutrition, finance, and environmental sciences. The current volume reflects the scope of impulsivity by including contributors from a wide range of fields who work across levels of analysis, species, and timescales to understand the many faces of impulsivity.

## 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 multi-faceted 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, Ortengren, Richards, & de Wit, 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 sheer 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 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, Everitt, & Robbins, 2011; Robbins & 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 and a larger, later option (see Barack & Platt, Bickel et al., Mitchell, Rahimi-Golkhanden et al., Robbins & 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 & Ebbesen, 1970; Toner, Holstein, & Hetherington, 1977). Rather than making a single choice, delay maintenance requires making a constant stream of choices for the larger, later option. Walter Mischel’s

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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 & Platt, Bickel et al., Rahimi-Golkhanden et al., Robbins & 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, Stevens, & Reader, 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, Eagle, & Robbins, 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 both in terms of 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 & Platt, Bickel et al., Mitchell, Robbins & Dalley, this volume), financial well being (Laibson, Repetto, & Tobacman, 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,

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this volume). Therefore, investigating its cognitive mechanisms (Bickel et al., Mitchell, Peake, Rahimi-Golkhanden 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 & Platt and Robbins & 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 (Chapter: “Delay of gratification: Explorations of how children wait and its linkages to outcomes over the lifecourse”). 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 (Chapter: “From risk and time preferences to cultural models of causality: On the challenges and possibilities of field experiments, with examples from rural southwestern Madagascar”). 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 (Chapter: “A Fuzzy Trace Theory of risk and time preferences in decision making: Integrating cognition and motivation”). 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 minutes vs. in 7 days). Incorporating this component of cognition captures many aspects of contextual effects on choice across the lifespan, 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 (Chapter: “Devaluation of outcomes due to their cost: Extending discounting models beyond delay”). 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 (Chapter: “Engaging and exploring: Cortical circuits for adaptive foraging decisions”). 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.

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Trevor Robbins and Jeffrey Dalley synthesize behavioral and neural data in humans and other species to fractionate impulsivity into different subtypes (Chapter: “Dissecting impulsivity: Brain mechanisms and neuropsychiatric implications”). Importantly, waiting 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 (Chapter: “Toward narrative theory: Interventions for reinforcer pathology in health behavior”). 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.

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