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Impulsivity and Self-Control as Timeless Concepts: A Conceptual Analysis of Intertemporal Choice

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Intertemporal choice tasks are used to measure how people make decisions between outcomes occurring at different time points. Results from these tasks are typically used to study impulsivity and self-control, concepts central in theories and empirical research concerning addiction, criminology, psychopathology, and organizational behavior, among many. Accordingly, preferences for smaller rewards received sooner, over larger rewards received later, have been linked to higher impulsivity and less self-control. This article is a critique of that approach. We first provide a historical overview of research on time preferences tracking the origins of the theoretical link between intertemporal choice, impulsivity, and self-control. Our subsequent conceptual analysis reveals that impulsivity concerns a lack of reflection on one's choices, not a lack of concern with the future, and self-control concerns internal conflict due to temptation, rather than future-orientedness. We draw attention to the fact that people may, and do, use self-control to choose a "smaller-sooner" reward or impulsively select a "larger-later" reward. We also address technical limitations about intertemporal choice tasks' reliability and external and predictive validity. We conclude that impulsivity and self-control cannot be measured using a standard intertemporal choice task. We canvass possible future directions for decision-making models in this area, providing the basis for a new understanding of how impulsivity, self-control, and time preferences influence behavior across different domains. We suggest that to study impulsivity and self-control in a temporal context, more information is needed about agents' motivation, affect, and deliberative process.

Keywords: delay discounting, impulsivity, intertemporal choice, self-control, time preferences

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Many everyday choices have consequences occurring at different timescales. Do I buy a coffee or save my money for later needs? Do I cycle to work for the health and environmental benefits or take the car for convenience? Should I eat pizza for dinner or opt for something healthier? Similar dilemmas are faced by organizations and governments, some involving consequences that shape nations. Do we lower fuel taxes to combat inflation, or do we reduce dependency on fossil fuels by building green energy capacity?

The ubiquity and importance of these choices have resulted in a wealth of research on intertemporal choice. Intertemporal choice involves rewards or costs that can occur at different moments in time. Generally, humans and nonhuman animals prefer rewards that arrive sooner rather than later, a pattern economists refer to as *time preferences*. The most prominent economic framework to account for this phenomenon is called delay discounting (Chabris et al., 2010). Researchers use delay discounting to explain time preferences by assuming diminishing utility of an option as it moves further away into the future. The rate at which a decision maker devalues an option as a function of time is known as a "discount factor."

Delay discounting models can be described as "as-if" models, that is, if agents discount outcomes in the future with some function $f(t)$, where t denotes time, then their utility function takes the form of $u(f, X)$, where X includes sources of enjoyment (positive or negative). The agent is therefore assumed to make decisions *as if* they walk around with a (discounted) utility function in their head, using it to adjudicate between options. Fisher (1930) suggested that discounting the future was fundamental to the economy more generally: The price of capital is merely the discounted value of its expected future income streams. Early delay discounting models (notably, Fisher, 1930; Samuelson, 1937) then served as normative accounts of intertemporal choice and underpinned economic models of how interest rates arise. Though it is fundamental to answering these questions, delay discounting was not developed as a decision-making process model for trading off money and time; it is a parsimonious post hoc explanation of common decision-making patterns. Currently, however, delay discounting models are commonly taken to be both a normative and descriptive account of decision making (Chabris et al., 2010; Ericson & Laibson, 2019; Odum et al., 2020).

The concept of delay discounting found many applications in behavioral sciences. Indeed, many researchers over the years sought to measure individual differences in time preferences, linking them to a range of different attitudes and behaviors. To learn more about people's time preferences, behavioral scientists, psychologists, and clinicians commonly use the *intertemporal choice task*. In intertemporal choice tasks, participants are typically asked to choose between options comprised of rewards arriving at different points in time. In each trial, participants must therefore trade off a smaller reward arriving sooner against some larger reward that arrives later, usually (hypothetical) monetary amounts (or food rewards for nonhuman animals). Based on people's responses across multiple trials, researchers then fit people's choices to a delay discounting model and estimate discount factors to quantify individual differences in time preference.

Central to the thesis of the current work is our observation that researchers who measure time preferences with intertemporal choice tasks often use these measurements to estimate the level of impulsivity and/or self-control exhibited by an individual decision maker. More specifically, it is customary across many domains of behavioral sciences to denote those who discount the future strongly as impulsive and those who do not as self-controlled.

In this article, we challenge the preconception that impulsivity and self-control are implicated in time preferences, questioning the assumption that they can be measured using intertemporal choice tasks. We begin by providing a historical overview of research on time preferences to track the link between impulsivity, self-control, and time preferences. Using these insights, we conceptualize impulsivity and self-control based on definitions and theories from various relevant disciplines. Next, we evaluate whether impulsivity and self-control are implicated in time preferences conceptually, before we discuss empirical issues, such as estimating reliable discounting parameters that are predictive of real-life behavior. Finally, using these insights, we canvass possible new directions for research on impulsivity and self-control and discuss implications.

Impulsivity, Self-Control, and Time Preferences in the Literature

It is common in behavioral science to refer to people's tendency to discount future rewards as impulsive or lacking self-control. To illustrate how commonly this occurs, we have compiled a table with a sample of influential articles that discuss impulsivity and self-control in the context of time preferences. See Table 1.

Ainslie (2021) formulated the role of self-control (though he normally refers to "willpower," seemingly taking it to be equivalent) as "choices that evoke willpower typically compare options that pay off over different time courses, with poorer but faster-paying ones weighed against the better but slower paying" (p. 3).

In clinical psychology and neuroscience, this type of formulation is also common (for a prominent example, see "Impulsivity: the neurological and behavioural study of discounting"; Madden & Bickel, 2010). Nigg (2017) wrote: "Impulsivity: Nonreflective stimulus-driven action when a later-rewarding goal-relevant response was also available. … Mediated by both bottom-up processes (e.g. spontaneous reward valuation/discounting) and top-down processes (e.g. biasing from prior goals; response inhibition)" (p. 363).

Linking time preferences to impulsivity and self-control is also not uncommon in nonhuman animal behavior research; Laude et al. (2012) wrote:

> The steepness of the discounting function can be taken as a measure of the degree to which an animal is characterized as impulsive or, the degree to which it lacks self-control. … That is to say, behavioural measures of discounting are often interpreted as indicating the degree of impulsivity.

In other texts, the equivalence between present-oriented and future-oriented intertemporal choice patterns, and impulsivity and self-control is tacitly accepted rather than explicitly asserted (e.g., Doyle, 2012; Stevens & Stephens, 2010).

It is worth examining why impulsivity and self-control have come to be conceptualized in this way. Many authors, including some mentioned in Table 1, reference either Ainslie (1975) or Logue (1988); Logue, in turn, references Ainslie (1975) who is concerned with preference reversals (more on this phenomenon below) and calls this "impulsiveness." Ultimately, this view of time preferences appears to date back to Fisher (1930), who names weakness of will as one of several drivers of discounting future outcomes. That line of reasoning is subsequently continued by Strotz (1955), who theorizes about why people do things against their best interests.

It should be noted that Ainslie (1975) initially wrote that the concavity of an agent's discount function (i.e., hyperbolic discounting, which we will discuss in more detail below) is what makes choices impulsive or self-controlled—not their general preference for sooner rewards over later rewards. He acknowledges that there are many situations where a preference for smaller-sooner rewards is adaptive and justified, and thus, these situations were not of interest to his project.

According to Ainslie, one is impulsive if by choosing the smaller-sooner reward one reduces their lifetime utility. In this, he focuses on what we now call *preference reversals* (also known as dynamic inconsistency or common delay effects). A preference reversal occurs when an agent prefers larger-later Option A over smaller-sooner Option B when both options are temporally distant, but as time goes on (and no new information presents itself in the interim), Option B becomes more immediate, at which point the agent prefers B to waiting for Option A. Ainslie (1975) suggested that this type of choice is due to curvature in the delay discount function, which was later formalized in the following equation (Mazur, 1987):

$$f(D) = \frac{1}{1 + kD}, \tag{1}$$

where f is the discount factor applied to a reward received after delay D, and k is the discount parameter. This is in contrast with the discounted utility model function (Samuelson, 1937), based on Fisher's (1930) theory of interest:

$$f(D) = e^{-kD}, \tag{2}$$

where f and D mean the same as above, k is the (exponential) discount parameter, and e is the base of the natural logarithm. Discounting future rewards through this exponential function never leads to preference reversals. See Figure 1 for a depiction of the different parametric forms of these models.

In the clinical psychology and neuroscience literature on "choice impulsivity" (i.e., delay discounting), however, Ainslie's more nuanced point that impulsivity and self-control are related to the parametric form of the discount function is

Table 1
A Sample of High-Impact Articles From the Intertemporal Choice Literature Discussing Impulsivity and Self-Control

Author[s] (year). Journal	Title	Number of citation	Quote
Impulsivity			
Baumann and Odum (2012). *Behavioral Processes*	Impulsivity, risk-taking, and timing	192	"Steep delay discounting is also known as impulsive decision making"
de Wit (2009). *Addiction Biology*	Impulsivity as a determinant and consequence of drug use: A review of underlying processes	1,623	"The most commonly used behavioral measures of impulsivity are delay discounting, which assesses impulsive decision-making, and behavioral-inhibition tasks."
Rubia et al. (2009). *Philosophical transactions of the Royal Society of London*	Impulsiveness as a timing disturbance: Neurocognitive abnormalities in attention-deficit hyperactivity disorder during temporal processes and normalization with methylphenidate	362	"We argue that impulsiveness is characterized by compromised timing functions such as premature motor timing, decreased tolerance to delays, poor temporal foresight and steeper temporal discounting."
Sharma et al. (2014). *Psychological Bulletin*	Toward a theory of distinct types of "impulsive" behaviors: A meta-analysis of self-report and behavioral measures	683	"Another aspect of neuropsychologists' definition of impulsivity, termed 'choice impulsivity' by some … is the inability to delay gratification or to choose smaller, immediate rewards over larger, distant ones … ."
Nigg (2017). *Journal of Child Psychology and Psychiatry*	Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology	1,269	"Impulsivity: Nonreflective stimulus-driven action when a later-rewarding goal-relevant response was also available. May be adaptive or maladaptive depending on context and degree of inflexibility as context changes. Mediated by both bottom-up processes (e.g. spontaneous reward valuation/discounting) and top-down process (e.g. biasing from prior goals; response inhibition)."
Wiers et al. (2010). *Frontiers in Psychology*	Impulsivity, impulsive and reflective processes and the development of alcohol use and misuse in adolescents and young adults	132	"Aspects of impulsivity and sensation seeking can also be assessed with behavioral performance measures such as delay discounting."
Coffey et al. (2003). *Experimental and Clinical Psychopharmacology*	Impulsivity and rapid discounting of delayed hypothetical rewards in cocaine-dependent individuals	710	"However, the behavioral economics literature provides a behavioral method of assessing impulsivity by assessing the reduction in the subjective value of delayed rewards as a function of delay interval."

(*table continues*)

Table 1 (*continued*)

Author[s] (year). Journal	Title	Number of citation	Quote
Kris N. Kirby and Herrnstein (1995). *Psychological Science*	Preference reversals due to myopic discounting of delayed reward	790	"Their delay discount rates do not remain constant; their relative preferences change; they are indifferent between outcomes at some points in time but not at others; and they reverse preference as their temporal vantage point changes. All of these apparently haphazard features of human decision making are consistent with the ordinary definition of impulsiveness, in which a choice is made on the basis of a temporary, and often sudden, change in preference."
Self-control			
Rachlin and Green (1972). *Journal of the Experimental Analysis of Behavior*	Commitment, choice and self-control	1,726	"The preference for the large delayed alternative with long durations of T parallels everyday instances of advance commitment to a given course of action. Such commitment may be seen as a prototype for self-control."
Thaler (1981). *Economic Letters*	Some empirical evidence on dynamic inconsistency	3,161	"This hypothesis is that the discount rate will vary inversely with the size of the reward for which the individual must wait. This hypothesis is derived from viewing intertemporal choice as problem [sic] in self-control."
Both concepts			
Stevens and Stephens (2010). (in Madden & Bickel, 2010)	The Adaptive Nature of Impulsivity	132	"We define impulsivity as choosing a smaller-sooner option when a larger later option produces a better outcome."; "In self-control studies, the investigator trains subjects … to choose between a small reward the subject can obtain quickly … and a larger reward it must wait a bit longer to obtain."
Logue (1988). *Brain and Behavioral Sciences*	Research on self-control: An integrating framework	1,053	"… self-control referring only to the choice of a larger, more delayed reinforcer over a smaller, less delayed reinforcer and impulsiveness referring to the opposite."[a]

(*table continues*)

Table 1 (*continued*)

Author[s] (year). Journal	Title	Number of citation	Quote
Van den Bergh et al. (2008). *Journal of Consumer Research*	Bikinis instigate generalized impatience in intertemporal choice	436	"Visceral factors may drive impatient and impulsive behaviors … and demonstrate less self-control (defined by a greater preference for smaller, less delayed access to apple juice … .)."
Bickel and Marsch (2001). *Addiction*	Toward a behavioral economic understanding of drug dependence: Delay discounting processes	1,364	"Impulsivity has been defined as the selection of a smaller more immediate reward over a larger more delayed reward (self-control has been defined as the opposite … .)."

Note. Citations as from Google Scholar on July 5, 2023.
[a] Logue does not commit to this without weighing the advantages and disadvantages, but she never touches on any of the substantial disadvantages discussed.

often lost. What is denoted as choice impulsivity is instead often associated with the degree of discounting (i.e., the value of k). Crucially, in the hyperbolic discounting model, the steepness of the function and the parametric form are indissociable because they are both captured by one parameter. The hyperbolic model therefore has no "impulsivity" parameter but a single parameter, partially influenced by impulsivity (in Ainslie's view of the construct). The other common measurement taken is the area under the curve, a mostly theory-neutral measure of the value of future rewards lost to delay discounting (Myerson et al., 2001), which is also uninformative about the convexity of the discount function. There is, thus, a lack of information provided by the parameter estimates most widely taken from intertemporal choice experiments. The entanglement of steepness and convexity in single parameter estimates renders making theoretical claims about impulsivity based on intertemporal choice task responses difficult.

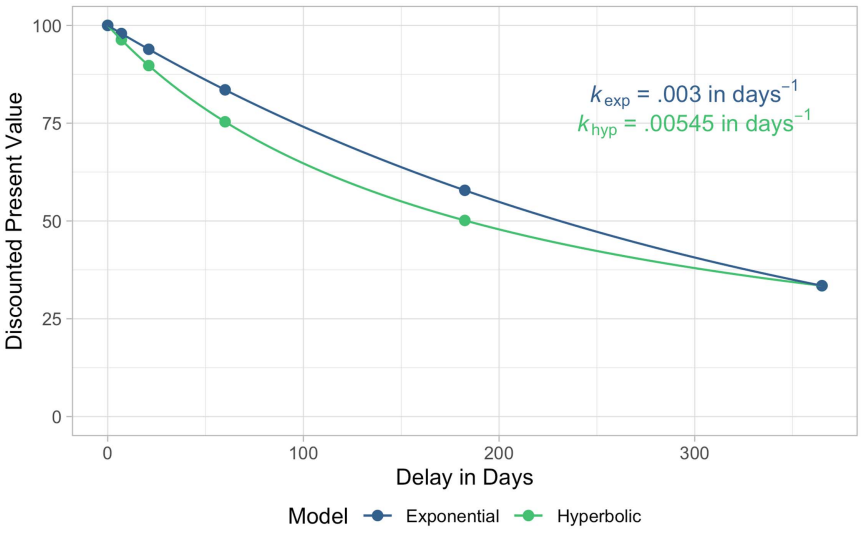
Yet, this approach is common. In their review on choice impulsivity, Hamilton et al. (2015) wrote that choice impulsivity refers to "making impulsive decisions and involves tendencies to select smaller-sooner rewards over larger-later rewards (e.g., the choosing of immediate but smaller vs. delayed and larger rewards)" (p. 4). Further, Hamilton and colleagues wrote that impulsivity can be measured through indifference points, the discount rate, area under the curve, or even, in a model-free way, just by taking the percentage of larger-later choices made, noting that "a higher k reflects greater CI [choice impulsivity]."

In the context of intertemporal choice, impulsivity and self-control are often treated as antitheses. That is, they are not only both implicated in various ways in intertemporal choice, but they are opposites—if you are high in impulsivity, you are low in self-control and vice versa. Authors endorsing this view explicitly put the concepts on opposite ends of the future-oriented decision-making spectrum. Along these lines, Duckworth and Kern (2011) wrote "Several authors have noted the challenge of defining and measuring self-control … and its *converse*, impulsivity or impulsiveness" (emphasis added; p. 2).

Taken together, then, it is common to relate measurements of people's time preferences to impulsivity and self-control. Drawing such

Figure 1

The Exponential Discounted Utility Model (Blue) and the Hyperbolic Discounting Model (Green)



Note. As the reward moves further away in time, the decision maker values it less in the present. In the hyperbolic model, this devaluation is stronger when the reward is closer to the present and attenuates when rewards arrive further into the future. For the discounted utility model, the devaluation occurs at a constant rate. Exp = exponential; Hyp = hyperbolic. See the online article for the color version of this figure.

inferences can be problematic for a number of reasons; we discuss the conceptual issues in the following section.

The Need for Conceptual Consensus

There have been many discussions about the relationships between intertemporal choice, impulsivity, and self-control, and indeed, many before us have taken the important step in arguing, much as we do here, that self-control does not equate to a lack of present bias or delay discounting (Bulley et al., 2021; Goschke & Job, 2023; Inzlicht et al., 2021; Loewenstein, 2018). Strickland and Johnson (2021) have suggested that impulsivity should be rejected as a psychological construct, and thus that it cannot be measured using intertemporal choice tasks. We are, however, currently unaware of researchers arguing that time preferences on one hand and impulsivity and self-control on the other hand are theoretically distinct (though there is significant overlap in arguments on the relationship between self-control and temporal discounting in Loewenstein & Carbone, 2024). Therefore, we intend to go further and examine the possible links impulsivity and self-control might have to time preferences. Given the proliferation of research in this area, we believe a comprehensive discussion is warranted because clarity on this topic will define boundaries and future directions for scientific inquiry.

One of the problems with a lack of conceptual consensus on a construct is that it could lead to conclusions that do not translate to other domains or only apply in limited circumstances. For example, Bickel and Marsch (2001) noted: "By identifying such behavioural processes [that result in impulsivity and loss of control] delay discounting may also suggest potential interventions for modifying impulsivity and self-control failure" (p. 81). If delay discounting is not an important part of impulsivity and self-control, their claim could be challenged. For if the concepts are orthogonal, knowing more about delay discounting would not necessarily suggest potential interventions for modifying impulsivity or self-control.

A further issue is that many measures of impulsivity and self-control only partially overlap theoretically, and commonly, time preferences

only play a minor (explicit) role. We have listed a sample of commonly used measures of impulsivity, self-control, and related constructs in Table 2.

Another issue with tying impulsivity to short-term rewards and self-control to long-term rewards is that it severely limits the scope of research on the topic. Few studies examine people who are troubled by frequent impulsive future-oriented behaviors (such as in Kivetz & Keinan, 2006) or a lack of self-control in attaining short-term rewards. These patterns could play a role in anorexia nervosa (though more research is needed; see Howard et al., 2020; Levitt et al., 2020; Steinglass et al., 2012), compulsive behavior patterns such as attentional capture and cognitive hijacking (Muela et al., 2022), and workaholism (Taris & de Jonge, 2024). It has been argued that in some domains many people are too future-oriented (Loewenstein, 2018). Workaholism is a good example of this because workaholics frequently put work, an activity that predominantly rewards them in the future, before any immediate rewards. In doing so, they often harm their connections with family, community, and their mental health. For workaholics, it can take considerable self-control to tear themselves away from their work (more on this in the next section) and do something that is more immediately rewarding (though this depends on the specific preferences of the decision maker, see Urminsky & Zauberman, 2017). In addition, especially in regard to economic decision making, there has been little discussion of self-control outside the temporal domain. For example, people may use self-control to overcome selfish motivations and start regularly donating money to charity.

At its core, our argument is that many everyday decisions may reflect a temporal preference and yet have little to do with the notion of impulsivity and self-control. Such a dissociation would restrict our ability to draw strong conclusions about impulsivity and self-control based on people's preferences for rewards received at different points in time.

To better illustrate our argument, consider the following hypothetical decision. Imagine Charlie, an accountant at a large company, who is moving to a new city for a different position. It is the month of June, and she is looking to buy a new house. She knows that a colleague, David, wants to sell his house. After showing her the property, David says he would accept an offer from Charlie of $1 million if she moved in December. But Charlie notes that she might want to move in right away when she arrives to start her new job in October. David tells her they could arrange for this to happen, but that it would be inconvenient for him. To accommodate Charlie's plan, David and his family would need to stay somewhere else and move all their belongings twice. Therefore, David suggests he would accept Charlie's offer and let her move in October if she added $25,000 to the $1 million initially proposed. That is, Charlie now faces a choice between speeding up the purchase by 2 months for a 2.5% increase in cost. At this point, since her moving date is still a long time away, Charlie says she would be fine with December.

Charlie's decision is the type of situation meant to be approximated by intertemporal choice tasks. Researchers want to learn how people like Charlie make decisions with outcomes spaced out over time. The idea, here, is that if Charlie chooses smaller-sooner rewards in the choice task, she would be more likely to choose those in real life too. And, if that is true, then because smaller-sooner rewards are typically associated with impulsivity (e.g., risk-taking, substance use, online shopping) and larger-later rewards are typically associated with self-control (e.g., saving, investing, health, career), intertemporal choice task outcomes are frequently assigned labels of impulsivity and self-control.

Admittedly, the extent to which Charlie's behavior reflects impulsivity and self-control depends on our definitions of these constructs. We now turn to different conceptualizations of impulsivity and self-control, linking them with time preferences.

Conceptualizing Impulsivity and Self-Control

Impulsivity and self-control both enjoy long-standing philosophical inquiries (for some historical insight, see Goschke & Job, 2023; Madden & Bickel, 2010; Stroud, 2021). The constructs were already discussed among the ancient Greeks. The Aristotelian term akrasia (loosely translatable to "weakness of will") comes in two forms: *astheneia*, where one has deliberated and decided on the best course of action, but then succumbed to a passion (i.e., a self-control lapse), and *propeteia*, where the same result occurs but one never deliberated before the act (i.e., impulsivity; Aristotle, NE 7.7, 1150b18-28).

Table 2

A Sample of Measures of Impulsivity, Self-Control, and Related Constructs

Measure	Author (year)	Type	Time preference element present
Impulsivity measures			
Behavioral Inhibition System, Behavioral Activation System (BIS/BAS)	Carver and White (1994)	Scale	No
Dickman's Impulsivity Inventory (DII)	Dickman (1990)	Scale	No
Grasmick Attitudinal Self-Control Scale	Grasmick et al. (1993)	Subscale	Yes
Schedule for Nonadaptive and Adaptive Personality (SNAP-2)	Clark et al. (1993)	Subscale (control)	No
Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking (UPPS-P)	Cyders (2013)	Scale	No
Emotional Activity, Sociability, and Impulsivity Inventory (EASI)	Buss and Plomin (1975)	Subscale	Yes
Eysenck I7	Eysenck and Eysenck (1978)	Scale	Implied ("Do you often buy things on impulse?")
Barratt Impulsivity Scale 11 (BIS-11)	Patton et al. (1995; Stanford et al., 2009)	Scale	Yes
Cognitive Impulsivity Suite (CIS)	Verdejo-Garcia et al. (2021)	Cog. battery	No
Self-control measures			
Grasmick Attitudinal Self-Control Scale	Grasmick et al. (1993)	Scale	Yes
Self-Control Scale (SCS)	Tangney et al. (2004)	Scale	Implied ("I spend too much money")
Self-Control Schedule	Rosenbaum (1980)	Scale	Yes
Self-Control Strategies Scale	Hennecke et al. (2019)	Scale	No
Retrospective Behavioral Self-Control Scale	Marcus (2003; Ward et al., 2010)	Scale	Implied in "Wastefulness"
Related measures			
Balloon Analogue Risk Task (BART)	Lejuez et al. (2002)	Cog./pref. task	No
Experiential Discounting Task	Reynolds and Schiffbauer (2004)	Pref. Task	Yes
Consideration of Future Consequences Scale	Strathman et al. (1994)	Scale	Yes
Strelau Temperament Inventory-Revised	Strelau et al. (1990)	Subscale	Yes
Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ)	Torrubia et al. (2001)	Scale	Yes
Tridimensional Personality Questionnaire	Waller et al. (1991)	Subscale	Yes
Sensation Seeking Scale (SSS)	Kolin et al. (1964)	Scale	No

Note. We note whether the construct is the subject of the scale, a subscale, or a task, and we note whether a time preference element is present in that measure.

It was not until the 1970s, however, that research on impulsivity and self-control picked up momentum. It has since then been susceptible to considerable *concept-creep*. The phenomenon of concept-creep refers to the application of constructs to tangential phenomena, causing the understanding of those constructs to broaden, as has been observed in the *Psychology and Neuroscience* literature (Haslam, 2016). Concept-creep can lead to the jingle-jangle fallacy—either assuming two things are the same because they have the same name or assuming two things are different because they are denoted by different terminologies (Dang et al., 2020). For impulsivity and self-control, an additional limitation is that research has historically seen a lack of consistency in their conceptualization. Therefore, even in tracing these concepts to their origin, it remains difficult to disentangle exactly how the concepts are expanding. To that effect, de Wit (2009) wrote that different definitions of impulsivity incorporate "seemingly unrelated maladaptive behaviours including, for example, inability to wait, difficulty withholding responses and insensitivity to negative or delayed consequences" (p. 22)—evidence of the concept being too broad, making it easy to commit a jingle fallacy. It appears prudent, then, to now delineate our understanding of what impulsivity and self-control are.

A Conceptual Framework for Impulsivity

Currently, the most widely used meanings of impulsivity in the literature are derived from various influential works published around the change of the millennium (Evenden, 1999; Moeller et al., 2001; Whiteside & Lynam, 2001). Impulsivity is considered to be multidimensional (Huang et al., 2024). In the model developed by Whiteside and Lynam (2001) and then adapted by Cyders (2013), impulsivity consists of five dimensions: sensation-seeking, negative urgency, lack of perseverance, lack of premeditation, and positive urgency. Some dimensions can be loosely mapped onto other conceptualizations, for example, one where impulsivity consists of motor impulsivity (response inhibition), cognitive impulsivity (making quick cognitive decisions), and choice impulsivity (delay discounting; e.g., Caswell et al., 2015; Dick et al., 2010; Green & Myerson, 2013; Patton et al., 1995; Vassileva & Conrod, 2019). Finally, impulsivity could be divided into information impulsivity (acting without considering consequences) and temporal impulsivity (the tendency to pick sooner outcomes over later ones; Fenneman et al., 2022).

There are also widely differing definitions of impulsivity. In Stedman (1995): "Impulsive: relating to or activated by an impulse rather than controlled by reason or careful deliberation" (p. 860). Evenden (1999) wrote that impulsivity refers to "actions that are poorly conceived, prematurely expressed, unduly risky, or inappropriate to the situation and that often result in negative outcomes" (p. 348.), and this conceptualization is still commonly used.

Given the diverging schools of thinking on impulsivity, it is important to settle on a conceptualization that captures the key components of the construct to facilitate clear discussion. For the purpose of the present discussion, we will conceptualize impulsivity as both:

1. A predisposition toward unplanned reactions to stimuli.
2. A disregard for the consequences of these reactions.

This conceptualization largely follows Moeller et al. (2001), which is one of the most commonly used definitions and reflects the complexity of impulsivity (Stanford et al., 2009). For these reasons, we use it here as our target, although we note that current definitions of impulsivity—such as this one—have problems (mostly because they are overly inclusive; see, e.g., Strickland & Johnson, 2021).

A Conceptual Framework for Self-Control

There is also disagreement about the proper conceptualization of self-control. An important factor is that some researchers think of a self-control conflict as tension between short-term temptations and long-term goals (see, e.g., Duckworth et al., 2018; Evans & Stanovich, 2013; Fujita, 2011; Milkman et al., 2008), while others relax the assumption that self-control necessarily has a temporal aspect (see, e.g., Goschke & Job, 2023; Inzlicht et al., 2021; Loewenstein & Carbone, 2024).

Common conceptualizations of self-control can be broadly classed as based on either a conflict between goals and temptations (e.g., Evans & Stanovich, 2013; Gottfredson & Hirschi, 1990; Hennecke et al., 2019; Holton, 2009) or a conflict

between emotional desires, drives and motivational feeling states (such as pain), and a more deliberation-aligned options (e.g., Baumeister & Alghamdi, 2015; Loewenstein, 2018; Loewenstein et al., 2015; Milkman et al., 2008). These views correspond with elements of our common-sense (pretheoretical) concept of self-control but are not without their disagreements. For example, Milkman et al.'s (2008) want/should conflict is unduly cast in a short-term versus long-term conflict (see Loewenstein & Carbone, 2024). And even when abstracting away from that issue, it appears that the deliberative option in such a self-control conflict might not always entail a "should." The deliberative option in a self-control conflict often also represents or stems from a "want" (unless, perhaps, wants are taken to be equivalent to affect). For instance, one could, after much deliberation, decide to take a day off in a few weeks to go to a theme park because they want to spend time with the kids (i.e., a deliberative *want*).

Self-control could otherwise be understood as the opposite of *weakness of will* (an over-readiness to revise a resolution; Holton, 2009) or as *enkrateia*—the opposite of *akrasia* (Kraut, 2001; Mele, 2010, 2012), where an agent fails to act in accordance with reason or better judgment (i.e., an individual judges *X* to be best but does *Y* instead).

There are many distinct theories of self-control, and an exhaustive discussion of them is beyond the scope of the present article. For the purpose of our work, we will broadly conceptualize self-control conflicts as those that concern deliberation versus temptation, that is, situations where the agent has a view on the best course of action but has conflicting desires. We take self-control to entail both willpower or interventive self-control—adopting strategies to avoid giving into present temptation—and preventive self-control or precommitment strategies—changing the decision-making environment such that the temptation is removed or made less attractive in some way (e.g., not buying any unhealthy snacks to take home; Baumeister & Vohs, 2003).

To evaluate how intertemporal choice relates to self-control, we will, like many others, not take self-control to necessarily entail temporal aspects (Goschke & Job, 2023; Inzlicht et al., 2021). People's reasons for using self-control may also extend into the social domain, for example. Our conceptualization can handle these situations: An individual may see that it is best to donate a large sum of money to those in need, but be tempted to spend it on their new smartphone of choice.

The Relationship Between Impulsivity and Self-Control

Based on the above conceptualizations and definitions, impulsivity cannot be the opposite of self-control. Impulsivity mainly consists of acting with a disregard to consequences, or lack of deliberation or premeditation, and does not need to involve an imbalance of want over should, nor of temptation over judgment. It is possible, for instance, to use self-control to be impulsive: "I should do more things I enjoy doing without thinking about all the consequences; I should live a little!" Or, for the alternative understandings of self-control, we may think it best to, or have a goal to, enjoy life and discard the weight of society's expectations, rather than be tempted to or be habitually/emotionally moved to think about consequences all the time. If we then act impulsively, we have not necessarily experienced a lapse in self-control.

Necessary and Sufficient Conditions for Impulsivity and Self-Control

To understand the roles of impulsivity and self-control in time preferences, we must evaluate whether intertemporal choice patterns fulfill the necessary and sufficient conditions of impulsivity and self-control (as we defined them above). In other words, we must evaluate whether time preferences map onto impulsivity and self-control in a meaningful way, to see if it is valid to measure individual differences in impulsivity and self-control using intertemporal choice tasks.

Necessary and Sufficient Conditions of Impulsivity

Steep delay discounting, or temporal myopia (short-sightedness), is implicated in impulsive behaviors, such as substance use and behavioral addictive disorders (Verdejo-García et al., 2008). People with substance use disorders, for example, are regarded as impulsive in their inability to suppress the urge to consume their drug of choice (i.e., succumbing to the smaller-sooner reward). However, it does not follow from the correlations between addiction and substance use that steep

delay discounting is necessary or sufficient for an individual to be impulsive. It is just as likely that impulsivity and time preferences contribute separately to addiction (de Wit, 2009).

To illustrate this point further, consider a person who is prompted by their employer to pick a pension scheme. They are asked to answer a multiple-choice question on the proportion of their salary they would like to put into their pension fund. Courtesy of some behavioral economists working for the company, the default option is the one with the highest proportion of income that goes to their pension. Without thinking too much about their budget constraints, the person proceeds with the default option (Jachimowicz et al., 2019). Here, their choice of a future-oriented option was impulsive. This shows that making present-oriented decisions, or excessively discounting time delays of rewards, is not *necessary* for someone to be impulsive.

Next, to see whether excessive delay discounting or preference reversals are *sufficient* for impulsivity, we will use the earlier example of Charlie, who had clearly thought through changing her earlier decision to choose the smaller-sooner reward, at a cost of $25,000. Her preference reversal should tell us her discounting fits the hyperbolic model better than the exponential model, and the amount she pays for speeding up her move indicates steep discounting. Yet to say she was impulsive in her subsequent decision to move in at the earlier date would be inaccurate because there was no lack of deliberation or hasty reaction associated with her choice. Therefore, strong delay discounting is not *sufficient* for impulsivity.

Indeed, one may say that her initial decision to wait with the move until December was impulsive. She may not have thought through the consequences that moving twice would have on her well-being and performance. Does her choosing the larger-later reward preclude her initial decision from being impulsive? We think not.

Therefore, even though impulsive behaviors may correlate with delay discounting in some cases, that does not mean that steep delay discounting reflects impulsivity.

Necessary and Sufficient Conditions of Self-Control

In the intertemporal choice literature, a tendency to choose larger-later options is often denoted as a self-controlled choice pattern. A plausible explanation of this time-bound conceptualization of self-control is that choosing the larger-later option connects with some aspect of self-control, namely, delay of gratification (such as in the marshmallow test; Mischel et al., 1989). However, the temporal aspect of these delay of gratification experiments is not the part that indicates self-control in the subject.

If the most famous version of the marshmallow test experiment (i.e., waiting 15 min for a second marshmallow) is changed marginally, such that the first reward is an apple, while the second reward that requires waiting 10 min is two marshmallows, it is easy to see that choosing the apple—the smaller-sooner reward, hardly as rewarding for most children as two marshmallows—could indicate self-control. Children are generally aware that the apple is something they should eat, whereas the marshmallows are something they want to eat, even if they must wait for them (as evidenced by the findings of Mischel and colleagues). This indicates that waiting for a larger-later reward is not *necessary* for self-control; one can be self-controlled without choosing the larger-later option.

To establish whether shallow delay discounting (i.e., the discounting curve has a gentle gradient) is *sufficient* for self-control, consider an extremely future-oriented (i.e., hyperopic) agent, who wishes they made more present-oriented decisions because they want to enjoy themselves more in the present moment (Kivetz & Keinan, 2006). This sophisticated hyperopic agent may judge it best to enjoy themselves today and go to dinner with their friend. They therefore intend to not do any penny pinching, to just be in the moment. When the waiter comes, however, they cannot help but succumb to temptation, even though they realize their goal was to forget about these considerations. As a result, they choose the cheapest wine on the menu—the others are so expensive! Such hyperopic behavior would be indicative of a lack of self-control because the tempting option wins out over the deliberative option. Yet most intertemporal choice research would have us conclude that this person was showing self-control through their future-oriented decision of choosing to save money for later. The story shows that the contrary is true: Shallow delay discounting, or a lack of curvature in the delay discounting function, is not *sufficient* for self-control because it was a lapse of self-control that led the agent to this future-oriented choice.

Finally, taking this reasoning one step further, what this example shows is that eliciting preferences via an intertemporal choice task without knowledge of contextual factors is incompatible with the study of self-control. A preference, in the economic sense relevant to intertemporal choice, is a combination of wants, shoulds, goals, temptations, and other social and contextual factors (i.e., there is no way of telling whether there is a want/should conflict, or a discrepancy between deliberation and temptation).

Thus, unless we can prove that a participant feels that they *think it best* to pick the $100, but are *tempted* by the $80 today, and ends up choosing the latter, it is difficult to argue that they lack self-control if they choose the smaller-sooner option. Therefore, elicited time preferences on their own cannot be seen as self-controlled or not self-controlled.

Considering that time preferences do not satisfy the necessary and sufficient conditions of impulsivity and self-control, we can conclude that the three constructs are dissociable. When writing about time preferences (e.g., in intertemporal choice research), we recommend using specific descriptors about the patterns we observe instead, such as present bias, degrees of future-orientation, and apparent uses of heuristics. For instance, one could collect data where participants explain their decision-making process while making their decisions (Ericsson & Simon, 1980; Weber et al., 2007). If a participant is inclined to smaller-sooner rewards, we may call them present-oriented, not impulsive or impatient (the latter, we opine, has an unnecessary normative flavor). If they tend toward larger-later options instead, we may call them future-oriented, rather than self-controlled or patient. If they commit preference reversals, depending on the pattern, we could call them present-biased, or more charitably, immediacy-oriented/short-term focused. If the participant describes a heuristic for their decision making, we can relate it to existing ones in the literature.

What Can Be Learnt About Impulsivity and Self-Control Through Intertemporal Choice?

If we accept that time preferences are neither necessary nor sufficient for impulsivity and self-control, or even that the study of these constructs with standard measurements from the intertemporal choice task is uninformative, then we should critically evaluate what we can learn from this paradigm at all.

It is possible that even though delay discounting metrics do not meaningfully represent impulsivity or self-control as we define them, it may be used as an instrumental variable in cases where the validity of self-report responses on clinical questionnaires is especially tenuous (e.g., for individuals with memory deficits). To be useful in this respect, impulsivity and self-control measures would need to correlate strongly with delay discounting parameters.

Research correlating impulsivity with delay discounting has produced mixed results (for extensive discussion, see, e.g., Odum, 2011). Some studies have found no correlation, or even negative ones (e.g., Lane et al., 2003; Mitchell, 1999; Reynolds et al., 2006; White et al., 1994). Other studies did report a positive correlation of varying magnitudes (e.g., Cherek et al., 1997; De Wit et al., 2007; Kirby et al., 1999; Reimers et al., 2009). More generally, Cyders and Coskunpinar (2011) conducted a meta-analysis of 27 studies comparing self-report and behavioral measures of impulsivity and failed to demonstrate a strong relationship between "delay response" tasks, of which intertemporal choice is one, and dimensions of impulsivity, even before correcting for publication bias (for sensation-seeking: r 95% CI [.031, .094]; lack of planning r 95% CI [.119, .149]—which correlated better with other laboratory tasks too). No significant correlations were found where one would (also) expect them: in positive and negative urgency.

In a more recent work, Huang et al. (2024) collected data from 1,676 participants who completed 10 behavioral tasks and 10 self-report measures designed to measure impulsivity. The bifactor solution showed a general factor of impulsivity, along with four latent factors, two of which related to a collection of survey-based measures, and two that corresponded to responses on behavioral tasks. Crucially, however, the intertemporal choice tasks were neither strongly correlated with the general impulsivity factor nor with any of the remaining factors (all rs $< .11$). In fact, intertemporal choice task outcomes were only weakly correlated with other behavioral tasks meant to measure impulsivity (e.g., Balloon Analogue Risk Task; Lejuez et al., 2002). These results reinforce the idea that any intertemporal

choice outcome would be a poor measure of any definition of impulsivity.

Evidence of convergent validity (strong correlations between different instruments designed to assess a common construct) is the minimum requirement for the validity of any psychological test (Fiske, 1971, p. 164). Although one could also attribute this lack of convergent validity to poor reliability, validity, or inadequate measurement invariance (see, e.g., Enkavi et al., 2019). Additionally, behavioral measures are generally designed to maximize within-subject variability rather than between-subject variability and tend to measure granular state information rather than accumulated trait information. Regardless of which interpretation of the lack of convergent validity is correct, it appears unlikely that intertemporal choice tasks directly measure impulsivity. Further, they might not be good instrumental variables for the construct either, given the small correlations with the general factor as identified by Huang et al. (2024).

However, recall that Ainslie's original position was that impulsivity corresponds to preference reversals. In other words, intertemporal choice tasks could tell us about people's "impulsive" tendency to switch from larger-later to smaller-sooner rewards as time progresses. So the reason for the lack of convergent validity among the various impulsivity measures could be due to the use of the wrong metric (i.e., rates of smaller-sooner choices, discounting parameters, but not preference reversals). However, this position is also problematic for several reasons. To illustrate why, we return to the example of Charlie facing a choice of when to move to her new home.

Some time has now passed since Charlie opted for moving in in December (the later date), at a lower cost. Now, in September, Charlie reconsiders accepting David's proposal to expedite her move. She thinks it will be a great home to start her new job from. It is within cycling distance of her office and the house was recently renovated, thus needing minimal work. Given the size and location, it is also reasonably priced. If she chose to wait, she would have to move twice and start her new job in temporary housing (which she would also have to spend time looking for). She would like to avoid this because she wants to be in a good headspace for her new job. Ultimately, Charlie changes her mind and decides that it would be best to take the option to move in earlier. In other words, she would now prefer to incur the $25 k cost to forego these inconveniences.

Charlie's decision to incur additional costs and move in sooner, most would agree, is not impulsive. Equally, it would appear odd to claim that Charlie lacks self-control. Indeed, her decision seems deliberate and based on sound and careful evaluation of the pros and cons of each option, which further speaks against labeling her behavior as impulsive. Her decision can also be explained with respect to Charlie's goals; she was not tempted by something that works against her goals. Yet, the decision made by Charlie is regarded as analogous to intertemporal choice tasks. In such a task, if a person opted for a smaller-sooner reward (or in this case, larger cost sooner), this person would be assumed to be impulsive or lacking (or failing to exercise) self-control.

Certainly, given Charlie's preference reversal (she prefers the later outcome initially, then changes her preference to the sooner outcome), her decision making would be better described by hyperbolic discounting (Ainslie, 1975; Thaler, 1980, 1981) than exponential discounting. Though Charlie's discounting may not follow the traditional normative decision-making model, it is not clear why she was impulsive or lacked self-control.

Our argument here is that even if we use intertemporal choice tasks to record people's tendency to reverse their preferences, we would still be limited in our ability to make claims about decision makers' impulsivity and self-control.

A counter-argument is that a reader might endorse different definitions of impulsivity or self-control. It could then be possible that intertemporal choice task outcomes speak to impulsivity or self-control processes beyond ones that we defined here. In other words, there could still be value in estimating either a discount factor or the hyperbolicness of ones preferences. We would note that even if readers do not agree with our definitions of impulsivity and/or self-control, the majority of our conclusions about the intertemporal choice paradigm would still hold. Broader conceptions that incorporate time preferences would need to admit multiple subdimensions of the construct. See, for instance, Fenneman et al. (2022) who split impulsivity into information impulsivity (most closely aligned with how we describe impulsivity here) and temporal impulsivity (time preferences). If such

terms are preferred by the reader, it is possible to swap the terms and take the arguments relating to impulsivity, for example, to be an examination of the dissociability of information and temporal impulsivity.

Another potential reason for the lack of correlation between time preferences, impulsivity, and self-control is that the effect of nonexponential discounting on real-life behavior may be modulated by whether one is naïve or sophisticated about future self-control problems (O'Donoghue & Rabin, 1998; further discussion in O'Donoghue & Rabin, 2015). That is, if one realizes that their preferences will revert when a tempting reward approaches, they can employ strategies to reduce their chance of succumbing to temptation (e.g., by precommitment strategies or by removing the temptation). This illustrates that an important aspect of impulsivity and self-control is taken away in intertemporal choice experiments: There is no temptation to go back on the initial decision. Thus, there is no deliberation-temptation conflict. In other words, we find out whether Odysseus decides to tie himself to the mast, but we attain no information on the journey past the sirens.

Another problem is that eliciting true time preferences with the money-earlier-or-later type of intertemporal choice experiments is difficult because there are problems such as trust in payment reliability (Andreoni & Sprenger, 2012) and because time preferences for money should be, and often are, different from preferences for consumption (for a discussion of limitations, see Cubitt & Read, 2007). Moreover, true time preferences may only be elicited when individuals face exceptional liquidity restraints (only then participants show how they allocate their budget over time) or if they engage in narrow choice bracketing (i.e., deciding without taking outside options into account; Rabin & Weizsäcker, 2009), an assumption that is often violated (see, e.g., Oberrauch & Kaiser, 2020).

Finally, another possible reason for the lack of evidence on convergent validity is that the influence of time preference on impulsive behaviors and self-control varies depending on the domain. That is, time preferences are likely important for the extent to which people deliberate the consequences of their actions, and how tempted they are to choose temptations over better judgment. However, the direction of the influence depends on what the stimuli, rewards, shoulds, and wants are (Harris, 2012; Hursh & Schwartz, 2023; Weatherly et al., 2010). If we again consider a hyperopic agent: Their time preferences play a role in causing them to make (potentially impulsive) future-oriented decisions, whereas, for someone with a substance use disorder, their time preferences contribute to high valuation of rewards that are immediately available. Time preferences may inhibit both types of agents' ability to consider the consequences at the time or to act per their better judgment. Therefore, both future-oriented time preferences and present-oriented time preferences can cause impulsivity and (lapses of) self-control.

Taken together, intertemporal choice research appears to be an ineffective way to investigate impulsivity and self-control. Part of the reason for this ineffectiveness is the lack of consideration of the broader context in typical experiments. Yet that need not deter us from researching the impact of time preferences on impulsive behavior and lapses in self-control, since time preferences may have a different role in the manifestation of these behaviors that has not been captured by traditional intertemporal choice task-based research.

Future Directions

So far, our account has challenged the role of the intertemporal choice task in the study of impulsivity and self-control. In this final section, we describe the implications of our arguments and make several recommendations for future research.

Computational Modeling

One possibility for decision-making models would be to develop an impulsivity parameter. As such, many models developed since the hyperbolic discounting model focus on accounting for a particular set of choice anomalies (Loewenstein & Prelec, 1992), or on incorporating additional, more psychologically plausible parameters.

A prominent alternative is quasihyperbolic discounting (Laibson, 1997), where discounting is composed of two parameters where one represents present bias, while the other is the discount rate. Such a model resolves the underspecification issue discussed before, of having one parameter govern both the steepness and convexity of the discount function.

Another commonly used model is the Constant Sensitivity model (Ebert & Prelec, 2007). This model is attractive because it can achieve a similar convex shape as the hyperbolic model, while it can also have the shape of the exponential model. It can also functionally resemble the quasihyperbolic model, allowing for immediacy effects. This model can, thus, capture many different behavioral patterns in intertemporal choice.

Some of the other most commonly used alternative models belong to a class called "hyperboloid" models (for a comprehensive list, see He et al., 2022). These usually add a time sensitivity parameter. The Myerson-Green model (Myerson & Green, 1995) and the Modified Rachlin model (Vincent & Stewart, 2020)—the original (Rachlin, 2006) suffers from muddled units so using that one to estimate discounting parameters is ill-advised—are examples of this.

Even though these models have many virtues and their iterations render the delay discounting framework closer to the psychological processes underlying human time perception and preferences in the lab, most of the problems we have discussed remain. This is due to two reasons. First, much of our critique challenged the notion that intertemporal choice task measures anything about a person's impulsivity or self-control. Model fitting exercises are typically restricted to data from simple intertemporal choice tasks, and so this renders them particularly ill-suited for estimating anything about people's propensity to be impulsive or lack self-control. Second, we note that the delay discounting framework was not intended as a *process model* (Ericson et al., 2015; He et al., 2019), so by design it is unlikely that psychological concepts such as impulsivity and self-control will map onto discounting model parameters in any variation.

To illustrate this point: There have been many reports of anomalies and biases in intertemporal choice that cannot be accounted for by traditional delay discounting models, including findings of subadditive discounting (Read, 2001), query-order effects (Loewenstein & Thaler, 1989; Weber et al., 2007), date/delay effects (Read et al., 2005), similarity effects (Rubinstein, 2003), and delay/speedup asymmetry (Loewenstein, 1988). These anomalies suggest that intertemporal choice, as a process, is not well-described by either exponential or hyperbolic delay discounting models.

If delay discounting is not the correct way to describe what humans do because it is not the mechanism through which they "solve" intertemporal choices they typically face, then we might need to reconsider claims made based on differences in delay discounting parameters (not limited to those concerning impulsivity and self-control). It might be, for instance, that what most people actually do can be captured by an attribute-based additive model (Ericson et al., 2015). The researchers who use such models will then need to determine what it is about the application of this model (e.g., the weights allocated to attributes) that is indicative of addictions and other disorders, for example. Even if we do know what model fits best on aggregate, though, there will be between-person variance in how people make decisions. Making inferences about any individual's cognitive processes based on a parameter estimate from the best-performing model for the aggregate will, in many cases, not be justified.

But even if we could all agree on a single model, the chances are that choices from the standard intertemporal choice task would not be sufficient to estimate model parameters. Indeed, in a systematic analysis of 11 prominent discounting models, Ballard et al. (2023) found that parameter recoverability was generally poor, and correlations between parameters across different models were low. Therefore, we think that even though computational modeling is a promising avenue, the field needs to innovate beyond the monetary intertemporal choice task to measure impulsivity and self-control.

Abstracting away from the intertemporal choice task, it is good to define the boundaries of what the wide range of extant models can do or explain (He et al., 2022). Many useful insights can be drawn from fitting cognitive process models (e.g., Konstantinidis et al., 2020), such as the Drift Diffusion Model (Gold & Shadlen, 2007; Krajbich & Rangel, 2011; Peters & D'Esposito, 2020; Zhao et al., 2019). It is likely such modeling methods could enable insights on impulsivity and self-control, partly because they are not tied to the intertemporal choice paradigm.

A few possible avenues for the computational modeling approaches we could foresee are, first, the drift rate or starting point bias in the Drift Diffusion Model across tasks may correlate with impulsivity measures. In a Drift Diffusion Dodel, an agent's decision process is described as an alternating evidence accumulation process. The decision is made when the evidence "drifts" over the decision boundary. As such, impulsivity

could constitute a starting point bias, putting one closer to either of the boundaries or cause the agent to drift more quickly. Second, models of decision making could add an impulsivity parameter that determines whether a simple heuristic or a more elaborate decision strategy will be used. Third, for modeling the relationship between time preferences and self-control, one might have a model (e.g., weighted additive) of goals and temptations, or deliberative and affective aspects, where intertemporal choice adds/subtracts from each of these.

Context Dependence

Using nonintertemporal choice modeling methods to study impulsivity and self-control allows for research to move away from the current focus on time preferences. Intertemporal choice can then be studied as merely one of the domains where these processes are in play (just as in risky choice, multiattribute choice, and prosocial/altruistic behavior). The relationship between time preferences and impulsivity and self-control will only matter for choices and behavior where (a) the outcomes of options vary meaningfully along the temporal axis and (b) those outcomes are known and salient to the agent. This limitation means that, for example, knowing the interplay between an agent's impulsivity, self-control, and time preferences will tell us little about whether they will buy an ice cream or use their self-control to donate to charity.

There are contexts where two or more of the concepts matter, and thus may be measured. One could disentangle them using experience sampling (Hofmann et al., 2012; van Baal et al., 2022). Further, it may be feasible to measure impulsivity or self-control with primary reinforcers present (e.g., food and shelter). One could induce potentially impulsive or low self-control states through sleep deprivation (Gillett et al., 2021; McKenna et al., 2007; Mullin et al., 2013) or hunger (Gailliot, 2013; Skrynka & Vincent, 2019; Xu et al., 2015) and elicit cross-modal choices. It would then be possible to see whether different experimental groups use different decision-making methods (thought-listing could be used here). One may also use wait times or information seeking to measure or manipulate impulsivity. Alternatively, researchers may gather data beforehand on what tempts people in moments of weakness and what goals they have. When eliciting cross-modal choices, we can disentangle the temptation of the specific rewards present from the deterrence of short-timescale delays. However, as Cubitt and Read (2007) argued, measuring preferences even for nonmonetary goods has its problems because we do not know about the outside options (e.g., one can opt for less tasty food in the experiment and compensate afterward).

Moreover, the importance of considering context in interpreting intertemporal choices as self-controlled or impulsive highlights the inherent incommensurability of everyday choice. Often the options available sooner or later are very different, mapping onto different goals and desires. Although intertemporal choice tasks are an attempt to elicit preferences in as context-free situations as possible, many everyday choices are difficult on account of their incommensurability and incomparability (Walasek & Brown, 2024).

Research on impulsivity and self-control should turn toward contexts outside of the intertemporal, especially because the adaptivity of those traits or states is context-dependent (for evidence on this regarding impulsivity, see Fenneman et al., 2022). Moreover, people are known to employ many self-control strategies (Hennecke et al., 2019), which are likely to vary in prevalence and success rates across domains. As of yet, little is known about dynamic use of such strategies in everyday choices.

Our position, therefore, is that standard intertemporal choice tasks should not be used to assess impulsivity or self-control. But, tasks can be conceived that measure impulsivity and self-control as cognitive processes, while measuring time preferences as outcomes.

Implications

The policy implications of the arguments we presented concern the targeting of interventions at the right cognitive construct. For instance, if the policy goal is to increase savings, then it is good to have a clear understanding of how time preferences for consumption, and impulsivity and self-control relate. In this scenario, one potential strategy is to temporarily change time preferences by getting banks to suggest in-app savings goals that prompt episodic future thinking (Peters & Büchel, 2010). Or, by capitalizing on people's impulsivity, banks could prompt people with a suggested contribution of 5% of their paycheck to their investment account (e.g., with a preset Exchange Traded Fund allocation). Self-control

can also be facilitated by offering savings accounts that only unlock deposited money after a fixed term or accounts that offer higher interest rates when the money is untouched for longer. Understanding how these three concepts differ increases the number of conceivable policy options and allows decision makers to choose according to their goals. This all is of course not to deny that there are more standard policy instruments, such as raising interest rates.

The most important implication of the current work for the general public concerns the stigmatization of behaviors associated with time preferences, impulsivity, and a lack of self-control. This work, hopefully, elucidates some of the (sometimes conflicting) cognitive mechanisms that lead up to people's decisions. Not knowing the details of the situation or thinking process surrounding Charlie's decision to speed up the purchase of the house in our earlier example may prompt certain judgments about her decision, such as that she was capricious or irrational. Arguably, the same stigmatization processes occur for people who suffer from addiction and a variety of mental health issues (see, e.g., Delfabbro et al., 2022; Hing, 2015; Sheehan et al., 2016).

In addition, we believe it is important that people know how the cognitive processes we discuss may conflict and how this relates to their goals. For example, if one tends to do things without thinking, and if this tendency produces issues in everyday life, one could consider to only make that choice when not in an impulsive state (e.g., not going to the supermarket when hungry) or remove the choice in question altogether (e.g., swap chores with someone, so you are not tempted by the unhealthy foods at the supermarket at all).

Conclusion

We discussed how impulsivity and self-control are conceptualized in the intertemporal choice literature and how they are used to denote choice patterns in intertemporal choice and thus time preferences. We considered whether various time preferences satisfy the necessary and sufficient conditions for impulsivity and self-control and whether they may play a different role in impulsive and self-controlled behaviors.

We suggest that common ways of conceptualizing impulsivity and self-control would require us to conclude that time preferences, impulsivity, and self-control contribute independently to real-world choices between options involving different timescales. Resulting from this observation, we argue that impulsivity and self-control are unlikely to play an important role in standard intertemporal choice tasks. We also discuss whether we should attach any cognitive labels to delay discounting parameters because delay discounting models were not designed to capture cognitive processes.

We conclude that we should, therefore, (a) dissociate time preferences from impulsivity and self-control and thus (b) not assume that we measure impulsivity and self-control through delay discounting parameters and thus (c) also not assume that people who tend to be impulsive (self-controlled) will prefer present-oriented (future-oriented) options.

We have made suggestions for future work in computational modeling on these topics (e.g., impulsivity as a transition paramater) and the measurement of impulsivity, self-control, and time preferences (e.g., experience sampling, cross-modal intertemporal choice).

Our conceptualization puts pressure on preconceptions about the connections between time preferences, impulsivity, and self-control. We are hoping that this invites scrutiny, where this scrutiny leads us to a clearer understanding of the role of time preferences in impulsivity and self-control.

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