Accepted Manuscript

DOI: https://doi.org/10.1177/10422587231178882

Citation: Bort, J., Wiklund, J., Crawford, G. C., Lerner, D. A., & Hunt, R. A. (2024). The strategic advantage of impulsivity in entrepreneurial action: An agent-based modeling approach. Entrepreneurship Theory and Practice, 48(2), 547-580.

The Strategic Advantage of Impulsivity in Entrepreneurial Action: An Agent-Based Modeling Approach

Abstract

Our study extends and enhances entrepreneurial action theory (EAT) by considering the strategic advantage or disadvantage of impulsive action. To date, EAT has largely sidestepped the role of dispositional impulsivity, limiting its veridicality and inclusivity. Popularized notions of celebrity entrepreneurs and an increasingly large body of empirical research on the prevalence of impulsivity have inspired a reassessment of what drives entrepreneurs. Looking beyond both the anecdotes and well-established prevalence of impulsivity, we develop and illustrate a novel theory concerning the fate of impulsive nascent entrepreneurs who are wired for nondeliberative, less-calculative action. We use an agent-based model (ABM) and conduct simulation-based experiments involving 2.7 million virtual entrepreneurs to identify and explicate the specific conditions under which impulsivity does or does not generate strategic advantage. Accordingly, we contribute a broader and deeper theorization of EAT, taking notable steps toward the inclusion of nontraditional entrepreneurs and the varied impacts of impulsive action in this domain's evolving conception of new venture emergence.

1 INTRODUCTION

A growing body of research acknowledges that many entrepreneurs exhibit high levels of impulsivity (Hunt, Lerner, Johnson, Badal, & Freeman, 2022; Yu, Wiklund, & Pérez-Luño, 2021). Impulsivity, despite being pathologized and often associated with dysfunction or error, may offer a strategic advantage in nascent organizing. This is because impulsive individuals have a bias toward action, even when uncertainty is high (Upton, Bishara, Ahn, & Stout, 2011). Acting under uncertainty is a defining characteristic of entrepreneurship (McMullen & Shepherd, 2006) and sets the stage for successful new venture creation (Davidsson, 2021). Impulsivity does not eliminate uncertainty or the decisional obstacles it presents, but the bias toward speedy decision-making opens possibilities that might otherwise evaporate due to indecisiveness or inaction (Hunt et al., 2022).

While scholars have recognized the potential influence of impulsivity on entrepreneurial action (Wood, Bakker, & Fisher, 2021; Zellweger & Zenger, 2021), these ideas have yet to be integrated into mainstream entrepreneurial action theory (EAT). Predominant theories of entrepreneurial action (e.g., Alvarez & Barney, 2007; Foss & Klein, 2012; Kirzner, 1997; Klein, 2008; McMullen & Shepherd, 2006; Sarasvathy, 2001) have largely sidestepped the issue or have argued that impulsivity is a form of reasoned judgment (Brown, Packard, & Bylund, 2018) – a notion that Wiklund (2019) rebuts, asserting that an impulsivity-as-judgment perspective is in direct conflict with prevailing definitions of impulsivity in the psychological sciences. Such discord suggests the need for a more explicit and accurate conceptual alignment between entrepreneurial action and impulsivity (Hunt et al., 2022; Lerner, Hunt, & Dimov, 2018).

Consequently, the purpose of this study is to develop a conceptual framework that identifies and unpacks the conditions under which dispositional impulsivity may or may not influence the outcomes of new venture creation based on a direct, longitudinal comparison with deliberative logics. We pose three important, unanswered questions: Do conditions exist wherein impulsive entrepreneurial action offers a strategic advantage? If so, how can these conditions be captured in EAT? If not, how should scholars assess the theoretical boundaries concerning the role and impact of impulsivity?

In constructing our framework, we draw on the scientific literature that defines dispositional impulsivity as the "predisposition toward rapid, unplanned reactions to internal or external stimuli with diminished regard to the negative consequences of these reactions" (Hamilton et al., 2015, p. 1). Additionally, we leverage the "speed versus accuracy tradeoff" (SAT) framework (Heitz, 2014) to inform our understanding of impulsivity in the context of entrepreneurship. The SAT framework, akin to entrepreneurial action (McMullen & Shepherd, 2006), is rooted in action under uncertainty, capturing both the benefits and costs associated with rapid actions (Franken & Muris, 2005). The balanced approach of the SAT framework is therefore critical because it acknowledges the tradeoffs associated with decision speed and deliberation, which must be taken into consideration (e.g., Vuori & Vuori, 2014). New venture creation is at the core of entrepreneurship, entails substantial uncertainty, and is sensitive to the economic environment. As such, the strategic implications of impulsivity are especially important in the earliest stages of business venturing (Wiklund, Hatak, Patzelt, & Shepherd, 2018), where rapid and decisive action can be critical for success.

In line with the recent developments in entrepreneurship research that have employed computational systems to assess the drivers, outcomes, and boundaries of entrepreneurship theory in complex, multistakeholder contexts (e.g., Keyhani, 2019; Keyhani & Lévesque, 2016), our study employs an agent-based model (ABM) to develop a conceptual framework. An ABM is a simulation-based method for theory development that is particularly well suited to time-based, interactive processes such as new venture creation (Lévesque & Stephan, 2019; McMullen & Dimov, 2013). Our empirically grounded model thus simulates the competition for resources between "impulsive" and "typical" agents attempting to launch ventures. Through this approach, we shed light on the key dynamics underlying the strategic advantages and disadvantages of impulsivity in new venture creation and provide a novel lens for reassessing EAT. By employing a simulation-based method to derive propositions, our study also contributes to a deeper understanding of the complex interactions and tradeoffs involved in entrepreneurial decision-making. Additionally, this approach provides a conceptual pathway for further research on the role of impulsivity in entrepreneurship, potentially informing the development of more effective strategies and tools for supporting the growth and success of new ventures.

Our study therefore makes several important contributions. First, we develop a conceptual framework of entrepreneurial action, contrasting typical and impulsive entrepreneurs. This framework provides a theoretical grounding for hitherto disparate research endeavors concerning the role of impulsivity in entrepreneurship (Lerner, Hunt, & Verheul, 2018; Wiklund et al., 2018). For example, we identify mechanisms in the entrepreneurship process where impulsivity has critical importance (e.g., environmental scanning, resource prioritization). Running simulation experiments in this conceptual framework allows us to observe unexpected and interesting implications of impulsivity, such as when environmental conditions flip impulsivity from disadvantage to advantage and vice versa. Furthermore, our simulation of entrepreneurial action allows experimentation and time-based observations that would be untenable with real-world data.

Second, our findings provide scholars and practitioners with a more definitive understanding of the circumstances that can reveal the strategic advantage of impulsivity. Traditionally, uncertainty has been considered an aversive state that can reduce an entrepreneur's inclination to act (McKelvie, Haynie, & Gustavsson, 2011). However, this generalization does not apply to impulsive entrepreneurs, whose bias for speed remains steadfast regardless of the uncertainty of the economic environment. Specifically, through successive experiments exploring the boundaries of uncertainty and available resources, we provide greater clarity regarding the circumstances in which impulsivity beneficially influences speed-to-outcome in both harsh and munificent resource contexts.

Third, our study provides a more sophisticated understanding of how individual differences influence entrepreneurial action. EAT struggles to account for impulsivity because it violates common assumptions of individual behavior (cf. Wood et al., 2021; Zellweger & Zenger, 2021). Therefore, we argue that EAT must recognize impulsivity as a potent force in new venture creation; its implications for success or failure are not consistent, but vary depending on environmental conditions. The results of our simulation, then, not only challenge the received wisdom that impulsivity is a maladaptive trait, but also provide greater balance to contemporary research that focuses exclusively on the positive outcomes of impulsive conditions, such as attention deficit/hyperactivity disorder (ADHD; Moore, McIntyre, & Lanivich, 2021; Yu et al., 2021). Hence, by providing a more nuanced understanding of the role of impulsivity in entrepreneurship, our study contributes a more comprehensive understanding of the factors that underlie successful new venture creation, potentially informing the development of more effective strategies and tools for supporting the growth and success of new ventures.

2 THEORETICAL FOUNDATIONS

The notion that nondeliberative impulsive actions may provide a strategic advantage represents a departure from extant management theory, as well as a significant expansion of our understanding of what constitutes effective organizational decision-making (Hodgkinson & Healey, 2011). This conception, supported by an increasingly large body of empirical work on the role and impact of impulsivity in entrepreneurship (Pietersen & Botha, 2021; Wiklund, Patzelt, & Dimov, 2016; Yu et al., 2021), broadens the range of viable pathways that can lead to new venture creation (Lerner, Hunt, & Dimov, 2018). Moreover, it demarcates the limits to which reasoned foresight and rationality definitionally precede entrepreneurial action (Hunt et al., 2022).

Whereas "rationality" implies a deliberate, calculated consideration of the choice sets that maximize utility, "impulsivity" is often associated with negative connotations, viewed as a symbol of reckless, thoughtless action that leads to failure. However, this binary opposition of impulsivity and rationality, akin to many others in entrepreneurship research (e.g., causation-effectuation, creation-discovery, persist-pivot), is fraught with misconceptions and oversimplifications that impede the comparability of various forms of EAT (Hunt & Townsend, 2020). In reality, both rational and impulsive entrepreneurial pathways take multiple forms and exert both favorable and unfavorable impacts.

What is missing, however, is an integrated theory that fully accounts for impulsivity in dynamic economic environments. Even as scholars acknowledge the presence of impulsivity (Wood et al., 2021) and the need to somehow conceptually incorporate its impact (Zellweger & Zenger, 2021), the absence of a conceptual solution to the rationality-impulsivity divide in extant EAT has become conspicuous. Nevertheless, the starting point for a resolution must begin with a review of the forms of EAT.

2.1 Entrepreneurial Action Theory

Entrepreneurial action, which we define as the behaviors or steps an individual takes toward the creation of a venture in the face of uncertainty (cf. Wood et al., 2021), is foundational to the entrepreneurial journey (McMullen & Dimov, 2013). Action plays a pivotal role in entrepreneurship; thus, many theories of entrepreneurial action have emerged, drawing on mechanisms related to discovery (e.g., Kirzner, 1997; Shane & Venkataraman, 2000), creation (Alvarez & Barney, 2007), imagination (Klein, 2008), effectuation (Sarasvathy, 2001), judgment-based belief development (Foss & Klein, 2012), or design (Berglund, Bousfiha, & Mansoori, 2020).

The variants of EAT share common beliefs concerning the importance of uncertainty in entrepreneurial action (McMullen, Brownell, & Adams, 2021) and draw upon a range of explanatory frames, extant EATs are devised to address epistemological questions regarding opportunities, actions, and outcomes in contexts characterized by uncertainty (e.g., McMullen & Shepherd, 2006). However, contemporary EATs largely sidestep the role of impulsivity in entrepreneurship. For example, Wood et al.'s (2021) time-calibrated EAT provides valuable insights into initialization, pace, and chronology, positing that setting proximal dates for "initiating an entrepreneurial endeavor" increases the potential for entrepreneurial action. Essentially, in this view, an entrepreneur who aims to launch her venture next week is more likely to do so than one who aims to launch it next year. While Wood and colleagues do not explicitly integrate the role of impulsivity in their theory, they do acknowledge its relevance and the potential benefits of future research that situates impulsivity within their time-calibrated framework (p. 165).

In sum, the extant EATs may fail to describe and explain many aspects of entrepreneurial action by overlooking the possibility for nondeliberative action. However, the implications for EAT may extend beyond omission. Impulsivity can lead to equivalent or even superior outcomes, e.g., the performance of exceptionally successful entrepreneurs (Hunt et al., 2022; Van Lent, Hunt & Lerner, 2020). Anecdotal evidence has reinforced the scholarly findings indicating that many "superstar" (i.e., outlier) entrepreneurs attribute their success to a neurological condition associated with chronic impulsivity, such as ADHD (e.g., Richard Branson, Elon Musk, David Neeleman); however, no extant theoretical EAT framework can explain why this is the case. Thus, in terms of conceptual inclusivity, empirical fidelity, and explanatory power, there is an opportunity to revisit and revise EAT in light of the roles and impacts of impulsivity.

Accordingly, in the following section, we build upon the notion that impulsivity potentially offers strategic benefits. Based on the above discussion, new venture creation is particularly germane for further exploration; the first step on this path entails explicating the nature of impulsivity.

2.2 Impulsivity

The potential for entrepreneurial action based on behavioral impulse presents a challenge for entrepreneurship scholars (Lerner, Hunt, & Verheul, 2018), as the absence of reasoned judgment and an unrelenting bias for speed impede extending the theoretical boundaries of EAT (e.g., Wood et al., 2021). However, the individual differences in impulsivity are well established. Within the field of personality psychology, impulsivity—particularly sensation seeking—has been theorized and empirically shown to be a core indicator of personality (Zuckerman, 2002). From a bottom-up perspective, strong appetitive behavioral impulses are generated from a heightened sensitivity to reward stimuli (e.g., fun), yielding temperamental and behavioral differences across individuals (Carver & White, 1994). Sensation-seeking is characterized by a tendency to seek exciting, novel experiences and the willingness to take risks for the sake of these experiences, often without much planning or consideration (Zuckerman, 2002, p. 382). Thus, impulsivity reflects a propensity to act first and think later—if at all—in the pursuit of stimulation. Furthermore, impulsivity is related to lower arousal from negative outcomes (Cservenka, Herting, Seghete, Hudson, & Nagel, 2013) and a lower ability to learn from negative outcomes (Cox et al., 2015). As a result, impulsive individuals generally fail to reflect on their past activities and the outcomes of those activities, which makes them less likely to learn from their experiences (Patterson & Newman, 1993). Therefore, they are likely to face difficulties in appropriately interpreting environmental cues and potential negative feedback, thus diminishing learning (Carlson, Pritchard, & Dominelli, 2013; Franken, van Strien, Nijs, & Muris, 2008).

Impulsive individuals also tend to act fast; they give little forethought across situations and over time (Wittmann & Paulus, 2008). In this context, then, impulsivity represents a stable proclivity or trait similar to “Big 5” personality traits (Whiteside & Lynam, 2001). However, impulsivity is central to various disorders and carries some social stigma (Hamilton et al., 2015). The stability of individual-level impulsivity is, nevertheless, related to brain structure and function, specifically frontal lobe activity (White et al., 1994). In particular, impulsive actions engage a dopamine-releasing reward system (Buckholtz et al., 2010), while individual differences in impulsivity are related to hereditary genetic factors (Ebstein et al., 1996). Impulsivity is also related to the motivational system in the brain, in terms of an overactive behavioral activation system (BAS), which is triggered by signals of reward and the absence of punishment, leading to approach and reward-seeking behavior (Gray, 1970).

The stability of impulsivity as a personality trait is further evidenced by the fact that impulsivity is central to several pervasive mental disorders. For example, in the diagnostic criteria of the DSM-5 (American Psychiatric Association, 2013), impulsivity informs clinical diagnoses as diverse as ADHD, bipolar disorder, and borderline personality disorder. To avoid characterizing chronically impulsive individuals as “abnormal” (especially given recent evidence suggesting impulsivity may not be uncommon among entrepreneurs), those with more typical functioning have been called “neurotypical” (Sachs, 2013). Thus, throughout the remainder of this manuscript, we refer to “impulsive” and “typical” individuals.

Furthermore, the impact of impulsivity on decision-making extends beyond the differentiation between relatively comprehensive information processing on the one hand and heuristic or intuition-based decision calculus on the other. Impulsivity differs in that it drives action with stimulation-seeking impulses (Zentall & Zentall, 1983) rather than quick judgments based on intuition or heuristic analysis (e.g., Lerner, Hunt, & Dimov 2018, p. 57).

2.3 The Speed versus Accuracy Tradeoff

When empirically operationalizing and grounding individual differences (including for modeling purposes), it is useful to view impulsivity within the SAT framework (Heitz, 2014). Impulsive individuals, given their inclination toward action rather than forethought, can be deemed consistently biased toward decision speed at the expense of decision accuracy. The underlying principle of the SAT is that the decision-making process can be improved by progressively collecting and analyzing information. In essence, a greater degree of information processing leads to better decision accuracy but require more time, which results in a tradeoff between decision accuracy and decision speed.

In terms of the SAT, impulsive individuals do not premeditate, engaging instead in behavior without any careful consideration of the consequences, entailing a limited evaluation of their ability to successfully complete the focal task. This lack of premeditation also suggests that impulsive individuals are typically less apt to gather and analyze information about the situation and the necessary resources before acting. Thus, while impulsive individuals more rapidly search for and act on opportunities, they do so without calculative preparation (Wiklund et al., 2016). Instead, impulsive individuals are biased toward speed over accuracy, introducing tension with regard to whether these traits have advantages (Dickman, 1990). Swift action in the wrong direction, even if initially successful, will not provide a first-mover or strategic advantage.

Under conditions of very high uncertainty—akin to the unforeseeable implications of the worldwide shutdown during the COVID-19 pandemic or the energy shocks accompanying Russia's 2022 invasion of Ukraine—the environment provides very few cues regarding appropriate action, while the causal relationship between actions and outcomes disables probabilistic modeling. Under these circumstances, when the most viable sequence of activities may emerge largely from guesswork, acting rapidly may instead be adaptive. Meanwhile, inertia under such circumstances may lead to foregone value capture. Hence, counterintuitively, swift, albeit error-prone, action by impulsive individuals may hold strategic benefits compared to action modes favoring reasoned foresight (Dickman, 1990). As such, action-oriented experimentation can be beneficial in environments characterized by greater uncertainty (McGrath, 1999), i.e., impulsivity may be adaptive for individuals in environments with extreme levels of uncertainty, e.g., new venture creation.

2.4 New Venture Creation

Creating a new venture is often a long, arduous process that resembles a journey of twists and turns more than a predetermined set of calculative logics (McMullen & Dimov, 2013).

Notably, prior research has demonstrated that many attempts at putting together a new venture are abandoned before a business launches (Shim & Davidsson, 2018). The salient challenges are numerous and formidable. New organizations lack internal reliability (Aldrich & Martinez, 2001), i.e., the basic infrastructure required to produce marketable goods and services, as well as external validity due to sociocultural and cognitive "taken-for-grantedness" (Aldrich & Fiol, 1994). Internally, ventures must establish organizational goals, roles, and routines where none existed before (Nelson & Winter, 1982). Externally, ventures must engage and convince investors, suppliers, customers, and other market participants who, despite the former's lack of a track record, must trust ventures to deliver quality outcomes.

Accordingly, the requisite steps for creating a new venture often take longer than anticipated, and many activities carried out during the startup process are likely to lead to disappointing outcomes. Given the high-velocity nature of the startup environment and the high variance of relevant outcomes, the decision-making speed of its founder(s) is often linked to a venture's fate (Eisenhardt, 1989). While speed may inadvertently crash a venture, slowness may suffocate it. In this sense, neither impulsivity nor calculative deliberateness is strictly prescriptive or proscriptive in new venture formation. On the other hand, since impulsive entrepreneurs are biased toward action (Lerner, 2016; Wiklund et al., 2016), speed can play a strategically advantageous role in swiftly establishing a market presence in dynamic contexts with relatively short windows of opportunity. However, as the balanced assessment criteria of the SAT framework make clear, such lack of deliberation comes with certain costs. If impulsivity does in fact serve as a source of strategic advantage in the startup context, it can only manifest through a complex combination of enabling and disabling impacts (Hunt & Lerner, 2018; Lerner, Hunt & Verheul, 2018). This requires a novel model of strategic advantage, impulsivity, and EAT.

3 MODELING THE STRATEGIC ADVANTAGE OF IMPULSIVITY

Impulsivity, akin to all motivational drivers of entrepreneurial action, initially exerts influence during the early stirring of new venture creation. For this reason, observing the presence and impact of impulsivity poses a significant challenge. As entrepreneurship scholars are acutely aware, the factual details circumscribing nascent-stage venturing are notoriously difficult to excavate. Hence, instead, scholars generally utilize retrospective accounts subject to narrativity and *post hoc* rationalization (van Lent et al., 2022). Fruitful assessment of impulsivity's strategic advantage thus requires analysis that captures temporal dynamics (Lévesque & Stephan, 2019) while avoiding confounds/endogeneity with regard to the ideas or industries an entrepreneur pursues. Accordingly, to simultaneously minimize the pitfalls of narrativity and maximize the authenticity of impulsivity's nascent-stage impacts, we employ an ABM to develop and illustrate novel theory (cf. Keyhani, 2019; Mauer, Wuebker, Schlüter, & Brettel, 2018).

First, we build our baseline model by establishing simulated features of the venture creation process. Then, we derive a set of theory-motivated propositions, each involving readily identifiable variances with respect to our baseline model. These model comparisons form the bulwark of our boundary exploration and theory development. Each model is then operationalized by introducing a set of virtual entrepreneur agents into the simulation through a series of experiments that are designed to capture the critical aspects of the SAT framework. Previous studies building on SAT in the psychology literature have employed formal mathematical models (Heitz, 2014). For entrepreneurship, however, these mathematical models from psychology lack the complexities and protracted time horizons associated with creating new ventures. As McMullen and Dimov (2013) note, an ABM offers a closer approximation of the real-world dynamics associated with nascent venturing. More recently, Lévesque and Stephan (2019) have suggested that theoretical development in entrepreneurship understates the criticality of time.

ABMs comprise simplified abstractions of a complex ecosystem where the actions of individual agents influence a shared environment. While existing and acting within the same environment, agents are independent of each other and follow a simple set of decision rules as they attempt to reach an objective. Thus, in terms of establishing validity, the modeling assumptions are calibrated based on previously established findings (cf. Arnold, 2019). Consistent with best practices, we use open-source ABM software, NetLogo (version 6.1), a tool often used by entrepreneurship scholars (e.g., Bylund, 2015) and the broader scientific community (Wilensky & Rand, 2015).

Last, in support of open science, we offer a supplemental online appendix, linked in the Appendix below, which shares the model's source code in NetLogo (S.1.1), pseudocode to ease interpretation and replication of the model (S.1.2), and, finally, a table that maps NetLogo's technical terminology according to our "real-world" observations (S.1.3).

3.1 Model Conceptualization

At its foundational level, our baseline model represents an environment in which virtual autonomous agents act as nascent entrepreneurs searching for and attempting to collect resources when starting new ventures; it thereby allows true *ceteris paribus* comparisons. To isolate the effects of agent impulsivity on venture emergence in differing environments and conduct virtual experiments (cf. Harrison, Lin, Carroll, & Carley, 2007), all focal agents (i.e., *typical* and *impulsive*) start with identical resource endowments and the same ability to identify preexisting resources. Akin to real-world entrepreneurs, the agents in our model search for preexisting resources and incur costs as they try to capture them (Fiet & Patel, 2008), a process that depletes their endowments. Practically, the expenditure of endowments in the search and resource acquisition process is equivalent to an entrepreneur "working on" venture development, which includes activities such as developing products, preparing financial projections, conducting market research, and traveling to meet with potential resource providers. As agents successfully capture resources, they move toward the objective of firm emergence. One strength of such simulations is their ability to observe outcomes as they change over time (Lévesque & Stephan, 2019). Hence, this simulation involves 72 iterations, each of which corresponds to a simiulated month. This time-frame is consistent with widely studied, large-scale longitudinal samples of nascent venturing, e.g., the Panel Study of Entrepreneurial Dynamics (PSED) II (Reynolds & Curtin, 2011).

3.2 Outcomes of Interest

Building on Davidsson and Gordon's (2012) systematic review of the literature on nascent entrepreneurs, we consider three potential outcomes of founding attempts: (1) *emergence*, (2) *exit*, and (3) *still trying.* Studies have employed specific achievements, such as making a first sale, hiring an employee, or receiving external funding, as indicators of *emergence* (Tornikoski & Newbert, 2007). Although milestones such as these are not the ultimate venturing objective, each serves as a clear indicator for objectively classifying successful nascent organizing efforts (i.e., *emergence*). We thus rely on this definition in our research design, as described in the following section. We also follow the literature when defining *exit* as any organizational founding attempt that starts at time t and ends (i.e., ceases to exist) at some later time ($t+x$), before the business can successfully emerge.

The third possible outcome, *still trying*, is somewhat harder to classify as a success or a failure, as neither *emergence* nor *exit* has occurred. Instead, this constitutes a condition in which agents are still trying to start their venture at the end of the focal time frame (72 simulated months in our case). Those still trying after the observed time frame may eventually create a venture, but their lengthy startup process may also signal their inability to develop a working business concept and/or raise needed resources. In turn, this may represent a futile venturing attempt, implying a waste of time, energy, and resources along the way. These definitions of the focal three outcomes align with extant conceptual, empirical, and simulation studies of organizational emergence (McMullen & Dimov, 2013).

4 MODEL ASSUMPTIONS

4.1 Agents

Consistent with the literature on impulsivity, *impulsive agents* differ from *typical agents* in four important respects: (1) they take additional action in each time period (greater *speed*); (2) they have a lower probability of successfully capturing a resource in a given attempt (lower *accuracy*); (3) they attempt to capture the first resource they see (less *deliberation*); and (4) as they do not reflect, they are less able to enact any learning from their experiences (less *learning)*. To operationalize and validate these processes, we draw on extant empirical findings and experimental results in the domains of both psychology and entrepreneurship. Given every model's dependence on assumptions, we also run a series of sensitivity analyses to identify potential boundaries. We provide an overview of these analyses in the Appendix and offer further details in supplementary online appendix S.3.

Below, Figure 1 depicts the agent search process; both types of agents search in an extended Moore neighborhood containing 24 surrounding cells. *Speed* is operationalized as the number of actions undertaken by the agent. Comprising the actions searching for, moving toward, and ultimately attempting to capture resources, impulsive agents take six actions per simulated month, while typical agents take five. This 20% difference represents more rapid action in the same amount of time, which is conceptually consistent with Wiklund et al. (2016) and empirically comparable with Dickman and Meyer's (1988, p. 287) experiments where they found that highly impulsive individuals complete 23% more activities in the same timeframe than less-impulsive individuals.

Insert Figure 1 About Here

Furthermore, typical agents are more reasoned in their approach toward resource capture. Impulsive agents, meanwhile, do not engage in *deliberation*. Typical agents target and move toward resources based on the lowest complexity (expanded on below), while impulsive agents target the first resource they see. This is emblematic of findings indicating that impulsive entrepreneurs are not concerned with event sequence (Lerner, Hunt, & Dimov, 2018). Last, typical agents display benefits from *learning* (McMullen & Dimov, 2013), slightly improving their baseline accuracy (from 55%) after each resource capture attempt (accuracy increases by 0.5%). Impulsive agents are likely to learn less. They are generally less likely to reflect on the past and incorporate insights from previous experiences, and biased towards positive rather than negative feedback, which reduces learning.

Regarding *accuracy*, the mean probability of the typical agent successfully completing an action is 55%; an impulsive agent's probability is discounted by 13% relative to a typical agent, resulting in a mean of 47%. The first value is based on Ganco and Agarwal's (2009) probability of effective organizational adaptation (49%) and Dickman and Meyer's (1988) probability of a low-impulsive individual correctly solving a complex matching problem (85%). In relation to the accuracy discount, Dickman and Meyer (1988: 287) have found that highly impulsive individuals are 13% less likely to correctly solve a complex problem ([(85%–74%)/85%]), and Lerner (2016: 245) has shown that potential resource providers are 13.5% less likely to support an entrepreneur who exhibits impulsive behavior. To account for both natural and performance variance in accuracy, these values are normally distributed with a standard deviation of 10% in each attempt to capture a resource. As such, it is possible for agents to successfully capture a resource beyond their baseline ability or fail despite the apparent ease of an action. In sum, impulsive agents are faster, but less accurate, than typical agents. In addition, in the ABM, impulsive agents represent 15% of the population, based on the connection of impulsivity to ADHD. Specifically, the United States Centers for Disease Control estimates that approximately 10% of the U.S. population has ADHD, although this number is rising rapidly and likely remains underreported among certain demographic groups (see e.g., Chung et al., 2019).

Both types of agents have memory capacity, allowing them to remember the location and relative size of resources in the environment after scanning. This memory is updated after an agent attempts to acquire all the resources in his or her search scope; if an attempted capture is unsuccessful, the agent will not attempt to recapture the resource until the simulated month passes. For example, if nascent entrepreneur (agent) X fails to capture an investment from a given investor, he or she is unlikely to try again with (or be considered by) the same resource provider until he or she completes some other actions. However, as agents progress and their circumstances evolve, their previously failed attempts might become more tenable. Thus, each agent's memory of failed attempts is cleared each month. Below, Table 1 summarizes the agent attributes.

Insert Table 1 About Here

4.2 Resources

Resources are randomly distributed throughout the environment at the start of the simulation, and we follow Davis et al. (2009) in establishing the resource attributes. Resources serve two purposes in the model. The first is the accumulation of resources, akin to successfully completing nascent entrepreneurial activities, such as procuring vital equipment or publishing marketing material, which aid venture emergence. Once an agent has captured the number of resources required to emerge (as set in the model), he or she becomes operational rather than aspirational (i.e., a *successful emergence* outcome). Additionally, each resource is assigned a value in terms of the number of expendable endowments, which contribute to the agent's endowment total (i.e., provide the agent extra runway as he or she tries to emerge). Agents expend endowments with each action (elaborated in the next section), analogous to the "cash burn" that aspiring entrepreneurs experience as they attempt to organize their ventures.

Similar to Davis et al. (2009), each resource has a random degree of *complexity* and is defined as the number of actions required to capture the focal resource (mean = 2, SD = 1). Each action toward capturing this resource is more difficult than the previous one and is operationalized, per the formula below, to target an average *difficulty* of approximately 50%, aligned with the agent's baseline ability to capture resources. A key advantage of this modeling choice is that it allows individual agents to influence their environment, which then impacts the actions undertaken by other, competing agents (Knudsen & Srikanth, 2014). Multiple agents can therefore be working to capture a single resource simultaneously (i.e., a venture pitch competition with multiple entrants); should an agent successfully capture it, that resource becomes unavailable and forces the other agents to move on.

$$Difficulty = Abs.value\ (\ Random.normal\ (mean = 20, SD = (15 * complexity)\ )\ )$$

In addition to these vital parameters, we incorporate an element of environmental uncertainty into the model. As initially noted above, existing theories of entrepreneurial action propound uncertainty's central role in the decisions, actions, and outcomes related to the practice and study of business venturing (McMullen & Shepherd, 2006). Although debates concerning the precise nature of uncertainty continue to proliferate in entrepreneurship research (Townsend, Hunt, McMullen, & Sarasvathy, 2018), a growing consensus broadly supports the notion of uncertainty as an "unpredictable decision environment" (e.g., Foss & Klein, 2012; McKelvie et al., 2011;

Sarasvathy & Dew, 2013), suggesting that the set of outcomes for any particular action is unknown (Packard, Clark, & Klein, 2017). For example, entrepreneurs in the cryptocurrency industry must largely react to regulations as they unfold; hence, the outcomes of any actions they undertake to marshal resources toward creating a new venture may manifest at just the right time or evaporate completely when a new regulation is enacted. Furthermore, entrepreneurs tend to be susceptible to reductive tendencies in the face of uncertainty (Gras, Conger, Jenkins, & Gras, 2020), whereby they might misinterpret the problem at hand and pursue the wrong type of resource.

We operationalize the essence of this unpredictability as "false resources". False resources appear viable to the agent but offer no value and, therefore, do not contribute to moving the nascent entrepreneur toward successful emergence, nor do they add value to the agent's existing endowments. This choice is predicated on two foundational ideas aligned with the conceptualization of environmental uncertainty. First, while (typical) agents can prioritize the pursuit of one resource over another, agents have no a priori knowledge of the potential outcomes of the resource they are pursuing (cf. Packard et al., 2017). Second, the number of false resources can be manipulated in the model, offering sufficient flexibility to simulate different levels of uncertainty (e.g., McKelvie et al., 2011). This offers an efficient way to build experiments that assess changes in uncertainty due to sudden and unforeseen events, such as the COVID-19 pandemic (Rauch & Hulsink, 2021).

In sum, the presence of "dry holes" and empty promises that can only be accurately assessed *ex post*—that is, after financial and nonfinancial resources have been invested in resource access—contributes to a decision environment that is inherently uncertain. Since the attempted capture of false resources consumes the same amount of resources as capturing viable, useful resources (Dimov, 2011), a greater number of the former in the decision environment results in greater levels of environmental uncertainty. Figure 2 illustrates the resource attributes as they appear in the simulation.

Insert Figure 2 about here

4.3 Actions

Agents continue to search for, move toward, and attempt to capture resources until (1) sufficient resources to successfully emerge are captured, (2) all their endowments are expended and their venture exits, or (3) 72 simulated months elapse. Figure 3 contrasts the action sequences of typical and impulsive agents and depicts all associated endowment expenditure. If no resources are in the agent's search field, the agent moves one space in a random direction and searches again. To capture a resource, the agent must successfully complete each required action in the action sequence. To accomplish this, the agent's accuracy must be greater than the difficulty of resource capture at each step of the action sequence. Table 2 provides an example. Successful resource capture requires a sequence of three successful actions, each with a specific associated difficulty. Agent 1 has an accuracy that exceeds the difficulty at each step and therefore successfully captures the resource. Agent 2 successfully completes the first action, but its accuracy in the second step is lower than the difficulty (39% vs. 41%). Therefore, Agent 2 cannot complete this step of the action sequence and fails to capture the resource.

Insert Figure 3 and Table 2 about here

Last, when agents emerge, ten additional resources spill over into the environment, although with a higher probability of being a false resource. Shane and Eckhardt (2013) note that as entrepreneurs exploit opportunities, they transmit information to the market, thus not only educating other entrepreneurs (Aldrich & Yang, 2014), but also drawing in new potential investors and employees as their venture shows signs of legitimacy (Navis & Glynn, 2010). We model these resources as having a 50% chance of being false. In addition, entrepreneurs are likely to view a new resource set more favorably than they should (Ramoglou & Tsang, 2016) and, as Gras and colleagues (2020) note, are susceptible to reductive tendencies, whereby they potentially pursue resources that are imagined rather real.

5 RESULTS

5.1 Tuning the Baseline Model

Simulation models offer immense flexibility, limited only by computing power and imagination. Thus, philosophers of science note that empirical validity is central to the construction of simulation models for deriving plausible theoretical insights (Arnold, 2019). Accordingly, in addition to the efforts highlighted above, we tune the remaining model parameters to align with the outcomes found in the PSED II, a randomized, country-wide representative sample data collection effort in the United States. The PSED II is publicly available and has been used in nearly 200 published articles (see Davidsson & Gordon, 2012 for a review). It includes a representative sample of all startup attempts in the USA, suggesting a high degree of generalizability.

To ensure proper model calibration, we run a series of manipulations involving variances in the agent population, their starting endowments, the number of resources, and the number of resources required to emerge. Each iteration of input values is operationalized through Monte Carlo[1] experiments using the three primary outcomes of interest: *emergence, exit,* and *still trying*. *Successful emergence* represents the percentage of agents that capture enough resources to exceed a minimum threshold of achievement, and *exit* comprises the percentage of starting agents whose

[1] Monte Carlo experiments entail calculating the mean of outcomes during a number of iterations; then, the value of a single variable is changed, and the process is repeated.

endowments are reduced to zero (effectively, from searching and moving without successfully capturing enough resources). Table 3 displays our baseline model's parameter values and offers a brief description of each.

Insert Table 3 about here

5.2 Baseline Results

Figure 4.1 displays the results over the 72-month period after running and taking the mean of 1,000 simulations of the baseline model, as outlined above. At the start of each simulation, there are 340 typical agents and 60 impulsive agents. As highlighted previously, the outcomes of the baseline model at the end of the period align with the PSED, i.e., 30% of nascent entrepreneurs successfully emerge, 50% exit, and 20% are still trying. The potential advantage of the unreasoned actions of impulsive agents manifests quite early in their venture's existence. Specifically, impulsive behavior initially yields a first-mover advantage that offsets the penalties associated with accuracy (from approximately month nine to 36), as illustrated in Figure 4.1 and rescaled to better illustrate venture emergence in Figure 4.2. Impulsive agents initially surpass and then keep close pace with typical agents until approximately the halfway point in the simulation. In the nascent startup phase, behaviors associated with impulsivity (e.g., approaching every resource without deliberation and cycling through them as fast as possible) create an early cohort of successful impulsive entrepreneurs.

However, these positive effects among impulsive agents dissipate. Typical agents outnumber impulsive agents in terms of surpassing the emergence threshold around month 40, when impulsive agents become increasingly more likely to exit their respective venture (see Figure 4.1). One important outcome of the bias toward action is that resources are expended quickly, leading to a quicker exit. In a manner analogous to the "moneyball" theory (Holmes, Simmons, &

Berri, 2018; Lewis, 2004) utilized by the Oakland Athletics Major League baseball team and later adapted into a hit film, the behaviors associated with typicality, while less exciting, yield more consistent successes. Thus, the benefits of speed do not outweigh the penalties of lower accuracy over longer durations, suggesting that the strategic advantage of impulsivity is limited to the first mover advantage among the few that obtain it. This leads to our baseline propositions:

> ***Proposition 1a****: Impulsive agents are* ***less*** *likely than typical agents to reach the emergence threshold.*

> ***Proposition 1b****: Impulsive agents emerge and exit* ***faster*** *than typical agents.*

Insert Figures 4.1 & 4.2 about here

5.3 Impulsivity and the Impact of Uncertainty

To varying degrees, all entrepreneurship occurs in the context of indeterminism (Knight, 1921). Through action, and only through action, indeterminism is confronted and, in at least some small measure, addressed (Hunt et al., 2022). All extant EATs have taken full account of this fact; hence, knowledge problems—composed of ambiguity, complexity, uncertainty, equivocality, and risk (Townsend et al., 2018)—play a central role therein, paradoxically functioning as both epistemic obstacles to the formulation and enactment of optimizing decisions and wellsprings for new ventures, manifested through both reasoned and unreasoned actions (Lerner, Hunt, & Verheul, 2018).

On the one hand, the ability to move quickly on a resource is paramount in a highly uncertain environment. For example, during the COVID-19 pandemic, a steady flow of storefront leases became available in highly competitive locations that had not been available in years. Entrepreneurs who act impulsively might have been more likely to sign a lease for one of these locations before anyone else, capitalizing on rare friction in an otherwise stable market. However, the uncertainties surrounding the pandemic, such as restrictions on opening a new business, could have rendered such a lease useless (i.e., a false resource that offers no value to the entrepreneur). Thus, we ask the following question: Is impulsivity an asset or liability under high uncertainty?

Accordingly, we model high uncertainty as a proxy for environments where the "unknown unknowns" are elevated, i.e., we increase the model's uncertainty from 10% to 20%. Consistent with the notion that under high uncertainty, people become more cautious, e.g., by delaying actions and displaying the tendency to seek out additional information (cf. McKelvie et al., 2011), we slow the typical agent's movement by 20% (i.e., from five to four movements per simulated month). In contrast, because a defining feature of impulsivity is action despite uncertainty, impulsive agents act at the same pace (Leland, Arce, Feinstein, & Paulus, 2006).

Heightened uncertainty poses challenges for both sets of agents, but impulsivity offers a strategic advantage, as speed outweighs the costs of inaccuracy. Therefore, whereas 17% of the typical agents emerged at the conclusion of the simulation, 21% of the impulsive agents were successful. Figure 5 depicts these outcomes over time and illustrates a more substantial difference in speed-to-outcomes. Despite their accuracy disadvantages, impulsive agents begin to emerge at approximately twelve months, while typical agents start emerging approximately six months later. This early jumpstart helps impulsive agents maintain their advantage, which becomes evident at approximately the 18th simulated month and remains consistent through the conclusion of the six-year period.

Notably, the number of impulsive agents exiting their ventures surpasses those remaining at approximately the 34th month, nearly three months ahead of the baseline scenario, highlighting the overall potential for faster exits as well. Thus, we derive the following propositions:

> ***Proposition 2a:*** *Under high environmental uncertainty, impulsive agents are* ***more*** *likely than typical agents to reach the emergence threshold.*

Proposition 2b: *Under high environmental uncertainty, impulsive agents emerge and exit **much faster** than typical agents.*

Insert Figure 5 about here

5.4 Impulsivity in Munificent and Scarce Resource Environments

As initially noted above, EAT is awash in competing conceptions of how opportunities, resources, and actions relate to one another. For example, Stevenson (1983) sees entrepreneurship as action without regard for resources. Research investigating the role of bricolage (Baker & Nelson, 2005) has elaborated on how entrepreneurs discover and navigate varied and often ingenious pathways while commissioning required resources. In a similar vein, Sarasvathy's (2001) study of experienced entrepreneurs has insightfully revealed that idiosyncratic resources and capabilities inspire new venture creation, in contrast to the perspective that a fully formed new venture idea will drive one to action. Thus, in any case, resources are integrally connected to EAT.

Accordingly, to consider how resources may affect the (dis)advantage of impulsivity in venturing while keeping the ABM parsimonious and tractable, we vary the resource munificence of the environment. An environment rich in resources generally eases the burdens associated with launching a new venture (Specht, 1993). Most importantly, munificence offers more room for trial and error (e.g., Baum & Wally, 2003). For example, the high valuations of early internet companies in the 1990s led to plentiful high-quality talent, money, and strategic alliance partnerships for new ventures, providing them sufficient bargaining power to explore their potential markets on their terms and timelines (Park & Mezias, 2005).

Conversely, in a highly resource-constrained environment, both speed and accuracy provide a strategic advantage for performance, as the risks of failure are much higher (Baum & Wally, 2003). Speedy decision-making offers entrepreneurs more chances to capture the resources needed to successfully launch their ventures. However, this advantage may be offset by lower accuracy. First, in a zero-sum situation, failing to capture a key resource may result in a competitor capturing that same resource. Park and Mezias (2005) have noted how strategic partnerships became rare during the fallout of the dot-com bubble boom and how those who successfully found partnerships enjoyed greater success. The failure to acquire a given resource is, therefore, more costly due to the heightened lack of available resources and the time and effort invested in the attempted capture. Similarly, entrepreneurs must make choices regarding which resources they attempt to capture. For example, an entrepreneur can choose between traditional financing options, such as bank loans or venture capital, or newer methods, such as crowdfunding (Pollack, Maula, Allison, Renko, & Günther, 2019). Both options carry costs and, more importantly, require precious amounts of time. Failed efforts—such as an unsuccessful crowdfunding campaign or unexpected venture capital snub—can distract, derail, or prove to be permanently disabling when second chances are rare.

To explore these scenarios, we alter the baseline model's resource population. First, we create a munificent environment by increasing the resource population by 50%. Figure 6 illustrates these outcomes over 72 simulated months. Compared to the baseline scenario, exit is universally lower, and emergence is universally higher. The average impulsive agent still finds an exit faster, which coincides with the previously revealed differences in exit. Impulsive agents hold a more prominent first-mover advantage in this scenario and hold this advantage for a longer duration, nearly 54 simulated months. However, as the simulation concludes, the advantages of speed wane, and typical agents level the playing field, leading to the following propositions:

> ***Proposition 3a:*** *Under resource munificence, impulsive agents are initially* ***<u>more</u>*** *likely than typical agents to reach the emergence threshold.*

> ***Proposition 3b:*** *Under resource munificence, impulsive agents emerge and exit* ***<u>faster</u>*** *than typical agents*.

Insert Figure 6 about here

Next, we explore the harsh, resource-scarce environment described above by reducing the number of resources by 25% compared to the baseline model. Figure 7 shows these results as they unfold over time. Due to this highly competitive environment and geographic sparseness of resources, agents universally struggle to emerge under these conditions. Whereas impulsive agents' speed allows them to traverse the resource environment more quickly—which might be especially important when resources have more distance between them—surprisingly, it offers them no advantage in terms of emergence. Instead, the penalties of inaccuracy and the failure to capture a resource are more consequential, and the typical agent consistently outperforms the impulsive agent in terms of emergence. Additionally, only 3% of impulsive agents remained at the conclusion of the simulation, reinforcing the speed to exit linked with impulsivity.

Thus, we offer the following propositions:

> ***Proposition 4a:*** *Under resource scarcity, impulsive agents are* ***<u>less</u>*** *likely than typical agents to reach the emergence threshold.*
>
> ***Proposition 4b:*** *Under resource scarcity, impulsive agents exit* ***<u>faster</u>*** *than typical agents.*

Insert Figure 7 about here

5.5 Impulsivity in Munificent and Scarce Resource Environments with High Uncertainty

In our final models, we combine the two previous manipulations by simulating how agents perform under different levels of resource munificence while facing high uncertainty. This environment is analogous to a rapidly growing, innovative industry, where the amounts of both investment and uncertainty are profound, e.g., that of financial firms facilitating cryptocurrency transactions. Here, capital inflows are substantial across numerous stakeholder groups, but government regulations lag behind, suggesting a highly uncertain future. Below, Figure 8 illustrates the scenario of concurrent high uncertainty and high munificence.

This scenario appears ideal for the impulsive agent, as the strategic advantage of impulsivity is the most substantial across our models. On average, approximately 62% of the impulsive agents successfully emerge, as they are undeterred by greater uncertainty, thus maintaining their advantages via speed and cycling through resources much faster. This is especially valuable when there are more false resources present. Meanwhile, typical agents are more measured in their approach to high uncertainty, causing them to lose access to resources at a greater rate and exacerbating the impediments to their emergence; they are forced to search more often and over greater distances due to frequent changes in the resource configurations, which ensue without their participation. Accordingly, we propose the following:

> ***Proposition 5a:*** *Under high environmental uncertainty and resource munificence, impulsive agents are* ***substantially more*** *likely than typical agents to reach the emergence threshold.*

> ***Proposition 5b:*** *Under high environmental uncertainty and resource munificence, impulsive agents emerge and exit* ***much faster*** *than typical agents.*

Insert Figure 8 about here

Our final, and most extreme, scenario combines high uncertainty with scarce resources. Here, the insights from our second proposition suggest that impulsivity offers a strategic advantage because impulsive agents are undeterred by high uncertainty. However, our fourth proposition illustrates some consequential disadvantages and suggests that the impact of mistakes weighs more heavily. Speed might not necessarily lead to an advantage when wider and more frequent searches are needed. Furthermore, if typical agents move slower because of heightened uncertainty, they might also find an advantage by conserving their endowments while letting impulsive agents expend theirs at the same pace despite environmental challenges.

Below, Figure 9 illustrates how impulsivity offers a marginal emergence advantage while, surprisingly, impulsive agents do not emerge at a faster rate. This is partly due to the difficulty of emergence more generally—at the conclusion of the six-year period, 7% of impulsive agents emerged versus 6% of typical agents. Rather, the effects of speed-to-action are captured in the exit rates; impulsive agents start exiting at approximately the third simulated month, versus the typical agent at month six, and maintain a substantially quicker exit rate throughout the six-year period. Furthermore, the impulsive agents exit at double the rate of the typical agents, and only approximately 2% remain as the simulation concludes. This finding is especially important in a hostile scenario such as this, where the probabilities of successful emergence are very low and quicker exits might allow entrepreneurs and stakeholders to move on and divert their efforts elsewhere. Thus, we propose the following:

> ***Proposition 6a:*** *Under high environmental uncertainty and resource scarcity, impulsive agents are* ***<u>marginally more</u>*** *likely than typical agents to reach the emergence threshold.*

> ***Proposition 6b:*** *Under high environmental uncertainty and resource scarcity, impulsive agents exit* ***<u>much faster</u>*** *than typical agents.*

Table 4 summarizes the outcomes of our typical and impulsive agents in the six different scenarios that we have simulated (two levels of uncertainty and three levels of resources). Next, Table 5 provides the exact parameter changes that each scenario entails relative to the baseline model.

Insert Figure 9 and Tables 4 & 5 about here

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6 DISCUSSION

Based on an extensive discussion of the empirical manifestations of entrepreneurship as well as existing entrepreneurship action theories, we develop and simulate the conceptual model depicted above in Figure 3. This model highlights the differences between typical and impulsive agents, functioning as a lens for viewing the dynamic interactions among virtual entrepreneurs that are representative of the real world but notably difficult to capture in traditional empirical settings (McMullen & Dimov, 2013). We then manipulate environmental conditions to simulate how the differences between typical and impulsive agents manifest. Controlled ABM experiments reveal the pros and cons of different strategies under various conditions and how these relationships evolve and change over time. In particular, we account for the individual agent’s influence on the external environment (cf. Keyhani, 2019) while also taking changes over time into consideration (cf. Lévesque & Stephan, 2019).

The outcomes of these experiments are crystallized in our propositions, which reveal the intricate and often unexpected effects of impulsivity in ways that traditional analytical methods cannot. Concerning resource access, for example, while munificent resources initially provide advantages to impulsive agents in terms of a higher probability of emergence, these advantages dissipate over time. Critically, the ABM results reveal when gaps narrow and whether advantages dissipate completely as time elapses. While an argument could be made that the first-mover advantage associated with impulsivity yields a greater strategic advantage in a resource-constrained environment, the ABM suggests that this is only the case when uncertainty is elevated. Furthermore, while our simulations and propositions primarily focus on the probability of successful emergence, they also reveal which agents are less likely to continue trying and more likely to exit their attempts.

For example, in most scenarios, impulsive agents are more likely to exit and less likely to continue trying. If the probability of successful emergence is low (e.g., under high uncertainty and constrained resources), then, this is an effective strategy that could potentially reduce opportunity costs and allow impulsive entrepreneurs (and their stakeholders) to move on to other endeavors. While perseverance is typically lauded in entrepreneurship, our findings nevertheless suggest that under certain circumstances, the lack of perseverance associated with impulsivity can entail advantages. Accordingly, our approach offers a divergent path to theory building; that is, if and when impulsive entrepreneurial action entails strategic advantage, this leads to novel and surprising findings that can better define the boundaries of EAT.

6.1 Implications for Entrepreneurship Action Theory

Cognizant of the schism between EAT (Hunt et al., 2022), which tends to overlook impulsivity (Wood et al., 2021; Zellweger & Zenger, 2021), and empirical findings, which point to important alternatives (Lerner, Hunt & Dimov, 2018; Wiklund, 2019), we developed new theory to incorporate the role of impulsivity in entrepreneurial action. In doing so, we have not only accounted for the notable presence of non-rational drivers through a broadened conception of EAT, but we have also illuminated the ways in which impulsivity offers strategic (dis)advantage(s) in new venture creation, which are predicated on the speed versus accuracy tradeoff (SAT) framework (Heitz, 2014) and bounded by changes in external conditions.

Driven by the motivation to draw rationality-laden EAT into closer alignment with less-rational empirical manifestations of entrepreneurship, we have performed a simulation-based exploration of the boundaries of EAT and impulsivity, deriving a set of propositions that offers new insights into the nature of entrepreneurial action. While Figure 3 illustrates the conceptual framework that we simulated, Figure 10, below, provides a conceptual representation of our resulting propositions. As illustrated in these figures, impulsivity extends and enhances EAT in fascinating and complex ways. At the core of these varied impacts is an assortment of tradeoffs that are notable from the outset of new venture creation. Although successful emergence is a formidable challenge for all entrepreneurs, this challenge is particularly acute for impulsive individuals who appear to be chronically unprepared (Lerner, 2016; Lerner, Hunt & Verheul, 2018).

Insert Figure 10 about here

Entrepreneurship does not occur in a vacuum (Chen et al., 2021). Any assessment of impulsivity's impact must therefore account for the heterogeneity and dynamism that characterizes entrepreneurial contexts, especially those with heightened levels of uncertainty and resource scarcity. This is where impulsivity becomes very interesting—and very important with regard to the boundaries of EAT—because impulsivity is associated with action *regardless* of uncertainty (Leland et al., 2006). As uncertainty increases, so does the strategic advantage of impulsivity. Conversely, these benefits cease to exist when resources are scarce, since the costs of failure are too high to be offset by the gains associated with speed. While more work must be performed before it can be understood whether impulsivity is advantageous, the interactions between uncertainty and resources are intriguing—for example, high uncertainty paired with low resources—and impulsivity may act as an equalizer in such scenarios.

6.2 Toward a More Inclusive and Veridical Entrepreneurial Action Theory

Our primary contribution in this work, then, is our provision of a comprehensive view of the role of impulsivity with regard to EAT in new venture emergence. Specifically, we offer a multilevel perspective and provide insights into the new venture creation phenomena by incorporating impulsivity. Indeed, impulsive entrepreneurial action resembles the chaotic movement of molecules in a high-pressure gas (far more than the orderly structure in a solid or liquid), which partly explains why scholars who have acknowledged the presence of impulsivity have nonetheless excluded it from EAT (e.g., Wood et al., 2021; Zellweger & Zenger, 2021).

Far from single-minded valorizing impulsivity, our propositions explicitly acknowledge and incorporate the potential downsides as well. Speed can be advantageous, but not when it invites recklessness. Indeed, clinical studies have often found that impulsive behaviors carry performance challenges (Dickman, 1990; Gonzalez-Gadea et al., 2013; Uebel et al., 2010). To capture the complex array of impacts that accompany neurodiversity, Lerner, Hunt, and Verheul (2018) have formulated a seven-phase business venturing lifecycle that articulates a “double-edged sword” across these phases. In this sense, the challenges our findings have revealed during the most nascent stages of business venturing are consistent with the theoretical foundations of the SAT framework (Heitz, 2014). However, as the business venturing lifecycle unfolds, such challenges become increasingly focused on efficiency and effectiveness improvements, posing an even more potent set of obstacles for entrepreneurs with a proclivity toward impulsivity. The extent to which entrepreneurs successfully navigate these obstacles is, then, decisive in determining their firm’s fate. Finally, our extended theory of entrepreneurial action and associated ABM encompass the bulk of the venturing framework identified by Lerner, Hunt, and Verheul (2018) and illustrate how both impulsive and intentionally rational pathways are instrumental in theories of entrepreneurial action. Without the integration of both business venturing pathways, key issues facing scholars and practitioners—such as the SAT—will remain under-conceptualized.

6.3 Implications for Diversity and Inclusion

Our efforts also make a notable step toward the inclusion of nontraditional entrepreneurs in EAT, especially concerning their ability to identify, acquire, and control the resources required for entrepreneurial action. For example, scholars have increasingly examined individuals with atypical conditions such as ADHD (Lerner, 2016; Yu et al., 2021) to better understand how individuals with proclivities for stimulating, nondeliberative, and less-calculative action may initiate behavior that ultimately results in entrepreneurial outcomes. Individuals with these differences are likely to play an influential role in generating the highest performers, the outliers, which are critical to the functioning of innovative markets and in the generation of novel business models (Hunt et al., 2022).

Mental health diagnoses such as autism, ADHD, and hypomania are rapidly increasing in society and these contributions provide space within EAT for atypicality that has thus far suffered from marginalization (Moore et al., 2021; Tucker, Zuo, Marino, Lowman, & Sleptsov, 2021). In addition, these diagnoses are becoming less stigmatized. While research on neurodiversity has long studied negative outcomes, such as problems at school, social isolation, unemployment, and incarceration, entrepreneurship scholars have instead suggested that neurodiverse individuals might find success in entrepreneurship, where they can craft their jobs in ways suited to their unique needs (Wiklund et al., 2018).

6.4 Implications for Simulation-Based Theory Building

As with all scholarly research, our study has incorporated design decisions that involved inherent tradeoffs. Many of these key decisions were indispensable in answering our research questions and, simultaneously, for our ability to freshly theorize EAT through a novel lens that offers conceptually valuable insights. These same governing design decisions justifiably invite reflection concerning the diverse opportunities to pursue the empirical agenda we have outlined above through the use of other designs and methods. Nowhere are these issues and opportunities clearer than in our choice to employ an ABM as a theory-building tool.

Building robust theory that encompasses new venture creation is notoriously difficult (Davidsson & Gruenhagen, 2021) due to the wide range of salient milestones and outcomes that unfold over time (Shepherd, Souitaris, & Gruber, 2021), many of which are only identifiable and comprehensible in a retrospective fashion—a fact that has a stultifying impact on efforts to better understand nascent-stage business venturing. For these reasons, we have taken the less-usual step of creating an ABM to engage in this challenging form of reconceptualization. ABMs offer a dynamic and interactive analytical environment through which to derive more credible theoretical insights for process-based phenomena that unfold over long periods of time (Lévesque & Stephan, 2019). Our use of an ABM as a theory-building tool in entrepreneurship research is not without precedent (e.g., Bylund, 2015); it has even been recommended as a means to gain novel insights into new venture creation (McMullen & Dimov, 2013).

Nevertheless, the use of ABMs—though well-ensconced in the methodological canon, widely embraced across the social sciences and advocated in entrepreneurship for more than two decades (Aldrich, 2001)—is not without its opponents (Arnold, 2019). The relevant question is not whether the use of an ABM is right or wrong, but when and how it should be employed in theory-building contexts. Discomfort with this technique, although increasingly rare, stems from concerns that its results are little more than an inevitable confirmation of ABM's underlying assumptions. Such assumptions are critical in ABM; hence, we have offered complete transparency regarding our coding. While simulation models require a level of parsimony to be interpretable, advantageously, they also eliminate potential confounds in field or archival settings (Harrison et al., 2007).

7 CONCLUSION

Entrepreneurial action is characterized by a wide assortment of circumstances and motivations. Although elusive, the entrepreneurial actions of unreasoned individuals must also be captured, understood, and assessed. Thus, by placing impulsivity and other unreasoned drivers of entrepreneurial action inside the fence line of EAT, our reconceptualization addresses the overarching theory-empiric schism and allows fresh perspectives on the sources of entrepreneurial action, the nature of strategic advantage, and the critical importance of atypical differentness in fostering the system-wide benefits of novelty.

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TABLE 1
Summary of Agent Assumptions

Assumption	**Parameter**	**Value**		**Conceptual and Empirical Proxies**	
		Typical	***Impulsive***	***Description***	***Reference(s)***
1	Speed	5	6	Speed is operationalized as the number of actions the agent takes per time period. Inclusive of searching for, moving toward, and ultimately attempting to capture resources, impulsive agents take six actions per simulated month, while typical agents take five per month. The 20% increase in speed for impulsive agents is derived from experiments that suggest that high-impulsive individuals completed 20% more activities in the same timeframe as low-impulsive individuals [1] and has been demonstrated among entrepreneurs as well [2].	[1] Dickman & Mayer, 1988 [2] Wiklund et al., 2017
2	Accuracy	55%	47%	Accuracy is operationalized as the probability to complete an action required to capture a resource, and is inspired by previous simulations with a similar function [3]. Previous organizational research suggests a 49% probability of successful organizational adaptation [4], while clinical studies comparing impulsive and neurotypical individuals find accuracy ranges of 42% - 66%, and 54% to 73% [5]. Furthermore, studies find that higher impulsivity is associated with an ~13% penalty both in general [6] and entrepreneurial contexts [7]. We chose 55% as a representative baseline accuracy for the typical agent as it is consistent with the literature and brings the impulsive agent's accuracy, discounted by 13%, within a consistent range. Given that accuracy is inconsistent, the baseline serves as a mean from which a random number within one standard deviation is generated each time an agent attempts an action to make progress on a resource.	[3] Davis, Eisenhardt, & Bingham, 2009 [4] Ganco & Agarwal, 2009 [5] Gonzalez-Gadea et al., 2013 [6] Dickman & Meyer, 1988 [7] Lerner, 2016
3	Deliberation	Reasoned	Indifferent	Action for impulsive agents is prepotent, i.e., they move quickly without consideration toward any potential resources. Typical agents consistently pursue the lower-risk option, targeting less complex resources, and as such, have a higher probability of being captured. This behavior is consistent with experimental studies testing decision-making with varying degrees of risk and uncertainty [8].	[8] Upton, Bishara, Ahn, & Stout, 2011
4	Learning	Increases Accuracy	No effect	Experimental studies found that impulsive individuals learn less from experience [9]. For example, typical individuals increased performance by ~50% across 100 successive decisions, while impulsive individuals showed no improvement [5]. In our simulation, for each successful attempt, a typical agent becomes more accurate and adds 0.5% to their baseline probability.	[9] Carlson, Pritchard, & Dominelli, 2013

TABLE 2

An Illustration of the Resource Capture Process

	Resource Capture *Difficulty*[1]	Agent 1 *Accuracy*	Agent 2 *Accuracy*
Action Sequence			
1	**15%**	**52%**	**47%**
2	**41%**	**72%**	39%
3	**51%**	**54%**	-
Outcome		***Capture***	*Fail*

[1] Resource *complexity* is three, *difficulty* increases with each step.

TABLE 3

Simulation Model Baseline Parameters: Computationally Optimized Environment

Parameter	**Value**	**Description**
Agent Population	400	340 typical; 60 impulsive.
Agent Starting Endowments	500	All agents start with equal endowments.
Resources	4,800	Attempts to collect market research information; hire employees; seek funding. Varies in complexity, required actions to capture, and difficulty per required action.
Uncertainty (False Resources)	10% (480)	Operationalized as false resources with no actual value, consistent with Dimov (2011) conceptualization that veracity or value can only be known *ex-post*.
Emergence (Successful)	20	Researcher-defined, objective existence of emergence: A combination of achieved milestones (Crawford et al., (2015)and a “strict indicator of ‘success’ for a nascent venture” (Davidsson & Gordon, 2012, p. 868).

TABLE 4
Summary of Outcomes (1,000 iterations)

Scenario		**Baseline Uncertainty**			**High Uncertainty**		
		Typical		Impulsive	Typical		Impulsive
Baseline Resources	Emerged	**31%**	>	27%	17%	<	**21%**
	Exited	48%	<	**65%**	51%	<	**72%**
	Still Trying	**21%**	<	8%	**31%**	>	7%
Munificent Resources	Emerged	**74%**	>	73%	51%	**<**	**63%**
	Exited	12%	<	**19%**	17%	<	**27%**
	Still Trying	**14%**	>	8%	**31%**	>	10%
Scarce Resources	Emerged	**13%**	>	10%	6%	**>**	**7%**
	Exited	73%	<	**87%**	73%	<	**90%**
	Still Trying	14%	**<**	**3%**	**21%**	>	3%

TABLE 5

Summary of Scenarios, Propositions, and Model Manipulations

Scenario	Proposition	Δ Uncertainty [Value]	Δ Resources [Value]
Baseline	1	No Change [10%]	No Change [4800]
Heightened Uncertainty	2	2x [20%]	No Change [4800]
Munificent Resources	3	No Change [10%]	1.25x [6000]
Scarce Resources	4	No Change [10%]	0.75x [3600]
Heightened Uncertainty * Munificent Resources	5	2x [20%]	1.5x [7200]
Heightened Uncertainty * Scarce Resources	6	2x [20%]	0.75x [3600]

FIGURE 1

Extended 24-cell Moore Neighborhood of the Agent's Search for Opportunities

x	x	x	x	x
x	x	x	x	x
x	x	Agent	x	x
x	x	x	x	x
x	x	x	x	x

FIGURE 2

Resource Attributes

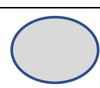
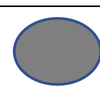
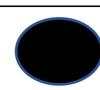
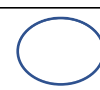
Parameter				
Complexity	1	2	3	random (1:3)
Progress	1	2	3	**0**
Endowment	442	770	1,553	**0**
Difficulty	[37%]	[22%, 47%]	[4%, 32%, 58%]	[4%, 32%, 58%]

FIGURE 3

Action Sequence of Typical and Impulsive Agents

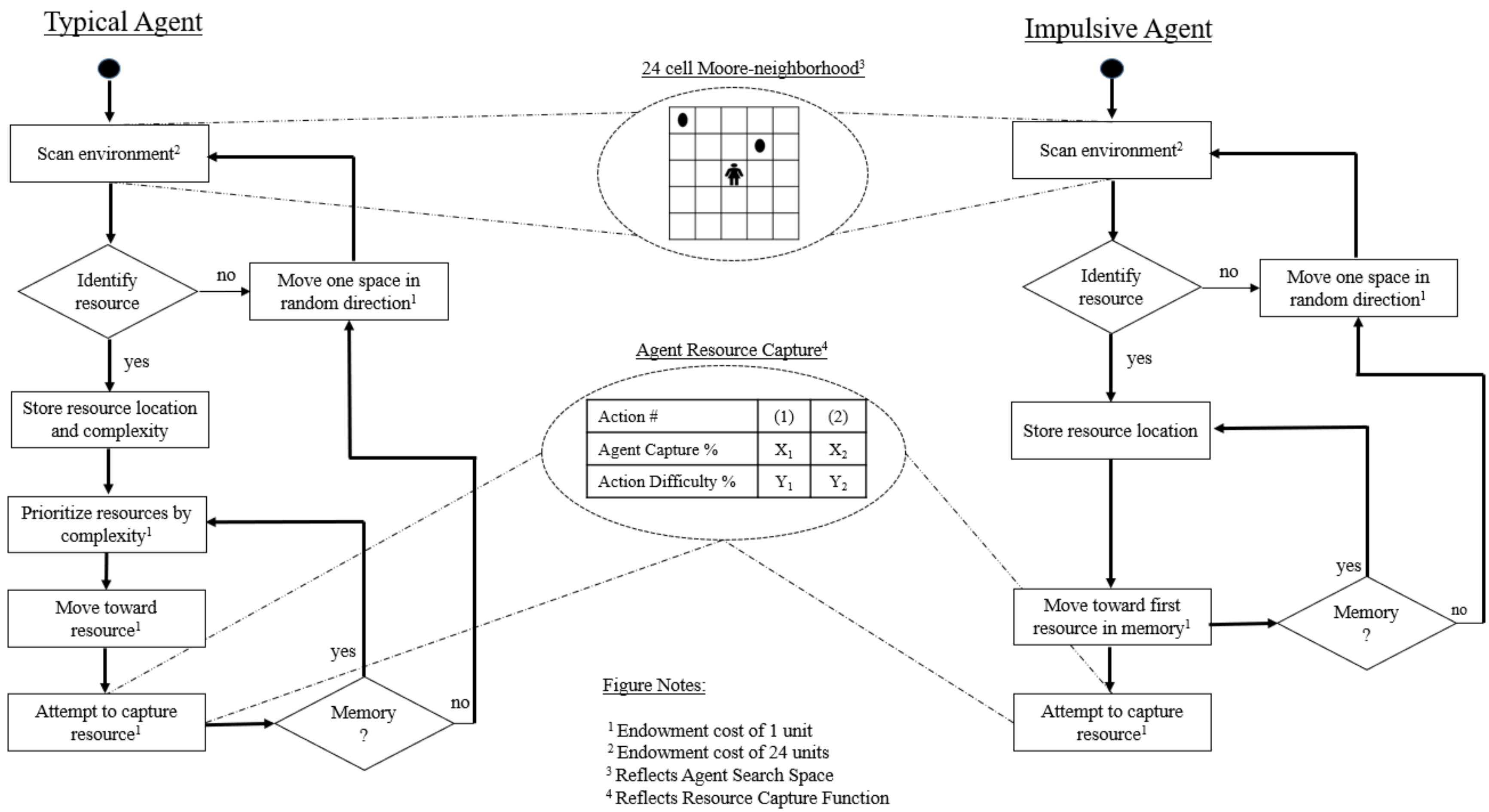


FIGURE 4.1
Baseline Model Agent Outcomes

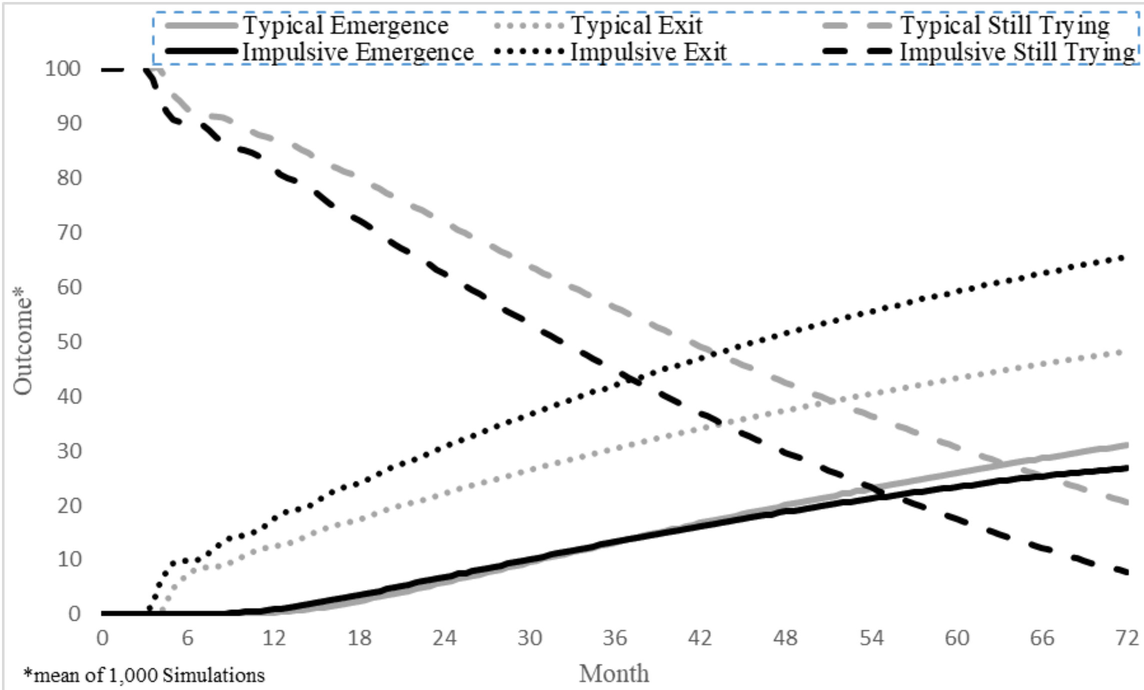


FIGURE 4.2
Rescaled Agent Emergence Outcomes

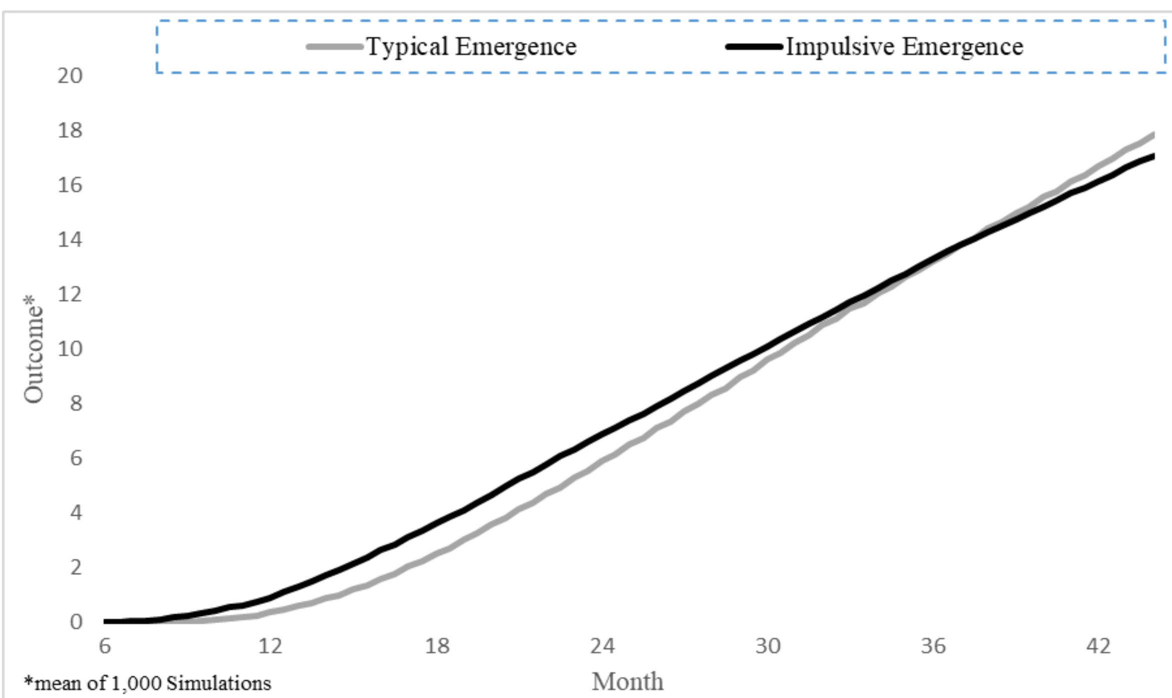


FIGURE 5
High Uncertainty Agent Outcomes

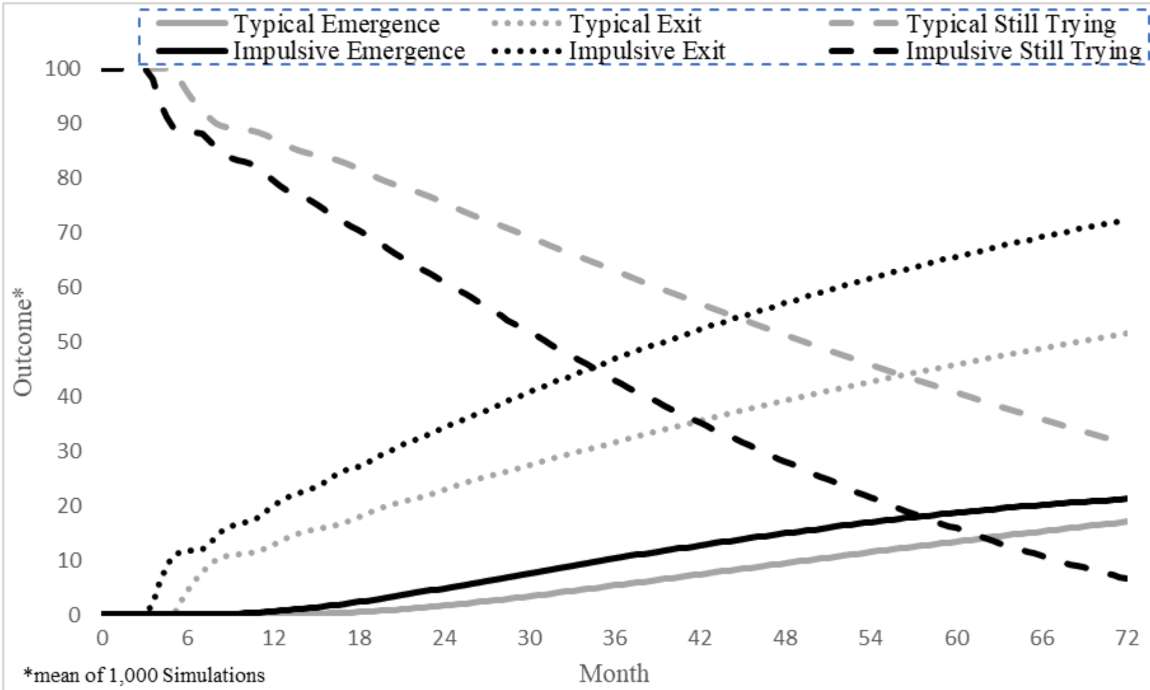


FIGURE 6
Munificent Resource Agent Outcomes

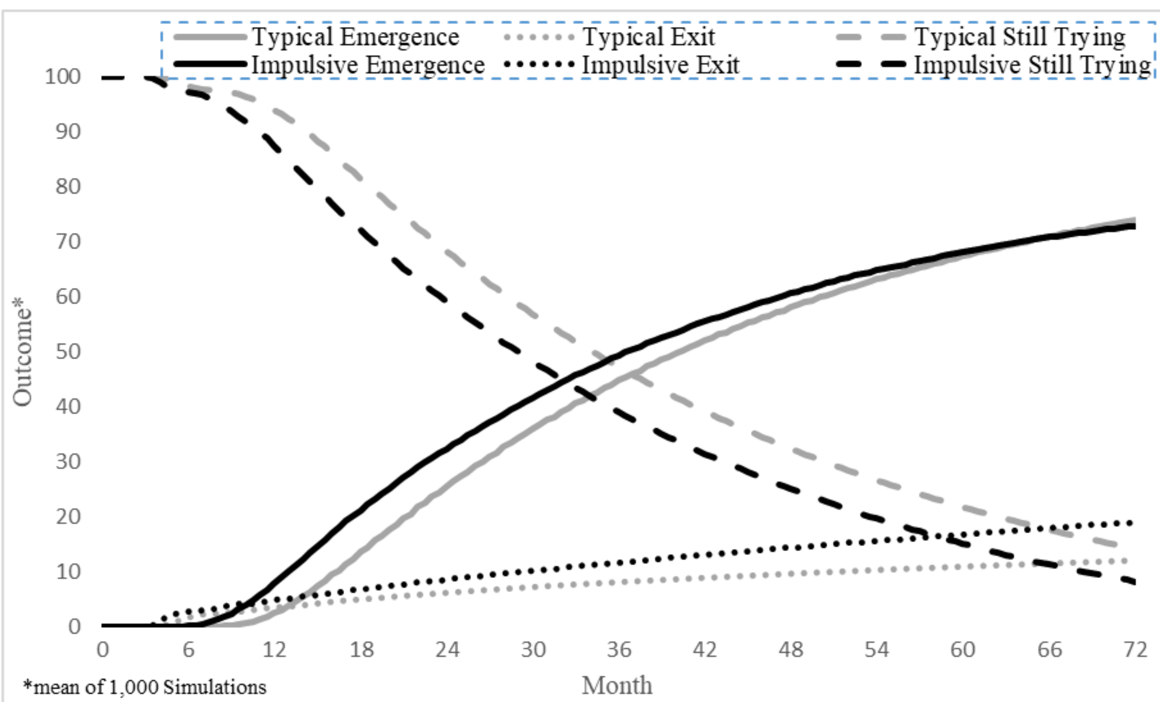


FIGURE 7
Scarce Resource Agent Outcomes

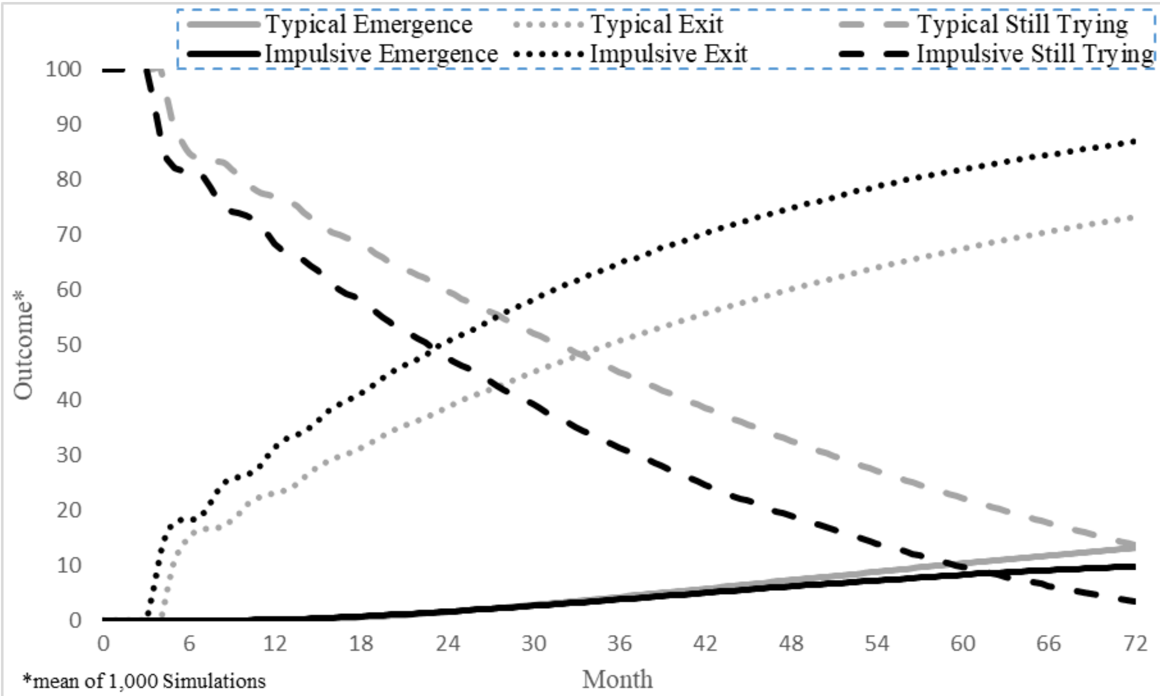


FIGURE 8
High Uncertainty & Munificent Resource Agent Outcomes

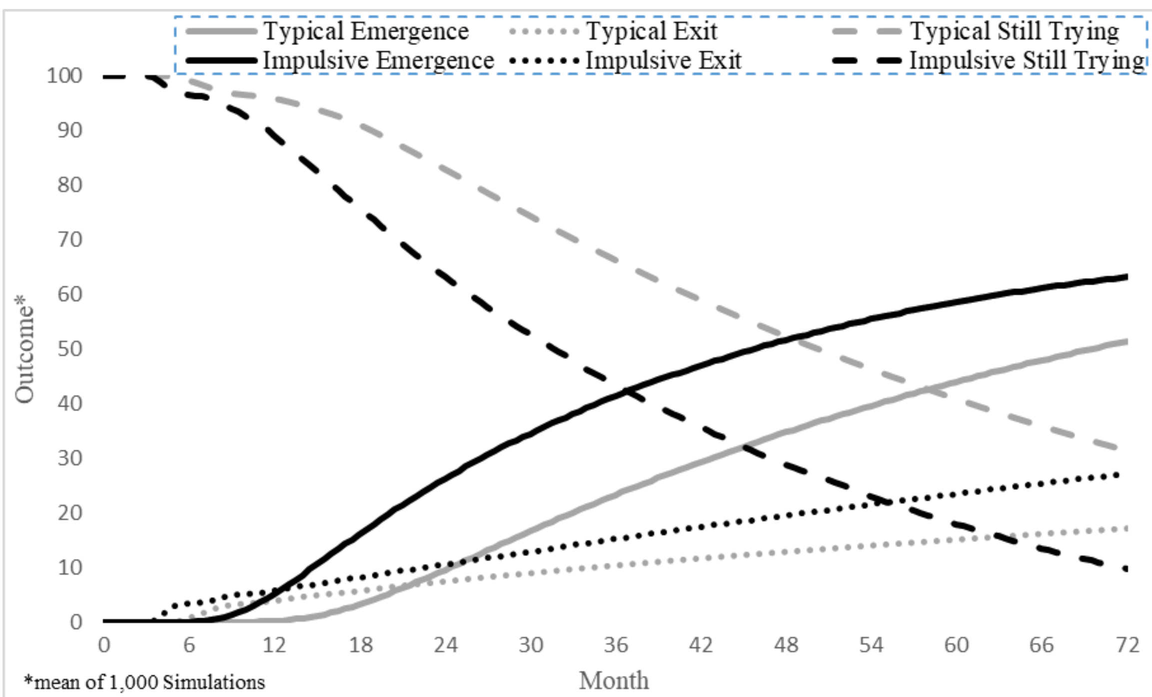


FIGURE 9
High Uncertainty & Scarce Resource Agent Outcomes

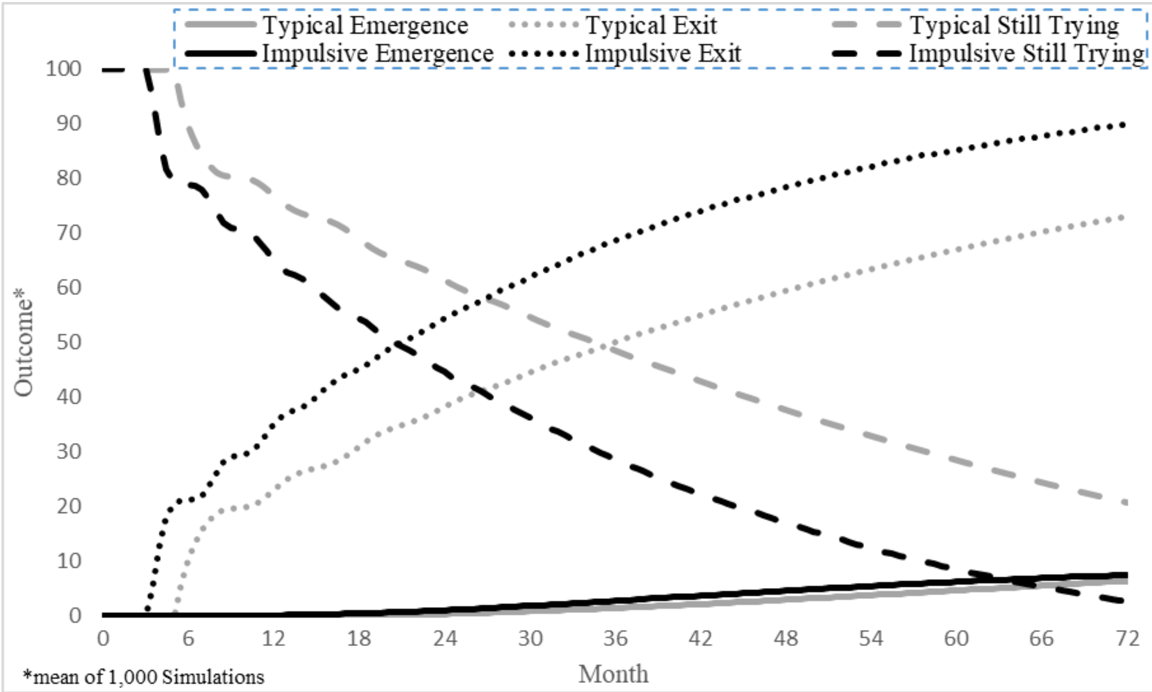
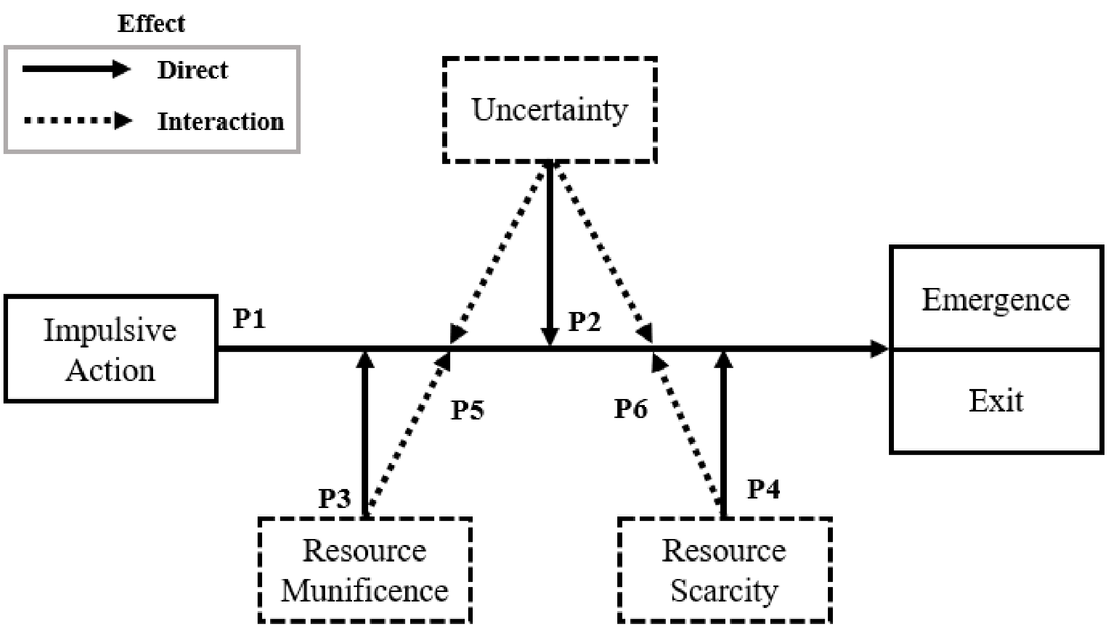


FIGURE 10
Conceptual Representation of Propositions



APPENDIX

Supplemental Online Materials

To aid transparency, we created a supplemental appendix to further elaborate our agent-based simulation model which is available on the open science framework website: https://osf.io/fsdq6/?view_only=65d8a6f1777a4af2a8a0bc3baa75424f.

First, Appendix S.1 illustrates the graphical user interface, offers a link to the version of the modeling software we used, and the source code of the model. Appendix S.2 offers pseudocode for the key functions of the model. As with many modern programming languages, there are idiosyncratic elements of NetLogo's syntax that could potentially obfuscate the model. Thus, we wrote generic pseudocode to provide a simple and syntax-free illustration of the key functions of the model. This section concludes with a mapping of NetLogo's terminology to the real-world constructs observed in the manuscript.

Appendix S.3 manipulates key model assumptions to assess the sensitivity of the model. Simulation outputs are contingent and dependent on input values; thus, it can be helpful to understand how sensitive the model is to its assumptions. While we offer nine total manipulations, we point to the sensitivity of the speed versus accuracy tradeoffs, as they are the most prominent variables in our model. Figure S.3.2 illustrates the variation in the impulsive agent's accuracy from 37% to 57% in increments of 5. The penalties of (in)accuracy, holding the impulsive agent's speed at the baseline, dissipate at approximately 50% accuracy. Notably, the typical agent's accuracy is 55%, highlighting how speed offers a substantial advantage. Figure S.3.3 illustrates how with enough speed (40% advantage), emergence performance is approximately equal, as the speed advantage overtakes the baseline accuracy penalty. However, in contrast to increases in accuracy, the benefits of speed become more marginal as it increases to more extreme values.

Finally, Appendix S.4 provides plots of the means for the baseline model and each environmental manipulation, providing further insights into Propositions 1–6.