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The virtue of calculative mindset: A community-based view of entrepreneurial action and its implications to altruistic venturing

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Abstract

We develop a community-based model of entrepreneurial action under value-destroying uncertainty (e.g., disasters) to formalize two well-established altruistic motivations—*reciprocal opportunity belief* (a 'calculative' mindset of doing good with expectations of future payback) and *compassionate opportunity belief* (a 'non-calculative' mindset of doing good without expectations of future payback)—and identify which belief and contingencies produce greater community welfare (i.e., value). Three moderating factors are considered: community size, actor's action desirability, and welfare value increment of the community members. Our analysis shows that when the three moderating factors are large, the reciprocal opportunity belief generally produces greater community welfare than the compassionate opportunity belief; otherwise, the reverse occurs. We conclude that calculative mindset and community size go hand in hand to produce greater network effects through altruistic-venturing actions, which ultimately lead to greater community welfare. Our findings contribute to the emerging literature on the post-disaster venturing by advancing the contingency effects of altruistic motives on entrepreneurial actions to alleviate others' sufferings and the counter-intuitive benefits of "calculative" mindset. We also stimulate a new conversation to redirect research in entrepreneurship toward the "community" as a viable unit of analysis.

Keywords: opportunity belief, altruism, value destruction, entrepreneurial action, computational social science

Introduction

Research that combines social mission and profit-making goals in entrepreneurial ventures has received enormous interest in recent years (Branzei et al., 2018; Koehne et al., 2022; Pache and Santos, 2013; Shepherd and Williams, 2014; Van de Ven et al., 2007). Altruistic ventures are emerged to improve others' welfare. They can be motivated by a *calculative, reciprocal* mindset, in which actors engage in entrepreneurial action by expecting future reciprocal actions from others or a *non-calculative, compassion* mindset, in which actors engage in entrepreneurial action but do not expect anything in return. The difficult question in entrepreneurship research is to understand which *motivation in altruistic ventures* will lead to better outcomes (i.e., welfare) for the community. Conventional empirical reasoning, from surveys to case studies, offer limited capabilities to i) observe an actor's genuine entrepreneurial motivation—being calculative or non-calculative—when s/he acts altruistically (a question of 'intent') and ii) to repeatedly experiment various types of entrepreneurial motivations and examine many plausible consequences on the overall community welfare (a question of 'what if'). These can be addressed by the use of 'thought experiments' in computer laboratories (Davis et al., 2007; Davis et al., 2009).

A nascent domain of research that attempts to address the aforementioned question is the entrepreneurship-disaster interface (Engel, et al., 2020; Mittermaier et al., 2021, 2022; Shepherd, 2015; Shepherd and Williams, 2014; Williams and Shepherd, 2016). Disaster and other (exogenous) 'value-destroying' events (e.g., earthquake and financial crisis) form opportunities for people to act to benefit the 'needy' others, and these actions spark subsequent opportunities to improve welfare of the community. Integrating the discovery and creation schools (Alvarez and Barney, 2013, Alvarez et al., 2013) as well as the feedback systems perspective (Shepherd and Patzelt, 2013), disaster is a unique context to study the outcomes of reciprocity- or compassion-driven motivation in entrepreneurial action. The act to improve others' welfare following a disaster is essentially 'entrepreneurial' because it involves risk-taking, innovation and the creation and discovery of opportunities to generate social value with an uncertain return for the actor(s) (Alvarez and Barney, 2007; Cordero, 2023; Miller et al., 2012; Shepherd , 2015; Shepherd and Williams, 2014; Thorgren and

William, 2023). Disaster is an ‘extreme’ phenomenon and power law distributed, characterized by a few major and the many minor events (Crawford et al., 2015). Disasters provide opportunities to study people’s and community members’ social-political strategies to achieve strategic goals or non-market strategies (Doh et al., 2012). Disasters necessitate a focus on the largely understudied ‘interaction and community-based perspective of entrepreneurial action’ in the face of adversity (Shepherd, 2015; Shepherd et al., 2020).

Consider the 2013 European horsemeat scandal (BBC, 2013c), a man-made disaster. Following the discovery of its tainted frozen products, Sweden’s Findus, one of Europe’s largest frozen food companies, quickly withdrew its products from many supermarket chains across Europe (BBC, 2013a) thus absorbing substantial financial losses. To rebuild its reputation and customer trust, Findus joined the Supplier Ethical Data Exchange (Sedex), which incentivizes all global supply chain players to conduct ethical, health, and safety audits (Guardian, 2013). By doing so, Findus facilitates information sharing and transparency between meat-industry suppliers and retailers. Findus’ actions, driven by motivation to ensure its own survival (i.e., calculative) and the survival of its partners (i.e., reciprocal), pulled Findus and its suppliers out of the disaster and restored the public’s trust in the frozen meat industry (BBC, 2013b). In this illustration, altruistic act is not charity but serve as ‘insurance’ to secure future benefits.

The above anecdotal case suggests that when each actor’s motivation to engage in altruistic venturing (i.e., to preserve its reputation, sales and profits) aligns with that of the community’s (i.e., supply chain members and customers) objectives and if actors (i.e., supply chain members) reciprocate (to Findus’ altruistic act) in response to a value destroying event (i.e., horsemeat crisis), the overall community welfare is enhanced. However, we can only theorize this phenomenon in hindsight. The reality may consist of alternative pathways and we cannot know them using the conventional research toolbox (e.g., case studies, surveys). We do not know if this pattern (i.e., the impact of Findus’ action on the supply chain community) always holds and under what circumstances we might see alternative outcomes unfold. We can study this phenomenon through simulations in computer laboratories, yet this ‘third way of doing science’ (Korsgaard et al., 2016) remains rare in entrepreneurship research. To date, little research has examined about how calculative- and non-calculative motivations influence community welfare in the aftermath of a value-destroying event. These trigger two key questions that we seek to answer in this study: First, *how do different forms of altruistic motivation in entrepreneurial action produce different community welfare outcomes?* Second, *to what extent do important contingency factors, such as community size, actors' action desirability, and actors' resourcefulness, influence the community's welfare associated with a particular motivation?*

To answer these questions and contribute to entrepreneurship literature, we develop a formal analysis of how actors and the broader community engage in different types and levels of entrepreneurial action in the aftermath of a value-destroying event (e.g., human-made or natural disaster) in a computer laboratory. Computer simulation offers immense opportunities to test various assumptions and factors that would be otherwise impossible to capture empirically (Davis et al., 2007; Harrison et al., 2007). Our model assumes that value destruction brings about human suffering and that actors in a community afflicted by a value-destroying event engage in some form of action (which are essentially entrepreneurial) to recover from that event. We ground our model in the interaction- and community-based perspective of entrepreneurial action as it is applied to a value-destruction context (McMullen and Shepherd, 2006; Rao and Greve, 2018; Shepherd, 2015; Shepherd and Patzelt, 2013; Williams and Shepherd, 2021).

Our proposed model integrates the key constructs in the entrepreneurial action literature and simulates the micro-level process of opportunity creation and discovery (Alvarez and Barney, 2007, 2013; Kirzner, 1973, Klein, 2008; Miller, 2007). We introduce *reciprocal opportunity belief*, drawn from the reciprocal altruism concept and rooted in evolutionary studies, social psychology, and network science literature (Axelrod and Hamilton, 1981; Nowak, 2006; Penner et al., 2005; Trivers, 1971), as a new and central element in community-based entrepreneurial action. In the reciprocal opportunity belief, actors sacrifice themselves to alleviate others' suffering with an expectation that others will reciprocate or 'pay back' in the future. Thus, this type of altruistic act is not charity but insurance where the action entails calculative efforts to secure future benefits. As emphasized in the creation school, the (reciprocal) entrepreneurial actions in the community emerge as an outcome of continuous interactions among actors with calculative mindsets. Hence the opportunity and willingness to reciprocate (or not) is initiated by the calculative mindset. We also examine *compassionate opportunity belief,* drawn from the entrepreneurship literature (Dutton et al., 2006; Miller et al., 2012; Shepherd, 2015; Renko, 2013), which refers to a motivation to sacrifice oneself to improve the welfare of less fortunate or unfortunate others with no expectation of future reciprocal action from the beneficiaries. We then conduct comprehensive simulation experiments to examine the influence of the reciprocal vs. compassionate opportunity beliefs on the community's welfare.

Our results show that when the community size, action desirability, and welfare value increment of the community members (resulting from their resourcefulness) are large, the calculative mindset (i.e., reciprocal opportunity belief) generally produces greater community welfare outcomes than the non-calculative mindset (i.e., compassionate opportunity belief). However, when these factors are small, the reverse takes place. The findings reveal an insightful counter-intuitive finding which suggests that in many instances under value destroying uncertainty, entrepreneurs can create greater community welfare by taking a calculative mindset in their altruistic venturing (rather than a pure charitable mindset), because a calculative mindset incentivizes reciprocal returns to many actors and can leverage a much larger network of entrepreneurs to capitalize on the network effects of doing good. Our work extends and enriches Shepherd's (2015) proposal for an altruistic and community-based 'turn' in entrepreneurship research.

Model description

In this section, we develop a dynamic, interactive model of entrepreneurial action to address uncertain value-destroying events. Using agent-based modeling for complex adaptive systems such as ecosystems (Dosi et al., 1995; Grimm and Railsback, 2005; Miller and Page, 2007), we model a community of 'prospective' entrepreneurs (i.e., or '*actors'* in our model)) who face uncertain value-destroying events, following the assumption in the entrepreneurial action literature that does not differentiate entrepreneurs and non-entrepreneurs ex ante (Alvarez and Barney, 2013; Alvarez et al., 2013; McMullen and Shepherd, 2006; Shepherd, 2015). Prospective here means that we study the entrepreneurial phenomenon 'as it happens' by generating simulation data and analyzing the patterns that unfolded instead of relying on (historical, post-hoc) empirical data. Each prospective entrepreneur has an altruistic tendency to alleviate others' suffering in the community. The exogeneity of opportunity is captured in the 'external shocks' such as the frequency and severity of value destroying events and the initial state of welfare of each actor in the community. The endogeneity of opportunity is captured in the way that actors' welfare and 'resources' are dynamically updated through their entrepreneurial actions over time. That is, the interaction among community members is an iterative process that allows subsequent opportunities to be created and discovered following the exploitation of a current altruistic venturing opportunity. Thus, our model embraces both the 'created' (emanating from the interactions of actor's action) and 'given' (emanating from the environment and not related to actor's action) types of opportunity. For readability, most technical details are relegated in the appendices.

Community size

The *community* is represented as a two-dimensional network (i.e., matrix in the mathematical language) with K horizontal dimensions (i.e., rows) and N vertical dimensions (i.e., columns). Therefore, the community size can be calculated as $K \times N$, and each cell in the network represents an actor. Our community setting can be thought of as a global supply chain network where the actors located on the vertical dimension belong to the same supply-chain tier and produce similar outputs while the actors located on the horizontal dimension of the same supply chain play different roles from other players in the supplier-buyer relationship, and are located on a unique supply chain tier. Therefore, the community can be thought of as K actors who have similar functions in a supply chain; each K actor has N supply-chain (upstream and downstream) neighbors. To build a formal theory, we represent each actor's gains (i.e., welfare) at a certain time with a numerical *value* in an abstract manner. For example, value can represent economic, social, or psychological welfare, a combination thereof.

Our *community* setting, formulated as a network (or, matrix in the mathematical sense), can be visualized as a landscape in which each actor's welfare changes as the result of dynamic, social interactions between the actor and the community members, following Shepherd's (2015) call for an 'interactive' perspective of entrepreneurship. We adopt

Parker's (2008) bounded landscape design by assuming that each actor is constrained by her/his location in the community, which affects what opportunities (e.g., ways to help disaster victims, or ways to identify which disasters to exploit) they can create and discover. Therefore, our community setting is 'unwrapped'—walls exist to limit the community borders and limit actors' ability to create and discover opportunities. This mimics real life global supply chain networks, where upstream suppliers are restricted by their geographic locations and thus have little to no opportunity to approach downstream buyers who are in close proximity to end consumers.

Drawing on the network science (Lieberman et al., 2005; Ohtsuki et al., 2006), we model a neighborhood (see Appendix 1 for the technical details) where an actor interacts with two neighboring actors to the east and west (horizontal neighbors), as well as two neighboring actors to the south and north (vertical neighbors) (Miller and Page, 2007). The neighborhood model is depicted in Figure 1a.

Figure 1 goes about here

Actor and community welfare

In our model setting, each actor's welfare at each period may decrease if a random (and exogenous) value-destroying event (e.g., an earthquake) hits the community. Value-destroying events decrease the total welfare of the community (e.g., think the Fukushima nuclear disaster that caused a sharp decrease in the economic, social and psychological welfare of the local community). If a disaster occurs and threatens the community, some actors who are regular community members may take initiatives to bring about relief to the needy by expending resources that they own or can acquire, assemble, and/or recombine, which we label *resourcefulness*. This is consistent with what Shepherd (2015) calls "resourcefulness for compassionate responding" whereby entrepreneurial actions enable those who are not suffering in a disaster to help the unfortunate others who are suffering. We consider various resourcefulness scenarios in our model (discussed in more detail later).

We construct three possible states for each actor's welfare: *poor* (e.g., suffering from property damage and physical injury) , *fair* (e.g., alleviated suffering by meeting the basic human needs) or *good* (e.g., full recovery in health, mind, and financial security) and assign a value of 0, 1, and 2 respectively to each of the state. We also define the welfare of the actor on each particular cell at each period before and after an entrepreneurial action takes place with the corresponding 'pre-action' and 'post action' welfare value in the model (see Appendix 2 in details).

Uncertainty

In our model, we construct a world in which each actor has a probability of being affected by *major* and *minor* value destroying events at each period with different levels of severity and adversity. We also assume that an actor's pre-action welfare will turn to poor (0) when s/he is affected by a major value-destroying event but the pre-action value can range between poor (0) to fair (1) when s/he is affected by a minor value-destroying event, see Appendix 3. From there, we calculate the total community welfare following actions taken by all actors.

Entrepreneurial action process

Figure 2 goes about here

The sequence of entrepreneurial action process in our model—opportunity recognition, evaluation and exploitation—at period t is summarized in Figure 2. The logic of the model follows the interaction-based view of entrepreneurial action developed by McMullen and Shepherd (2006), Shepherd (2015), Shepherd et al. (2007), and Shepherd and Patzelt (2013). After a random value-destroying event such as a natural disaster occurs, each actor uses her/his knowledge about others' (and/or oneself's) suffering to recognize an opportunity for *someone* to act altruistically (i.e., recognizing third-person opportunities in the 'attention' stage of entrepreneurial action). Next, each actor evaluates the desirability and feasibility of the recognized opportunity to decide whether it is desirable for her/him self to act altruistically (i.e., evaluating first-person opportunities in the 'evaluation' stage of entrepreneurial action). Therefore, our model portrays a *feedback system* that involves mutual adjustment between the prospective entrepreneur and her/his community members to alleviate each other's suffering under value-destroying context, as suggested by Shepherd (2015) and Shepherd and Patzelt (2013).

Reciprocal vs. compassionate opportunity beliefs

In the opportunity exploitation stage of an entrepreneurial process (see Figure 2), each actor's action in each period is determined by her/his belief about the potential of an opportunity or what we label *opportunity belief* (Shepherd et al., 2007). An actor's opportunity belief is based on information about the actor's welfare and that of her/his two immediate neighbors (horizontal or vertical actors). We separate the possible amount of welfare imputed from the horizontal versus the vertical neighboring actors in order to test for the different degrees of desirability of opportunities for entrepreneurial action. We describe the technical description of the input and output states from opportunity recognition to exploitation in Appendix 4.

There are two well-received constructs in altruistic motivation that apply to the process of third-person opportunity recognition and first-person opportunity evaluation, and that lead to entrepreneurial action: *reciprocal altruism*, where altruistic acts are driven by an expectation of reciprocity or future payback from beneficiaries (Nowak, 2006; Trivers, 1971), and *compassionate altruism*, which is driven by a genuine concern for others with no expectation for reciprocity, payback of any form, including social recognition (Batson et al., 2008; Dutton et al., 2006; Grant and Berry, 2011; Miller et al., 2012; Patzelt and Shepherd, 2011; Penner et al., 2005). Reciprocal altruism brings about venturing opportunity to reciprocate with each other, which we operationalize as a construct called *reciprocal opportunity (RO) belief*. In this type of belief, actors engage in altruistic venturing only if the benefit-to-cost ratio, b/c, of the action is equal to or greater than the average number of connected neighbors, w, per actor (i.e., $b/c \geq w$), where c is the cost incurred to the altruist for alleviating others' suffering, b is the future benefit for the altruist's actions, and w is determined by the community structure (Lieberman et al, 2005; Nowak, 2006; Ohtsuki et al., 2006). Compassionate altruism brings about venturing opportunity to show genuine compassion to others, which we operationalize as a construct called *compassionate opportunity (CO) belief*; specifically, $b/c < w$. We do not assume altruism as being either reciprocal or compassionate but rather embrace and study both beliefs as a continuum that is differentiated by applying a simple rule of $b/c \geq w$ (driven by an RO belief) or $b/c < w$ (driven by a CO belief) as commonly used in the evolutionary literature on altruism and cooperation (Nowak, 2006).

We operationalize each *opportunity belief* at three levels: *low*, *medium*, and *high*. As shown in Table 1, CO belief is operationalized as low compassionate opportunity (CO-L), medium compassionate opportunity (CO-M), and high compassionate opportunity (CO-H) beliefs, where the levels increase in the benefit-to-cost (b/c) ratio. Likewise, RO belief is operationalized at three levels: low reciprocal opportunity (RO-L), medium reciprocal opportunity (RO-M), and high reciprocal opportunity (RO-H) beliefs, where the levels increase in the b/c ratio. For each type of belief, high (or low) level refers to high (or low) degree of the reciprocal b/c ratio as theorized in the evolutionary and network science literatures (Axelrod and Hamilton, 1981; Nowak, 2006; Santos et al., 2008). Consequently, a high (or low) level of opportunity belief is associated with a high (or low) likelihood of overcoming ignorance (leading to a third-person opportunity recognition) in the community (e.g., Ryan and Deci, 2000) because the expected benefit from others' reciprocal action may exceed (fall below) the resources needed to engage in altruistic action.

Each *opportunity belief* in our model is governed by a 'heuristic' that influences third-person opportunity recognition (recognizing that an opportunity exists for someone) and first-person opportunity evaluation (that an opportunity is desirable for her/himself) (McMullen and Shepherd, 2006; Shepherd et al., 2007). This follows the principle of bounded rationality in human and organizational decision-making and judgement in complex adaptive systems (Miller and Page, 2007). An actor, after sensing potential opportunities by inferring the welfare of horizontal and vertical neighbors in the community, evaluates whether the opportunities are feasible and desirable to warrant the costs and efforts required for entrepreneurial action (Autio et al., 2013; Haynie et al., 2009; Shepherd et al., 2007). (Please refer to the Appendix 5 for the technical operationalization of each opportunity belief in details.).

Table 1 goes about here

Action desirability: Low and high action threshold

Desirability refers to the extent to which an opportunity satisfies an actor's motives and goals (Shepherd and Patzelt, 2013). An actor is more likely to engage in entrepreneurial action if s/he has a low threshold for engaging in action, or being more optimistic, and high threshold for action or being pessimistic (Autio et al., 2013; McMullen and Shepherd, 2006). In this study, we model the low threshold of action by designing a small gap between opportunity belief and action desirability (see Appendix 6 for the technical details). Under the *low-action threshold* (LAT), an actor is more optimistic in forming a first-person opportunity belief and thus proceeds with an entrepreneurial action, informed by the recognized third-person opportunities from her/his neighboring actors. We also model *high action threshold* (HAT) by designing a large gap between opportunity belief and action desirability. For the sake of simplicity, we label both low and high action thresholds as *action desirability.*

Our formalization of the (high versus low) action threshold is consistent with 1) Shepherd et al.'s (2007) opportunity evaluation process that specifies how prospective entrepreneurs overcome doubt by forming a first-person opportunity belief that an opportunity is of value and desirable for him/her, and 2) Shepherd and Patzelt's (2011) intrinsic-motivation argument and desirability for sustainable entrepreneurial action.

Feasibility assessment: Actor's resources

Feasibility here means whether a desirable action meets or exceeds a prospective entrepreneur's capabilities and resources (McMullen and Shepherd, 2006; Shepherd and Patzelt, 2013). An opportunity is considered feasible when the resources needed for an entrepreneurial action are less than the resources that an actor owns or can acquire, assemble, and/or recombine (Shepherd, 2015). In this study, the feasibility of entrepreneurial action depends on actor's resourcefulness (how much resource an actor has). We design four *resourcefulness scenarios*, in which each scenario is affected by the *actor's resources* at a particular period, the exogenous resources added to an actor's resources (or *degree of external resource support*), and a *resourcefulness function* that determine whether actors' engage in an entrepreneurial action or not, see Appendix 7 for technical details. Table 2 lists all possible resourcefulness scenarios and the numerical instances of $y_1, y_2, y_3 \in \{1,5,10\}$ are used to operationalize the resourcefulness function in our study.

Table 2 goes about here

We divide the six resourcefulness scenarios into three categories, each of which represents a different way of acquiring, assembling, and/or recombining resources to engage in altruistic entrepreneurial action. Our scenarios comprise actors that need the *least amount of resources* to recover from a 1) 'poor to good' welfare (which we call Y1 and Y2), 2) a 'poor to fair' welfare (or Y3 and Y4), and 3) 'fair to good' welfare (or Y5 and Y6), see the examples in Table 2 for further illustration.

Our resourcefulness setting is conceptualized and operationalized in a generic manner and, hence, can reflect various situations in terms of the amount of resources that can be acquired, assembled, and recombined to alleviate suffering, suggested by Shepherd (2015). So our approach in modeling 'resourcefulness' captures the 'feasibility assessment' in the evaluation stage of entrepreneurial action.

Model operationalization

The simulation procedure for the proposed model is described as follows. At period 0, we assign the opportunity belief, the resourcefulness scenario, the probabilities of major and minor value-destroying events, and the initial welfare value to actors and their community. We assume that neighboring actors outside the edge of the community (or network) have good prior-action welfare. This good prior-action welfare reflects the community's situation before it is hit by a disaster. (Based on our robustness check, this specification does not affect the outcomes in the computational analysis.) The simulation is executed until time T is reached. At the end of the simulations, we calculate the average overall welfare of the community by tallying the welfare accumulated by each actor. This enables us to evaluate the robustness of each opportunity belief under various resourcefulness scenarios. Value-destroying (f and g) and external resource support (Δ) settings are considered exogenously in our model so we can focus on how the various opportunity beliefs, action desirability levels (i.e., action thresholds), and resourcefulness scenarios can affect altruistic action and the community's overall welfare.

Analysis

We conduct a computational analysis of the two opportunity beliefs (i.e., reciprocal vs. compassionate) under uncertain value-destroying events in line with prior simulation research in management (see Davis et al., 2007; Fauchart and Keilbach, 2009; Harrison et al., 2007). We first conduct a base-case analysis to derive preliminary insights (following a standard practice in simulation studies; see Sterman, 2000), and then conduct extensive computational analyses using a carefully designed simulation experiments (as prescribed by Kelton and Law (2000) and Montgomery (2004)).

Base case analysis

We set $N = 5$, $K = 3$, $U_{n,k}(0) = 3$, $\Delta = 1$, and $T = 365$ in the base case. This 5×3 community size network reflects a real-world configuration of global supply networks, where the most popular real-world supply networks range in size from 2 to 12 horizontal dimensions and 3 to 10 vertical dimensions (Graves and Willems, 2008). According to Sheffi (2007), natural disasters and supply-chain disruptions occur at $g = 134/365$ and $f = 17/365$ so we use these figures as the probabilities of minor and major value-destroying events, respectively, within a one-year window.

Each actor's welfare at period 0 is randomly assigned: poor (value = 0), fair (value = 1), or good (value = 2). Each parameter instance is repeated 200 times to achieve statistically reliable results. In line with the emergency and risk management literature (e.g., Myerson, 2005), with the focus of value destruction we are mostly concerned with the 'worst-case' scenarios. Therefore, Table 3 shows the 1st percentile of the community's overall welfare, Ψ, per period.

Table 3 goes about here

In addition, we plot the ranking outcomes of all opportunity beliefs (e.g., from CO-L to RO-L and RO-H) considered in Figure 3. As illustrated in Figure 3, the ranking of each opportunity belief for the 1st percentile of community welfare Ψ per period is dependent on the action threshold level (i.e., action desirability assessment, see Figure 2) and the resourcefulness scenario (i.e., feasibility assessment, see Figure 2), which fits our expectation.

Our findings show that, first, *under the low action threshold* (Panel A in Figure 3), *low-to-high reciprocal opportunity beliefs* (RO-L to RO-H) *generally outperform* (produce greater community welfare outcomes) *low-to-high compassionate opportunity beliefs* (CO-L to CO-H) in terms of the ranking of the 1st percentile of community welfare Ψ per period. That is, the dashed lines are mostly below the solid lines as lower rank means higher welfare to the community (i.e., rank 1 is the best and rank 6 is the worst). The exception goes to low reciprocal opportunity belief (RO-L) under Y3, as it fares worse than low compassionate opportunity belief (CO-L) under Y3. This may be explained by the possible mismatch between the low reciprocal opportunity belief (RO-L), where actors in the community strive to recover to the good post-action welfare 2 ($0 \rightarrow 2$ or $1 \rightarrow 2$), and the resourcefulness scenario (Y3), where actors perform best only in increasing their welfare from poor to fair value ($0 \rightarrow 1$) following a value-destroying event. In other words, under the low reciprocal opportunity belief (RO-L) and low action threshold (LAT) scenario, resourcefulness has a weak influence on entrepreneurial action.

Figure 3 goes about here

On the other hand, under the high action threshold (Panel B in Figure 3) scenario, the low and high compassionate opportunity beliefs (CO-L and CO-H) rank the highest in welfare value, particularly under resourcefulness scenarios Y3 and Y4 compared to all other opportunity beliefs. Interestingly, medium reciprocal opportunity belief (RO-M) consistently has the lowest ranking (i.e., producing the least community welfare) compared to all other opportunity beliefs. This suggests the downside of reciprocal altruism. Thus, under the high action threshold (where opportunities do not meet an actor's motives and goals), reciprocal altruism generates a 'negative' feedback loop such that each actor is reluctant to engage in strong altruistic action to alleviate others' suffering. As Figure 3 illustrates, the rankings of opportunity beliefs vary the most under resourcefulness scenarios Y3 and Y4. From the base case analysis, we conclude that for the overall community welfare of Ψ, *reciprocal opportunity beliefs generally outperform compassionate opportunity beliefs under the low action threshold* (Figure 3 Panel A). However, *compassionate opportunity beliefs generally outperform reciprocal opportunity beliefs under the high action threshold* and resourcefulness scenarios Y3 and Y4 (Figure 3 Panel B). The '*reciprocal – low action threshold' and 'compassionate – high action threshold' relationships are an important insight from the simulation.* While these findings are insightful, they require further robustness checks. We thus conduct extensive experimental studies to validate our preliminary findings, as described next.

Experimental design

Table 4 goes about here

In the following experimental design, we assess each parameter across various settings to understand how each parameter impacts the overall community welfare under the threats of random value-destroying events. Drawing on insights from the base-case analysis, we construct a full factorial design to explore and test the following proposed model. Specifically, we conduct experiments using 144 ($= 6 \times 3 \times 2 \times 2 \times 2$) designs based on the combination of each parameter instance described in Table 4. These parameter instances provide a wide range of possible scenarios (i.e., six resourcefulness scenarios, Y; a small, medium, and large number of vertical dimensions in the community, N; a small and large number of horizontal dimensions in the community, K; low and high external resource support per period, Δ; and, short and long simulated period lengths, T). We run each parameter instance 200 times to produce statistically reliable results.

The implications of the low-action threshold

Table 5 goes about here

Table 5 presents the main effect analysis of the low action (desirability) threshold (where opportunities satisfy an actor's motives and goals) using a regression analysis. We highlight the parameters that lead to significant differences in the welfare ranking of opportunity beliefs at p-value less than 0.05. Our experiments demonstrate that *resourcefulness (Y) has the largest effect on the rankings of the 1st percentile of overall community welfare* Ψ *per period, followed by external resource support per period* (Δ) *and community size* (N *and* K)*.* Note that the length of simulation (T) does not have a statistically significant effect except for high compassionate opportunity belief (CO-H), so it is omitted in the subsequent analysis.

Specifically, the RO-L produces the best ranking outcome, 2.271, when the community can recover from a poor prior-action welfare condition to a good post-action welfare condition in a more innovative and low-cost manner (i.e., Y1 and Y2) than the other resourcefulness scenarios (i.e., Y3-Y4 and Y5-Y6). Under resourcefulness scenarios Y3-Y4 (least resources required to change a poor prior-action welfare condition to a fair post-action welfare condition, see Table 2), the rankings of CO-L and CO-H improve by 0.958 (= 5.896 – 4.938) and 0.646 (= 5.375 – 4.729), respectively. The rankings of RO-M and RO-H also improve under resourcefulness scenarios Y5-Y6 by up to 0.374 (= 1.812 – 1.438) and 0.604 (= 2.208 – 1.604), respectively. Overall, these findings suggest that *reciprocal opportunity beliefs produce a higher level of post-action community welfare than that of the compassionate opportunity beliefs* under resourcefulness scenarios Y1, Y2, Y5, and Y6; but produce a lower community welfare level than compassionate opportunity beliefs under resourcefulness scenarios Y3 and Y4.

As also shown in Table 5, *external resource support* (Δ) *is the second most significant factor that influences the ranking of some opportunity beliefs*, particularly the CO-L, CO-H, and RO-M. The parameter Δ negatively affects the ranking of CO-L and CO-H by 0.972 (= 6.000 – 5.028) and 0.639 (= 5.472 – 4.833), respectively. In contrast, external resource support has a positive effect on RO-M with a 0.597 (= 1.903 – 1.306) increase in ranking. Finally, the community size, vertical dimension (N) and horizontal dimension (K), also significantly affect the rankings of some opportunity beliefs, particularly the CO-L, CO-H, RO-M, and RO-H. For instance, CO-L produces lower ranking outcomes as the community size grows in either the horizontal (K) and vertical (N) dimensions. Conversely, the increase of horizontal dimension (K) or vertical dimension (N) improves the ranking outcome of RO-M and RO-H.

Figure 4 shows the boxplots of the ranking of the 1st percentile of the overall community welfare Ψ per period for each opportunity belief, under the six resourcefulness scenarios, Y1 to Y6. The mean and variation of the ranking outcomes reveal the robustness of each opportunity belief. Figure 4 illustrate a large ranking dispersion (i.e., long boxes) under Y3 and Y4 (to change a poor prior-action welfare to a fair post-action welfare; see Table 2) across all six opportunity beliefs; the same large variation was observed in the base-case analysis. It is not surprising to see that RO-L and RO-H on average rank higher than CO-L and CO-H (*suggesting that the reciprocal opportunity beliefs outperform compassionate opportunity beliefs*); which is consistent with our findings in Table 5.

Figure 4 goes about here

The implications of the high action threshold

Under the high action (desirability) threshold (where opportunities do not satisfy an actor's motives and goals), as Table 6 shows, *the rankings of opportunity beliefs with respect to the 1st percentile of overall community welfare of Ψ per period are influenced by resourcefulness (Y), external resource support per period (Δ), and community size (N and K).* Moreover, the effect of these factors significantly varies between the reciprocal and compassionate opportunity beliefs scenarios. For instance, under the resourcefulness scenarios Y3 and Y4, the rankings of CO-L, CO-M and CO-H increase by 0.5 (= 3.646 – 3.146), 0.250 (= 5.000 – 4.750), and, 0.375 (= 3.542 – 3.167) respectively. Yet the rankings of two reciprocal opportunity beliefs, RO-L and RO-H, decrease by 1.000 (= 2.000 – 1.000) and 0.250 (= 2.625 – 2.375), respectively; note that these two opportunity beliefs perform the best among other reciprocal opportunity beliefs, under resourcefulness scenarios Y1 and Y2 with a ranking of 1.000 and 2.208.

Table 6 goes about here

Likewise, both external resource support per period and community size positively influence the ranking of reciprocal opportunity beliefs such as RO-H, yet negatively influence the ranking of compassionate opportunity beliefs such as CO-L. Therefore, *reciprocal opportunity beliefs are associated with greater overall community welfare than the compassionate opportunity beliefs when community size and/or external resource support per period are large*; however, this does not hold under Y3 and Y4 resourcefulness scenarios. A plausible explanation for this finding is that reciprocal opportunity beliefs are more likely to motivate actors to reciprocate benefits and help each other to achieve good outcomes, post-action welfare, but this is costly to attain under Y3 and Y4 resourcefulness scenarios. As a result, the ranking of overall community welfare is negatively affected. On the other hand, compassionate opportunity beliefs rank well for actors located in small communities and have low levels of external resource support; this effect is even stronger under resourcefulness scenarios Y3 and Y4. In other words, *reciprocal opportunity beliefs outperform compassionate opportunity beliefs when the community size and resourcefulness are high; and compassionate opportunity beliefs outperform reciprocal opportunity beliefs when the community size and resourcefulness are low.*

Figure 5 goes about here

To illustrate the rankings of the six opportunity beliefs under the high action threshold (where opportunities do not satisfy an actor's motive and goal), we provide the boxplots under various levels of resourcefulness in Figure 5. Figure 5 shows that the rankings of the opportunity beliefs are insensitive to resourcefulness except for in resource scenario Y3. RO-L is consistently the highest ranked opportunity belief, followed by RO-H. Two of the two reciprocal opportunity beliefs, RO-L and RO-H, outperform all three compassionate opportunity beliefs, CO-L, CO-M, and CO-H. However, compared to the analysis under the low action threshold in Table 5, one notable difference is the dramatic drop in RO-M's ranking from 1.5 to 6 under the high action threshold. In other words, when actors doubt the desirability of the recognized opportunities, eventually they are less likely to pursue entrepreneurial action.

Overall, our study reveals that *different opportunity beliefs produce different community welfare outcomes* (see the ranking of opportunity beliefs, under the various action desirability thresholds, as shown in Figures 6a and 6b). To ease the comparison between Figures 6a and 6b, we provide Figure 6c to demonstrate the ranking differences under different action threshold levels. We do so by calculating the differences of the rankings under the low from the high action threshold. A net positive difference means that a specific opportunity belief ranking is higher under the low action threshold, and a net negative difference means a specific opportunity belief ranking is higher under the high action threshold. To illustrate this, we use the RO-M as an example. On average, for RO-M, the ranking difference between the high and low action thresholds is 4.5 (= 6 – 1.5); that is, RO-M's ranking is 4.5 higher under the low action threshold. Following this logic, as demonstrated in Figure 6c, *the reciprocal opportunity beliefs tend to rank higher (produces higher community welfare) than the compassionate opportunity beliefs under the low action threshold condition*. This finding is consistent with the insights derived from the base case analysis illustrated in Figure 3. More details on the ranking differences across all opportunity beliefs and each resourcefulness scenarios are provided in the Appendix, and reflect similar patterns as observed in Figure 6c.

Figure 6 goes about here

Discussion

Our model and analysis offer the first mapping of the relationship between two types of altruistic motivation in entrepreneurial action that improves others' welfare—reciprocal (calculative) and compassionate (non-calculative) opportunity beliefs—and three important moderating factors—community size, actor's action desirability, and community members' welfare value increment (see Figure 7)—as well as their joint influence on community welfare creation. As our analysis shows, reciprocal opportunity belief generates greater community welfare than compassionate opportunity belief in the aftermath of a random value destroying event (e.g., disaster) when actors are more able to recognize that an opportunity fits their desires (i.e., have low action threshold), and the community size and welfare value increment of community members are large. In contrast, compassionate opportunity belief generates greater community welfare than reciprocal opportunity belief in the aftermath of a value-destroying event when actors are less able to recognize that an opportunity fits their desires (i.e., have high action threshold; hence act cautiously in improving community welfare), and when the community size and community members' welfare value increment are small. The square box in the lower middle part of Figure 7 is the zone where both reciprocal and compassionate opportunity beliefs co-exist, with no specific direction of influence on the community welfare.

Figure 7 goes about here

In general, our study demonstrates that any altruistic-venturing action following a value-destroying event (i.e., disaster) will lead to increased community welfare. However, the path from opportunity belief to the decision to pursue an opportunity depends on the actor's degree of optimism or what we label as *desirability* of the action (high or low action threshold). Specifically, an actor is likely to engage in an entrepreneurial action in the post-value destroying event when the opportunity is deemed desirable for action (i.e., it satisfies the actor's motives and goals for low action threshold). When actors who engage in entrepreneurial action are driven by an expectation of future payback (i.e., reciprocal opportunity belief), the more desirable an action is, the higher the likelihood that the actors will act to increase community welfare because such action also increases the actor's own welfare in the form of potential future payback. In this scenario, altruistic-venturing act is not charity but insurance where action entails calculative effort to secure future benefits.

On the other hand, when actors are driven by genuine compassion and personal sacrifice (with no or little potential future payback) to alleviate others' suffering in a post-value destruction recovery effort, the more desirable an action is, the lesser the likelihood that the actors will act to increase community welfare because such action will be very costly to the actors. In this scenario, altruistic-venturing act is pure charity where action entails selfless and costly effort with no possible returns. These insights lead to the following two propositions.

> **Proposition 1a.** *Ceteris paribus, the positive relationship between reciprocal opportunity belief and community welfare creation in the post-value destroying event is positively moderated by the desirability of entrepreneurial action. That is, the more desirable an entrepreneurial action is, the stronger the positive relationship between reciprocal opportunity belief and the overall community welfare.*

> **Proposition 1b.** *Ceteris paribus, the positive relationship between compassionate opportunity belief and community welfare creation in the post-value destroying event is negatively moderated by the desirability of entrepreneurial action. That is, the less desirable an entrepreneurial action is, the stronger the positive relationship between compassionate opportunity belief and the overall community welfare.*

Next, we propose that *the welfare value increment* of community members (which is dependent on actors' resourcefulness and external resource support) in the post-value destroying context influences the exploitability of an identified opportunity. Similar to the moderating role of the 'action desirability' construct above, when actors engage in reciprocal entrepreneurial action with an expectation of future payback (i.e., reciprocal opportunity belief), the greater the welfare value increment of community members (due to actors' higher resourcefulness and external resource support), the higher the likelihood that the actors will act to increase community welfare because such action will increase their individual welfare in the form of potential future payback. In this scenario, the welfare value increment of community members is a determining factor that strengthens the link between altruistic acts and community welfare creation, thus it creates a positive feedback loop connecting entrepreneurial action, community member's welfare value increment, and total community welfare.

In contrast, because compassionate action for others' welfare (i.e., compassionate opportunity belief) consumes one's own resources (with no guarantee of future payback), the lower the community members' welfare value increment (due to actors' lower resourcefulness and external resource support), the more the actors will be motivated to engage in entrepreneurial action. However, when the welfare value increment of the community members is comparatively high (due to actors' greater resourcefulness and external resource support), it will weaken the actors' tendency to engage in entrepreneurial action to increase community welfare. This is primarily because entrepreneurial actors do not see the need to act altruistically when community members are in good condition (i.e., not suffering, have high welfare value) following a value destroying event and if they act altruistically when community members are in good condition, such action will consume a large amount of an actor's own resources. These insights lead to the following propositions.

Proposition 2a. *Ceteris paribus, the positive relationship between reciprocal opportunity belief and community welfare creation in post-value destroying event is positively moderated by the degree of welfare value increment of community members. That is, the higher the welfare value increment of community members, the stronger the positive relationship between reciprocal opportunity belief and the overall community welfare.*

Proposition 2b. *Ceteris paribus, the positive relationship between compassionate opportunity belief and community welfare creation in post-value destroying event is negatively moderated by the degree of welfare value increment of community members. That is, the lower the welfare value increment of community members, the stronger the positive relationship between compassionate opportunity beliefs and the overall community welfare.*

Finally, we propose that the larger the *community size*, the larger the number of community members with good welfare value and the greater the potential third-person opportunities will be in the post-value destroying event. When acting altruistically is driven by an expectation for future payback (i.e., reciprocal opportunity belief), actors are more likely to seek reciprocal help from community members with good pre-action welfare value; the tendency to do this is enhanced when the community size is larger, because larger communities have more members with good welfare value. Therefore, community size strengthens the relationship between calculative altruistic acts (i.e., reciprocal opportunity belief) and community welfare.

On the other hand, when acting altruistically consumes personal resources and offers no future payback (i.e., compassionate opportunity belief), actors are likely to focus their efforts on community members with poor pre-action welfare value and the tendency to do this is enhanced when the community size is smaller, because a smaller community has fewer members who can be helped and helping fewer community members is less costly to the actors. Even though actors feel compassionate to help others, they are limited by the amount of personal resources. Likewise, a larger community tends to have more members with good welfare value, which makes it less attractive for compassionate actors to act, because such action will be very costly and likely not affordable. These lead to the final propositions:

Proposition 3a. *Ceteris paribus, the positive relationship between reciprocal opportunity belief and community value creation in the post-value destroying event is positively moderated by the community size. That is, the larger the community size, the stronger the positive relationship between reciprocal opportunity beliefs and the overall community welfare.*

Proposition 3b. *Ceteris paribus, the positive relationship between compassionate opportunity belief and community value creation in the post-value destroying event is negatively moderated by the community size. That is, the smaller the community size, the stronger the positive relationship between compassionate opportunity beliefs and the overall community welfare.*

Conclusion and future research directions

This study leads us to conclude several important general mechanisms behind the opportunities for entrepreneurs wishing to engage as good citizens in the community. First, the findings suggest that entrepreneurs can create greater community welfare by taking a calculative mindset in their altruistic action (rather than a pure charitable, non-calculative mindset), because a calculative mindset incentivizes reciprocal returns to many actors and in this way, it can leverage a much larger network of firms to capitalize on the network effects of doing good. The simulations show that when altruism is purely driven by charity and non-calculative mindset, few entrepreneurs will be motivated to engage in doing good; and ultimately, when all other actors think alike nobody will be incentivized to act altruistically and therefore the community welfare will be less optimal. This pattern depends on the community size, action desirability, and welfare value increment of the community members (resulting from their resourcefulness); when these factors are large, being calculative (having reciprocal opportunity belief) produces greater community welfare outcomes than being non-calculative (having compassionate opportunity belief). However, when these factors are small, the reverse takes place.

Second, our study offers a stress test of the conditions under which entrepreneurs can create greater social impact (i.e., community welfare) and it identifies the contingency factors. Our findings imply that reciprocity-oriented entrepreneurs may generate greater social impact (than compassionate-oriented entrepreneurs) facing uncertain value-destroying event under several contingencies, particularly when (i) entrepreneurial action is more desirable, (ii) there are more community members in good condition (i.e., the community welfare value increment is higher) and (iii) the community size is larger (than smaller). In contrast, compassionate-oriented entrepreneurs may create greater social impact than reciprocity-oriented entrepreneurs facing uncertain value-destroying event while entrepreneurial action is less desirable, fewer community members are in good condition (i.e., the community welfare value increment is comparatively low), and community size is comparatively small.

As this study shows, *community size is a key factor in influencing the social impact of entrepreneurial efforts*. Larger community size entails higher number of community members with good welfare value (vs. a smaller community) and this induces reciprocity-oriented entrepreneurs to act as good citizens because greater community size leads to greater returns and higher reciprocal action to solve collective problems. This insight may explain why the reciprocal acts of altruism by Findus to help the European frozen food industry recover from the horsemeat scandal was successful (BBC, 2013ab; Guardian, 2013)—the frozen food industry comprises a large network of firms. This reveals the workings of the "network effect" (see e.g., Sterman, 2000), where the more actors are in a network, the greater the value of the network for entrepreneurs.

Our study illustrates that understanding the altruistic motives may help prospective entrepreneurs identify an opportunity in post disaster entrepreneurial context (i.e., an opportunity to alleviate others' sufferings with vs. without expectations of future payback). And the eventual outcome of the opportunity is dependent on the entrepreneur's desire to act and available resources. Specifically, we recommend that prospective entrepreneurs motivated by reciprocal returns actively exploit any identified opportunities within their resource constraints. On the other hand, entrepreneurs motivated by charitable compassion need to carefully evaluate the identified opportunities and be selective on taking actions. This motive generates the best outcome when there is an economical way (e.g., via donations and volunteers) to meet the basic human needs and minimize the sufferings of the affected others.

Moreover, as prospective entrepreneurs with a reciprocal mindset attempt to recover from a disaster, they must consider the size of embedded community (e.g., network, ecosystem), which is a key factor in influencing the community welfare outcomes. This means that reciprocity-oriented entrepreneurs to act as good citizens in a larger-sized community have greater returns and more reciprocal actions to solve collective problems. We therefore suggest that in many instances under value destroying uncertainty, prospective entrepreneurs with a calculative mindset (rather than a pure charitable mindset) can create better recovery outcome, since a calculative mindset incentivizes reciprocal returns to many actors and can leverage a much larger network to capitalize on the network effects of doing good.

This study has several limitations. First, it relies on certain assumptions that were built into the computer simulations. Although the assumptions built in the simulation design were grounded on known empirical facts, observations and well-accepted tradition in computer simulation, this study does not capture all variants of assumptions (e.g., other types of entrepreneurial motivation, different types and levels of resourcefulness) that may be important in this study.

The first promising avenue for future research involves extending our approach to allow actors (prospective entrepreneurs) to face multiple and often contradictory options at a particular time. The trade-offs and difficult decisions faced by prospective entrepreneurs can be simulated in the computer laboratory. Furthermore, the entrepreneurs in our computer experiments do not change their opportunity evaluation criteria over the simulation period. Yet we know that in reality entrepreneurs may adapt their thinking and change their opportunity belief over time. Future research can explore this adaptation process and its resulting impact on the community welfare.

The second future research direction is to enrich the network structures in the simulation model. This can be done by designing simulations in which actors can be influenced by other actors based on some form of 'similarity' (not just 'distance', as used in our study) or relatedness (e.g., friendship, kinship etc.). From a slightly different approach, future research can consider the team composition and team dynamics by employing a collective mindset of a team to form a particular opportunity belief. future research can consider the community size as an evolving dynamic network structure so that it can respond to post-disaster events by adding and/or removing a member (i.e., flexible community size) over time.

Last but not least, we propose future research that integrates computer simulation with 'rich and thick' longitudinal case study to enhance our understanding of the social reality and the alternative pathways that could have happened but did not eventuate.

Overall, our study makes a novel contribution to the domain of entrepreneurship-disaster interface (i.e., disaster entrepreneurship) and the broader entrepreneurship literature by advancing the contingency effects of altruistic motives and their eventual outcome in post disaster entrepreneurial context. That is, the outcomes of altruistic action in post disaster entrepreneurship driven by calculative or reciprocal motivations is to a large extent determined by the network size (or effect) of the actors, their desire to act, and how much value they can accumulate over time. When these factors are large, calculative post disaster entrepreneurial action will generate greater macro level benefits for the community than a reciprocal would. This offers a counter intuitive insight to the prevailing assumption that calculative mindset in businesses is not desirable nor ethical for the society as a whole. Through this counter intuitive insight, our study also moves the conversation on post-disaster entrepreneurship and the broader entrepreneurship literature toward the community level as a theoretically important unit of analysis. It is timely that scholars devote more research on the community instead of excessively focusing on the venture or entrepreneur level.

Appendices: Technical details

Appendix 1

We adopt the standard von Neumann neighborhood in which actors are located in a 2-dimensional space with neighbors across four directions (north, south, east, and west) For more details, see Miller and Page (2007). Figure 1a illustrates a focal actor (n, k) located at column $n \in \{1, \cdots, N\}$ and row $k \in \{1, \cdots, K\}$ who has four neighbors to its north, south, east and west. Each of the four neighbors (actors) at the edge of the community has fewer neighbors.

Appendix 2

We construct three possible states for each actor's welfare: *poor* (value = 0), *fair* (value = 1), or *good* (value = 2). The welfare of the actor on the (n, k) cell at period t, before entrepreneurial action, is denoted by $\phi_{n,k}(t) \in \{0,1,2\}$ (*pre-action* welfare of (n, k) actor at period t), and the welfare of the actor on the (n, k) cell at period t, after entrepreneurial action, is denoted by $\psi_{n,k}(t) \in \{0,1,2\}$ (*post-action* welfare of (n, k) actor at period t), where $t \in \{1, \cdots, T\}$ indicates the period in our model.

Appendix 3

In our model, each actor has a probability f of being afflicted by random events with *major* value destruction and a probability g of being afflicted by random events with *minor* value destruction at each period. These two types of value destruction vary in the levels of severity and adversity. Specifically, when encountering a major value-destroying event at period t, the (n, k) actor's pre-action welfare becomes $\phi_{n,k}(t) = 0$ regardless of its welfare in the preceding period, $\psi_{n,k}(t-1)$; whereas under the condition of minor value-destroying events at period t, the (n, k) actor's pre-action welfare becomes $\phi_{n,k}(t) = \left[\psi_{n,k}(t-1) - 1\right] \vee 0$, which is $\max\{\psi_{n,k}(t-1) - 1, 0\}$. To simplify the notations, we use $a \vee b \coloneqq \max\{a, b\}$ and $a \wedge b \coloneqq \min\{a, b\}$ for $a, b \in \mathbf{R}$, throughout this paper. The total community welfare, following the actions taken by all actors at period t, is thus $\Psi(t) = \sum_{k=1}^{K} \sum_{n=1}^{N} \psi_{n,k}(t)$.

Appendix 4

Our model maps and transforms each possible input state, $\phi_{j,k}(t),\ j \in \{n-1, n, n+1\}$ ($\phi_{n,l}(t),\ l \in \{k-1, k, k+1\}$), to an output state, $h_{n,k}(t)$ ($v_{n,k}(t)$), for every actor in the community. As illustrated in Figure 1b, we denote the possible third-person opportunity recognized by the (n,k) actor, at period t, in the horizontal and vertical dimensions, by $h_{n,k}(t)$ and $v_{n,k}(t)$, respectively.

Appendix 5

Community members form and act upon opportunity beliefs to pursue good post-action values after a value-destroying event. As discussed in the model section, an actor's opportunity belief is dependent on the value that the actor and her/his two neighbors (horizontal or vertical) possess following a random value-destroying event. Let $H = \{\phi_{n-1,k},\ \phi_{n,k},\ \phi_{n+1,k}\}$ represent the horizontal neighborhood set for the (n,k) actor, and $V = \{\phi_{n,k-1},\ \phi_{n,k},\ \phi_{n,k+1}\}$ for her/his vertical neighborhood set. We denote the possible third-person opportunity recognized by, at period t, in the horizontal and vertical dimensions, by $h_{n,k}(t)$ and $v_{n,k}(t)$, respectively. The actor then can evaluate the identified third-person opportunities in terms of the desirability. That is, under the low action threshold, $\Phi_{n,k}(t) = h_{n,k}(t) \vee v_{n,k}(t)$, whereas under the high action threshold, $\Theta_{n,k}(t) = h_{n,k}(t) \wedge v_{n,k}(t)$.

In this study, we consider six types of opportunity beliefs, CO-L, CO-M, CO-H, RO-L, RO-M, and RO-L. The detailed operationalization of them is explained as follows.

CO-L. An actor recognizes a compassionate opportunity even when both horizontal (or vertical) neighbors are in poor pre-action values. S/he coordinates the pain-relieving efforts to help community members get better (e.g., attaining fair post-action values) at her/his own costs—the good pre-action value deteriorates post action. Her/his post-action value remains good only when both horizontal (or vertical) neighbors are in good values prior to action. Formally, in the horizontal dimension, $h_{n,k} = 2$ if $\wedge_{\phi_j \in H}\ \phi_j = 2$; otherwise $h_{n,k} = 1$. Also, we derived the third-person opportunity in the vertical dimension as $v_{n,k} = 2$ if $\wedge_{\phi_j \in V}\ \phi_j =$

2; otherwise $v_{n,k} = 1$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \begin{cases} 2, & \text{if } \phi_{n,k} \wedge \left[\left(\phi_{n-1,k} \wedge \phi_{n+1,k}\right) \vee \left(\phi_{n,k-1} \wedge \phi_{n,k+1}\right)\right] = 2, \\ 1, & \text{otherwise.} \end{cases}$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \begin{cases} 2, & \text{if } \wedge_{\phi_j \in (H \cup V)} \phi_j = 2, \\ 1, & \text{otherwise.} \end{cases}$$

CO-M. An actor recognizes a compassionate opportunity when one horizontal (or vertical) neighbor is in poor pre-action value. S/he coordinates the pain-relieving efforts to help community members get better (e.g., attaining good post-action values). However, s/he cannot be successful without the cooperation of another good value neighbor prior to action. Formally, in the horizontal dimension, let $Q_h = \{q_1, q_2, q_3\}$, where $q_1 = \phi_{n-1,k} \vee \phi_{n,k}$, $q_2 = \phi_{n,k} \vee \phi_{n+1,k}$, and $q_3 = \phi_{n-1,k} \vee \phi_{n+1,k}$, then $h_{n,k} = 2$ if $\wedge_{q_j \in Q_h} q_j = 2$; otherwise $h_{n,k} = 1$. Similarly, in the vertical dimension, let $Q_v = \{q_4, q_5, q_6\}$, where $q_5 = \phi_{n,k-1} \vee \phi_{n,k}$, $q_5 = \phi_{n,k} \vee \phi_{n,k+1}$, and $q_6 = \phi_{n,k-1} \vee \phi_{n,k+1}$, then $v_{n,k} = 2$ if $\wedge_{q_j \in Q_v} q_j = 2$; otherwise $v_{n,k} = 1$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \begin{cases} 2, & \text{if } \left[\wedge_{q_j \in Q_h} q_j\right] \vee \left[\wedge_{q_j \in Q_v} q_j\right] = 2, \\ 1, & \text{otherwise.} \end{cases}$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \begin{cases} 2, & \text{if } \wedge_{q_j \in (Q_h \cup Q_v)} q_j = 2, \\ 1, & \text{otherwise.} \end{cases}$$

CO-H. An actor recognizes a compassionate opportunity when at most one horizontal (or vertical) neighbor is in poor pre-action value. S/he coordinates the pain-relieving efforts to help upstream community members get better (e.g., attaining good post-action values) at personal costs—a poor downstream neighbor may her/his good value post action. Formally, in the horizontal dimension, let $A_1 = \{\phi_{n-1,k} = 2\}$, $A_2 = \{\phi_{n-1,k} = 1,\ \phi_{n,k} = 1\}$, $A_3 = \{\phi_{n-1,k} = 0\}$, and $A_4 = \{\phi_{n,k} > 0\}$, then $h_{n,k} = 2$ if $A_1 \cup A_2$; $h_{n,k} = 0$ if $A_3 \cap A_4$;

otherwise $h_{n,k} = 1$. Likewise, in the vertical dimension, let $B_1 = \{\phi_{n,k-1} = 2\}$, $B_2 = \{\phi_{n,k-1} = 1,\ \phi_{n,k} = 1\}$, $B_3 = \{\phi_{n,k-1} = 0\}$, then $v_{n,k} = 2$ if $B_1 \cup B_2$; $v_{n,k} = 0$ if $A_4 \cap B_3$; otherwise $v_{n,k} = 1$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \begin{cases} 2, & \text{if } (A_1 \cup A_2) \cup (B_1 \cup B_2), \\ 0, & \text{if } A_4 \cap (A_3 \cap B_3), \\ 1, & \text{otherwise.} \end{cases}$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \begin{cases} 2, & \text{if } (A_1 \cup A_2) \cap (B_1 \cup B_2), \\ 0, & \text{if } A_4 \cap (A_3 \cup B_3), \\ 1, & \text{otherwise.} \end{cases}$$

RO-L. An actor recognizes a reciprocal opportunity when both horizontal (or vertical) neighbors and self are not in good pre-action values. S/he cooperates with the community members to help each other and improve their post-action values together. Formally, in the horizontal dimension, $h_{n,k} = 1$ if $\wedge_{\phi_j \in H} \phi_j = 2$; otherwise $h_{n,k} = 2$. Also, we derive the third-person opportunity in the vertical dimension as $v_{n,k} = 1$ if $\wedge_{\phi_j \in V} \phi_j = 2$; otherwise $v_{n,k} = 2$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \begin{cases} 1, & \text{if } \wedge_{\phi_j \in (H \cup V)} \phi_j = 2, \\ 2, & \text{otherwise.} \end{cases}$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \begin{cases} 1, & \text{if } \phi_{n,k} \wedge \left[\left(\phi_{n-1,k} \wedge \phi_{n+1,k} \right) \vee \left(\phi_{n,k-1} \wedge \phi_{n,k+1} \right) \right] = 2, \\ 2, & \text{otherwise.} \end{cases}$$

RO-M. An actor recognizes a reciprocal opportunity when at least one horizontal (or vertical) neighbor is in worse value than oneself prior to action. S/he helps the community members to improve their post-action values in exchange for reciprocal return in the future when s/he is in worse pre-action values than neighbors. Following this logic, s/he will benefit from a neighbor's good value (as a payback) to improve her/his post-action value. Formally, in the horizontal dimension, $h_{n,k} = \wedge_{\phi_j \in H} \phi_j$. Likewise, we derived the third-person opportunity in the vertical dimension as $v_{n,k} = \wedge_{\phi_j \in V} \phi_j$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \wedge_{\phi_j \in (H \cup V)} \phi_j.$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \phi_{n,k} \vee \left[\left(\phi_{n-1,k} \wedge \phi_{n+1,k} \right) \wedge \left(\phi_{n,k-1} \wedge \phi_{n,k+1} \right) \right].$$

RO-H. An actor recognizes a reciprocal opportunity when at least one horizontal (or vertical) neighbor is not in good pre-action value. The actor's good prior-action value remains when s/he helps the community members recover to good post-action values. So this favor can be easily returned in the future when she/he is in need of help. Formally, in the horizontal dimension, $h_{n,k} = 1$ if $\vee_{\phi_j \in H} \phi_j = 2$; otherwise $h_{n,k} = 2$. Similarly, in the vertical dimension, $v_{n,k} = 2$ if $\vee_{\phi_j \in V} \phi_j = 2$; otherwise $v_{n,k} = 1$.

Next, the actor determines whether the identified third-person opportunities are desirable. Specifically, under the low action threshold,

$$\Phi_{n,k} = \begin{cases} 2, & \text{if } \vee_{\phi_j \in (H \cup V)} \phi_j = 2, \\ 1, & \text{otherwise.} \end{cases}$$

In comparison, under the high action threshold,

$$\Theta_{n,k} = \begin{cases} 2, & \text{if } \phi_{n,k} \vee \left[\left(\phi_{n-1,k} \wedge \phi_{n+1,k} \right) \wedge \left(\phi_{n,k-1} \wedge \phi_{n,k+1} \right) \right] = 2, \\ 1, & \text{otherwise.} \end{cases}$$

Appendix 6

In this study, we model the low threshold of action, formally as $\Phi_{n,k}(t) = h_{n,k}(t) \vee v_{n,k}(t)$, by designing a small gap between opportunity belief and action desirability. Conversely, the gap between opportunity belief and action desirability can also be high, for in this model, the *high action threshold* (HAT), stated formally is $\Theta_{n,k}(t) = h_{n,k}(t) \wedge v_{n,k}(t)$. Then the desirability of entrepreneurial action leading to opportunity exploitation, $\psi_{n,k}(t) \in \{\Phi_{n,k}(t), \Theta_{n,k}(t)\}$, can be determined.

Appendix 7

To state it formally, $U_{n,k}(t) = U_{n,k}(t-1) + \Delta - C\left(\phi_{n,k}(t), \psi_{n,k}(t)\right) \geq 0$ where $U_{n,k}(t)$ is the (n,k) actor's resource amount at period t; Δ is an exogenous resource amount added to an actor's resources from external sources for each period and that support altruistic action, which we call the *degree of external resource support*; C is the *resourcefulness function* for an actor with prior-action welfare $\phi_{n,k}(t)$ to reach post-action welfare $\psi_{n,k}(t)$. If $U_{n,k}(t) < 0$, the (n,k) an actor will not engage in altruistic action because the opportunity is deemed not feasible. Therefore, the actor's welfare will remain in $\phi_{n,k}(t)$. The actor's resourcefulness function for altruistic action is given by

$$C(\phi_{n,k}(t), \psi_{n,k}(t)) = \begin{cases} 0 & \text{for } \{\phi_{n,k}(t) \geq \psi_{n,k}(t)\}, \\ y_1 & \text{for } \{\phi_{n,k}(t) = 0\} \cap \{\psi_{n,k}(t) = 2\}, \\ y_2 & \text{for } \{\phi_{n,k}(t) = 0\} \cap \{\psi_{n,k}(t) = 1\}, \\ y_3 & \text{for } \{\phi_{n,k}(t) = 1\} \cap \{\psi_{n,k}(t) = 2\}, \end{cases}$$

in which an actor expends: nil (zero) resource amount to engage in entrepreneurial action when prior-action welfare is no less than post-action welfare, the resource amount of y_1 to change a *poor* prior-action welfare to a *good* post-action welfare, the resource amount of y_2 to change a *poor* prior-action welfare to a *fair* post-action welfare, and, the resource amount y_3 to change a *fair* prior-action welfare to a *good* post-action welfare. We assume that $y_1 \neq y_2 \neq y_3$ such that different degrees of resourcefulness entitled to actors and their community can be considered in our analysis.

Table 1. Opportunity beliefs and their operationalization.

Table 1b. Opportunity beliefs and their operationalization.			
	CO-H (high compassionate opportunity belief)	CO-M (medium compassionate opportunity belief)	CO-L (low compassionate opportunity belief)
Meaning	An actor recognizes an opportunity to act when at most one horizontal (or vertical) neighbor has poor pre-action welfare. The actor coordinates the relief efforts to help community members with some expected personal gains (still less than the costs).	An actor recognizes an opportunity to act when one horizontal (or vertical) neighbor has poor pre-action welfare. The actor coordinates the relief efforts to help community members recover at the actor’ s own costs.	An actor recognizes an opportunity to act when both horizontal (or vertical) neighbors have poor pre-action welfare. The actor coordinates the relief efforts to help community members recover with little expectation of personal gains.
Benefit-to-cost ratio	$\frac{b}{c} = \frac{20/54}{8/54} < 4$	$\frac{b}{c} = \frac{30/54}{18/54} < 4$	$\frac{b}{c} = \frac{18/54}{16/54} < 4$
Examples	In August 2005, Hurricane Katrina devastated the New Orleans healthcare system. Many (charity) hospitals in the local area remained closed one year after the disaster, including the Medical Center of Louisiana at New Orleans—negatively affected the poor and uninsured population. Some entrepreneurs were motivated to alleviate the sufferings of these people, at the personal expense, by rebuilding the community-based health services and promoting broader access to care, under uncertainty about the size and composition of the population that would return to the affected areas (Eaton, 2007). Trauma nurse Alice Craft-Kerney and her Lower Ninth Ward Health Clinic is a typical example. Craft-Kerney gave up her secure nursing job and committed to building a clinic from scratch. Her compassionate action aimed to provide free health care to the residents of the Lower Ninth Ward, one of the poorest communities in New Orleans. With the help of volunteers, contractors, and the medical community, her clinic started to serve patients in early 2007, making a great contribution to community redevelopment (Rothschild, 2007).		

Table 1a. Opportunity beliefs and their Operationalization.

	RO-H (high reciprocal opportunity belief)	RO-M (medium reciprocal opportunity belief)	RO-L (low reciprocal opportunity belief)
Meaning	An actor recognizes an opportunity to act when at least one horizontal (or vertical) neighbor does not have good pre-action welfare. The actor helps the community members recover to good post-action welfare without sacrificing self-benefits, while the neighbors are willing to reciprocate the help in the future.	An actor recognizes an opportunity to act when at least one horizontal (or vertical) neighbor has worse pre-action welfare than the actor. The actor helps the community members improve their post-action welfare in exchange for a reciprocal return in the future (i.e., if s/he is in worse pre-action welfare than neighbors).	An actor recognizes an opportunity to act when both horizontal (or vertical) neighbors and one’ s self do not have good pre-action welfare. The actor works in collaboration with community members to help each other and attain good post-action welfare together.
Benefit-to-cost ratio	$\frac{b}{c} = \frac{28/54}{0/54} \rightarrow \infty$	$\frac{b}{c} = \frac{26/54}{0/54} \rightarrow \infty$	$\frac{b}{c} = \frac{36/54}{2/54} > 4$
Examples	Christopher Girdwood, the founder of Recovery Pledge, explores opportunities to help small businesses recover from disasters by connecting them with customers to stabilize their sales (see, www.recoverypledge.com). Specifically, a customer can purchase recovery pledges once a disaster occurs, which are the vouchers for the goods and services that are produced by small businesses in need. Her or his consumption behavior not only satisfies personal needs, but also offers cash to small businesses that is essential to their recovery from a disaster. In other words, recovery pledges build a *reciprocal relationship* between customers and small businesses in times of disasters. It is noticeable that Recovery Pledge addresses the major barrier for small businesses recovery—the loss of sales. Even though government can provide low-interest loans, the small businesses cannot pay the loans back if there are no customers. Examples include the turmoil that small businesses experienced during the 2010 Deepwater Horizon oil spill. Recovery Pledge identified and exploited this opportunity to launch a crowd-funding campaign in pursuit of both customer satisfaction and small business survival.		

Table 2. Resourcefulness scenarios.

<table>
<tr><th>Scenarios</th><th>y_1 $(0 \rightarrow 2)$</th><th>y_2 $(0 \rightarrow 1)$</th><th>y_3 $(1 \rightarrow 2)$</th><th>Remark</th></tr>
<tr><td>Y1</td><td>1</td><td>5</td><td>10</td><td rowspan="2">$y_1 = \wedge_{i \in \{1,2,3\}} y_i$</td></tr>
<tr><td>Y2</td><td>1</td><td>10</td><td>5</td></tr>
<tr><td colspan="5">These two scenarios represent the cases that altruistic ventures adopt a cheap and innovative way to improve others' welfare from poor to good $(0 \rightarrow 2)$. For instance, the 2019-20 bushfire season heavily impacted various states of Australia. Residents of the fire-affected communities faced a long journey of recovering and rebuilding. In January 2020, a Spend-With-Us initiative was started by Sarah Britz, Lauren Hateley, and Jenn Donovan with the aims to help those families and communities and do more than donating to charities. Utilizing their own web design skills and social media connections, they developed an e-commerce platform (www.spendwithus.com.au) where any small and micro business in the fire-affected rural and regional areas can create a free online store and Australian people can easily find those products and support the businesses. This shopping marketplace has shown great success on helping the communities bounce back financially and psychologically, and enhancing their resilience in the face of natural disasters.</td></tr>
<tr><td>Y3</td><td>10</td><td>1</td><td>5</td><td rowspan="2">$y_2 = \wedge_{i \in \{1,2,3\}} y_i$</td></tr>
<tr><td>Y4</td><td>5</td><td>1</td><td>10</td></tr>
<tr><td colspan="5">These two scenarios represent the cases that altruistic ventures alleviate others' suffering and provide basic human needs $(0 \rightarrow 1)$ at a low cost. But it would be resource intensive to fully recover to the good state. For instance, in the face of humanitarian refugee crisis in Germany, many altruistic ventures were set up to support the refugees (Mittermaier et al., 2021). Among them, the ones that aim to provide sustainable integration of refugees into local society (e.g., language and occupational training) would require more resources and long-term orientation than those that focus on meeting refugees' urgent needs (e.g., providing clothes and essential care packages, collecting and distributing used laptops).</td></tr>
<tr><td>Y5</td><td>10</td><td>5</td><td>1</td><td rowspan="2">$y_3 = \wedge_{i \in \{1,2,3\}} y_i$</td></tr>
<tr><td>Y6</td><td>5</td><td>10</td><td>1</td></tr>
<tr><td colspan="5">These two scenarios represent the cases that altruistic ventures need to spend enormous amount of resources to provide immediate disaster relief $(0 \rightarrow 1)$ and then restore the good state $(1 \rightarrow 2)$ at a low cost. For instance, the use of standard masks during the COVID-19 pandemic could impair verbal communication and hide facial expressions. A start-up company, ClearMask created transparent facial marks to address the this issue (www.theclearmask.com). The company was initially founded to create transparent surgical masks for deaf and hard of hearing patients who may rely on lip reading and facial expression to communicate with doctors. It took the entrepreneurs three years on R&D to optimize the mask design (anti-fog technology). While waiting from FDA approval in 2019, the company introduced the non-medical facial masks to meet the needs of a larger community affected by COVID and brings more connection and joy between people during the pandemic.</td></tr>
</table>

Table 3. Base case analysis of community welfare.

		Y1	*Rank*	Y2	*Rank*	Y3	*Rank*	Y4	*Rank*	Y5	*Rank*	Y6	*Rank*
Low Action Threshold (LAT)	**CO-L**	4.575	*6*	2.208	*6*	10.000	*3*	10.000	*4*	4.514	*6*	2.210	*6*
	CO-M	5.911	*4*	8.966	*4*	8.992	*5*	9.652	*6*	5.556	*4*	11.149	*4*
	CO-H	4.638	*5*	2.289	*5*	9.990	*4*	9.997	*5*	4.573	*5*	2.252	*5*
	RO-L	15.988	*1*	17.030	*1*	6.743	*6*	12.190	*3*	16.819	*3*	19.143	*3*
	RO-M	14.533	*2*	16.888	*2*	10.180	*2*	12.295	*1*	17.781	*2*	19.684	*2*
	RO-H	14.289	*3*	16.818	*3*	10.351	*1*	12.271	*2*	17.990	*1*	19.690	*1*
High Action Threshold (HAT)	**CO-L**	4.585	*4*	2.230	*3*	10.000	*1*	10.000	*2*	4.496	*4*	2.222	*4*
	CO-M	2.167	*5*	1.097	*5*	7.125	*4*	6.908	*5*	2.022	*5*	1.008	*5*
	CO-H	4.608	*3*	2.178	*4*	9.997	*2*	9.997	*3*	4.574	*3*	2.232	*3*
	RO-L	15.229	*1*	15.927	*1*	5.941	*5*	10.975	*1*	12.377	*1*	16.303	*1*
	RO-M	0.059	*6*	0.026	*6*	0.082	*6*	0.125	*6*	0.048	*6*	0.027	*6*
	RO-H	4.710	*2*	2.311	*2*	9.988	*3*	9.997	*3*	4.637	*2*	2.278	*2*

Note. The upper bound of the overall value where each actor in the community has a good state is 30 ($= N \times K \times 2$). The numerical figure in this table is the 1st percentile of community welfare per period, calculated based on 200 experiments in a 365-day period.

Table 4. Parameter instances in the simulation experiments.

Parameter	Values	Meaning
Y	{Y1, Y2, Y3, Y4, Y5, Y6}	The resourcefulness scenarios
N	{3, **5**, 10}	The vertical dimension of the community
K	{**3**, 5}	The horizontal dimension of the community
Δ	{**1**, 10}	The external resource support imputed at each period
T	{**365**, 3650}	Simulation period length of each run

Note. The base case parameters are indicated in bold letters.

Table 5. Experimental results under the low action threshold.

Parameter	value	CO-L	CO-M	CO-H	RO-L	RO-M	RO-H
Y	{Y1-Y2}	**5.896**	**4.000**	**5.375**	**2.271**	**1.562**	**2.208**
		(0.309)	**(0.000)**	**(0.489)**	**(0.939)**	**(0.616)**	**(0.651)**
	{Y3-Y4}	**4.938**	4.208	**4.729**	**3.750**	**1.812**	1.812
		(1.743)	(0.410)	**(1.395)**	**(1.313)**	**(1.197)**	(0.641)
	{Y5-Y6}	**5.708**	**4.208**	**5.354**	**3.000**	**1.438**	**1.604**
		(0.617)	**(0.617)**	**(0.565)**	**(0.000)**	**(0.501)**	**(0.494)**
N	{3}	5.479	**4.042**	**5.312**	3.083	1.562	**2.000**
		(1.337)	**(0.202)**	**(1.114)**	(1.048)	(1.009)	**(0.583)**
	{5}	5.438	4.125	5.250	3.021	1.625	1.896
		(1.236)	(0.393)	(1.101)	(1.082)	(0.866)	(0.692)
	{10}	5.625	**4.250**	**4.896**	2.917	1.625	**1.729**
		(0.841)	**(0.601)**	**(0.472)**	(1.200)	(0.606)	**(0.644)**
K	{3}	5.417	4.153	**5.292**	3.014	**1.778**	**1.750**
		(1.275)	(0.465)	**(0.971)**	(1.107)	**(0.791)**	**(0.727)**
	{5}	5.611	4.125	**5.014**	3.000	**1.431**	**2.000**
		(1.015)	(0.409)	**(0.927)**	(1.113)	**(0.853)**	**(0.531)**
Δ	{1}	**5.028**	**4.278**	**4.833**	3.014	**1.903**	**2.000**
		(1.482)	**(0.587)**	**(1.175)**	(1.570)	**(1.009)**	**(0.787)**
	{10}	**6.000**	**4.000**	**5.472**	3.000	**1.306**	**1.750**
		(0.000)	**(0.000)**	**(0.503)**	(0.000)	**(0.464)**	**(0.436)**
T	{365}	5.556	4.139	**5.014**	3.000	1.625	1.861
		(1.161)	(0.454)	**(0.911)**	(1.113)	(0.895)	(0.657)
	{3650}	5.472	4.139	**5.292**	3.014	1.583	1.889
		(1.150)	(0.421)	**(0.985)**	(1.107)	(0.783)	(0.640)

Note. The numerical value above represents the ranking of opportunity beliefs (compassionate opportunity beliefs or CO, and reciprocal opportunity beliefs or RO; low = L, medium = M, high = H), based on the 1st percentile of the overall welfare of the community per period; each welfare value is calculated based on 200 runs of 24 experiments. Standard deviations are in parentheses. Opportunity beliefs with smaller numerical figures mean higher welfare outcome, where "1" is the best in welfare outcome while 6 is the worst.

Table 6. Experimental results under the high action threshold.

Parameter	value	CO-L	CO-M	CO-H	RO-L	RO-M	RO-H
Y	{Y1-Y2}	**3.046**	**5.000**	**3.542**	**1.000**	6.000	**2.208**
		(0.526)	**(0.000)**	**(3.146)**	**(0.000)**	(0.000)	**(0.504)**
	{Y3-Y4}	**3.148**	**4.750**	**3.167**	**2.000**	6.000	2.375
		(1.111)	**(0.438)**	**(0.808)**	**(1.750)**	(0.000)	(0.489)
	{Y5-Y6}	**3.250**	**5.000**	**3.396**	**1.062**	6.000	**2.625**
		(0.934)	**(0.000)**	**(0.736)**	**(0.433)**	(0.000)	**(0.866)**
N	{3}	3.188	4.917	3.250	1.396	6.000	2.521
		(0.891)	(0.279)	(0.700)	(1.180)	(0.000)	(0.652)
	{5}	3.396	4.917	3.458	1.333	6.000	2.375
		(0.939)	(0.279)	(0.743)	(1.117)	(0.000)	(0.672)
	{10}	3.458	4.917	3.396	1.333	6.000	2.312
		(0.898)	(0.279)	(0.736)	(1.117)	(0.000)	(0.657)
K	{3}	**3.125**	4.917	3.361	1.375	6.000	**2.556**
		(0.903)	(0.278)	(0.718)	(1.156)	(0.000)	**(0.690)**
	{5}	**3.569**	4.917	3.375	1.333	6.000	**2.250**
		(0.802)	(0.278)	(0.740)	(1.113)	(0.000)	**(0.599)**
Δ	{1}	**2.903**	**4.833**	**3.014**	**1.708**	6.000	**2.597**
		(1.050)	**(0.375)**	**(0.778)**	**(1.524)**	(0.000)	**(0.709)**
	{10}	**3.792**	**5.000**	**3.722**	**1.000**	6.000	**2.208**
		(0.409)	**(0.000)**	**(0.451)**	**(0.000)**	(0.000)	**(0.409)**
T	{365}	3.375	4.917	3.319	1.375	6.000	2.361
		(0.926)	(0.278)	(0.700)	(1.156)	(0.000)	(0.635)
	{3650}	3.319	4.917	3.417	1.,333	6.000	2.441
		(0.901)	(0.278)	(0.746)	(1.113)	(0.000)	(0.690)

Note. The experiment settings are identical to those in Table 5 (under low action threshold).

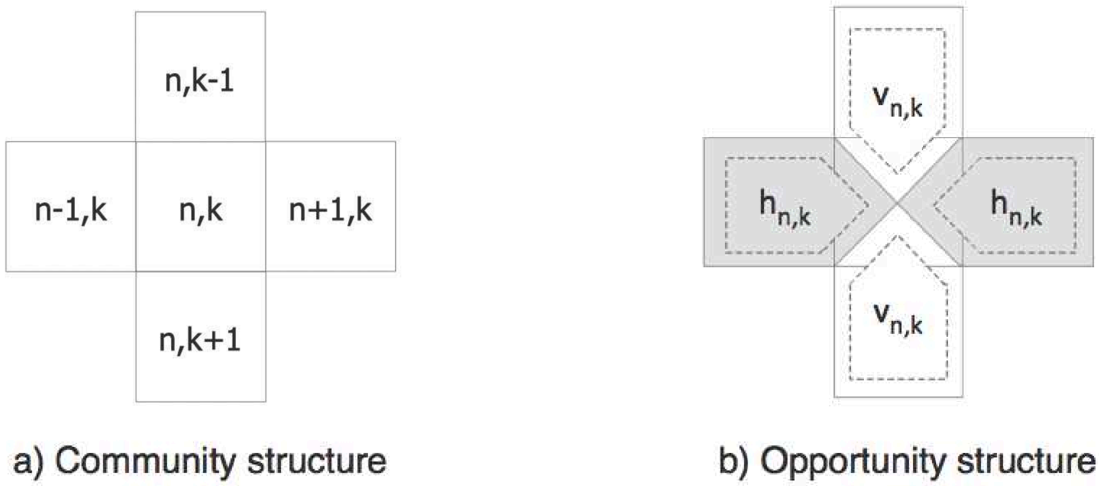


Figure 1. The Interaction structure of prospective entrepreneurs and their community.

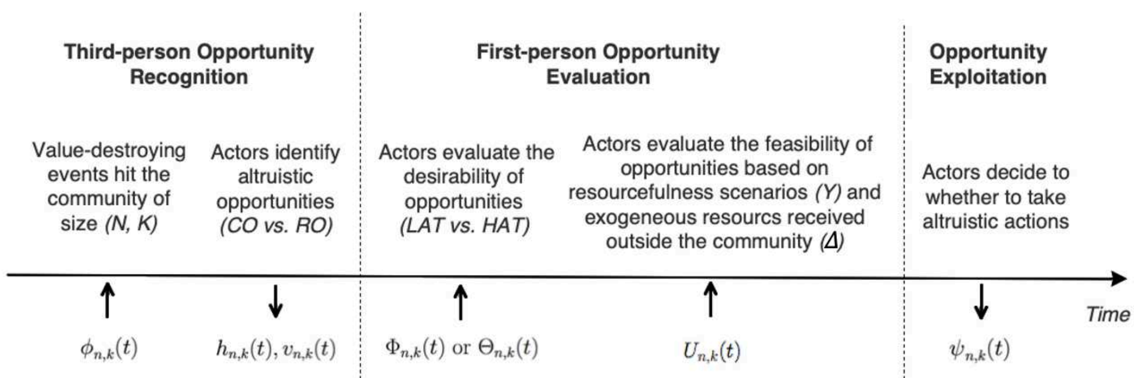
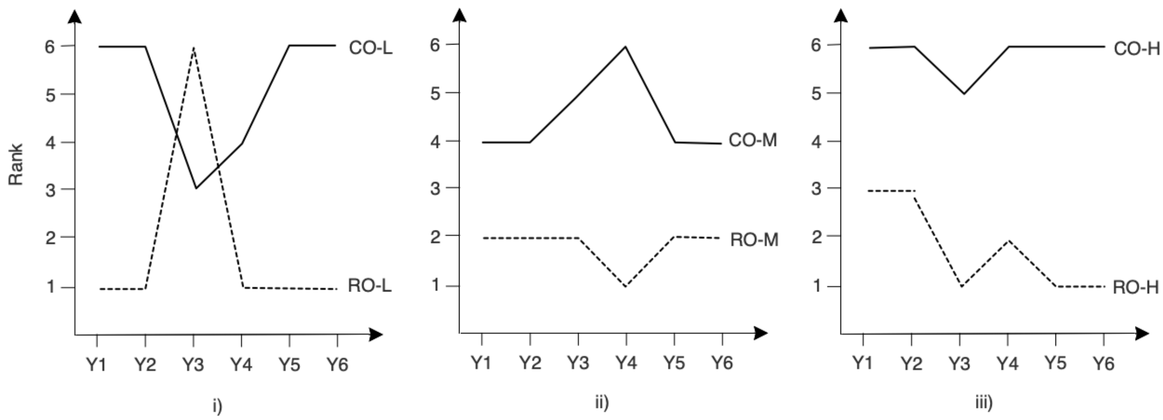
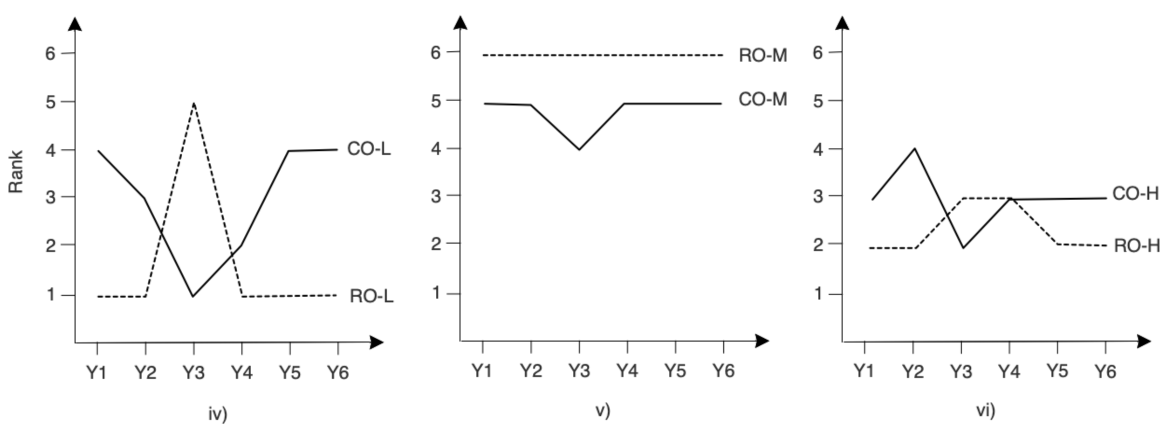


Figure 2. An entrepreneurial-action process under value-destroying uncertainty at period t.

Panel A. Welfare rankings under the Low Action Threshold (LAT).



Panel B. Welfare rankings under the High Action Threshold (HAT).



Note. The plots are based on the 1st percentile of community welfare ranking of the opportunity beliefs in Table 3. Compassionate opportunity beliefs are represented by solid lines; Reciprocal opportunity beliefs are represented by dashed lines. Lower ranking means better value or outcome; thus rank 1 is the best and rank 6 is the worst in terms of the community's overall welfare (1st percentile).

Figure 3. Base case plot of the welfare ranking of opportunity beliefs.

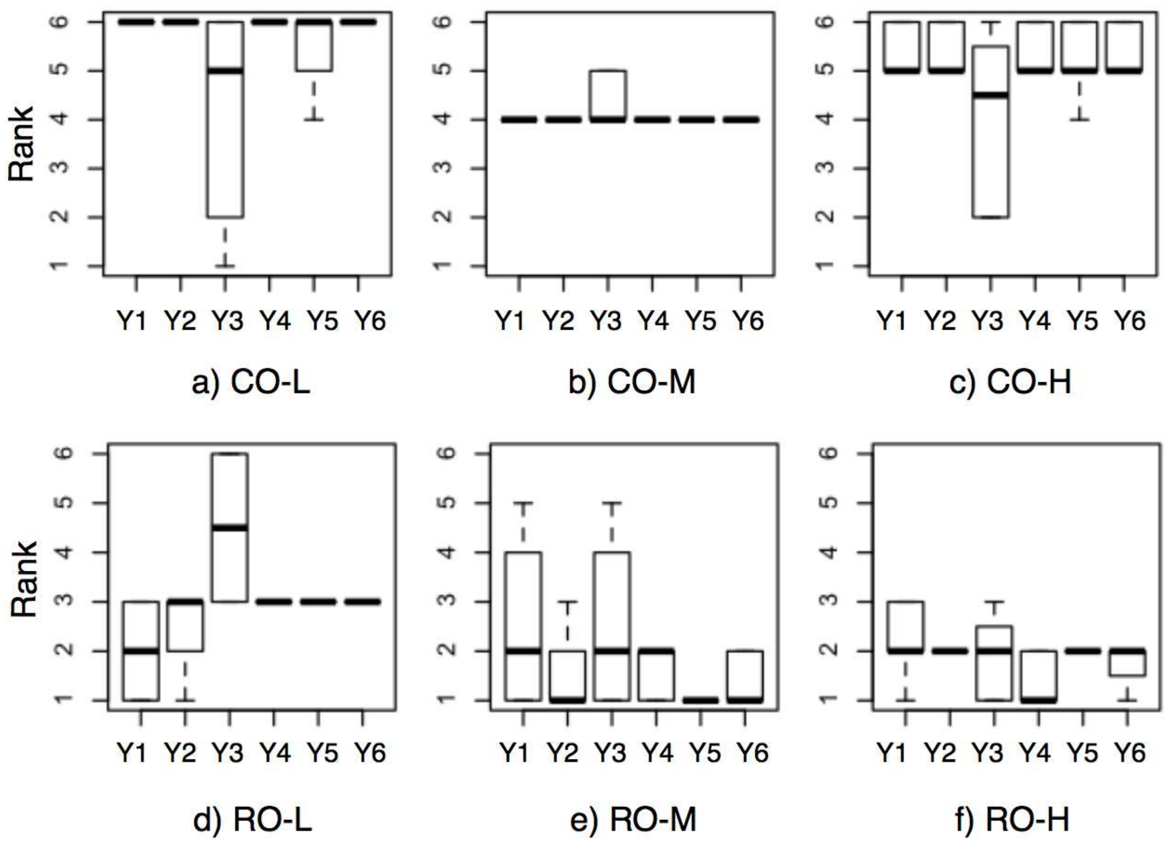


Figure 4. Ranking of opportunity beliefs under the low action threshold.

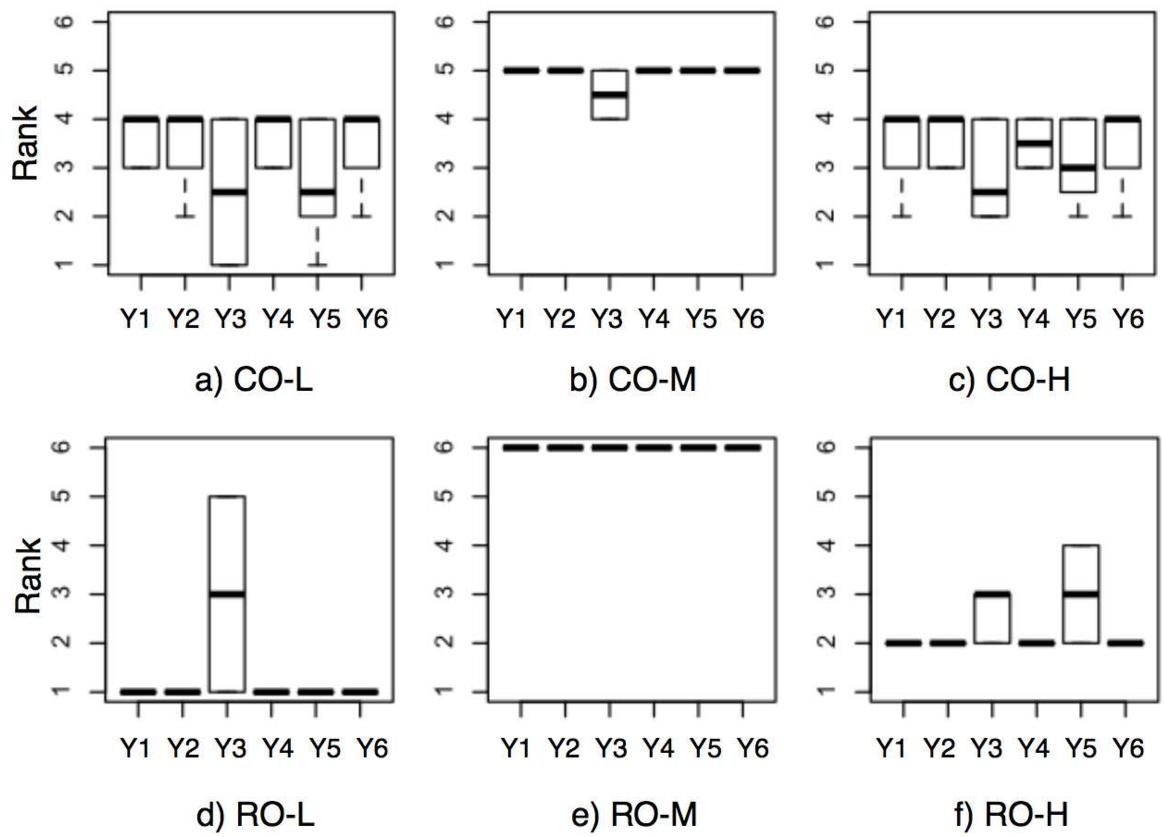


Figure 5. Ranking of opportunity beliefs under the high action threshold.

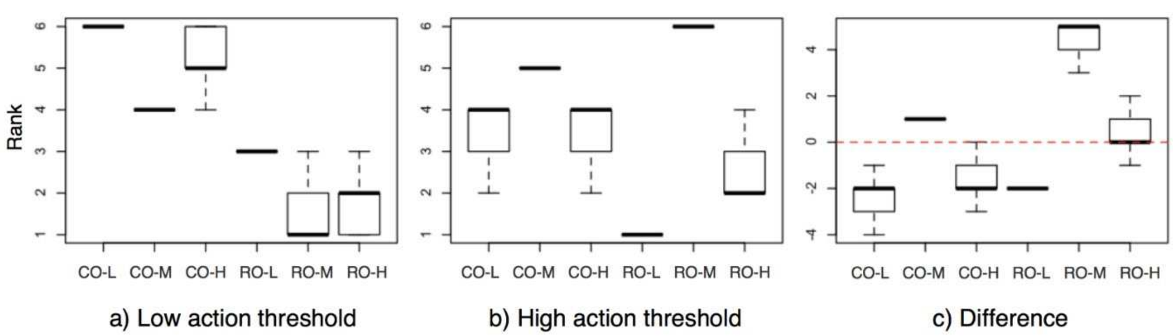
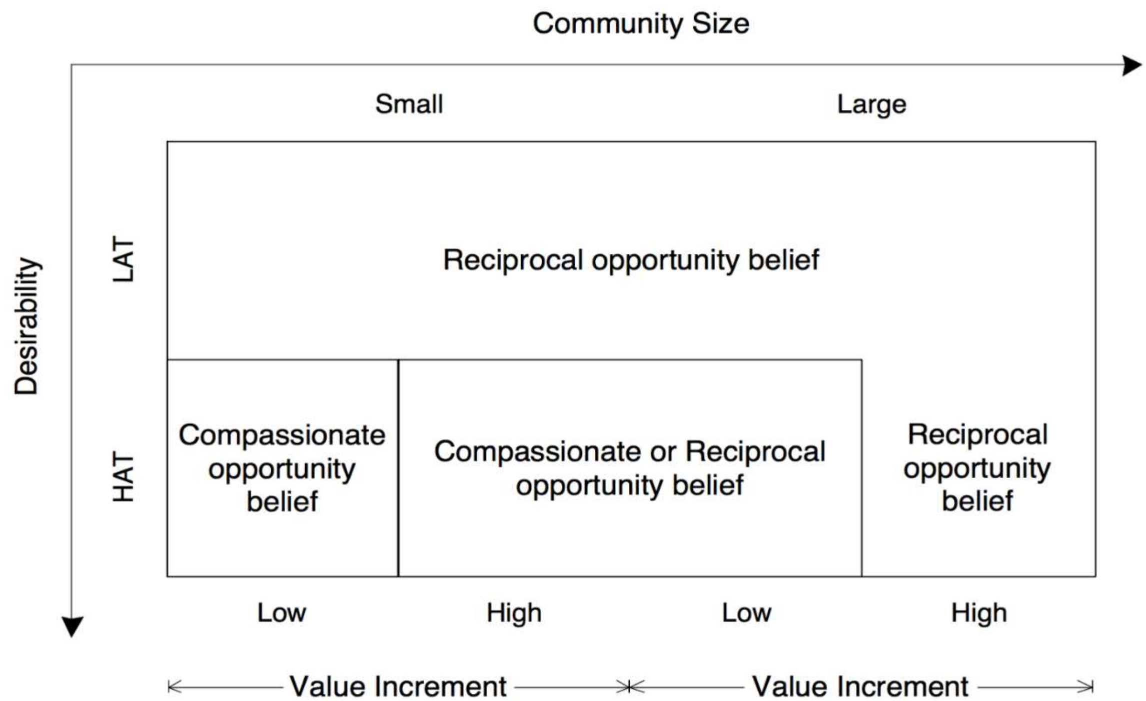


Figure 6. Boxplots of opportunity beliefs.



Note. LAT=low action threshold; HAT = high action threshold.

Figure 7. A community-based model of entrepreneurial action in the aftermath of a value-destroying event.

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