

Commoning toward urban resilience

The role of trust, social cohesion, and involvement in a simulated urban commons setting

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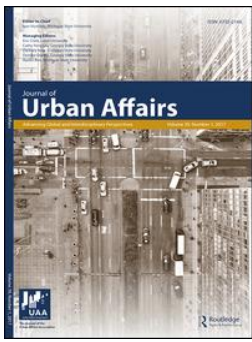
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Commoning toward urban resilience: The role of trust, social cohesion, and involvement in a simulated urban commons setting

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ABSTRACT

In this paper, we investigate the potential of urban commons for building community resilience. We focus on the issue of adaptability to socio-ecological issues, which depends on the social capital built by the local community of practice. We measure this capital through the variables of volunteer involvement, perceived trust, and social cohesion in an agent-based model, which simulates the dynamics of participation in collective activities. We anchor our model with the case of Kaskantine in Amsterdam, a cooperative and restaurant run by volunteers. Our model shows that both trust and social cohesion emerge from the interactions in the cooperative, especially when group sizes are kept small. This contributes to the adaptability of such social-ecological systems, helping their communities build social resilience.

Introduction

In the aftermath of an environmental, socio-economical, or sanitary crisis, we question our adaptability as individuals within a community. We thus thrive for community resilience as a means to mitigate future crises. With the population concentration happening in cities, such concerns are particularly legitimate for urban communities. “A city without resilient communities will be extremely vulnerable to disasters. Human communities are the social and institutional components of the city, directing its activities, responding to its needs, and learning from its experience” (Kim & Lim, 2016, p. 6).

Recent research has placed emphasis on processes of co-production and collective governance as drivers of urban resilience (Elmqvist et al., 2019; Kim & Lim, 2016; Meerow et al., 2016; Shah & Garg, 2017). Among such processes, the wide-spread urban practice of commoning “involves a collaborative process of bringing together a wide spectrum of actors that work together to co-design and co-produce shared, common goods and services at different scales” (Bollier & Helfrich, 2015; Bresnihan & Byrne, 2015; Foster & Iaione, 2019, p. 4). In the city context, the urban commons are generated through commoning processes, either as resources, which can be material, immaterial or digital, or as more complex “forms of social infrastructure” (Foster & Iaione, 2019, p. 16). In the latter case, the commons comprise dynamics of mobility, encounter and the re-imagination of the social and spatial environment (Susser & Tonnelat, 2013). What matters is not only preserving the urban commons, but the struggle over the conditions of producing them (Hardt & Negri, 2009). These conditions revolve around an ecosystem of local practices, guaranteed by a citizen-based democratic governance at a community scale (Petrescu et al., 2016). Multiple studies have highlighted the urban commons as a potential for higher urban resilience (Camps-Calvet et al., 2015; Colding & Barthel, 2013; Mundoli et al., 2017; Petrescu et al., 2016; Radywyl & Bigg, 2013; Schuppenlehner-Kloyber & Penker, 2016). R-Urban in Paris is a good example of a network of commons which is part of a participatory strategy of civic resilience. It connects local inhabitants, researchers, and public authority mostly around an urban community garden, which is a gate to

other pedagogic activities: recycling facility, co-working space, repair café, communal kitchen, and compost. All activities have a social, economical, and ecological dimension, with a strong collective decision-making part (Petrescu et al., 2016).

Although community resilience through the urban commons has been emphasized in numerous research articles, none have formally demonstrated the role of the urban commons in sustaining community resilience, nor the conditions that lead to this resilience.

In this research, we explore the role of urban commons for building community resilience and investigate conditions under which such communities can reach higher resilience. In addition to grounding our research in a real-world example, we use agent-based modeling and simulation to conduct our research. In the next section, we provide theoretical evidence of the role which urban commons can play in community resilience building. Then, we introduce our experimental methodology, by formulating clear hypotheses to be tested in this research, and laying the theoretical basis of the agent-based model used for that purpose. In the following section, we present the empirical data which we calibrate and populate the model with, and we develop the structure of our agent-based model: overview, conceptualization, and measured outcomes. In the results section, we present the outcomes of interest of our model in terms of social capital building, we test our research hypotheses, and we give details on the conditions favorable to community resilience. Finally, we discuss our findings on social capital building in the urban commons in the light of recent research. This allows us to indicate paths for further research in the field of urban community resilience.

Urban commons and community resilience

In this section, we provide theoretical background on urban resilience and hypothesize how urban commons can potentially lead to higher urban resilience. Meerow et al. (2016, p. 39) defined urban resilience as “the ability of an urban system—and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales—to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity.” The most recent paradigm of resilience thinking is about social-ecological resilience, with adaptability rather than robustness as its key characteristics (Quigley et al., 2018). Adaptability comes out as a key requirement in the social-ecological resilience paradigm (Meerow et al., 2016), and has been recognized as a way to deal with increasing deep uncertainties, for example, regarding climate and global changes (Pahl-Wostl, 2009). Adaptability allows making alterations in the processes of a system: simple direct changes or more structural changes through iterations to enable the mitigation of expected perturbations in the societal or natural environment.

In the next paragraphs, we provide arguments suggesting that community resilience and adaptive capacity emerge from the urban commons (Camps-Calvet et al., 2015; Colding & Barthel, 2013; Petrescu et al., 2016; Scharf et al., 2019; Schuppenlehner-Kloyber & Penker, 2016). In the urban commons, “commoners” work together to manage and allocate a shared resource (Foster & Iaione, 2016), which can be tangible or not (Moss, 2014). Ostrom has shown the potential of such communities to self-organize (Ostrom, 1990). The social processes happening within the urban commons initiatives can be described from an evolutionary perspective, in which not only predictable processes are taken into account, but also complex, unpredictable ones (Kim & Lim, 2016). We mean here the implicit evolutionary approach which Ostrom describes in her work on collective action, and not the strict evolutionary definition, for example, used in generalized Darwinism (Kim & Lim, 2016; Ostrom, 2000). In this implicit perspective, individuals have predispositions to act in accordance or not with existing social norms, depending on how they individually value reciprocity, fairness, or trustworthiness. This individual behavior can trigger adaptability in the urban commons, through processes of collective decision-making, cooperative behavior and planning, collective learning, and governance as a political process involving society at large (Resilience Alliance, 2010).

The urban commons potentially support this type of adaptability via informal networks of actors interacting in a bottom-up manner (Colding et al., 2013; Foster, 2011; Nagendra & Ostrom, 2014),

their experimental and sometimes disruptive character (Arora, 2014; Borch & Kornberger, 2015; Chatterton, 2016; Corsín Jiménez & Estalella, 2013; Radywyl & Bigg, 2013) and their openness to newcomers (Arora, 2014; Bruun, 2015; Foster & Iaione, 2019; McShane, 2010). This results in the formation of a network as community of practice with shared practices, shared knowledge, identity building, and tangible products. Each element of this network—space, infrastructure, actor—can undergo continuous cycles of change (Anderies, 2014).

The urban commons therefore become a fertile ground for the adaptability of their communities, a driver of their resilience. Their ongoing potential to change can help respond to a sudden shock (Schauppenlehner-Kloyber & Penker, 2016). From our earlier comprehensive review of the urban commons, we mean adaptability with respect to institutional, socio-economical, and ecosystem factors (Feinberg et al., 2019; Plummer & Armitage, 2007).

The institutional dimension of the commons has been covered by scholars such as Ostrom (1990), who identified principles, rules and power relations, which can support the commons. This is exemplified by the Design Principles for robust collective action (Ostrom, 1990), which have been adapted to the urban context (Foster & Iaione, 2019). We propose to look at the urban commons' potential for adaptability through the socio-economical and ecosystem factors (Plummer & Armitage, 2007) because of the equally important lens of subjectivity production in the commons (Singh, 2017).

The urban commons ensure the maintenance of collective subjectivities (Hardt & Negri, 2009), a phenomenon which has been earlier described by Simondon (1989) in his theory of transindividuality (Singh, 2017): individuals never stop constituting themselves and this process is reinforced through collective experiences. This offers potentials for adaptability: the interdependence of the commoners generates spaces of care (Corsín Jiménez & Estalella, 2013) where individuals evolve through collective practices, and are concerned with the more-than-human world. This enables reinventing nature–society relations which contribute to solving the ecological crisis (Singh, 2017).

In this article, we study the conditions for urban community resilience within the urban commons with a lens on adaptability. Adaptive co-management was shown to depend on social capital and social networks (Folke et al., 2005). Similarly, urban resilience relies both on social capital and social relations (Kim & Lim, 2016). Inspired by Jacobs (1961), social capital is defined by “the networks of residents who build and strengthen working relationships over time through trust and voluntary cooperation” (Foster & Iaione, 2019, p. 1). As this definition already encompasses the idea of networks, which together with social capital, can trigger more resilience, we focus in this article mostly on the notion of social capital to evaluate the resilience building of urban commons communities.

A community's social capital relies on involvement, mutual assistance, trust and social cohesion (Adger et al., 2005; Folke et al., 2005; Quigley et al., 2018; Rusch, 2010). Past research has also shown that smaller groups are more successful in the management of the commons, thanks to more frequent interactions and higher levels of trust (Nagendra & Ostrom, 2014; Poteete & Ostrom, 2004; Rogge et al., 2018). Involvement in the urban commons may be voluntary in the case of informal arrangements; otherwise it may be guided by institutions in state-owned or privately-owned systems. Voluntary involvement better contributes to sustainability and equity (Shah & Garg, 2017). Mutual assistance and, to a larger extent, risk sharing, facilitate acting collectively in an atmosphere of trust (Adger et al., 2005). Adaptability through trust-building may not be straightforward, as it relies on a form of collective identity, an “urban citizenship,” which is often described as threatened by neoliberal or capitalist environments such as cities (Harvey, 2012; Huron, 2015). Relating to this last point, trust more likely emerges from smaller groups (Poteete & Ostrom, 2004). Members of smaller groups are indeed more prone to set their own rules, and comply with those (Marshall, 2008). In addition, concrete and intermediate outcomes, “small wins,” are more visible in smaller groups, which feeds successful collaboration (Ansell & Gash, 2008). Mui defines trust as the “subjective expectation an agent has about another's future behavior based on the history of their encounters” (Mui, 2002). This definition is in line with the one given by Lumineau and Malhotra (2011), who highlight a vulnerability to the actions of others, given positive expectations on why and how they could

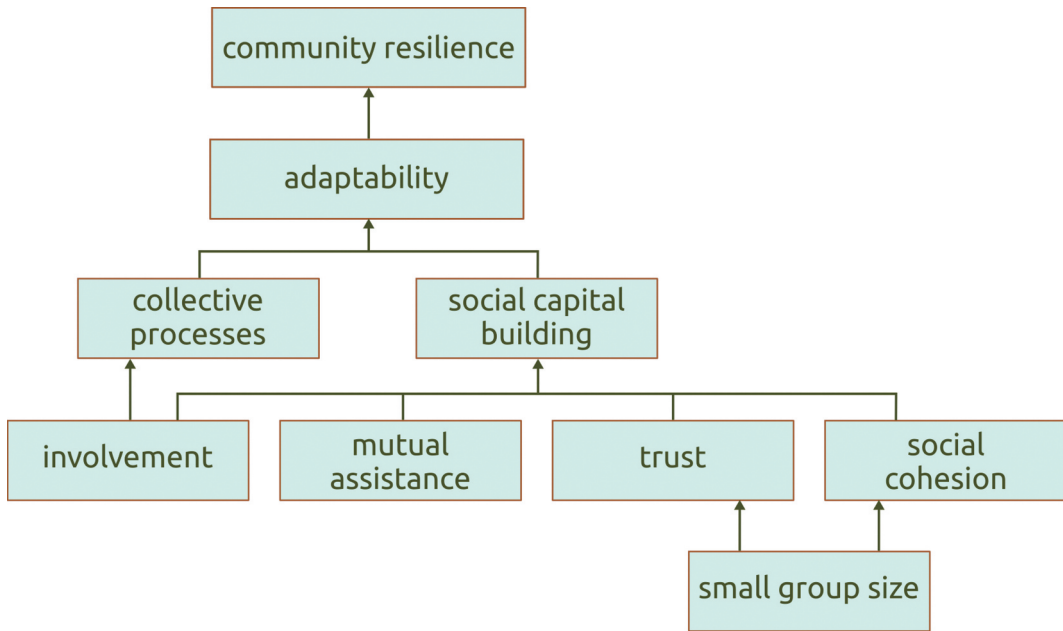


Figure 1. Factors of urban community resilience; mutual assistance is not evaluated in our model.

perform. Finally, the sense of cohesion is a measure of the group ability to bond and potentially engage in meaningful collaboration (Quigley et al., 2018).

We have framed the theoretical dependencies above in Figure 1. We conclude this section by specifying a definition of urban community resilience on which we build this study of the urban commons. It is the ability of a more or less formal group of individuals, forming a self-organized community, to mitigate the effects of future environmental, socio-economical, and sanitary crises through experimental or disruptive social processes, the unpredictability of which supports collective learning and continuous cycles of change with respect to space, infrastructure, and actors. This adaptability strongly relies on the community's social capital, which builds up through voluntary involvement, trust, social cohesion and mutual assistance.

Methods

In this section, we translate the theoretical framing (Figure 1) developed above into research hypotheses that can be tested with our agent-based simulation model. We also present the case study and the data used to test these hypotheses. The use of this data is detailed in the next section, together with the model.

Research hypotheses

In order to characterize the adaptability of communities engaged in cases of urban commons, thus building urban community resilience, we formulate the following hypotheses based on the theoretical background that was discussed in detail in the previous section:

- (H1) interactions within the urban commons contribute to building trust;
- (H2) interactions within the urban commons provoke a higher sense of cohesion;
- (H3) more trust emerges from smaller self-organized groups.

We test these hypotheses through the development of an agent-based model, representative of an urban commons community. With this model, we focus on the internal dynamics of participation and social interaction, and we aim to clarify the contribution of such urban commons practices to urban community resilience, via the emergence of social capital. We explain in the subsections below how we measure social capital within an example of urban commons community.

External factors related to public institutions and local governments are left out of this research to only focus on the intrinsic conditions for urban community resilience within the urban commons. Regarding these external factors, we give a few indications for future research in conclusion. Our goal, in this research paper, is to clarify the contribution of urban commons practices to urban community resilience, with the help of a model which looks at the internal dynamics of participation and social interaction.

Agent-based model

Agent-based modeling is a simulation technique, which is well-suited to study complexity (Ghorbani & Bravo, 2016; Macal & North, 2009): it allows the simulation of the interactions of individual social entities within a specified environment and allows individual choice-making, often leading to the emergence of behavioral patterns. It takes into account adaptive mechanisms of agent interaction and heterogeneous systems (Balbi & Giupponi, 2011). In this sense, it matches well the bottom-up dynamics of most urban commons. Finally, agent-based modeling enables more experimentation on the system variables than real-life experiments would allow.

We use the initial structure of a model originally developed by the authors to study the interaction patterns within urban community gardens (Feinberg et al., 2020), considering individual and group beliefs, and under different sets of organizational rules (i.e. local institutions). We adapt this model to match the context of an urban commons case in Amsterdam which we will explain next and re-design in such a way to enable the testing of our hypotheses. The model is coded in Netlogo software version 6.0.4 (Tisue & Wilensky, 2004).

To test the hypotheses stated above with our agent-based model, we proceed to field observations in an urban commons initiative and build a model, which recreates the dynamics of volunteer participation and interaction in the initiative. The model features events, which could affect the rate of emergent participation, evaluates trust and cohesion within the modeled volunteer community.

Empirical data

Our empirical urban commons site is the “KasKantine” (Dutch for “GreenhouseEatery”), a cooperative located in the south-west of Amsterdam. It pioneers ways of living sustainably and in autonomy. They have developed several Do-It-Yourself (DIY) infrastructures, the blueprints of which are available on their website: an efficient wood-fueled pizza oven, a self-sufficient aquaponics wall-garden, or a gray water filter.

KasKantine was initiated in 2012. Thanks to temporary agreements with the municipality of Amsterdam, it has been able to lease vacant lots and experiment with living off-the-grid, meaning disconnected from electricity, water, and sanitation amenities. Its modular architecture mostly consists of recycled materials, including a greenhouse and several cargo shipping containers. These containers are refurbished either for collective, or individual purposes. They offer spaces for small-scale rooftop agriculture, storage, office space, culinary and artistic activities, which would be too expensive in the conventional estate market. For such individual use, a financial contribution to the container purchase is usually asked. More than a restaurant, it is run by volunteers, who are involved in many tasks such as cooking, serving, but also gardening, building, fixing and supporting bottom-up activities, such as bike-fixing workshops, yoga classes, and a social change discussion group. Volunteers contribute in the form of shifts, which are 4-hour straight time slots of activity.

KasKantine is meant as a free space for the local community with a focus on food waste reduction, up-cycling materials and circular economy.

We have collected the data first through semi-structured interviews of two of the three initiators. The initiators are self-employed Amsterdam residents who teamed up of own free will to build the KasKantine project. Their answers informed us on the institutional context of the cooperative, the existing tasks, the issues encountered, and the annual participation. A guided tour of the cooperative also informed us on the available amenities.

In addition, we asked the volunteers about their motivations (or beliefs) to participate. We thus asked the initiators to forward an online questionnaire to their regularly active volunteers: those contributing at least one shift per week (4 hours). Out of 25 regular volunteers, 8 responded. The online questionnaire contained one multiple-answer question, the possible answers to which were specified and defined to prevent any ambiguity. The possible answers consist of the most common beliefs to participate in commoning, according to an auxiliary literature review (see next section and [Appendix](#) for the interview answers). We recap these beliefs in the next section. The data collected through the interviews and the questionnaires allow us to calibrate our model to match the reality of KasKantine. In order to build a model sufficiently representative of people participating in such urban commons initiatives, we also refine our calibration using a dataset on urban community gardens (another type of urban commons) in Germany and the Netherlands which we will explain in the next section (Feinberg et al., 2020; Rogge et al., 2018).

An agent-based model of urban commons

Theoretical basis for the model

Our agent-based model should describe a system in which agents choose to volunteer and interact with other agents, based on existing motivations and rules, and in which they evaluate that interaction to re-assess their intention to volunteer again.

The model follows the structure of the Institutional Analysis and Design (IAD) framework (Ostrom et al., 1994; [Figure 2](#)): external variables (Biophysical conditions, Attributes of Community and Rules-in-Use) determine the Action situations taken by the members of the system; the resulting Interactions and their Outcomes are evaluated to update the external variables and the actions taken. Our main external variables are the institutions (Rules-in-Use) and the beliefs toward commoning in KasKantine (Attributes of Community). Institutions are sets of rules defined by individuals to organize repetitive activities, and we formalize them through Ostrom's Design Principles for robust collective action (Ostrom, 1990). These can be summarized as follows (Wilson et al., 2013):

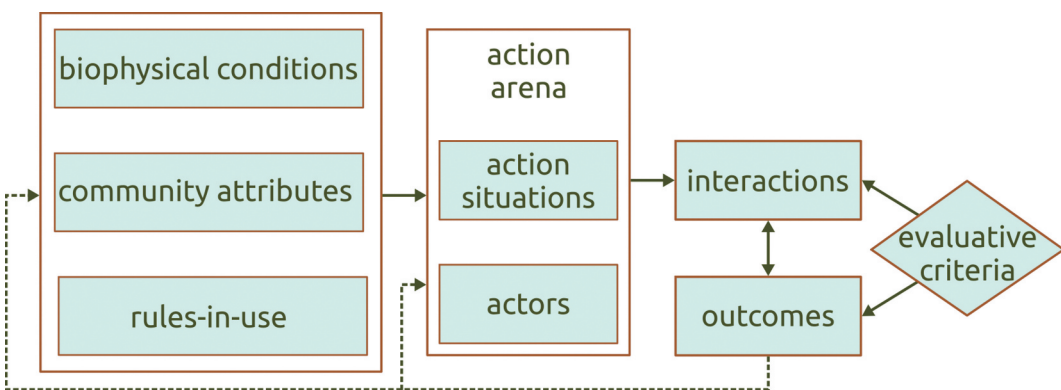


Figure 2. Overview of Ostrom's IAD framework (adapted from McGinnis & Ostrom (2014)).

- (1) Clearly defined boundaries: both for the resource system and the community;
- (2) Proportional equivalence between benefits and costs: a higher contribution is better rewarded;
- (3) Collective-choice arrangements: possibility for the group members to create new rules or adapt existing rules;
- (4) Monitoring: keeping track of actions and possible violations of rules in the group;
- (5) Graduated sanctions: the sanction is proportional to the violation;
- (6) Conflict-resolution mechanisms: inexpensive mechanisms to solve conflicts;
- (7) Minimal recognition of rights to organize: smaller units of decision makers have authority over certain matters;
- (8) Nestled enterprises: for better coordination across groups, sometimes working at different scales.

We use these principles to conceptualize the institutions which affect the dynamics in our model. We express the agent's motivation, or beliefs, toward commoning as in the Theory of Reasoned Action (TRA, [Figure 3](#); Fishbein & Ajzen, 2011). Motivation is a broad term which encompasses two dimensions in the TRA: an individual drive (attitudes) and a collective drive (social norm), which rely, respectively, on behavioral and normative beliefs (see [Figure 3](#)). Agents, therefore, have beliefs or expectations of outcomes with respect to certain actions. For each belief, agents have a belief strength, which relates to how much they care for the related outcome, and a belief evaluation, which depends on the agent's experience regarding that outcome. The conjunction of a high belief strength and a positive belief evaluation motivates a related behavior intention.

The most common beliefs to join this type of urban commons, as found in earlier work (Feinberg et al., 2020) are given below. Only the last two beliefs are considered as negative, in the sense that they limit the chances of participation.

- Social development: commoning fosters a social environment that enhances the activity itself by providing participants with a social network that becomes important particularly when they are feeling isolated (Duchemin et al., 2009);
- Social cohesion: participants form relationships with one another and offer mutual help, which does not occur for example, in individual gardening lots (De Kam & Needham, 2004; Veen et al., 2016);
- Consuming fresh food: relevant for KasKantine, which has a food garden; its access depends on biophysical variables but also on the active institutions and the participants' behavior (Duchemin

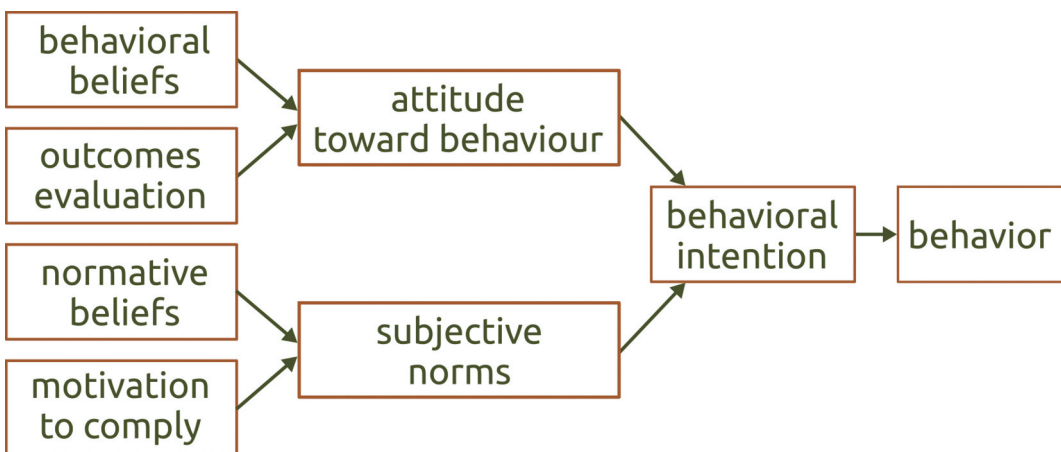


Figure 3. Overview of the theory of reasoned action (adapted from Fishbein and Ajzen (2011)).

- et al., 2009); it is a possible source of conflict when it comes to (fair) yield taking (Butler, 2013; Charles, 2012) or even stolen yield from non-participants (Ruggeri et al., 2016);
- economic benefits: eating or selling own garden production is a current practice (Guitart et al., 2012; Patel, 1991); KasKantine also collects non-sold products and contributes to reducing food waste in Amsterdam;
 - improving health: through improving a diet, increased exercise and involvement in nature (Guitart et al., 2012);
 - outdoor activities: give a sense of well-being (Rogge et al., 2018);
 - education: specific, such as gardening (Drake & Lawson, 2015) or more general: science, nutrition, and environmental education (Guitart et al., 2012); indirect social education can also be gained by simply participating (Duchemin et al., 2009);
 - enhancing cultural practices: cultural practices are broadly defined as the knowledge of 'what to do, when and where', and how to interact within a particular culture; in the urban gardening context, this can be translated to integration, particularly for foreign immigrants; in our work, this belief is satisfied by the simple presence of others in the garden (Rogge et al., 2018);
 - increasing land availability: this belief reflects the well-described claim to urban space, the accessibility to which is reduced by land developments and privatizations (Huron, 2015; Sassen, 2015; Williams, 2018); urban community gardens also increase the share of green spaces in the city (Schmelzkopf, 2002); this belief is influenced by access rules (e.g., fences, membership) (Milburn & Vail, 2010);
 - environmental sustainability: green spaces highly contribute to microclimate regulation, water run-off, pollution mitigation, water filtering, or biodiversity (Colding & Barthel, 2013; Wolch et al., 2014); participants may be driven by such goals;
 - enhancing spiritual practice: the connection to nature achieved through activities like gardening can be meditative, or help release tensions and develop spirituality (Kingsley et al., 2009); more caring connections with other participants may result (Okvat & Zautra, 2011);
 - social norm: trust in contributing to the cooperative is higher when the other participants are reciprocating (Chalise, 2015; Mui, 2002), which becomes the cooperative's social norm; the group's overall reputation is an important factor when deciding whether or not to participate;
 - amount of work: the engagement required toward a shared goal motivates participants, unless these efforts exceed expectations (Chalise, 2015), which can happen when there are not enough participants;
 - uncomfortable conditions: we mean physical conditions, such as bad weather or bugs, often mentioned to rebut participants (Drake & Lawson, 2015; Vercauteren et al., 2013).

Data usage

We populate our model with data that is collected from the KasKantine and community gardens. Our modeled system represents the KasKantine cooperative, from which we extract most of the characteristics (Table 1).

The IAD framework requires data on the system's biophysical conditions, rules-in-use (institutions), community attributes and action situations. In addition, since the TRA describes the pathway from certain motivations, or beliefs, to actual behavior, data addressing the beliefs of the agents is also required. Data for the community attributes, action situations, institutions and beliefs were collected from KasKantine. Table 1 summarizes the data that is used in the model and the sources. Based on our interviews in Amsterdam, an earlier literature review (Feinberg et al., 2020), and the fact that we are looking at urban commons in general, we assume the beliefs in KasKantine to be similar to those found in urban community gardens (Rogge, 2020, p.89). These beliefs are generally positive, in the sense that they motivate the agents to become a volunteer in the cooperative (see end of previous subsection). Most of them are defined for individual volunteers. From the group standpoint, the perceived need for contribution to the cooperative constitutes the group normative belief, or social

Table 1. Type and source of data fed in our model.

Data category	Output variables	Input parameters	Source of data
Biophysical conditions	product availability	Chance of uncomfortable conditions chance of available product	Case-study
Community attributes		Beliefs types number of initiators pool of potential volunteers beliefs strength (all agents) chance of bonding with others age of initiative (maximum) interaction rate	Community gardens (Germany, Netherlands) (Feinberg et al., 2020; Rogge, 2020), literature, case-study
Institutions		Design Principles, adapted from Ostrom, 1990.	Case-study, community gardens literature
Action situations		Tasks	Case-study
Outcomes	Beliefs evaluation (cohesion, trust, social time, product availability, ...) social ties good encounters lifetime (of initiative)	Conflict rate	Case-study

norm. The motivation to comply with it, which depends on trust, generates the subjective norm. We will explain this in the Outcome variables subsection. Other beliefs may discourage the agents: uncomfortable conditions (mostly bad weather) or the excessive amount of work required. According to our interviews in KasKantine, uncomfortable conditions do not influence participation.

Model overview

Our model represents a situation in which the agents are periodically invited to volunteer in the KasKantine cooperative, with no entrance fee. Their intention to volunteer depends on their beliefs and experiences in the cooperative. Agents indeed reevaluate their beliefs before renewing their participation on the next session, which is in line with the argument of adaptive capacity (Pahl-Wostl, 2009). We implement regular disruptions in the form of large conflicts in order to reflect real-life crises and test our model further. Other disruptions, not imposed by the modeler, occur in the form of rule violations.

The model functions as presented in Figure 4. The agents volunteer in the cooperative if they are motivated enough, according to their individual beliefs and the perceived social norm. Once volunteer (called commoner), the agent interacts with the physical system, by performing tasks or taking product which originates from the cooperative. The agents also interact with the other commoners of the cooperative. They may violate or see someone else violate a rule of the cooperative. This violation is made public and its treatment (i.e. sanctioning) affects the “history of encounters” (Mui, 2002) and the positive expectation toward future sessions (Lumineau & Malhotra, 2011). The commoners who witnessed it therefore perceive lower trust toward the group. A conflict may also occur and cause an additional decrease of trust. To mitigate this point, we consider in our model a temporary increase of motivation to volunteer after a large conflict (see details later in this section). This is a corollary of the evolutionary theory, in which modern humans are capable of learning social norms, not by reasoning about what is true or false, but by reasoning through deontic relationships inspired by the cultural context: in our case, by looking for violators (Ostrom, 2000). Each volunteering session may be seen as a learning opportunity. At the end of each session, commoners evaluate their experience in terms of the beliefs mentioned earlier. This evaluation impacts their willingness to volunteer again at the next session. The sense of social cohesion depends on the presence of other commoners. Details of these processes are explained in the conceptualization section.

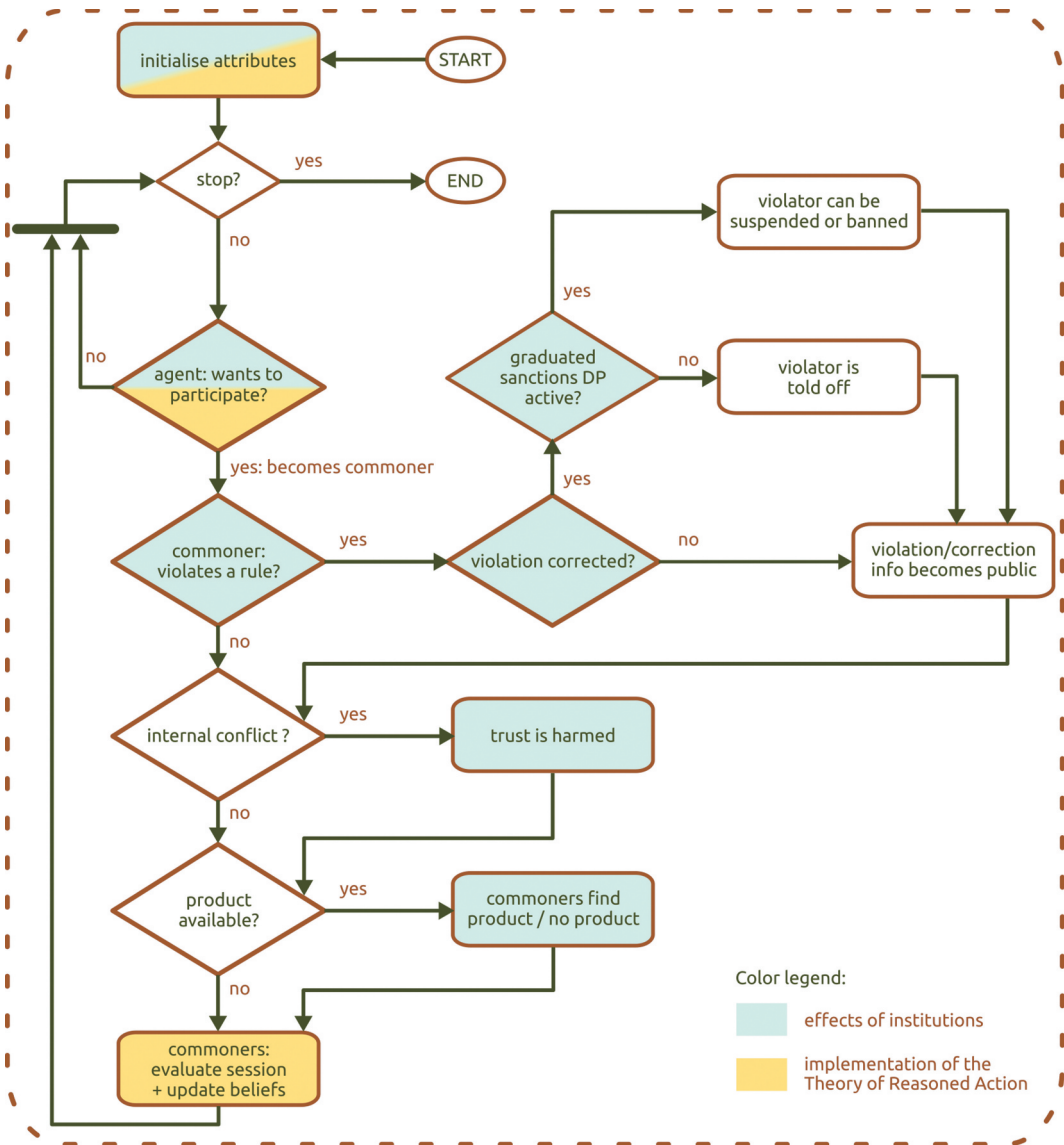


Figure 4. Narrative of the model.

Model conceptualization

Rule violations may be sanctioned with a certain probability. The institutions also define whether a rule violator may be excluded from the cooperative. The outcome of such events affects the number of good encounters, of which each agent keeps note for the belief evaluation for trust.

Agents are assigned a fixed value of belief strength for each of their beliefs, within a range defined by our data, and a value of belief evaluation which evolves across the sessions (Fishbein & Ajzen, 2011). The agents have one main action situation, volunteering, which entails two other possible actions: taking a product from the cooperative and violating a rule. At the beginning of the simulations, all agents are potential commoners. Potential commoners become commoners when they decide to volunteer. At each simulation step, the model tests the degree of motivation of all agents to volunteer. We derive the attitudes for volunteering as follows: social time, cohesion, getting product, education,

Table 2. Parameters and their experimental range of values.

Parameter	Definition	range swept
<i>ContributingThreshold</i>	Arbitrary value above which an agent becomes volunteer; defined through sensitivity analysis	[1, 6]
<i>DPconflictHarm</i>	Intensity of harm caused by each conflict	[10, 50]
<i>InteractionRate</i>	Amount of other commoners a commoner can connect with	(3; 4)
<i>RelationRate</i>	Probability to form a connection with a commoner interacted with	[0.1, 0.9]
<i>BalanceAttitudeSocialNorm</i>	Weight of the social norm	[0.5, 4]
<i>conflictlearn</i>	Degree of learning following a conflict	[0, 1]
<i>TotalPool</i>	Maximum number of agents	[10, 40]

pleasant tasks, sustainability, land availability. The latter attitude relates to the possibility to equip ship containers or bring new ones on the KasKantine parcel. The weight of the subjective norm versus the attitude is a parameter which we call *BalanceAttitudeSocialNorm* (Table 2). The weight for attitudes is thus expressed as a function of *BalanceAttitudeSocialNorm*.

In a given model run, the probability for volunteering depends on the weighted sum of the attitude and subjective norm tested against a contributing threshold (Table 2). The weights come from a study which evaluates the participation to team sports (Eves et al., 2007). If the agent’s weighted sum of beliefs is higher than *ContributingThreshold*, meaning that it is motivated enough, it becomes a commoner. The commoner may then violate a rule (e.g., not showing up at one’s work shift) or decide to take a cooperative product. Both decisions are regulated by a set probability.

The institutions controlling these actions are coded based on Ostrom’s Design Principles (see Feinberg et al. (2020) for more detail). At the end of a session, the agents evaluate two things: the realization of their expectations and the result of the past social interactions. Through this evaluation, which builds on both the IAD framework (Figure 2) and the TRA (Figure 3), the agents’ beliefs are updated. This influences their willingness to participate in the next session, partly reflected in the variables of social cohesion and trust, which are our outcome variables of interest.

Outcome variables

We have three outcome variables, which we derive from the beliefs evaluations and the duration of the collective involvement. Each agent reevaluates its beliefs at the end of each session, while the total involvement time is assessed for the entire group at the last simulation. Among the beliefs, we exclusively focus on trust and social cohesion.

Trust

Following the previously mentioned definitions of trust, we consider it in our model intimately related to reciprocity: in the presence of a group norm, or social norm, an agent who trusts that its peers are complying to this norm, will itself feel pressure to comply as well. An agent may value the idea of reciprocity, without necessarily experiencing it because of recent unfavorable encounters. In our model, reciprocity becomes the belief strength for trust. Mui estimated reciprocity by the proportion of cooperative actions over all encounters. From this expression, we propose a simplified expression for trust, which includes the expected negative effect of conflicts on trust:

$$Trust = \frac{Amount\ Of\ Good\ Encounters}{Total\ Encounters + Total\ Conflicts} \tag{1}$$

The variable *TotalConflicts* multiplies the actual number of conflicts experiences by an aggravation factor, which we call *DPconflictHarm*. This factor reflects the implementation of conflict-resolution mechanisms (6th Ostrom Design Principle). It is inversely proportional to the effectiveness of the conflict-resolution mechanisms.

We assume that conflicts also involve new coordination measures rather than new control measures. Such coordination measures trigger competence- and goodwill-based trust development (Lumineau & Malhotra, 2011), which enhances the present relations rather than the desire to switch partners. These measures may create channels of communication through which conflicts are discussed and which can help mitigation in the case of future conflicts. Therefore, we introduce in this model the parameter *conflictLearn*, which temporarily increases the willingness to volunteer after a conflict.

Cohesion

We define social cohesion as the extent to which the cooperative's volunteers bond and offer mutual help to each other. It is close to the concept of cohesiveness, which encompasses both the group's attractivity to its members and the attraction to mutual goals attained via the group (Gross & Martin, 1952). In the model, we measure social cohesion by the number of mutual dyadic ties within the group (Friedkin, 2004). In our model, the capacity to form bonds is influenced by two parameters: *InteractionRate*, the amount of other volunteers an agent can connect with, and *RelationRate*, the probability for an agent to form a relation with a volunteer it interacts with. In the results section, we use the terms cohesion and social cohesion interchangeably.

Involvement

The amount of commoners along the simulation gives an indication of participation in our model example. We measure involvement as the duration of the participation, as long as the number of participants stays above a threshold which we define below in the experimental design section.

Experimental design

We here present how we test our hypotheses on urban community resilience using the model. Below is the layout for each experiment:

- Agents interact within a random network and make individual choices;
- Disruption occurs in the form of conflicts and rule violations;
- Absence of an entrance fee;
- New agents are regularly invited to participate.

We design our experiments to estimate the emergence of social capital which reflects adaptability and in turn community resilience in our model (Figure 1). In other words, we are testing the adaptability of the KasKantine cooperative, in a simplified reality scenario. We, therefore, need to measure trust and social cohesion during and after the agents' interactions in the model to answer our first two hypotheses (H1 and H2). We also register the duration of the experiments, labeled lifetime. The different experiments test which variables affect our outcome variables, and to what extent. We explain below how we designed our experiments.

Procedure

The KasKantine initiative being 6 years old at the moment of this study, we set our experiments to run for a period corresponding to 10 years. It reflects reality sufficiently, without an excessive processing time on the computer simulations: only 0.035% of all our runs last more than 10 years. We have two main sessions per week (Friday and Saturday), during which KasKantine welcomes customers. This makes about 100 sessions per year. Each volunteering session corresponds to one simulation tick. Each experiment, therefore, runs until a maximum of 1,000 ticks. According to our interviews, the cooperative requires a minimum of 10 participants to run, 7 volunteers and 3 initiators, who should be present to maintain the cooperative activity. The attendance by customers of the KasKantine restaurant is high, which requires a sufficient volunteer participation in the cooperative. We, therefore,

assume that the cooperative activity would stop when the number of volunteers is below 7 for 16 consecutive sessions, or about 2 months. This would cause an experiment to stop. An experiment is said to have collapsed at the tick where the experiment stops.

Rule violations can occur anytime with a probability specified as parameter in the model. Volunteers who violate a rule can get a reprimand for example, when not showing up at their shift. We have translated such events as two probabilities in our model: one for the rule violation, one for the correction. Other minor violations usually go unnoticed, according to our field interviews. The overall sense of conviviality in the cooperative being opposed to strict sanctioning, we, therefore, set the chance of sanctioning to 50%.

Conflicts occur with a predefined periodicity. In our previous study on urban community gardens in Germany and the Netherlands, we observed conflicts on average every two years (Feinberg et al., 2020). From our field discussions in KasKantine, where no such count is made, we assume that this figure also applies. We arbitrarily define an experiment to be potentially resilient when it survives at least two conflicts. These cases are further analyzed to determine the system conditions more likely triggering resilience in the community. At the rate of one conflict every two years, it would take at least 4 years to qualify as potentially resilient. This represents only 5% of our total experiments. To get more material for discussing the conditions toward resilience, we increase the conflict rate to one per year. 18% of experiments now qualify for further analysis. We, therefore, isolate two types of output simulations: the collapsed cases, with a Lifetime below 200 ticks, and the potentially resilient cases, with a Lifetime above 201 ticks.

The cooperative institutions do not vary between each experiment: the combination of Design Principles is fixed to match reality. Exception is made for *DPconflictharm*, the degree of intensity of harm caused by any conflict, on which we lack data, and which we, therefore, sweep across a range of values as explained, among others, in Table 2.

We test the learning effect induced by conflicts through an artificial increase of the motivation to volunteer during the 50 sessions following a conflict. The corresponding parameter is called *conflictLearn*. A more straightforward approach would be to manually increase the belief for cohesion or decrease the value of *Total Conflicts* in Equation (1). However, this is not possible because it would create modeling bias as it would directly influence cohesion and trust, which are our main output variables of interest.

Earlier empirical research (Feinberg et al., 2020; Rogge et al., 2018) suggested that smaller group sizes were more likely to sustain trust and social cohesion. This is in line with the argument of Poteete and Ostrom (2004), which led to the formulation of our third hypothesis (H3) on group size effect. We measure it with the variable *TotalPool*, which is the maximum number of agents in an experiment.

Our experiments consist of testing the effects of the parameters which we assume can impact trust and social cohesion (Table 2). We first perform a sensitivity analysis to pinpoint the most relevant value interval for each variable above, except for *InteractionRate* and *TotalPool*, the values of which are based on field interviews. Then, we use the Latin Hypercube Sampling (Van Dam et al., 2012) method to derive 100 different values for each of the above variables in their respective value interval. We then use the BehaviorSpace tool of the Netlogo software, which allows the variable sweeps defined in Table 2.

The combination of the value ranges specified above, along with 10 repetitions and the use of 100 random seeds, led to a total of 200,000 experiments. For each of these, we measure the averaged value of perceived trust and social cohesion for all participants over the total duration of the simulation run, which is the number of ticks until collapse occurs. When no collapse occurs in the first 1,000 ticks, the Lifetime variable is set to 1,000.

The outcomes of the simulations are analyzed with the statistical tool R (version 3.6.1 from 2019 to 07-05) in the visualization software RStudio (version 1.1.383).

Results

Performance indicators of community resilience

Our goal in this study is to assess the capacity for community resilience within a case of urban commons. We focus in particular on the notion of adaptability of the volunteer community in the KasKantine cooperative, an example of urban commons. We need to demonstrate the building of social capital within the cooperative's volunteer community by means of the agent-based model results. We measure social capital through the emergence of trust, cohesion, and long-lasting volunteer involvement. Trust, in our model, reflects the reciprocity in the community's social interactions: positive encounters versus total encounters, including those aggravated by conflicts. Cohesion is measured by the number of dyadic ties that an agent has with others. Through simple dynamics of joining or leaving, under the influence of motivations fluctuating based on individual and collective performance assessment, we quantify the overall levels of trust and cohesion. In addition, we have measured the duration, in our model, of the volunteer involvement. All the analysis which follows is based on the experiments which lasted 2 years or more, so that they experienced at least two conflicts. This represents 18% of all experiments.

Testing the hypotheses

Our model allows us to test the previously-formulated hypotheses below:

- (H1) interactions within the urban commons contribute to building trust;
- (H2) interactions within the urban commons provoke a higher sense of cohesion;
- (H3) more trust emerges from smaller self-organized groups.

Our results first indicate that both trust and cohesion emerge from group interaction in the Amsterdam-based cooperative (hypotheses H1 and H2). We illustrate this with one of the experiments which lasted 436 ticks, long-enough to show the effects of four consecutive conflict crises ([Figure 5](#)). The maximal number of volunteers (*TotalPool*) is here set at 30, arbitrarily. Other experiments may show a different behavior of the variables represented, but the curves for trust, cohesion and the volunteer count remain very similar. Cohesion grows rather regularly as long as the number of volunteers present remains high enough. Trust follows a similar pattern, with sharp drops occurring at the time of occasional conflicts, which are set by the modeler every 100 ticks. Such events lower trust temporarily. If the initiative survives such an event, by maintaining a sufficient number of volunteers, the perceived trust among its volunteers grows back. A quick drop of the level of trust is visible at each conflict time, for example, at ticks 100 and 200 in [Figure 5](#). It is accompanied by a decrease in the number of volunteers and in the amount of good encounters. The effects of conflicts dampen over time, as the total number of good encounters grows and thus mitigates the negative perception of conflicts in the evaluation of trust. Both trust and cohesion briefly drop as rule violations occur.

In the rest of this analysis, we measure the cohesion and trust related to any experiment with their cumulative value over all ticks, taken at the last tick. This allows comparison between experiments. The correlation between trust, cohesion and lifetime is presented in [Table 3](#). Trust and Lifetime are negatively correlated. Nonetheless, during shorter periods of time without conflicts, trust grows saturatedly as we've observed above. Cohesion and Lifetime are positively correlated, a result which relates to the cumulative cohesion measurement. We present below the parameters which mostly affected these results, including the role of group size (H3).

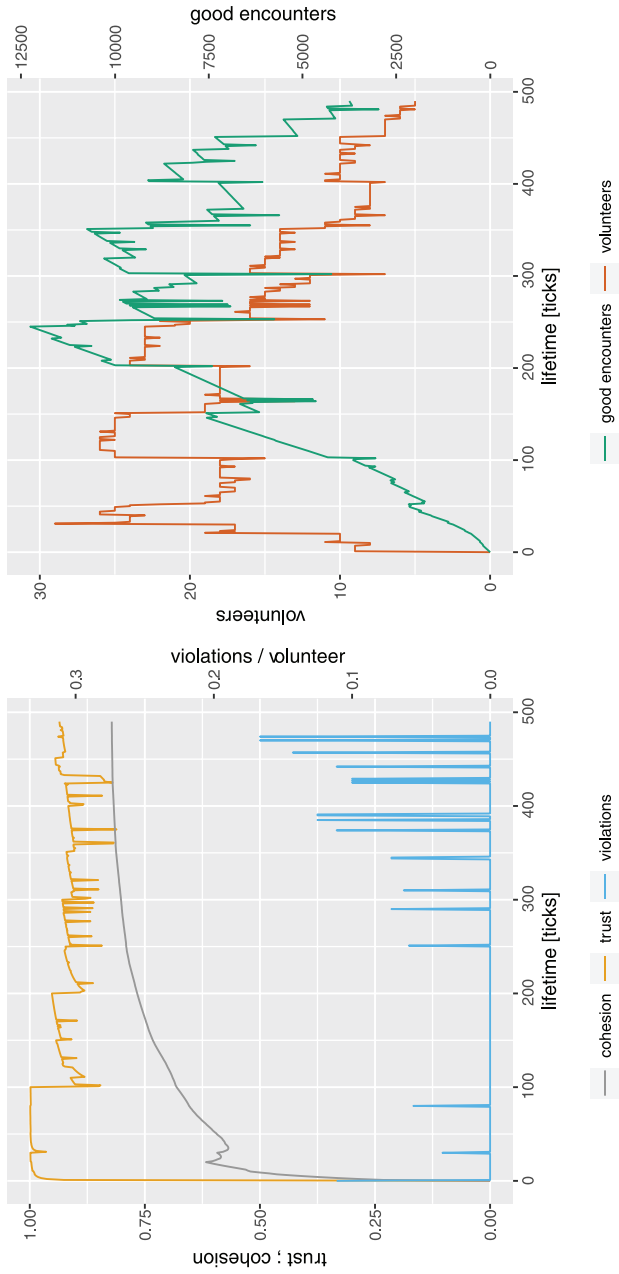


Figure 5. Typical evolution of trust, cumulative cohesion, violations, amount of volunteers and positive encounters over time, for example, of experiment.

Table 3. Correlation table for the outcome variables, in the resilient cases.

	Trust	Cumulative cohesion
Lifetime	-0.11***	0.16***
Trust		-0.02 ***

*** $p < .001$; ** $p < .01$; * $p < .05$

Analysis of the experiments

In the following sections, the terms cohesion and trust correspond to their respective cumulated value, for any given experiment. We visualize the degree of contribution of each tested parameter (Table 2) on a two-dimensional diagram obtained via Principal Component Analysis (PCA). We use R packages FactoMineR and factoextra for that. We project each variable as a vector on an orthogonal Cartesian coordinate system. The two axes in Figure 6 represent the two main axes of variance (eigenvectors) of our output data in the experiments. These axes are called principal components (PCs). The length and direction of each vector reflect the respective effect of its variable or parameter on the model's PCs. The color scale in Figure 6 indicates the degree of contribution of each variable to the PCs, in % of the total explained variance. Our output variables, cohesion, trust and lifetime, highly contribute to the two

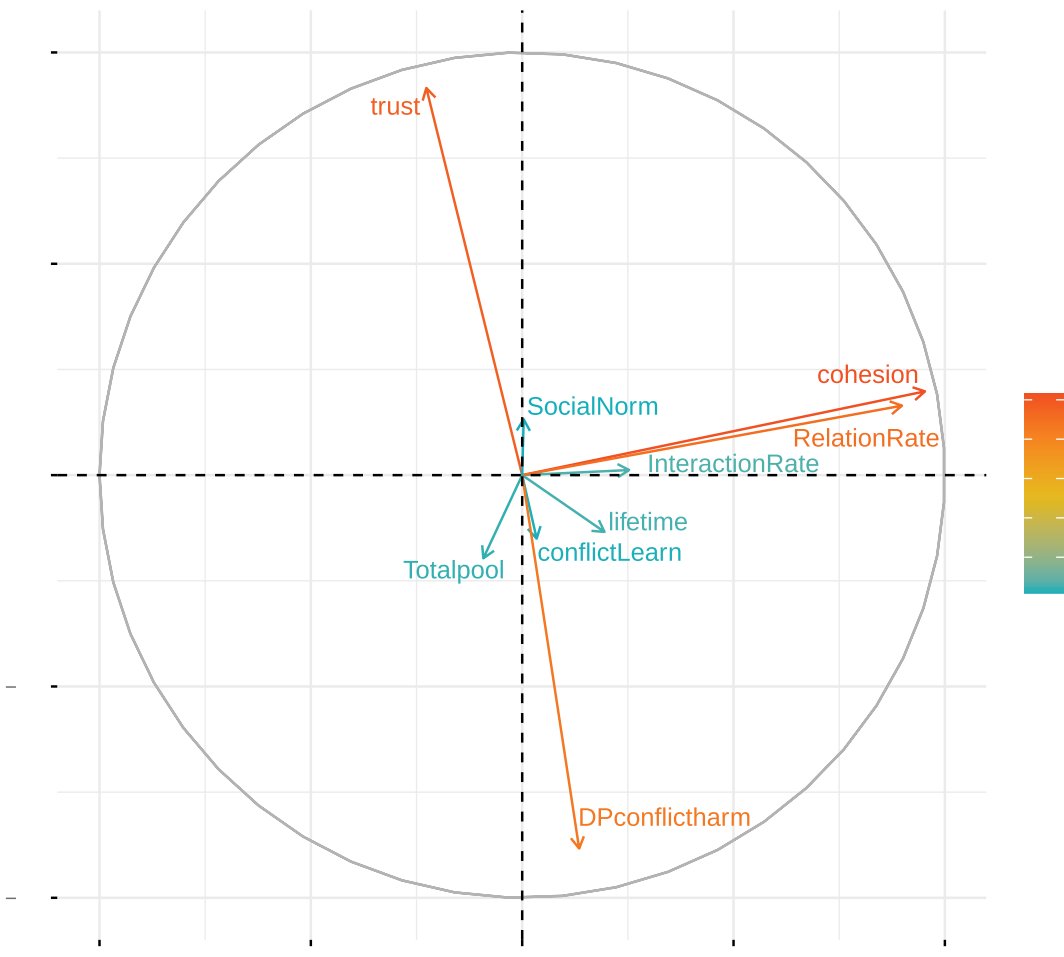


Figure 6. Principal component analysis diagram for the resilient cases.

Table 4. Correlation of the outcome variables with the input parameters in the resilient cases. In light gray font, we have represented the values deriving only from the model operationalization, and therefore not emergent from the model.

Parameter	Correlation with Lifetime	Correlation with trust	Correlation with social cohesion
DPconflictharm	-0.06***	-0.77 ***	-0.04***
InteractionRate	0.02**	-0.03***	0.24***
RelationRate	0.00***	-0.04 ***	0.86***
SocialNorm	-0.02***	0.05 ***	0.03***
Conflictlearn	0.12***	-0.07 ***	-0.03***
TotalPool (max. group size)	0.16***	-0.11 ***	-0.18***

Significance: *** $p < .001$; ** $p < .01$; * $p < .05$.

PCs, which means that the ranges of input parameters selected in our experimental design do affect the variability of our output variables. This was the purpose of the sensitivity analysis. We can now find the specific conditions leading to high cohesion, trust or lifetime.

The cohesion vector aligns with those of *RelationRate* and *InteractionRate*, indicating a positive correlation. This result is not surprising, as these two variables directly affect the belief for cohesion in the estimation of the number of dyadic ties per agent. *RelationRate* is the chance to form a bond with another commoner, and *InteractionRate* is the number of other agents a volunteer can connect with. *RelationRate* better explains the cohesion variability: in other words, the number of commoners I can connect with (3 or 4), matters less than the mutual affinity I may have with each of them. *TotalPool* is negatively correlated both with cohesion and trust: a higher maximum group size decreases the overall sense of cohesion and trust (Table 4). The diagram further indicates that trust is negatively correlated to *DPconflictharm*, which is the sensitivity to conflicts. This result is a consequence of our model, as explained earlier by the mathematical formula of trust given earlier. The vector for *conflictLearn*, the capacity to learn from conflicts, opposes the one for trust, while aligning close to the one for lifetime: higher *conflictLearn* is associated to higher lifetime, but slightly lower trust.

All the results hinted through the PCA analysis are confirmed in the correlation tables (Tables 3 and 4). Cohesion and lifetime are positively correlated ($\rho_{\text{Cohes-Lifetime}} = 0.16$). Even though trust and lifetime are negatively correlated ($\rho_{\text{Trust-Lifetime}} = -0.11$), we have seen in Figure 5 that, at another scale of analysis, trust grows with time in between two consecutive conflicts. *SocialNorm*, the weight put by agents on the collective drive to become a volunteer rather than on individual drives, is positively correlated to higher trust. Cohesion, in its cumulative definition, is somewhat negatively correlated to conflict sensitivity ($\rho_{\text{Cohes-DPconflictharm}} = -0.04$). Higher trust was observed in cases of higher collective drive ($\rho_{\text{Trust-SocialNorm}} = 0.05$) and lower conflict-induced learning ($\rho_{\text{Trust-conflictLearn}} = -0.07$). We can also confirm the third hypothesis; we measured a negative correlation of large maximal group sizes with both trust and cohesion ($\rho_{\text{Trust-TotalPool}} = -0.11$ and $\rho_{\text{Cohes-TotalPool}} = -0.18$). However, a larger group size also correlates with long-lasting collective action ($\rho = 0.16$). This reflects the dynamics of participating as volunteer or leaving, as simplified by our model, and may not be an argument in favor of larger group sizes.

Discussion

Our model showed that trust and social cohesion closely follow the cooperative's social interactions and degree of participation. Cohesion is intimately related to the number of volunteers present. Trust appears as an indicator for a stronger motivation for the cooperative's collective purpose (social norm). The community's perception of trust decreases during conflicts, but the group slowly regains trust during the sessions following a conflict. Trust tends to be higher in smaller groups, where conflicts and rule violations can cause less harm. Although certain parameters positively affect trust and not cohesion (and vice-versa), we have validated our three hypotheses.

We have outlined a significant link between lower group size and higher trust among the commoners, in line with recent research which has been drawing attention on the higher success potential of smaller-sized common initiatives (Nagendra & Ostrom, 2014; Poteete & Ostrom, 2004;

Rogge et al., 2018). Poteete and Ostrom (2004) identified ambivalent effects of group size on successful collective action: trust-generating interactions occur at lower group sizes, however such a lower workforce means lower resources (time, financial) for effective mobilization. We find this ambivalence in our results with higher group sizes being positively correlated with the lifetime of the initiatives, but negatively correlated with the group perception of trust and cohesion. Regarding transaction costs, larger groups seem to suffer more from the efforts required to bring users together and agree on institutional changes (Ostrom, 2009). A recent study isolated the most successful cases of collective urban lake management as those being relatively small with a moderate number of actors (Nagendra & Ostrom, 2014). They showed that trust and leadership contributed to the success of the resource's collective management. Regarding urban community gardens, a non-statistically significant negative correlation was also found between group size and perceived trust (Rogge et al., 2018). The difficulty to derive a clear guideline on the effect of community size comes from the diversity of institutional arrangements employed to overcome collective-action problems (Poteete & Ostrom, 2004). Local knowledge should be harnessed to optimize the community's institutions, which thus would appear more legitimate and fair. This is in line with the third design principle of Ostrom (1990).

Rogge et al. (2018) further identified trust as being more a product of social interactions than a precondition. This point is important when considering the conditions of urban environments and their high population diversity: mutual interests in commoning may drive social interactions, through which trust can emerge. Social capital can then bridge people together even in atmospheres of preexisting distrust and divergent interests (Rusch, 2010). Such bridging may lead to resilience of local collaboratives (Clarke, 2017). As framed by Stern et al. (2002), the institutional performance of such systems depends on how the institutional arrangements in place deal with group heterogeneity and group size. In an earlier version of the present model, we had varied these arrangements and measured their effects on the collective action within urban community gardens. We indeed found specific combinations of institutions which led to higher or lower rates of success, in line with another recent research on the management of common-pool resources (Baggio et al., 2016).

Literature mentions such places of conviviality, a term used to describe processes of friendly and welcoming cohabitation and interaction which accommodate individuals' differences, which are likely to occur in the urban multiplicity (Chiu & Giamarino, 2019; Hinchliffe & Whatmore, 2006). Developing as experimental spaces, such places are both an object and practice of care where people look for each other as much as they look after each other. A classical example is the assembling of neighbors in open-space, such as the urban commons. This produces a space of care and understanding, an "atmospheric installation" where people assemble and materialize their proximity (Corsín Jiménez & Estalella, 2013, p. 131). Such spaces are more likely produced with frequent interaction, or togetherness, of different individuals: in that sense, conviviality emerges more from semi-public spaces than public space (Wessendorf, 2014). This highlights the need of "zones of encounter" (Wood & Landry, 2008) or "micropublics" where human boundaries, such as ethnicity, religion or class can be bridged (Rusch, 2010). Our present case of urban commons represents such a zone of encounter. In the KasKantine cooperative, volunteers interact in a convivial space, physically materialized by shared premises with comfortable chairs and sofas. Such a space is a breeding ground for trustful interactions and social cohesion. It is perhaps not surprising to note the success of open events such as the social change discussion group, which proposed several events in spring 2019 at KasKantine. Such events are an opportunity to exchange and learn, either about the world, the other humans or oneself.

As shown in our model, smaller group sizes contribute to some extent to higher trust emergence, probably via the creation of such zones of encounter. Although stereotypes may still be privately kept, under a veil of apparent courtesy (Valentine, 2008), there is in conviviality this evidence of civility toward diversity, as a strategy to mediate positive relations and possible tensions (Wessendorf, 2014). This strategy aligns with the notion of symbiotic mutualism (Rose, 2012), which extends diversity to the non-humans (Metzger, 2015).

Urban commons communities can also be associated to the notion of Communities of Practice (CoP) (Euler, 2018; Radywyl & Bigg, 2013), originally defined by Wenger (1998, 2010). As reformulated from Wenger's work, CoP consists of "(1) a 'joint enterprise' of vigor in learning about a particular enterprise (e.g., gardening), (2) 'mutual engagement' through which people bond and build social capital, and (3) a 'shared repertoire' of rules, jargon, and metaphors that enable a community to reflect upon and understand its own state of development and to move forward" (Bendt et al., 2013, p. 19). Repeated interaction within CoP generates a so-called history of learning, which iteratively defines the community of practice. This shared knowledge base is similar, in a more comprehensive way, to the idea of history of encounters in our model which generates certain expectations, and influences trust.

In the same line of thought, we can question in such communities the evaluation of trust solely with reciprocity (based on the history of past encounters): "I follow the social norm because I trust my peers will do so too." In certain situations, interpersonal commitment, through predefined coordinating procedures, can outperform relations of reciprocity, by preventing defection through a mirroring effect (Bravo et al., 2012; Lumineau & Malhotra, 2011). We have not considered the emergence of trust through such contract mechanisms, formal or not. CoPs however encapsulate such institutions, or "shared repertoires of rules," as expressed through the third point of the definition given above (Bendt et al., 2013, p. 19).

As defined by Wenger, CoP are by definition built around social capital and the collective processes associated to a shared enterprise. According to our theoretical framework (Figure 1), CoP may a priori qualify as adaptive systems. CoP have been further described to build resilience in the urban context, with the examples of urban forestry (Campbell et al., 2016) and urban community gardens (Chan et al., 2015). The latter example is a typical example of urban commons.

According to Colding and Barthel (2013), solving ecosystem-related issues requires cognitive resilience building, which is also the result of repeated interactions of a group of individuals with a local ecosystem. They connect this notion with the earlier one of cultural capital (Berkes & Folke, 1992; Folke et al., 2005) which provides means of adaptation to the natural environment, but by adding to it social learning and the retention of knowledge, as we incorporated to some extent in our model. This latter element somehow relates to the history of learning which defines CoP. The conviviality of the urban commons brings individuals together in zones of encounter (Wood & Landry, 2008) where human boundaries, such as ethnicity, religion, or class can be bridged. It is at this boundary that the learning of these communities can occur. The term social capital seems to embrace the notions of cultural capital and social learning, which help communities adapt to their natural environment. In our understanding, social capital adds certain important conditions to successful urban adaptive co-management, namely trust and social cohesion, the two main outcomes of our model.

The earlier validation, via computer simulations, of hypotheses H1, H2, and H3 in the Amsterdam cooperative context means that social capital (which relies on social cohesion and trust, itself related to reciprocity) builds up over time, especially in smaller groups of volunteers. Both social cohesion and trust seem to grow, at least in between consecutive conflicts in the latter case, until a saturation point (Figure 5). From the literature above, we can link our case of urban commons to CoP, which are defined by a social history of learning, which repeated interactions around a shared goal produce. The social learning processes associated with such interactions have been identified as a strong component of resilience building at the community scale, although they still lack assessment from trans-disciplinary approaches (Schauppenlehner-Kloyber & Penker, 2016). Resilience is a term, which is difficult to embrace, especially for the younger inhabitants. It can be promoted precisely by activating it at community scale through mutual learning, community of practice and active land management (Colding & Barthel, 2013; Petrescu et al., 2016). In addition, the different types of resilience observed in urban systems may contradict one another: ecological resilience, social/community resilience, and technological infrastructure resilience may have different normative goals (Elmqvist et al., 2019). Emerging from the urban communities of practice which we here studied are: social capital (trust,

social cohesion) and a simple form of social memory. Both social memory and social capital contribute to “building social capacity for resilience in social-ecological systems” (Folke et al., 2003, 2005, p. 455).

Concluding words

Our study indicates that the KasKantine example of urban commons can improve the adaptability of local communities to institutional, social-economical and ecosystem issues, through repeated interactions generating social capital and social memory, thus increasing their social resilience. Such communities can be considered as Communities of Practice, which by definition produce social capital and can drive community resilience. The social interactions occurring within the KasKantine cooperative and urban community gardens, both forms of urban commons, support social capital building through trust and social cohesion. These traits are not preconditions, but rather emerge from the collective action occurring in such convivial spaces. This combination of openness, experimentation in the face of disruptions, and freely accessible knowledge can help local communities to better face possible socio-economic changes. Such capacity-building can trigger urban community resilience, notably through forms of cognitive resilience.

The fact that trust and cohesion do not need to be preexistent for communities to engage in the urban commons should not surprise us. Late 19th-century German philosopher G. Simmel, through the intellectual analysis of boundaries (Simmel, 1994), noted that only that which is previously separated can be connected; for example, the two banks of a river joined by a bridge. The paradoxical dependence of separateness and unity extends to human beings, which Simmel qualifies as “being-boundaries which have no boundary”: an individual is itself a boundary, with for example, its values, cultural background and lifestyle, but with the capacity, at any time, to modify its situation through its interactions. It is at this boundary that the learning of communities can occur. In an often multicultural urban scenario, this particular trait of capacity-building “from scratch” is a priori a strong argument for social resilience. Assuming the existence of a convivial urban space where communities potentially bring individuals together, this can trigger constructive interactions thanks to trust and cohesion.

Further research

Our conclusions above are given for the Amsterdam cooperative of KasKantine, and more empirical work is needed to assess the building of social capital in other examples of urban commons. We have not investigated the interpersonal commitments, formal or not, which could influence trust and therefore social capital building in our example of urban commons. In contexts where such contracts are relevant, it may be useful to consider trust emergence through such institutions. We also wish to highlight the need to study the role of alliances between citizens and public entities, such as municipalities, in contributing urban commons resilience building. Empowering citizens may be perceived as a threat to local governments (Petrescu et al., 2016). Similarly, commoners may prefer to maintain a certain distance with local authorities. The initiators of KasKantine accept certain help from the municipality of Amsterdam, mostly as moral and logistic support, but prefer to stay independent of financial help, perhaps for the sake of their autonomy. Participatory approaches in collaboration with local authorities have also generated positive results (Clarke, 2017; Nagendra & Ostrom, 2014). Such polycentric arrangements, on activities which are beyond the scope of local communities, offer a powerful alternative to the usual process of privatization and top-down ecosystem restoration. In line with this argument, adequate forms of governance and management may help the creation or promotion of urban places which trigger social integration and cognitive resilience building (Colding & Barthel, 2013). Exchanges public-civic are also proposed as further research by the authors of the study on R-Urban in Paris (Petrescu et al., 2016).

Humanities can further contribute to the question of alliances of the public and civic sector in an attempt to reach urban resilience through the urban commons.

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Appendix

Questionnaire sent to the KasKantine volunteers

Part 1/2: GOAL AND DEFINITIONS

For my research, I study the social interactions around shared resources or spaces. I need to know why you contribute to KasKantine: think of personal or collective motivations

Definitions	Social development	You like to be connected to one another and, through your activity, enjoy working for "something bigger": what happens in kk increases the value of the tasks you are doing
	Education	You come to learn
	Tasks	You like certain aspects in your tasks: being outdoor, cleaning (meditative?), creating, building with hands ...
	(Social) sustainability	You like the societal and environmental values in kk, the sense of freedom, the sharing or "gift economy"
	Land/space	You can finally use a space to express yourself: arts, smoothy, gardening ...
	Free time	You have too much time available ! (weekend, holiday ...)
	Product	You come to get some outcomes of the tasks in kk (food, fresh veggies/herbs, knowledge, locally-made stuff ...)
	Social interaction	You like hanging out with other volunteers and customers at kaskantine
	Environmental conditions	[Negative motivation] sometimes it's bad weather, or insect come out of nowhere: tick this box if you are affected by that
	Work conditions	[Negative motivation] sometimes there's too much work, and too little volunteers: tick this box if you are affected by that

Part 2/2: ANSWERS

Why do you come volunteering at KasKantine ? (see definitions above)

Ratios:	KasKantine	(German database)	Averaged result
Social development	0.83	0.30	0.67
Education	0.5	0.5	0.5
Tasks	0.83	0.8	0.82
(Social) sustainability	0.5	0.6	0.53
Land/space	0.17	0.3	0.21
Free time	0	/	/
Product	0.33	0.6	0.41
Social interaction	1	0.9	0.97
Environmental conditions	0	0.6	0.18
Work conditions	0.17	0.2	0.18

In the model, the belief strengths parameters correspond to the averaged result column, in which the KasKantine results weigh 70% and those of the community gardens 30%.