



# An identity perspective on the diffusion of user innovations in the household sector

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## ABSTRACT

User innovations are widely present in the household sector, but often do not spread to others because users lack incentives to sell and/or share. Previous studies of what alleviates this diffusion problem were empirically driven, while a theoretical framework that integrally explains alleviating factors is missing. We fill this void by proposing an identity perspective based on users' eudaimonic motivation: diffusion efforts may be in line with users' aspired 'daimon' or true self. An identity perspective unites previously unconnected alleviating factors (commercial motivation, community involvement, common cause motivation) and enables theorizing about interaction effects. We identify three types of user innovator identity with potential relevance for diffusion: professional, community-oriented and societal. Survey data of 999 Chinese user innovators confirm that aspired professional identity is associated with sales effort, and community-oriented and societal identity with free sharing. Moreover, community-oriented and professional identity interact positively with selling effort. We conclude that an identity perspective enhances our understanding of the diffusion of user innovations to everyone's benefit.

## 1. Introduction

User innovations are new goods, services or processes developed by firms or citizens to satisfy their own needs. User innovations complement so-called producer innovations, which are new products, services or processes that must be sold or adopted by others, before the innovator benefits (von Hippel, 2005). User innovations are found in any part of the economy, but prevail in the household sector: generally 4 to 6 % off all citizens can be considered user innovators (von Hippel, 2017; de Jong and von Hippel, 2023). Their innovations are often also valuable to other people facing similar problems or needs, and in such instances diffusion is merited. Broad availability of user innovations avoids duplicating the problem-solving effort, which would imply a welfare loss (von Hippel, 2005). Diffusion may occur commercially (after satisfying their personal needs, users may sell their innovations) or directly to peers (freely sharing innovations with other people) (de Jong et al., 2015; Hyysalo et al., 2017; Yu, 2022).

Unfortunately, user innovations do not diffuse as much as would be desirable from a societal welfare point of view (de Jong et al., 2015; von Hippel, 2017). The problem of 'diffusion failure' exists because users innovate to solve their personal problems, but do not reap benefits from

the *additional* effort required to make solutions broadly available (von Hippel, 2017). Lack of diffusion is a different type of market failure, compared to the challenges that producer innovators face. Where producers' effort to spread their innovations is entirely plausible (or they would not benefit), for users such an effort is not evident (de Jong et al., 2015).

Researchers have identified various factors that alleviate the diffusion problem. First, users sometimes become commercially motivated, in parallel with or after identifying their personal needs. Anticipated commercial benefits is what makes them diffuse (Hamdi-Kidar and Vellera, 2018; Shah and Tripsas, 2007; Yu et al., 2020). Second, user innovations are sometimes developed in communities, with the help of other people. When communities are involved sharing becomes likely (Franke and Shah, 2003; Ogawa and Pongtanalert, 2013). Third, user innovators occasionally seek to contribute to a 'common cause' which increases the odds of diffusion (Jeppesen, 2021a; Ornetzeder and Rohrer, 2006). Regardless, studying the diffusion of user innovations is in its infancy, and continued work is needed (de Jong et al., 2021).

Past diffusion studies in the user innovation area have been phenomenon-driven: alleviating factors were empirically identified (e.g., Franke and Shah, 2003; Ogawa and Pongtanalert, 2013; Yu, 2022)

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with limited theorizing about what makes individuals diffuse. The few scholars who did theorize applied economic reasoning, arguing that the decision to diffuse is extrinsically motivated. Thus, [von Hippel \(2017\)](#) reasoned that users will not diffuse unless they can reap additional benefits from adopters, which compensates the additional effort required for diffusion. However, many diffusion arguments that are observed in practice do not fit with this extrinsic motivation perspective. For example, users often freely share innovations out of conviction that knowledge should be open, or out of altruism ([Harhoff et al., 2003](#); [Ogawa and Pongtanalert, 2013](#)). Likewise, in social movements diffusion effort is arguably triggered by self-transcendent values like universalism ([Jeppesen, 2021a](#)). In all, a theoretical framework that can explain the existence of all known alleviating factors, and that can serve as a basis for continued work, is not yet available.

We fill this void by proposing an identity perspective as a theoretical basis to study diffusion. Identity approaches refer to theoretical frameworks that explain individuals' behaviors out of their aspired identity ([Brewer and Gardner, 1996](#); [Brown, 2015](#)). Our premise is that diffusion effort depends on how users perceive themselves towards other people. Their aspired identity may be influential because, unlike innovation development, diffusion is a social activity in which potential adopters are involved ([Rogers, 2003](#)). Users can reveal part of 'themselves' by spreading their innovations, such that their sales or sharing effort signals particular meanings that users associate with innovation, beyond satisfying their personal needs.

Identity perspectives emerged from social psychology, in particular self-categorization theory ([Turner, 1985](#)). A range of individual behaviors can be explained with identity concepts, ranging from life-changing events like fighting for a country ([Gómez et al., 2011](#)) to simpler behaviors like the choice of clothing ([Fields, 2003](#)) and holiday destinations ([Wang and Li, 2021](#)). In entrepreneurship, identity concepts have been associated with how founders develop their businesses ([Fauchart and Gruber, 2011](#)) and with the roles that founders play in venturing processes ([Cardon et al., 2009](#)). Applications to individual innovators have been scarce. One exception is [Lifshitz-Assaf \(2018\)](#) who, in a study at NASA, found that R&D workers only adopted open innovation practices if they reconsidered their job-related personal identity.

An identity perspective enables us to move beyond explanations based on economic rationality. Central to identity perspectives is eudaimonic motivation ([Waterman, 2004](#)), which refers to behaviors that contribute to people's 'daimon' or aspired true self, and that help to realize their human potential ([Ryan and Deci, 2001](#)). Eudaimonic motivation is the counterpart of hedonic motivation. Both are intrinsic motivations concepts, where the hedonic version refers to more superfluous behaviors that directly provide pleasure and happiness ([Ryan and Deci, 2001](#); [Waterman, 2004](#)). User innovation scholars identified hedonic motivation as a reason to innovate ([Raasch and von Hippel, 2013](#); [Stock et al., 2015](#); [Stanko and Allen, 2022](#)) but also as a cause of diffusion failure – because hedonic enjoyment fully emerges out of the innovation process itself ([von Hippel, 2017](#)). In contrast, eudaimonic motivation has been absent in the user innovation literature so far.

An identity perspective offers three advantages, corresponding with the contributions of our paper. First, it provides a theoretical framework that relates and integrally explains factors diminishing the diffusion problem (commercial motivation, community involvement, common cause motivation). Second, an identity perspective helps in further delineating the circumstances in which user innovations diffuse. For example, studies of user innovations that are developed in communities have argued that sharing is more likely for multiple reasons, including reciprocating external help, but also altruism ([Franke and Shah, 2003](#); [Ogawa and Pongtanalert, 2013](#)). Our analysis enables to distinguish the impact of identity-related factors (like altruism) from simple reciprocity. Third, identity perspectives recognize that individuals may simultaneously pursue multiple identities (for example, this explains why football hooligans are often decent workers and family people during the work week) ([Brewer and Gardner, 1996](#); [Turner and Oakes, 1986](#)).

Different identities exist and their co-occurrence may amplify users' diffusion behavior. Hence, an identity perspective enables theorizing and testing interaction effects, which has not been done in the diffusion of user innovations literature before.

In our theory section we identify three types of identity, corresponding with different eudaimonic motivations of users that are potentially relevant for diffusion. Professional identity implies that users are eager to show their professionalism as innovator, which they demonstrate by achieving personal benefits and by innovating at competitive market standards. Community-oriented identity is pursued by users who want to provide benefits to their ingroup of like-minded others. They closely align with a community to which they want to make authentic contributions. Societal identity refers to users who aim for collective benefits by impacting impersonal others. They seek to advance a common cause, and to demonstrate socially responsible behavior. Next, drawing on survey data of 999 user innovators in the Chinese household sector, we find that professional identity is directly related to users' sales efforts, and that community-oriented and societal identities are related with free sharing. Moreover, we find evidence for a positive interaction between professional and community-oriented identity, and sales effort – demonstrating that studying interaction effects is merited.

## 2. Theory

### 2.1. Diffusion failure and alleviating factors

So far, scholars theorized about the diffusion problem from an economics perspective, based on extrinsic motivation arguments. The diffusion problem is caused by lacking incentives: after building an initial prototype that solves their personal problem, users have no reason to continue with the development of their innovations and to make other people benefit ([de Jong et al., 2015](#)). The same lack of incentive applies when users are (partially) motivated by hedonic reasons ([Raasch and von Hippel, 2013](#); [von Hippel, 2017](#)). Only if users can reap additional (financial) benefits, i.e. by selling their innovations, the diffusion problem diminishes ([de Jong et al., 2015, 2018](#); [Yu et al., 2020](#)).

Other findings in the literature on why users diffuse, do not fit this extrinsic motivation perspective well. For example community involvement implies that users are sometimes part of a group of people with a shared passion, hobby or interest. In this context users may share innovations out of conviction, altruism, or to stick to community norms ([Franke and Shah, 2003](#); [Harhoff et al., 2003](#); [Ogawa and Pongtanalert, 2013](#)). Likewise, user innovators who innovate in the context of a social movement may seek to advance a common cause, and accordingly share their innovations for a greater good. Examples are found among people with vegan habits ([Jeppesen, 2021b](#)), or who build renewable energy applications ([Ornetzeder and Rohracher, 2006](#)) or car sharing platforms ([Truffer, 2003](#)). In many instances where users put effort into diffusion, extrinsic motives did not apply; rather intrinsic motivation seemed decisive.

### 2.2. Identity and eudaimonic motivation

We consider the possibility that diffusion efforts may be intrinsically motivated, that is, diffusion effort may be in line with users' aspired identity. Intrinsic motivation is the kind of motivation that makes individuals engage in behaviors because of its inherent satisfaction, rather than a desire for specific rewards or outcomes ([Ryan and Deci, 2001](#)). Eudaimonic and hedonic are two types of intrinsic motivation. The idea behind eudaimonic motivation is that individuals are eager to reach self-actualization, and do things that align with their aspired true self. In contrast, hedonic motivation can be catered by superfluous behaviors, like alcohol consumption or visiting parties, that do not define the self ([Waterman, 2004](#); [Ryan and Deci, 2001](#)). Eudaimonic motivation is

indispensably related with identity formation: people's subjective understandings of who they are and want to be, and how they perceive their place in society (Waterman, 2004; Brown, 2015).

Any type of aspired identity may be described along three dimensions (Brewer and Gardner, 1996). First, basic social motivation is about individuals' goals in their interaction with others. Individuals are intrinsically motivated to achieve positive distinctiveness on some criterion that defines their aspired self; resembling with their eudaimonic motivation (Waterman, 2004). Second, identities differ in their basis of self-evaluation, that is, criteria from which individuals derive their self-worth. Third, identities have different frames of reference: outcomes in relation to which individuals access their self-worth.

Moreover, identity approaches counsel that individuals' sense of self is determined by *multiple* identity concepts at are various levels of social inclusiveness (Brewer and Gardner, 1996; Turner and Oakes, 1986). This, for example, explains that many football hooligans have well-regarded jobs and live decent family lives during the work week (Tajfel and Turner, 2004). Brewer and Gardner (1996) identified three common identity levels. The *personal* level represents the part of a self-concept that differentiates individuals from all others. It is the most restricted level of social inclusiveness where individuals regard themselves as a unique entity, acting in terms of their individual goals and ambitions. Second, the *relational* level refers to that part of the self derived from relationships with others in the individual's social network. It is the intermediate level of social inclusiveness where individuals regard themselves as group members, and behave in line with group standards. Third, the *collective* level is the part of a self-concept derived from membership of larger, impersonal groups. It is the broadest and most inclusive level where individuals think of themselves as part of the human species or society at large, and act with concern for impersonal others.

### 2.3. User innovator identities

Combining aforementioned dimensions and levels with the user innovation literature, we identified three types of identity that may trigger diffusion effort. See Table 1.

The identities in Table 1 resemble Fauchart and Gruber's (2011) typology of Darwinian, communitarian, and missionary business founders – which we found helpful to conceptualize identities with potential relevance for user innovation. The overlap is not surprising, as proactive diffusion by users somewhat overlaps with founders' proactive, entrepreneurial behaviors.

#### 2.3.1. Professional identity

At the personal level, user innovators with professional identity are not only motivated to fix a personal problem, but they also like to

**Table 1**  
User innovator identities at three levels of social inclusiveness.

Characteristic	Professional	Community-oriented	Societal
Level of inclusiveness	Personal	Relational	Collective
Dimension:			
- Basic social motivation	Show professionalism	Align with community	Advance a cause
- Basis of self-evaluation	Market standards	Authenticity	Social responsibility
- Frame of reference	Competitive products	Community benefits	Societal impact
Alleviating factor/ related literature	Commercial motivation; reputation, expertise; Darwinian founder	Community involvement; communitarian founder	Grassroots innovation; social movements; missionary founder

demonstrate that their innovation can meet professional standards. They signal their professionalism by obtaining private benefits like generating revenues, developing an expert reputation, or even obtaining new skills to become a more professional innovator. Such users find it important to develop their innovation such that it meets regular market requirements. Normally, users solve their problems with quick prototypes, just enough to satisfy their immediate need (von Hippel, 2005; de Jong et al., 2023). However, these initial user innovations are not yet solutions that meet market standards (de Jong et al., 2023) and legal requirements (Torrance and von Hippel, 2015). Some users aspire business-level quality to demonstrate their professionalism, and develop solutions that can compete with available similar products.

Professional identity corresponds with studies in which users put effort into diffusion for commercial reasons (e.g., de Jong et al., 2015; Yu, 2022), but also with studies where users wished to develop an expert reputation (e.g., Raasch and von Hippel, 2013), on top of addressing their personal needs. The counterpart in Fauchart and Gruber's (2011) typology is the Darwinian business founder, who is motivated by self-interest (e.g., creating personal wealth), evaluates himself on business-related competences, and looks at competitors as a frame of reference.

#### 2.3.2. Community-oriented identity

At the relational level, user innovators with a community-oriented identity feel emotionally connected with a group of like-minded others in their social environment. They want to live up to the habits and preferences of their 'ingroup', and make authentic contributions that are useful to others. Providing benefits to their ingroup, based on deep knowledge about their shared needs, are important in the user innovator's frame of reference.

Community-oriented identity corresponds with studies in which user innovators developed solutions in the context of communities, from which they received help to solve their problem, and with whom they regularly interact. Such user innovators care for other community members, and appreciate the group's opinion (e.g., Franke and Shah, 2003; Hamdi-Kidar and Vellera, 2018). In Fauchart and Gruber's (2011) typology, the counterpart is the communitarian business founder who operates in a group with a shared hobby, passion, or interest. Communitarian founders seek to maintain beneficial relationships with familiar others, and to offer products that their peers find truly useful.

#### 2.3.3. Societal identity

At the collective level, user innovators may develop solutions not only to use themselves, but also to address a common cause. They find it important to demonstrate social responsible behavior and do good. Their frame of reference is the potential impact of their innovation to society, beyond its personal usefulness.

Societal identity corresponds with studies in which users contributed to grassroots innovation projects developed by collectives to address grand challenges, like energy saving (Ornetzeder and Rohracher, 2006). Societal identity also resonates with studies of user innovators in social movements (e.g., Jeppesen, 2021b). This type echoes Fauchart and Gruber's (2011) missionary founder, who seeks to impact society at large, and addresses public causes like sustainability or public health. Missionary founders evaluate themselves based on responsible behavior, and find it important to lead by example, and demonstrate that alternative practices are viable.

## 3. Hypotheses

We develop hypotheses about how the three user innovator identities are related to selling and sharing; the common diffusion pathways in the user innovation literature (de Jong et al., 2015; Hyysalo et al., 2017; Yu, 2022). Effort to sell includes a range of possible activities, including direct sales to other users, web sales, and licensing innovations to businesses. Users may also directly share their innovations, that is, document and reveal their designs, and provide assistance so that others

can build copies (von Hippel, 2017). Next, a first step is taken to investigate interaction effects, as multiple identity concepts can be simultaneously present. We consider the moderating role of community-oriented identity, as communities have been shown to play a significant role in the emergence of user innovations (e.g., von Hippel, 2005; Franke and Shah, 2003; Baldwin and von Hippel, 2011) and their diffusion (e.g., Shah and Tripsas, 2007; Ogawa and Pongtanalert, 2013).

### 3.1. Effort to sell

We anticipate that sales effort is positively related to users' professional identity. The more user innovators are motivated to meet professional standards, the more they will engage in some sort of commercialization effort. Its anticipated financial benefits, expert reputation, and/or new skills obtained then confirm their aspired identity.

Professional identity is of particular importance because commercializing user innovations requires additional effort, beyond the solution-prototyping activities that users normally do (de Jong et al., 2023). User innovations are often quickly designed, and just sufficient to fix a personal problem (von Hippel, 2005). To develop initial solutions into products that can meet market standards, additional effort is required: to design a product that is sufficiently reliable, and that can be produced and marketed (de Jong et al., 2023). Continued development is normally the expertise of producer firms, who can more effectively meet legal requirements (Torrance and von Hippel, 2015) and market standards (von Hippel, 2005). For user innovators who aspire a professional identity, however, engaging in continued development activities is a good match. Successful commercialization will demonstrate their professionalism and ability to meet competitive standards.

Given that professional identity comprises commercial motivation, which has been repeatedly associated with users' sales effort in previous research (de Jong et al., 2015, 2018), this hypothesis is not new. Rather, we regard it as a validation hypothesis to show that an identity perspective can replicate existing insights about alleviating factors:

**H1.** For user innovators in the household sector, effort to sell is positively related with their aspired professional identity.

### 3.2. Effort to share

Effort to share is expected to relate positively with aspired community-oriented identity. Users should freely reveal their innovations to signal commitment to their like-minded others. Free revealing is also in line with their desire to be authentic; it would signal that their concern is truly with the community, and helps them to stand out in a positive way. In this context, social identity studies have shown that individuals try to distinguish themselves by engaging in prosocial behaviors like providing help (Johnson et al., 2013), and favoring ingroup members (Ellemers and Barreto, 2003).

Our hypothesis about community-oriented identity may seem obvious, but we expect a positive relationship even in the absence of ingroup members who assisted in developing the innovation. Users typically return such favors by sharing their solutions back (Ogawa and Pongtanalert, 2013; Franke and Shah, 2003). Prior external help also implies that some revealing has been done already, as others were involved in its development - awareness is the first step in any diffusion process (Rogers, 2003). But even without external help, our identity perspective counsels that community-orientation triggers free revealing. In previous studies the effects of reciprocating external help, versus intrinsic motivation to freely reveal, were not separated.

A case that illustrates our reasoning is found in the literature on patients who developed innovations to cope with rare diseases. Oliveira et al. (2015) found that rare disease patients proactively revealed their innovations to other patients, especially when their innovations increased their overall quality of life. Rare disease patients were simply

compassionate with their peers, and this made them share, in line with our theorizing about community-oriented identity. We hypothesize:

**H2.** For user innovators in the household sector, effort to share is positively related with their aspired community-oriented identity.

Our third hypothesis is that effort to share is positively related with aspired societal identity. Some users innovate to address to a common cause, on top of their intention to personally use their innovation. We can expect those users to share their innovations broadly, beyond their current social networks, and regardless of community involvement or community orientation.

When user innovators pursue a societal identity, the problem they are solving for themselves more likely also applies to other people (e.g., save energy, increase public safety, diminish environmental pollution). Free sharing signals socially responsible behavior, and helps to truly change societal practices. These are the main criteria of self-evaluation, and a frame of reference, for this type of identity. In this vein, Jeppesen (2021a) explained that a shared common cause is usually strongly present among people in social movements, and adoption by others is a requirement before an innovation is deemed successful. "Innovation [may be] part of a desire to change the system by [...] collectively changing behaviors: for example, by saving the climate, not killing animals, or developing an economy less focused on consumption and growth. A social movement can only establish a new order of life (e.g., societal change) if everyone—or at least a sufficiently large crowd—adopts and uses the innovation. This common-cause motivation and the shared incentives to reach critical mass are clearly related to innovation diffusion" (Jeppesen, 2021a: p.2). In a follow-up working paper, Jeppesen (2021b) reported initial evidence in a sample of 410 vegan consumers.

Our hypothesis is also consistent with past observations of grassroots innovation projects. Grassroots innovations are developed by networks of activists or organizations, usually to contribute to sustainable development (Seyfang and Smith, 2007). For example, in the case of renewable energy technologies, pioneering user innovators were not only driven by personal need, but also wanted to contribute to a sustainable society. This made them develop innovations in formats that others could easily adopt. They also actively shared their innovations (Ornetzeder and Rohrer, 2006).

Our identity perspective counsels that societal identity will be related with users' proactive sharing effort, regardless of whether they developed their innovations with the help of others. Even when reciprocity-driven sharing is controlled for, we expect to find:

**H3.** For user innovators in the household sector, effort to share is positively related with their aspired societal identity.

### 3.3. Moderating role of community-oriented identity

As a first interaction hypothesis, we argue that community-oriented identity strengthens the relationship between aspired professional identity and selling behavior. At high community-oriented identity, users will more likely receive information from their environment about the broader market value of their innovation, and how they can improve it in order to be sold. Whereas professional identity triggers users to improve innovations to meet market standards (H1), these information benefits help users who aspired a professional identity to direct and enhance their commercial effort.

Our reasoning is in line with Shah and Tripsas' (2007, 2016) description of the user entrepreneurship process, on how new businesses emerge from user innovations. Users who become entrepreneurs initially interact with potential adopters; often in communities where they put their innovations into use. Community members may ask for copies, which provides signals about the broader value of the innovation. Or alternatively, they may suggest how initial solutions can be tweaked to meet broader demand. These information benefits accelerate the development of an emerging business. A similar mechanism was



observed by [Autio et al. \(2013\)](#) in an online user community. Information signals from community members increased the odds of 'entrepreneurial action' (i.e., sales effort) by users. In the context of our paper, we anticipate that community-oriented identity makes it more likely that environmental signals will be received that are helpful for commercialization efforts – but only if users are already open to make commercialization efforts as triggered by their professional identity.

Another reason to hypothesize this positive interaction is that in general, community-oriented identity facilitates customer orientation. Aspired community-oriented identity comes with a desire to be authentic and helpful to intimate others, so that user innovators will prioritize diffusing their innovations in formats that other people find useful ([Prandelli et al., 2016](#)). This amplifies the potential of their solutions, which they would already craft to meet market standards as dictated by their professional identity. We hypothesize:

**H4.** For user innovators in the household sector, the higher their aspired community-oriented identity, the stronger the relationship between their professional identity and selling effort.

Finally, we hypothesize that community-oriented identity strengthens the relationship between aspired societal identity and sharing behavior. Whereas societal identity triggers users to innovate for causes they feel should be embraced by many, and is associated with sharing behavior (as we posed in H3), community-orientation increases the odds that users receive information helping them to optimally disclose their innovations to a broader audience. Analogous to H4, at high community-oriented identity users are more likely to receive information from their ingroup about the broader use value of their innovation, and how they can best facilitate its sharing. This enables users to enhance their sharing effort to impersonal others outside their community, for the societal purposes they have in mind.

In the literature on grassroots innovation, cases have been reported where interactions of users in their local community were helpful to accomplish broad diffusion to unknown others. In cases of car sharing ([Truffer, 2003](#)) and renewable energy technologies ([Ornetzeder and Rohrer, 2006](#)), initial responses from closely related community members provided signals that the innovation was broadly useful. This increased users' confidence that putting effort into spread their innovations broadly (i.e., beyond their local community) would be viable. Also, users learned from their local community how to improve and expand their initial solutions, including additional innovations that required to facilitate massive adoption. For example, in the case of car sharing services in Switzerland, initial interactions with local community members were instrumental to improve reservation systems, and to develop blueprints for maintenance services. Broad diffusion across the country then accelerated thanks to the insights that users obtained from their community orientation ([Truffer, 2003](#)). Importantly, the pioneers of these car sharing services had common cause sustainability goals already when they started their project. Initial local community orientation strengthened the link between their societal objectives and effort to share. In a similar vein, [Ornetzeder and Rohrer's \(2006\)](#) studied renewable energy technologies in Austria, and found that spreading innovations to local communities (motivated by users' community-oriented identity) strengthened pioneers' broader sharing behavior that was motivated by their societal identity.

In all, the same information benefits of a community-oriented identity, as described by [Shah and Tripsas' \(2007, 2016\)](#) and [Autio et al. \(2013\)](#), are expected to strengthen the link between aspired societal identity and sharing effort. We hypothesize:

**H5.** For user innovators in the household sector, the higher their aspired community-oriented identity, the stronger the relationship between their societal identity and sharing effort.

## 4. Methods

### 4.1. Sample and data collection

We worked with an online research panel of citizens in China, managed by Zhongyan Technology. This panel is intensively used for research purposes by public and private organizations, including the Chinese government and over 200 domestic and international companies (e.g., Tiktok, Bosch, Panasonic).

The usual precautions were taken to improve the quality of data collection. All questions were translated from their original English versions into Chinese, then a back-translation procedure was applied with three translators uninvolved in the research. Their translations were compared with the original questions. The meaning of all questions was maintained.

Data were collected with a web survey. Respondents first received an introduction message about the academic purposes of the survey, then completed the questions on their computer or mobile device. The data collection took on average 6 min, ranging from two minutes (no user innovations, only screening questions) to 15 min (user innovators taking their time to complete the full survey). The runtime of the survey was three weeks.

We asked screening questions to identify Chinese citizens who had developed user innovations in the past three years. Panel members were contacted until 1000 respondents met our criteria (see hereafter). To reach this target, invitations were sent out to 18,841 panel members who completed the survey. One respondent appeared to be younger than 18 years, and was removed from the sample. Hence, our empirical results are based on 999 user innovators, who had answered questions about their identities and diffusion efforts.

We had no indication that responses were selective. In our sample of 999 user innovators, 50.2 % was female. In terms of age, 10.8 % was <25 years old, 53.0 % was 25–34 years, 28.6 % was 35–44 years, 4.8 % was 45–54 years, 2.3 % was 55–64 years, and 0.5 % was 65+ years old. As for education, 44.2 % had a bachelor, master or PhD degree. As for income, 3.7 % made <10,000 Yuan, 8.0 % earned 10,001–30,000 Yuan, 17.4 % had an income of 30,001–60,000 Yuan, 28.7 % generated 60,001–80,000 Yuan, 16.5 % had 80,001–100,000 Yuan, 10.1 % received 100,001–150,000 Yuan, 7.9 % realized 150,001–200,000 Yuan, 5.2 % made 200,001–300,000 Yuan, and 2.4 % earned >300,000 Yuan annually. Drawing on  $\chi^2$ -tests, no significant differences were found between user innovators and other citizens who had been invited for the survey.

Compared to the Chinese adult population, younger people and highly educated were overrepresented in our sample. However, it should be noticed that our purpose was *not* a representative sample to estimate the frequency of user innovation in a broad population, as in many previous studies ([de Jong and von Hippel, 2023](#)). Rather, we wanted a convenience sample of user innovators of sufficient size and with good variance on our key variables (identity, diffusion effort) to test our hypotheses.

### 4.2. Screening user innovators

To identify user innovators we applied the procedure described by [de Jong \(2016\)](#), that is known to be conservative and has been applied in more than ten countries ([de Jong and von Hippel, 2023](#)). The screening procedure offers a range of cues and combines simple questions that collectively determine whether a respondent is a user innovator.

We introduced the concept of user innovation as follows: "*In daily life some people develop home appliances for themselves, or improve the quality or performance of products for themselves. For example, (1) in order to make a child's schoolbag more comfortable, a mother may modify the schoolbag strap by wrapping it with a soft and silky material. (2) To improve the performance of a bicycle, an enthusiast may replace a bicycle component with a motorcycle component. (3) To add special effects to videos of his/her family,*

a computer hobbyist may write an original software code. These are examples of people engaging in do-it-yourself and creation in their leisure time.” We then asked the initial screening question “In the past three years, have you ever used your leisure time to develop or modify a product, or commit yourself to working on such a product?” Out of the 18,841 respondents 11,357 responded positively.

Next, we asked questions to screen out non-user innovators (de Jong, 2016). The first criterion was if the respondent, at the time of developing the innovation, could have bought the same application on the market. Hence, we excluded homebuilt versions of existing products, and dropped 7020 cases based on this criterion. The second criterion was if the respondent primarily developed the innovation to sell, or for other reasons than personal use. This ensured that our sample only included user innovations (213 cases discarded based on this criterion). The third criterion was if the respondent developed the innovation for his employer or business. This excluded innovations which belong to the business sector (another 787 cases removed). The fourth criterion was if the respondent had developed the innovation up to a working prototype, rather than ‘only’ ideation or blueprinting. To qualify as user innovator the solution should be completed and put into use. We discarded 2338 cases where the respondent had not completed their innovation.

Respondents then reported (with open questions) what they had developed, and why. A range of products and applications were reported, related to: household/garden, software, health/safety/medical, children/education, sports/hobby/pets, transport/vehicle, tools/equipment, or other. For example, one respondent developed a software: “I save on water with a software that controls a camera that I attached to my tap. The camera recognizes a person's face. The tap has a sensor, but even if it detects motion, water will not come unless a person is standing in front of it.” Another person created a household appliance: “I created a toothpaste package which has two apertures. It not only let two people use one toothpaste but addresses the difficulty of squeezing the content at the bottom. This is convenient for everyday life.” Finally, a respondent developed water recycling system: “It is a kitchen-toilet water recycling system. I first installed a filter for the kitchen waste effluent, then the filtered effluent is connected to the toilet flush water system. This saves water and keeps the sewer clean.”

Out of 11,357 individuals that initially reported some kind of creation, 999 were classified as user innovators. In the second part of the survey, these respondents provided data about their diffusion efforts and innovator identities.

#### 4.3. Variables

Table 2 specifies the variables used to test our hypotheses. Details of the multiple-item measures can be found in the Appendix A.

##### 4.3.1. Selling effort

We measured selling effort with three items from de Jong et al.'s (2018) measure of willingness to commercialize. We re-formulated the items to reflect actual selling behaviors, rather than intentions. The items reflect basic behaviors (direct sales, online sales, licensing) of users to commercialize their innovations (von Hippel, 2017). Reliability was good (Cronbach's  $\alpha = 0.91$ ).

We assessed criterion validity by correlating the selling effort measure with a three-item measure of selling outcome: “Did you generate any income from... selling your innovation?”, “... helping other people to apply your innovation?”, and “...licensing or receiving a compensation from a business that adopted your innovation?” (coded 1 (totally disagree) to 7 (totally agree),  $\alpha = 0.70$ ). Selling effort and selling outcome were significantly correlated ( $r = 0.45$ ,  $p < 0.01$ ), suggesting criterion validity.

##### 4.3.2. Sharing effort

Effort to share was measured with three items, based on de Jong et al.'s (2018) measure of willingness to freely reveal user innovations.

**Table 2**  
Variables ( $n = 999$ ).

Variable	Description	Statistics
Selling effort	Mean score of 3 items <sup>a</sup> ( $\alpha = 0.91$ ) coded 1 (not at all) to 7 (very much)	M = 3.61, SD = 1.54
Sharing effort	Mean score of 3 items <sup>a</sup> ( $\alpha = 0.86$ ) coded 1 (not at all) to 7 (very much)	M = 4.32, SD = 1.31
Professional identity	Mean score of 4 items <sup>a</sup> ( $\alpha = 0.81$ ) coded 1 (totally disagree) to 7 (totally agree)	M = 4.95, SD = 1.08
Community-oriented identity	Mean score of 5 items <sup>a</sup> ( $\alpha = 0.89$ ) coded 1 (totally disagree) to 7 (totally agree)	M = 4.87, SD = 1.19
Societal identity	Mean score of 5 items <sup>a</sup> ( $\alpha = 0.88$ ) coded 1 (totally disagree) to 7 (totally agree)	M = 4.85, SD = 1.17
Gender	Dummy for male gender (0: female; 1: male)	M = 0.50, SD = 0.50
Age	Age of the respondent in years	M = 33.16, SD = 8.03
Income	Respondent's income in the past year (1: $\leq$ 10,000 Yuan; 2: 10,001–30,000 Yuan; 3: 30,001–60,000 Yuan; 4: 60,001–80,000 Yuan; 5: 80,001–100,000 Yuan; 6: 100,001–150,000 Yuan; 7: 150,001–200,000 Yuan; 8: 200,001–300,000 Yuan; 9: $>$ 300,000 Yuan)	M = 4.49, SD = 1.82
Education	Dummy for best educational attainment (0: high school or less; 1: Bachelor's/Master's/PhD degree)	M = 0.44, SD = 0.50
Collaborative development	Dummy for respondents who worked with other people, or a community, to develop the innovation (0: no; 1: yes)	M = 0.33, SD = 0.47
Degree of novelty	Mean score of 4 items <sup>a</sup> ( $\alpha = 0.87$ ) coded 1 (totally disagree) to 7 (totally agree)	M = 4.51, SD = 1.26

Notes: M = mean, SD = standard deviation.

<sup>a</sup> Items are shown in the Appendix A to this paper.

Items were re-formulated to indicate sharing behaviors (i.e., direct sharing, revealing on the Internet, and demonstrating/showcasing the innovation) ( $\alpha = 0.86$ ).

Criterion validity was assessed with a formative measure of sharing outcome: “Did any people in your environment copy your innovation, or currently use it for free?”, “If yes, does this include people beyond your household, for example friends, remote family members or people that were formerly strangers?”, and “If yes, does this also include people that you did not know before?”. The number of positive answers (score 0 = lowest, to 3 = highest) was significantly associated with sharing effort ( $r = 0.27$ ,  $p < 0.01$ ), suggesting criterion validity.

##### 4.3.3. User innovator identities

We used Sieger et al.'s (2016) multiple-item measures of Darwinian, communitarian and missionary founder identity. In its original version, each identity is measured with five items, which cover the dimensions of basic motivation, basis of self-evaluation, and frame of reference. We modified the items to the context of user innovation. Modifications were mostly limited to the stem of each item, e.g., ‘I created my firm...’ and ‘As a firm founder...’ were replaced by ‘I created my innovation...’ and ‘As an innovator...’, respectively. Reliability of all measures was good ( $\alpha > 0.80$ ). For professional identity, we found that the five items lacked convergent validity (see below), and was better represented by dropping the item “As an innovator, it is very important to me to develop innovations on the basis of my solid innovation experience”. This finding was consistent with Sieger et al. (2016) who reported that professional/Darwinian identity measurement did not work as expected in Asian countries.

##### 4.3.4. Control variables

We controlled for gender, age, educational attainment, and income. These variables have been associated with the diffusion of user innovations before (e.g., Chen et al., 2020; Yu, 2023).

We also included a dummy variable whether respondents had developed their innovation with the help of other people in their environment. This ensured that respondents' sharing behavior can be

attributed to their aspired identities, rather than to reciprocation to people who had assisted in developing innovations (Franke and Shah, 2003; Ogawa and Pongtanalert, 2013).

Finally, we added a measure for the extent to which the innovation was deemed novel, which usually positively influences adoption by others (Rogers, 2003; de Jong et al., 2018). Degree of novelty influences diffusion potential, and likely also the effort that users are willing to do – e.g., at low novelty close alternative solutions more likely exist, or innovations are such that other people can put together a similar application without much effort. Our four-item measure included both technology and market-related items, which are both constituents of the degree of novelty of innovations (Garcia and Calantone, 2002).

4.3.5. Measurement model

We conducted a confirmatory factor analysis to test the discriminant and convergent validity of our multiple-item variables. Results are available on request. For each measure, the square root of the average variance extracted (AVE) exceeded the correlations with the other measures, confirming discriminant validity (Fornell and Larcker, 1981). Convergent validity was assessed based on two criteria: (1) composite reliability (CR) exceeding 0.7, and (2) AVE exceeding 0.5 (Fornell and Larcker, 1981). As we already mentioned, one item from our professional identity measure was removed in order to satisfy these criteria.

5. Findings

5.1. Correlations

Table 3 shows the correlation coefficients between our variables. We noticed that the three identity constructs were substantially related ( $r = 0.56$  to  $0.61$ ). This is not unusual, as entrepreneurship studies that applied Sieger et al.'s (2016) measures found similar correlations (e.g., Gubik and Vörös, 2023; Hand et al., 2020). We should also recall that our confirmatory factor analysis demonstrated discriminant and convergent validity. The high intercorrelations confirm that different identities can be simultaneously present, which is in line with the central idea of identity perspectives: that individual's sense of self is constructed at different levels of social inclusiveness (Brewer and Gardner, 1996).

A second observation is that selling effort and sharing effort are positively related at  $r = 0.602$ . Again, for user innovations this is not unusual. Many users who recognize and pursue opportunities to generate income also share their innovations (von Hippel, 2017). Importantly, user innovations are typically shared in a format that deviates from how they are sold, so that sharing is not at the expense of sales potential (de Jong et al., 2023). Free sharing is usually done by sharing design files, and/or by demonstrations, but the burden of replication is on the adopter. In contrast, when user innovations are sold, they are offered as a full-fledged products that people can effortlessly adopt for a payment (de Jong et al., 2023).

Recognizing that the correlations were sometimes substantial, we

carefully checked for multicollinearity. In the regression models presented hereafter, variance inflation factors and condition indices were  $< 2$  and  $< 24$  which is well below common thresholds (Echambadi et al., 2006).

Prior to our analyses, we also empirically checked for common-method bias. First, we applied Harman's one-factor test to our multiple-item measures, finding that the first factor accounted for  $< 50\%$  of the variance. Second, we included a common latent factor to our confirmatory factor analysis (Section 4.3) of multiple-item measures. All items were specified to load on their theoretical construct and an unmeasured common method factor (CMF), where we specified all factor loadings on the CMF to be identical (cf. Podsakoff et al., 2003). For all items, standardized factor loadings on their theoretical constructs were still significant, and overall model fit remained the same (without CMF:  $\chi^2/df = 3.3$ , CFI = 0.96, TLI = 0.96, RMSEA = 0.05; including CMF:  $\chi^2/df = 3.2$ , CFI = 0.97, TLI = 0.96, RMSEA = 0.05). Finally, one of our hypothesized interaction effects was significant (see hereafter). Detecting significant interactions is highly unlikely in the presence of common-method bias (Siemsen et al., 2010).

5.2. Testing hypotheses

We tested our hypotheses with ordinary least squares regression analysis (Table 4). In advance we mean-centered all continuous variables. In models III and IV, we created interaction terms by multiplying these, to prevent multicollinearity issues and ease the interpretation of significant interaction effects (Cohen et al., 2003).

The overall fit of model I was good ( $R^2 = 42.8\%$ ). As expected, the coefficients of the control variables of community collaboration and degree of novelty were positive and significant. We also found that older respondents were less likely to sell or share their innovations, and that highly educated were specifically less likely to sell; indicating higher opportunity costs from engagement in such behavior (Yu, 2023).

With regard to our first hypothesis, the effect parameter of professional identity was positive and significant ( $\beta = 0.159$ ,  $p < 0.01$ ). The more users aspire a professional identity, the more effort they put into selling their innovations. H1 is supported.

With model II we tested H2 and H3. In this model collaborative development was included to control for sharing behavior based on reciprocity. We found that user innovators with higher community-oriented identity spend more effort sharing ( $\beta = 0.173$ ,  $p < 0.01$ ). Likewise, societal identity was significantly related with sharing ( $\beta = 0.093$ ,  $p < 0.01$ ). Both H2 and H3 are supported.

Model III provides a test of H4. The interaction term of professional and community-oriented identity was positive and significant ( $\beta = 0.086$ ,  $p < 0.01$ ). To more clearly interpret this result we estimated the effects of professional identity on selling effort, at various levels of community-oriented identity (Cohen et al., 2003). See Fig. 1. At high levels of community-oriented identity the relationship was stronger, while at low levels it diminished. H3 is supported.

Table 3  
Correlation matrix ( $n = 999$ ).

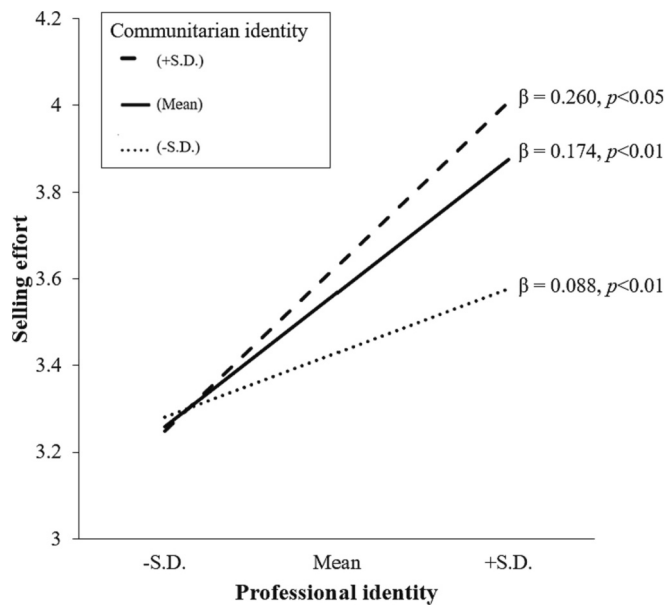
	1	2	3	4	5	6	7	8	9	10
1 Selling effort										
2 Sharing effort	0.602**									
3 Professional identity	0.476**	0.424**								
4 Community-oriented identity	0.426**	0.487**	0.563**							
5 Societal identity	0.427**	0.461**	0.565**	0.612**						
6 Gender	0.012	-0.045	-0.013	-0.014	-0.038					
7 Age	-0.118**	-0.143**	-0.097**	-0.094**	-0.097**	0.148**				
8 Income	0.019	0.049	0.075*	0.027	0.026	0.061	0.090**			
9 Education	-0.011	0.029	0.052	-0.016	0.041	-0.017	-0.089**	0.609**		
10 Collaborative development	0.297**	0.306**	0.228**	0.292**	0.248**	-0.038	-0.143**	0.005	0.036	
11 Degree of novelty	0.609**	0.573**	0.535**	0.510**	0.540**	0.004	-0.084**	0.041	0.065*	0.254**

Notes: Pearson correlations are shown. Two-tailed significance \* $p < 0.05$ , \*\* $p < 0.01$ .

**Table 4**  
Regression models of selling and sharing effort ( $n = 999$ ).

Dependent variable	Selling effort		Sharing effort		Selling effort		Sharing effort	
	I		II		III		IV	
Model	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
<i>Effect parameters:</i>								
Professional (P)	0.159**	0.046	0.033	0.040	0.174**	0.046	0.034	0.040
Community-oriented (C)	0.042	0.043	0.173**	0.037	0.061	0.043	0.166**	0.038
Societal (S)	0.035	0.044	0.093**	0.038	0.029	0.044	0.091**	0.038
P*C					0.086**	0.023		
S*C							-0.025	0.020
Gender	0.023	0.075	-0.029	0.065	0.021	0.075	-0.028	0.065
Age	-0.054*	0.005	-0.070**	0.004	-0.056*	0.005	-0.071**	0.004
Income	0.039	0.026	0.059	0.023	0.041	0.026	0.058	0.023
Education	-0.082**	0.096	-0.046	0.083	-0.080**	0.096	-0.046	0.083
Collaborative development	0.120**	0.084	0.118**	0.072	0.116**	0.083	0.119**	0.072
Degree of novelty	0.452**	0.038	0.382**	0.033	0.457**	0.038	0.381**	0.033
<i>Model fit:</i>								
$R^2$	0.428		0.409		0.434		0.410	
$\Delta R^2$ (baseline model)					0.007** (I)		0.001 (II)	

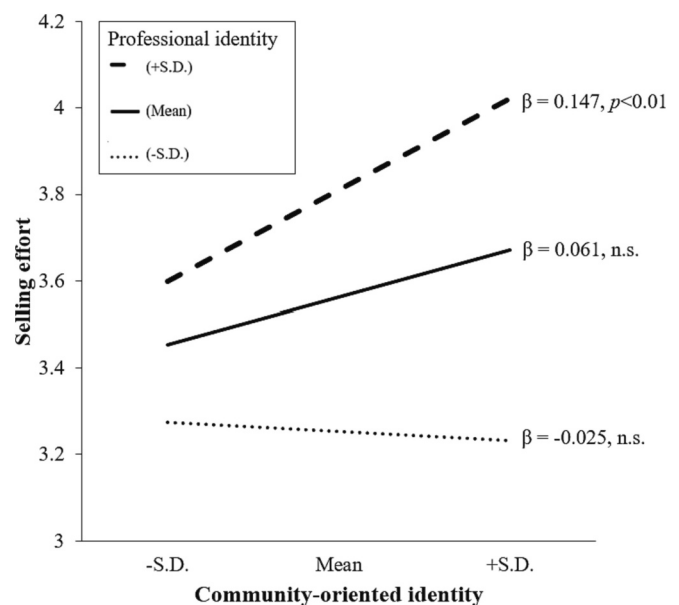
Notes:  $\beta$ : standardized effect parameter. SE: standard error. Two-tailed significance \* $p < 0.05$ , \*\* $p < 0.01$ .



**Fig. 1.** Simple regressions of selling effort on professional identity ( $n = 999$ ).

Alternatively, the significant interaction effect in model III may be interpreted with community-oriented identity as focal independent variable (we thank an anonymous reviewer for this suggestion). [Shah and Tripas](#)' (2007, 2016) description of the user entrepreneurship process can also be interpreted as that information obtained from communities makes users recognize that sales opportunities exist. When we assume that users first and foremost have high community-oriented identity, only a subset of them will sell their innovations instead of sharing only – in case their aspired professional identity is high. In this alternative interpretation, high professional identity implies that users want to meet a standard that allows them to ask money for their innovation, to do an even better job at contributing to their community. In [Fig. 2](#) we repeated [Cohen et al.](#)'s (2003) simple slope analysis, now with community-oriented identity as focal independent variable. It is confirmed that only at high professional identity, the relationship with selling behavior is significant. In our discussion, we will elaborate on both interpretations, which we believe to co-exist.

Finally, model IV provides a test of H5, regarding the interaction effect between societal and community-oriented identity. The interaction term was insignificant ( $\beta = -0.025$ ,  $p = n.s.$ ). H5 is not supported.



**Fig. 2.** Simple regressions of selling effort on community-oriented identity ( $n = 999$ ).

### 5.3. Robustness checks

We conducted various robustness checks; all available on request. First, we re-estimated our models with the original five-item version of professional identity, to obtain higher content validity (at the expense of convergent validity). The direction and significance of the coefficients in our models were maintained.

Second, as respondents' selling and sharing effort were highly correlated, we added sharing effort as a control variable to models I and III, and selling effort to models II and IV. In these robustness checks it was better ensured that our regression models test the effect of identities on the specific diffusion pathway that specified in our hypotheses. Again, we found similar results.

Third, the innovations in our sample related to different objects. Some of these may be easier to diffuse (e.g., software) or observe while being used (e.g., vehicle and transport-related innovations). We added seven dummies to our regression models: whether innovations were related to software (4%), health/safety/medical (5%), children/education (11%), sports/hobby/pet (13%), transport/vehicle (5%), tools/



equipment (39 %) or other (7 %). Household- and garden-related innovations (17 %) were the reference category. The same categories were applied in previous studies (de Jong et al., 2015, 2018; Chen et al., 2020). Controlling for these objects did not change our findings.

## 6. Discussion

We applied an identity perspective to explain when users put effort into diffusing their innovations – based on the thought that selling or sharing may be in sync with who users aspire to be. The hypotheses based on our framework confirm some previous findings, suggesting that an identity perspective is viable for this purpose. Specifically, professional identity is related with sales effort, and community-oriented and societal identity with freely sharing user innovations.

The identity perspective enabled us to deepen our knowledge of when user innovations are actively diffused. As most important empirical contribution, we took a first step to investigate interaction effects. We found that professional and community-oriented identity interact positively to explain users' selling effort. Two explanations were found; as we explain next, both resonate with past observations about user innovators.

First, to user innovators with higher professional identity, community-oriented identity strengthens the link between professional identity and selling behavior (as shown in Fig. 1). At higher community-oriented identity, users obtain information benefits about the market potential and continued direction of their innovations, which helps them to do a better job at demonstrating their aspired professionalism, and accordingly sell their innovation. This finding is in line with past empirical studies in which user-founded businesses had better survival and growth rates (Shah et al., 2012) and innovation performances (Yu et al., 2020) compared to regular ventures. The founders of these businesses were presumably primarily business-oriented (due to their aspired professional identity), and managed to outperform regular businesses because of the better market insights they obtained thanks to their community-oriented identity.

Second, we can interpret the significant interaction effect from the perspective of community-oriented identity (Fig. 2). When users primarily seek to contribute to their community, their identity provides the same information benefits, but only those who (also) aspire a professional identity will engage in commercialization. Hence, high professional identity is required before community-oriented users start to sell, rather than only reveal their innovations. This interpretation is in line with a different set of past studies. For example, business founders that emerge out of communities generally have low growth ambitions and stick to their initial market segments (Fauchart and Gruber, 2011), and users who sell their innovations often do not consider themselves entrepreneurs (Hamdi-Kidar and Vellera, 2018). Their businesses remain smaller, because their founders tend to restrict their selling effort to their community.

Next, another major finding is that we delineated the reasons why user innovations diffuse better within communities. We showed that community-oriented identity is associated with sharing effort, also when external help from other users is controlled for (see Table 4, model II). Hence, sharing effort is partially driven by reciprocation, but also independently by users' aspired community-oriented identity. Previous studies (e.g., Ogawa and Pongtanalert, 2013) did not disentangle these two explanations. Also, our study provides more robust evidence that common cause motivation, which is central to users' societal identity, is related with sharing behavior. So far only initial evidence for this relationship has been presented in Jeppesen's (2021b) working paper. As with community involvement, we found that aspired societal identity is related with sharing even when collaborative development is a control variable.

Finally, our hypothesis about the interaction between community-oriented and societal identity was not significant. Possibly, the phase of a social movement's life cycle is an additional variable to consider.

When user innovators contribute an existing social movement (like in Jeppesen's (2021b) study of vegans) the common cause is well-known and collectively shared by its participants. In this situation community-oriented identity may not accelerate users' sharing effort, since the information benefits from community-oriented identity are not required. In contrast, when social movements are in their nascent phase, local community orientation may make a difference – in Section 6.3 we will recommend this as an opportunity for future research.

### 6.1. Implications for theory

So far a theoretical framework that integrates and explains alleviating factors was not available, nor has the concept of eudaimonic motivation been applied to user innovation. Hereafter we discuss the most salient implications of our study, and provide recommendations.

The theoretical angle we have tested provides opportunities to further delineate why and how user innovations diffuse. For example, our framework enabled us to analyze why users freely share: if we control for prior external collaboration, community-oriented and societal identity both independently contribute. Yet, the identity perspective is probably not complete, especially when it comes explaining users' sales effort. Most important is that eudaimonic motivation does not rule out extrinsic motivation as a complementary mechanism. What if users are exclusively motivated by financial gains - a pure extrinsic factor – and do not aspire a professional identity? We speculate that users may still try to commercialize, but in a different way. Instead of the 'hassle' to develop a business, they would more likely prefer transfer their innovation to a producer firm for royalties. The related literature on individual inventors (who innovate for commercial reasons, not personal need) shows that both commercialization pathways exist: while most inventors become business owners, some prefer licensing (Amesse et al., 1991; de Jong, 2011). In future research we recommend to include both intrinsic and extrinsic motivation concepts to study users' selling effort in particular.

An obvious next step for theory building is to expand our framework, by exploring alternative identities that may be associated with diffusion behavior. Recall that individuals' aspired self is composed of identity concepts at three levels: personal, relational, and collective (Brewer and Gardner, 1996). Our study covered all levels, but the identities in Table 1 are unlikely to be exhaustive. We speculate that at the personal level, users may aspire a 'handyman' identity (instead of professional identity). Based on our knowledge of user innovation and observing many cases in practice, we expect that some users aspire to be a competent do-it-yourselfer (DIY), with no intentions to reach business-level standards. A handyman's basis of self-evaluation may be the DIY products and solutions he builds, and the frame of reference his technical skills compared to others. The handyman would differ from hedonically motivated user innovators (Raasch and von Hippel, 2013; von Hippel, 2017), as he would be intrinsically motivated to diffuse in order to show his 'handiness'. We speculate it would be a weaker sort of diffusion effort: not actively selling or sharing, but only showcasing innovations on social media or using them in public.

Another example is the relational level, where community-oriented identity may not be the only type of identity relevant for diffusion. In our study the focus was on users who were part of a group with a shared passion, hobby, or interest – the type of communities that have been prominent in past research (Franke and Shah, 2003; Ogawa and Pongtanalert, 2013). In a study in Finland, however, Kuusisto et al. (2013) reported that many user innovators collaborate with acquaintances or friends, who are not part of a community. These users preferred to share their innovations selectively, based on whether they liked the adopter. This suggests an alternative identity concept: more intimacy-oriented, with a basic social motivation to maintain and deepen relationships. We expect that such users will do a substantial effort to help adopters with replication, beyond only sharing the details of their designs.

Finally, the identity perspective provides a basis for continued work

on interaction effects. Our investigation of community-oriented identity as a moderating variable is only a first step. New possible interaction effects can be hypothesized, for example, about factors that influence individuals' generic commercialization behavior - like prior entrepreneurship experience, resource availability, and opportunity costs, to name only a few (Shepherd et al., 2019). Each of these may influence the strength of association between identity concepts and diffusion behaviors; there is a plethora of options to explore how users' resources, competences or environment may moderate how their aspired identities are pursued.

## 6.2. Implications to practitioners

To public policy makers diffusion failure is an important challenge, as it derails the positive welfare effects of user innovation (von Hippel, 2005, 2017). So far, scholars recommended one-size-fits-all policy measures based on the economic reasoning. Thus, suggested interventions mainly focused on lowering users' communication costs (Baldwin and von Hippel, 2011), e.g., by subsidizing online knowledge sharing platforms, and promoting open standards like Creative Commons (von Hippel, 2005, 2017). It has also been proposed to support Makerspaces where users can develop personal solutions, and take first steps in commercialization (e.g., von Hippel, 2017; Halbingler, 2018).

Our study brings to awareness that users may have quite different, intrinsic motivations, to actively sell or share their innovations. Given that different identity concepts are related with their diffusion effort, the implication is that policy makers should consider multiple versions of said policy interventions, tailored to users who aspire different identities.

For example, in the case of online knowledge sharing platforms, consider the case of 3D printing where many users develop innovative designs (Claussen and Halbingler, 2021; de Jong and Lindsen, 2021). Users who aspire a professional identity would prefer platforms with commercialization facilities, such as [Shapeways.com](https://www.shapeways.com) does. Those who strive for a community-oriented identity would prefer platforms where they can directly connect with other users. This may be a specific open-source project (e.g., as posted on Github) combined with an informal user group on social media like Discord or Telegram. For user innovators who want to contribute to a common cause (i.e., aspired societal identity) general purpose platforms seem a better match, like [Thingiverse.com](https://www.thingiverse.com).

Likewise, when it comes to promoting open standards, instead of a single intervention, different and tailored policies are probably much more effective. Creative Commons licenses will be a good match for users who aspire community-oriented or societal identities, while professionally-oriented users will more likely prefer classical intellectual property rights to protect their knowledge, in order to demonstrate their professionalism.

Finally, in the case of Makerspaces, users with aspired professional identity are expected to appreciate classical incubation services as part of the Makerspace environment. Those who seek a community-oriented identity will be more responsive to facilities that involve their ingroup members: as co-developer, tester or early adopter (e.g., a training program in which community members replicate the innovation with the help of the pioneering user innovator). Societal user innovators are probably more enthusiastic about services that help to spread their innovation to other geographical areas - so here policy makers are recommended to facilitate exchange between networks of Makerspaces in different regions.

Beyond public policies, user innovators can be an important source of new products in commercial businesses (von Hippel, 2005, 2017; Gambardella et al., 2017). Frequently suggested methods to involve users in new product development (NPD) are crowdsourcing (harvesting approach), toolkits to support users in developing personal solutions (farming approach), and active involvement of lead users who are ahead of important market trends (hunting approach) (Franke and Lüthje,

2020). However, involving user innovators in NPD is challenging, as user innovators are often reluctant to collaborate for reasons of fairness. When users perceive that businesses will generate a lot of revenues with their help, they are less willing to contribute for free (Franke et al., 2013).

Again, our findings imply that NPD methods should be tailored to users' eudaimonic motives, to increase the odds of collaboration. Users who aspire a professional identity will likely prefer crowdsourcing projects, toolkits, and lead user projects explicitly focused on a next generation of successful commercial products. Wannabe professionals would probably appreciate getting a stake, royalty and/or recognition (e.g., an award, or naming a product or part after their inventor). Community-oriented user innovators will appreciate NPD methods in which they can collaborate with ingroup members, and where the focus is on tailoring products to the collective interest of their community. Those who aspire a societal identity would prefer methods that address grand societal challenges (e.g., energy saving). They would be triggered by projects that promise broad implementation (e.g., 'We will introduce the new product in X countries where we already have local presence') and that focus on adoption by unconnected others.

In summary, when user innovators aspire different identities they will prioritize different incentives, facilities, and outcomes that help them become who they want to be. While lowering communication costs will always be helpful, we recommend more fine-grained policy interventions and NPD methods. This is not an evident or easy task, as facilities that would attract one type of innovator may alienate others.

## 6.3. Limitations and suggestions

Our study was not free from limitations. These translate into opportunities for continued research, beyond our recommendations in Section 6.1.

Our methods were not optimal because of resource and time constraints. We obtained survey data from a single source. Although we found that common-method bias was not present, more persuasive evidence would be obtained with a research method where user innovators first report their aspired identities, and their sales and sharing effort are measured later, or obtained from a different source. As a consequence we formulated our hypotheses as associations, not in causal terms.

Next, the Chinese context may have influenced our findings. Particular values and social traditions in the country include harmony, wisdom, guanxi and collectivism. Guanxi refers to social networks of relationships among various groups that support each other, and this highly affects people's attitudes towards social and environmental issues (Geng et al., 2017). Collectivism is about a general understanding of socially accepted norms and a sense of empathy to unknown others in the same social environment (Varma et al., 2009). These may have affected the correlations between our identity concepts, and the overall frequency of diffusion behaviors. In this vein, we noticed that reported diffusion efforts by user innovators in China are higher than in many Western countries, especially when it comes to free sharing (de Jong and von Hippel, 2023). Replication in other countries is recommended.

Third, as we already discussed above, a range restriction in our data may be the reason that our hypothesis about the interaction between community-oriented and societal identity was insignificant. When users seek to contribute to a well-known and broadly shared cause, community orientation may provide no additional benefits. However, in new/emerging social movements the situation may be different. For a sound analysis we recommend purposive sampling of emerging social movements, or detailed case studies like Truffer (2003) and Ornetzeder and Rohrer (2013) did.

Finally, in line with how scholars previously investigated diffusion (e.g., de Jong et al., 2015), our focus was on selling and sharing, but alternative dependent variables are possible. In particular, we advise to study the level of sophistication of innovations, defined as the extent to which user innovations have been developed beyond the initial

prototype that fixes a user's problem. Recall that selling user innovations generally takes most effort, as users have to finetune their innovation to meet market and legal requirements (de Jong et al., 2023). Our identity framework predicts that innovations of users who aspire a professional identity will be more sophisticated. In contrast, users who strive for a community-oriented or societal identity are expected to bring less sophisticated innovations. They may ease adoption by documenting their designs, and providing replication instruction (Hausberg and Spaeth, 2020; Jeppesen, 2021a), but would not develop full-fledged products like wannabe professionals would. Lastly, users who do not pursue any identity, but only solve their personal problem, will have innovations that are expected to be the least sophisticated (i.e., only an initial solution prototype). Investigating the relationships between various identity concepts and the level of sophistication of user innovations would cross-validate our framework.

An identity perspective based on users' eudaimonic motivation unifies existing knowledge of alleviating factors, manages to replicate past empirical findings, and generates new insights especially with regard to interaction effects. It creates opportunities to deepen our knowledge of when user innovations become available to the benefit of all.

### CRedit authorship contribution statement

**Xin Yu:** Writing – original draft, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jeroen P.J. de Jong:** Writing – review & editing, Supervision, Conceptualization.

### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Xin, YU reports financial support was provided by Ministry of Education of the People's Republic of China. Xin, YU reports financial support was provided by Ministry of Science and Technology of the People's Republic of China.

### Data availability

Data will be made available on request.

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### Appendix A. Items

#### Diffusion effort

Effort to sell: How much effort did you do to...

- ...license your innovation to a company?
- ...sell your innovation on a relevant Internet platform?
- ...sell your innovation to other users?

Effort to share: How much effort did you do to...

- ...showcase or demonstrate your innovation to other people?
- ...freely reveal your innovation on the Internet?
- ...share your innovation with other people for free?

(source: de Jong et al., 2018; rated 1 = not at all to 7 = very much)  
User innovator identities.

#### Professional

- I developed the innovation to improve my personal status (e.g., learning).
- As an innovator, it is very important to me to develop innovations on the basis of my solid innovation experience.\*
- As an innovator, it is very important to me to have thoroughly analyzed the financial prospects of my innovation.
- When developing the innovation it was very important to me to have a strong focus on what my innovation can achieve vis-a-vis other products.
- When developing the innovation it was very important to me to establish a strong competitive advantage and significantly outperform other products in the same domain.

#### Community-oriented

- I developed the innovation to solve a specific problem for a group of people that I strongly identify with (e.g., friends, colleagues, club, community).
- I developed the innovation to play a proactive role in shaping the activities of a group of people that I strongly identify with.
- As an innovator, it is very important to me to provide an innovation that is useful to a group of people that I strongly identify with (e.g., friends, colleagues, club, community).
- When developing the innovation it was very important to me to have a strong focus on a group of people that I strongly identify with (e.g., friends, colleagues, club, community).
- When developing the innovation, it was very important to me to support and advance a group of people that I strongly identify with.

#### Societal

- I developed my innovation to play a proactive role in changing how the world operates.
- As an innovator, it is very important to me to be a highly responsible citizen of our world.
- As an innovator, it is very important to me to make the world a "better place" (e.g., by pursuing social justice, protecting the environment).
- When developing the innovation, it was very important to me to have a strong focus on what the innovation is able to achieve for society at large.
- When developing the innovation, it was very important to me to convince others that the new product is indeed able to address the type of societal challenges that my innovation addresses (e.g., social justice, environmental protection).

(source: items based on Sieger et al., 2016; rated 1 = totally disagree to 7 = totally agree. \* Item removed for convergent validity, but included in robustness check – see Section 5.3)

#### Degree of novelty

My innovation...

- ...represents a major technological advance in a subsystem or component.<sup>1</sup>
- ...is a technological breakthrough.<sup>1</sup>
- ...would enable other people to do something they could not do before.<sup>2</sup>
- ...would help other people to save money.<sup>2</sup>

(source: <sup>1</sup> Gatignon et al., 2002; <sup>2</sup> de Jong et al., 2015; rated 1 = totally disagree to 7 = totally agree)

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