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Do lead users cooperate with manufacturers in innovation? Investigating the missing link between lead userness and cooperation initiation with manufacturers

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ABSTRACT
Past lead user research has provided strong empirical support for the claim that lead users tend to innovate independently. While the innovation activity itself is well documented, little is known about whether users’ ideas and solutions also reach manufacturers’ organizations. Recent research indicates that the majority of user discoveries remain limited only to local use and are rarely presented to a wider circle of other users, business angels, or manufacturers. This limitation presents a problem because if manufacturers do not have access to users’ needs, ideas, and solutions, they might fail to recognize essential opportunities for innovation.

Therefore, this research studies the question of whether lead userness and expected recognition from manufacturers and peers explain the user’s inclination to cooperate with manufacturers. We study cooperation initiated from two different ends: users pro-actively approaching manufacturers with problems and ideas and users participating in manufacturer-hosted innovation workshops. Drawing on lead user theory, we develop hypotheses and test them with two empirical studies with nurses and pharmaceutical technical assistants. The results provide support for the argument that a superior trend position and high expected benefits are strong and reliable predictors for both investigated forms of cooperation. The results on the effect of recognition from the manufacturer and peers are mixed, indicating that expected process benefits are less important.

1. Introduction

In the customer-active paradigm popularized by von Hippel (1978), individual users generate ideas, modify existing products, or invent completely new solutions. In different domains, many important innovations have been created by users and not by firms (e.g., Hienrich, 2006; von Hippel, 1978). Prior studies find that user innovation is a widespread phenomenon occurring in both industrial (e.g., Herstatt and von Hippel, 1992; Franke and von Hippel, 2003) and consumer markets (e.g., Franke and Piller, 2004). The rate of users modifying or innovating products as reported in multiple studies ranges from 6% to 40% (Baldwin and von Hippel, 2011) and is even higher when users are interviewed personally (Franke et al., 2016).

For manufacturers and their new product development efforts, lead users are especially attractive partners for innovation activities (e.g., Franke and von Hippel, 2003). Lead users are defined as members of a user population who are characterized by their trend leadership and their high expected benefits, i.e., they are ahead of the broad market, and due to their high demands, currently available products do not meet their needs (von Hippel, 1986). Therefore, lead users often start innovating on their own (Luethje, 2003; Schreier and Priegl, 2008), and their ideas and solutions have been found to be superior in terms of market attractiveness and success rates (Lilien et al., 2002; Franke et al., 2006).

While the activity of user innovation is well documented in research (e.g., Morrison et al., 2000; Franke and Shah, 2003), there are few insights about the further processing of these ideas and solutions (von Hippel et al., 2017), especially whether they eventually reach manufacturers’ organizations (Bin, 2013). In addition to anecdotal evidence on lead user workshops (Herstatt and von Hippel, 1992), we know little about whether lead users actually transfer their knowledge and ideas to

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manufacturers and are more or less willing to cooperate with them at the front end of the innovation process. In their recent literature review, Hienert and Lettl (2017) also emphasize the interaction between lead users and manufacturers as an essential future research avenue.

Lead users are especially valuable knowledge sources for manufacturers because they are ahead of the trend and experience high problem pressure (Franke et al., 2006). However, recent studies indicate major challenges for manufacturers in accessing knowledge about users’ needs and solutions: use knowledge is often tacit, i.e., it is difficult to transfer and requires active involvement of the knowledge source to make it accessible (von Hippel, 2005). However, the majority of user discoveries remain limited to local use and are rarely presented to a wider circle of other users, business angels, or manufacturers (de Jong et al., 2015; von Hippel et al., 2017; Luethje, 2004). This phenomenon represents a problem because if manufacturers do not have access to users’ needs, ideas, and solutions, they might fail to recognize essential opportunities for innovation. Furthermore, lead users are mainly intrinsically motivated because they want to find better solutions to perform their demanding tasks (Guerkan, 2014), but to date, research cannot answer whether lead users are also willing to transfer their knowledge through cooperation and whether in-process benefits such as recognition from the manufacturer or recognition from peers can motivate users to cooperate with manufacturers.

Consequently, the present research addresses the question: Do lead userness and expected recognition from manufacturers and peers explain users’ cooperation intensity with manufacturers? In particular, we investigate users’ cooperative behavior initiated from two different ends: (a) the users proactively approaching the manufacturer with their problems and envisioned potential solutions, and (b) the users’ decision to participate in external, manufacturer-hosted innovation workshops. Both represent initial, transaction-light forms of cooperation that do not require either complex contracts or strong commitment on either side. These initial forms of cooperation may later translate into a deeper, long-term co-development relationship once trust, mutual understanding, and valuable outcomes have been achieved (Salters et al., 2014), but the decision to engage in these initial forms of cooperation is exclusively in the decision domain of the user and thereby fit best with the focus of the study.

This research establishes a missing link between lead users and manufacturers by investigating users’ cooperation behavior. Therefore, we join the conversation on lead userness and its behavioral outcomes, but we shift the perspective from independent user innovation to cooperative behaviors with manufacturers. Through this research, managers can learn who is more likely to approach them and who is more receptive to a call for cooperation: the average user base or leading-edge users. Furthermore, managers can learn about the effectiveness of recognition mechanisms to attract users to engage in cooperation. Drawing on empirical field survey data collected from two independent samples, one sample of nurses (n = 243) and one sample of pharmaceutical technical assistants (n = 146), we provide ample support for the hypothesis that lead user characteristics are strong drivers of both proactive contact initiation and innovation workshop participation. Thus, lead users are not only important knowledge carriers and inclined to innovate themselves but also more open to cooperating with manufacturers than their average peers. The results regarding the relevance of expected recognition from the manufacturer and peers are mixed. The findings indicate that neither peer nor manufacturer recognition facilitates users to cooperate more frequently. This study contributes to the literature by extending the predictive power of lead user theory for new user behaviors not previously considered in research. This study explains the emergence of user-manufacturer interactions necessary to transfer lead user knowledge into the manufacturer’s domain. Furthermore, this study improves our understanding of the motivating effect of process benefits in the early stages of user-manufacturer cooperation.

2. Theoretical foundation

2.1. Research on lead users and related outcomes

Two individual characteristics define the cornerstone of lead user theory (von Hippel, 1986): expected benefits and being ahead of the trend, which together are also referred to as lead userness. Whereas early studies have only distinguished between lead users and non-lead users, this dichotomy has been abandoned in favor of a continuous conceptualization of lead userness (Morrison et al., 2004; Schreier and Prügl, 2008). Thus, each population contains users ranging from low to high degrees of lead userness.

There is strong empirical support that lead userness is associated with user innovation (see Table 1), and most studies investigate user innovation activity as the central outcome variable for lead userness. However, independent innovation is not a mandatory consequence or a defining element of lead userness (Hienert and Lettl, 2017), and research to also consider other behaviors is strongly recommended. As shown in Table 1, only a few scholars explain other behaviors (e.g., knowledge sharing in online communities, early new product adoption) and further attributes of lead users (e.g., opinion leadership, perceived complexity), and the outcomes of lead userness (e.g., commercial attractiveness and originality of ideas). Prior lead user research considering the manufacturer’s perspective has mainly focused on how to identify leading-edge users in a population by screening and pyramidining (e.g., von Hippel et al., 2009; Poetz and Pruegl, 2010) and on how to design the actual joint innovation activities referred to as the lead user method (e.g., Herstatt and von Hippel, 1992; Luethje and Herstatt, 2004). Related research on embedded users—i.e., employees who are simultaneously users of their employer’s products (Schweifurth and Herstatt, 2016)—finds that embedded users with higher lead userness show more internal boundary spanning and innovative work behavior, have better-quality ideas, implement more ideas, and diffuse more innovations in their organizations (Schweifurth and Raasch, 2015; Schweifurth, 2017; Schweifurth and Dharmawan, 2019). Thus, manufacturers can internalize lead users’ knowledge by hiring such users or by cooperating with them. Regarding the latter, however, no study has yet investigated the link between the lead userness of external users and their inclination to initiate cooperation with manufacturers.

2.2. Challenges of manufacturers in accessing (lead) user knowledge

Manufacturers require a profound understanding of the customers’ needs and problems to innovate products and services that are successful on the market. However, customers are situated outside of the firm’s boundaries, which causes challenges for manufacturers in accessing this knowledge, including the following:

**Stickiness of use knowledge:** User knowledge is tacit, i.e., it is difficult to capture and transfer into the organization, so that the active involvement of the knowledge source—the user—is required (von Hippel, 2005). Thus, accessing the tacit knowledge of lead users requires some type of interaction and collaboration. The basic willingness and motivation of lead users to engage in cooperation with manufacturers has not yet been investigated, and manufacturers cannot take this for granted because lead users are able to innovate autonomously.

**Stickiness of solution knowledge:** Related research on user innovation also finds that users’ created solutions are “sticky”. In contrast to prior assumptions (von Hippel, 2007), users’ discoveries and knowledge of solutions tend to not reach a wider circle and to remain limited to local use (von Hippel et al., 2012, 2017) and are revealed by only a fraction of user innovators to firms or business angels (de Jong et al., 2015). For instance, only 66% of physicians who reported that they had discovered valuable off-label uses for FDA-approved drugs told close colleagues about their discovery, while 78% did not make an effort to diffuse this knowledge to a wider audience (von Hippel et al., 2017). In the context of consumer innovations, only 22% of consumer innovators shared their
ideas with peers or firms (Kim, 2015), and 79% never contacted a manufacturer during their innovation activities (Bin, 2013).

Lack of incentive to reveal knowledge: The reason for this low diffusion of knowledge is not that users want to protect their innovation—most of them would be ready to reveal this information for free—but rather that innovating users simply lack an incentive to incur the costs of knowledge transfer, even if they perceive an inherent value for others in their innovations (e.g., de Jong et al., 2015; Kim, 2015; Luethje, 2004).

These findings relate to user innovation in general and emphasize the challenges manufacturers face in accessing “sticky” use and solution knowledge and the necessity of better understanding the willingness of lead users to cooperate with manufacturers. In the following section, we argue why the leading-edge status of users might explain why they are more willing to cooperate by proactively contacting manufacturers and participating in manufacturer-hosted workshops.

2.3. Lead userness and cooperative behavior

The characteristic of being ahead of the trend refers to users who are at the leading edge of a specific market or technology trend. These users already operate in a specific context and face challenges that will be relevant for the broad market in the future and therefore experience needs earlier than other users. Because the available standard products do not provide solutions matching their needs, users who are ahead of the trend need to innovate autonomously to resolve their problems. Because of their superior position, these users are better informed about what is technologically possible and are less functionally fixed on existing solutions. Therefore, it is easier for them to anticipate new approaches to using products and applying technologies (von Hippel, 1986; Franke et al., 2006).

We propose that users who are ahead of the trend are also more likely to initiate contact and cooperate with manufacturers for several reasons. First, in articulating their advanced needs and problems to manufacturers, they may see a possibility to realize future options sooner than would otherwise be possible by drawing manufacturers’ attention to these future needs in their innovation activities. Second, users who are trend leaders may also anticipate a greater willingness to cooperate with lead users on the manufacturer’s side—given that manufacturers are able to identify lead users actively or through signaling—because they are aware that manufacturers would benefit from user contributions in

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### Table 1
Overview of the literature on behaviors, attributes, and outcomes explained by lead userness.

| Explained by Lead Userness                      | Authors                          | Context                                      | Method            |
|------------------------------------------------|----------------------------------|----------------------------------------------|-------------------|
| Degree of engagement in user innovation         | Bin (2013)                       | Six industrial and consumer goods categories | Quantitative      |
| User innovation (vs non-innovator)              | Franke & Shah (2003)             | Sports-related consumer products             | Quantitative      |
| User innovations/modifications                  | Franke & von Hippel (2003)       | Apache security software                     | Quantitative      |
| User innovation probability                     | Franke et al. (2006)             | Kite surfing                                 | Quantitative      |
| User innovation activity                        | Hienerth (2006)                  | Rodeo kayaking                              | Qualitative       |
| User innovation                                 | Jeppesen & Frederiksen (2006)    | Computer controlled music instruments        | Quantitative      |
| User innovation                                 | Luethje (2003)                   | Medical devices                              | Quantitative      |
| Innovation efforts                              | Luethje (2004)                   | Sports-related outdoor products              | Quantitative      |
| User innovation/modification activity           | Morrison et al. (2000)           | Library information systems                  | Quantitative      |
| Innovation likelihood                           | Schreier & Pruegl (2008)         | Three sports-related product categories      | Quantitative      |
| User innovation contributions in different phases| Lettl (2007)                     | Medical equipment technology                 | Qualitative       |

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gathering information about future user requirements and new product ideas. This positive framing could increase the motivation of lead users to initiate cooperative engagement with manufacturers. Third, innovation in technical products also requires users to have domain-specific technical expertise (Lettl, 2007; Magnusson, 2009), and users of technologically complex systems might need assistance from manufacturers to innovate (Doughwaite et al., 2001). Users who are ahead of the trend might imagine how a new technology can help them to serve their advanced needs better, but the necessary technological knowledge to realize a new solution might still be unavailable without support from the manufacturer, thus motivating lead users to cooperate.

In contrast, average users are expected to not see future developments in their field and to not question established products and technologies due to their functional fixedness. As average users do not intend to innovate, they also face no innovation barriers that would require approaching manufacturers to provide technical expertise and development resources. Average users perceive manufacturers as suppliers rather than innovation partners. Consequently, average users also perceive no need to contact manufacturers and are less motivated to follow up on an invitation to an innovation workshop. The mismatch is not a major issue for most users, leading-edge users with high problem pressure and high expected benefits from better solutions motivate them to take the innovation initiative (von Hippel, 1994; Luethje and Herstatt, 2004; Franke et al., 2006).

We assume that users with high expected benefits are also more likely to cooperate with manufacturers for several reasons. The problem pressure experienced by lead users motivates them to find new and better solutions to improve their job execution, and in addition to innovating independently, cooperating with manufacturers might represent a second action strategy for achieving this goal. Furthermore, the motivation to cooperate with manufacturers might be grounded in the dispersed locations of needs-related and solutions-related knowledge, which are both required to innovate. In many cases, however, the problem, i.e., needs-related, knowledge, is held by the user, whereas solution-related knowledge often resides with the manufacturer (von Hippel, 1994; Magnusson, 2009). Similar to manufacturers who are motivated to apply customer integration methods to access the needs-related knowledge of users, users are supposed to cooperate with manufacturers to access their solutions-related knowledge, particularly when technological complexity is high or product systems are closed (i.e., when manufacturers establish technological hard- and software barriers that prevent users and competitors from hacking or bypassing the manufacturers’ technology to protect their business model and intellectual property as well as to avoid liability issues and reputational losses in case third-party modifications result in failure and incidents) (Braun and Herstatt, 2008). Furthermore, users can be limited in their freedom to experiment with and modify a product due to regulations or the fact that they are not the owner of the product they use (Tietze et al., 2015). Thus, contacting manufacturers proactively with ideas and suggestions and sharing their knowledge in manufacturer-hosted workshops is a viable approach for users with high problem pressure to come closer to new solutions that better fulfill their underserved needs. In contrast, users with low problem pressure are expected to be better satisfied with current solutions or simply accept the underperformance of the applied solutions. Thus, these users will be less motivated to innovate independently and less willing to approach manufacturers proactively or to accept workshop invitations to find new solutions.

H.2: Lead useriness in terms of high expected benefit is positively related to (a) initiating contact with manufacturers and (b) participating in manufacturer-hosted innovation workshops.

2.4. The role of recognition from manufacturers and peers

Recognition—from manufacturers and peers—has been shown to be an important motivator for users to engage in cooperative innovation behavior (Kankanahalli et al., 2015; Jeppesen and Frederiksen, 2006). Recognition is a type of process benefit, where users derive benefits from the process of participating in innovation activities themselves, such as learning, enjoyment, reputation gains, and recognition for one’s contributions. Process benefits differ from outcome benefits, which refer to the result or the outcome of engaging in innovation activities, such as receiving new or better products (Raasch and von Hippel, 2013). In practical terms, recognition is any form of gratification or acknowledgement a user may receive from manufacturers or peers for his/her innovation contributions. This recognition can be of many forms, such as positive comments from peers; posts about the outcome or the contributor made on the manufacturer’s website that highlight and thank the user for the contribution he/she personally made; or a symbolic gift indicating that the manufacturer values the contribution made by the user. According to motivation theories, recognition as a motivator is based on introjected regulation, where the desired consequences of performing an activity are externally controlled, but at the same time, an internalization of these desires takes place. Recognition to enhance self-esteem, pride, and ego-involvement are typical examples of this form of motivation and differ from purely compensatory extrinsic rewards (e.g., monetary payment) in that an individual perceives them as self-selected goals (Gagné and Deci, 2005; Mack and Landau, 2020; Ihl et al., 2019).

Recognition from both manufacturers and peers has been found to be positively related to user innovation activities. For instance, in the context of firm-hosted online communities, Jeppesen and Frederiksen (2006) found that a major motive for users to engage in online innovation activities is the recognition they expect from the manufacturer. Kankanahalli et al. (2015) also show that users’ intentions to independently innovate are facilitated by the anticipated recognition provided by the campaign-hosting firm. Similar findings are reported for recognition from peers, which has been shown to be a major driver of user innovation activities, especially in user innovation communities (Jeppesen and Laursen, 2009).

We propose that users with a positive attitude toward recognition—from both manufacturers and peers—are also more motivated to actively contact manufacturers and participate in firm-hosted innovation workshops. The mechanism in both cases can be derived from their desire to enhance self-esteem through the recognition received from manufacturers or peers. Being able to contribute knowledge to the development of potential new products endows these users with an expert status that increases self-esteem and reputation. In addition, in the case of peer recognition, these activities may also increase the user’s social status in the peer group and therefore further facilitate a higher level of cooperation intensity. In the case of manufacturer recognition, recognition may also be seen as a form of compensation for the efforts associated with the knowledge transfer.

In contrast, users who do not value manufacturer or peer acknowledgments of their contributions to innovation will be less motivated to share their knowledge with the manufacturer. We expect that they do not contact manufacturers and refuse invitations to manufacturer-hosted innovation workshops.

H.3a: Attitudes toward manufacturer recognition are positively...
related to (a) initiating contact with manufacturers and (b) participating in manufacturer-hosted innovation workshops.

H.3b: Attitudes toward peer recognition are positively related to (a) initiating contact with manufacturers and (b) participating in manufacturer-hosted innovation workshops.

3. Methods

3.1. Study context, data collection and samples

The proposed hypotheses were tested in two empirical studies that tested the same main model in two different populations and product domains. We selected the health care sector because it has frequently been chosen for lead user and user innovation research, and prior exploratory research has also demonstrated the benefits of (lead) user integration for manufacturers in this sector (e.g., Lüthje and Herstatt, 2004; Lettl et al., 2007). Study 1 investigates nurses working in hospitals and their interactions with manufacturers of medical devices. In Study 2, we examine pharmaceutical technical assistants (PTAs) working in pharmacies and their interactions with manufacturers of pharmaceutical supplies. Thus, both studies investigate intermediate users (as opposed to end users of consumer goods) who are employees of an organization and use products or devices from manufacturers, i.e., suppliers. We selected the product domains of medical devices and pharmaceutical supplies because they represent situations in which the needs-related knowledge is held by the user performing tasks with these products and the solutions-related knowledge is held by the manufacturer with the technological expertise and resource availability to produce these devices and supplies. In this setting, a clear separation between the holders of needs and solutions knowledge can be observed, which makes the importance of lead user cooperation even more salient (von Hippel, 2005).

The health care context: Health care has seen significant progress in technologies and practices over the last decades as well as increasing workloads and job complexity. New devices, more patients, and more complex treatments and practices challenge nursing care (Ebright, 2010). Nurses provide up to eighty percent of primary care in the health care system (Hughes, 2006), and in their hybrid position as technology users and the main interface with the patient, their role in the health care system cannot be reduced to being only adopters of innovations but needs to include their potential as innovators in the field of nursing (McSherry and Douglas, 2011). PTAs face similar challenges such as increases in task complexity, in technological and medical progress, and in workloads, and they hold a similar position in the health care system regarding their needs-related knowledge in the field of drug admixture.

Prior research has shown that health care staff innovate (e.g., West, 1989; Hinsch et al., 2014) and has highlighted the associated challenges these staff members face. Due to high levels of regulation and formality in the implementation process for new innovations in health care, which exists to protect employee and patient safety (Li-Ying et al., 2016; Kessler et al., 2017), innovation activities in the hospital or pharmacy (even if incremental) must be declared and approved. Strict protocols have been established, and committees usually consisting of commercial, medical, and technical representatives make decisions about innovation projects and whether they are realized internally or externally. Once new processes are created, their introduction requires the installation of new standard operating procedures and the communication of these procedures to all involved health care professionals. The same procedure must be applied when new products (e.g., devices, supplies) from manufacturers are introduced into the hospital or pharmacy. This formalized process and the involvement of multiple stakeholders make innovating in health care organizations challenging. The medical and nursing staff know the problems they face in accomplishing their professional tasks, but the organization and its decision makers often lack this understanding, making the introduction of innovations difficult (Fox et al., 2018).

In addition to these institutional barriers for innovation by health care staff, the required technological knowledge from multiple domains, such as medical science, electrical engineering, and physics, to create new medical devices and supplies represents another. Scholars have emphasized that innovation in health care requires expertise in both nursing and engineering (Glasgow et al., 2018). This creates the dilemma that despite the sophisticated technology available to support nurses, many opportunities to improve health care are missed when nurses, the primary care providers for patients, are not participating in the innovation process (Glasgow et al., 2018). The same applies to PTAs.

However, this does not mean that health care staff do not engage in innovative behavior (e.g., Li-Ying et al., 2016). Even independent user innovation by nurses has been reported in prior research (e.g., Glasgow et al., 2018). In the pretest interviews for this study, nurses and PTAs who indicated having innovated on their own described having created new dressings to prevent catheters from being removed by the patient, having developed new techniques for labeling infusion lines to prevent the administration of contraindicated medications when delivering complex infusion therapies, and having modified syringe spikes and vial adapters to allow for more precise dispensing and to prevent toxic contamination when admixing drugs in the pharmacy, which illustrate their innovation outcomes. Consequently, nurses and PTAs are essential carriers of knowledge that is valuable for new product development by medical and pharmaceutical device manufacturers—even if these populations are not the typical populations (physicians or surgeons) studied in lead user research.

A common way in which manufacturers try to gather needs (and solutions)-related knowledge from nurses and PTAs is by inviting them to workshops where nurses and PTAs support the manufacturers’ development teams by reporting their challenges at work, participating in ideation sessions, and giving feedback on concepts presented and prototypes tested during the workshop. While most manufacturers organize these collaboration formats in an ad hoc manner, some have established platforms for contact initiation. For instance, the Johnson & Johnson Nursing platform enables nurses to easily approach the manufacturer, and in return, Johnson & Johnson promotes challenges aiming to gather ideas from nurses for future products.

Informants: In both studies, the individual user was the information source for two reasons: (1) the interactions of nurses and PTAs with manufacturers is not fully observable by supervisors or peers because these interactions typically occur outside working hours; (2) the personal characteristics of higher benefit expectations, a leading trend position, and the individual’s personal attitude toward manufacturers’ recognition require self-rating. This approach is consistent with prior research that also relies on self-reported data to measure lead userness (e.g., Franke et al., 2006), attitudes toward recognition (Jeppeksen and Frederiksen, 2006), and innovative behaviors that are difficult to observe by others (e.g., Hornsby et al., 1999; Globocnik and Salomo, 2015). Several measures recommended in the literature (Podsakoff et al., 2003; Chang et al., 2010) were taken to avoid the common-method variance issues associated with this approach. Study participants were ensured confidentiality for their responses and that there were no incorrect answers. Fact-based items, which are less likely to be associated with bias, were used. Different scales for the dependent and independent variables were applied to reduce biases caused by commonalities in scale endpoints and anchor effects. The participants were also asked about other behaviors not related to cooperating with manufacturers to cover the actual focus of the study and to reduce biases caused by the respondents’ theories-in-use. Harman’s single-factor test to assess common-method variance did not indicate a bias.

Recruitment: Respondents were recruited directly from hospitals and pharmacies. Informants having a direct job affiliation with a manufacturer were excluded to ensure that the frequency of cooperation is not the result of an existing employee-employer relationship. Due to the researchers’ geographical affiliations, data were collected from hospitals and pharmacies located in Germany and the United Kingdom.
For Study 1, nurses from 700 randomly selected hospitals in Germany and the United Kingdom were recruited. In each hospital, only one nurse was selected to avoid biases caused by uncontrolled organizational and departmental characteristics. Those willing to participate (49.9%) received a questionnaire by email. The nurses who did not respond within two weeks received an email reminder. Seven questionnaires were excluded because of missing values. The final sample consists of 243 cases with a return rate of 34.7% (Germany: 34.3%, United Kingdom: 35.1%). The same data collection procedure was followed in Study 2. PTAs were recruited from 400 randomly selected pharmacies in Germany and the United Kingdom. Pharmacies without drug admixture activities were excluded because of their business focus on the distribution of premixed medication instead of the preparation of customized drugs requiring PTAs. Of the contacted PTAs, 46.3% expressed interest in participation. After eliminating eleven cases due to missing values, the final data set includes 146 cases, representing a return rate of 36.5% (Germany: 39.5%, United Kingdom: 33.5%). To assess potential nonresponse bias, the main model constructs of early respondents (25% of the sample) were compared with late respondents (25% of the sample; used as proxies for non-respondents), but no significant difference was identified.

3.2. Measures

The constructs were measured with existing indicators where possible. Drawing on past recommendations, we applied shortened scales that reflect the core items of a scale to reduce the likelihood of cross-national measurement bias and to increase predictive strength (Douglas and Nijssen, 2001). The items were pretested with two academic experts, three nurses, and three PTAs. Content validity was improved by adding examples and/or using context-specific vocabulary. For all independent main-model items, a five-point Likert-type scale was used.

Independent variables. The two dimensions of lead userness were captured with established reflective multi-item scales that have been used in multiple studies in different user domains and across countries. Expected benefit was captured with three items adapted from Franke et al. (2006) and Franke and Shah (2003) asking about perceived problem pressure under current solutions. Trend position assessed whether the respondents were ahead of the broad market by using three items adapted from Franke et al. (2014) and Franke and Shah (2003). Responsiveness to recognition from manufacturers was assessed with one item, and attitudes toward peer recognition were captured with two items adapted from Jeppesen and Frederiksen (2006). The items were modified to fit the recognition from manufacturers, and the wording was changed from questions to fact-based statements. As attitudes toward recognition from manufacturers can be assumed to be easily and uniformly imagined, a single item was considered sufficient for capturing the conceptual domain of this construct (Berghkvist and Rossiter, 2007).

Dependent variable. The development of the two dependent variables, which measure the frequency of contact initiation and workshop participation, followed prior research on individual innovative behaviors (e.g., Luethje, 2004; Bin, 2013). The respondents were asked how often they have contacted the manufacturers in their corresponding product domains with complaints and improvement suggestions regarding functions, features, technologies, and the usability of medical devices and supplies and how often they have participated in external innovation workshops hosted by manufacturers in this product domain. The questions referred to activities within the previous twelve months to reduce potential bias caused by job tenure or memory and referred to the domain of medical devices and supplies (functions, features, technologies, usability) to avoid complaints about delivery or related issues that might factor into responses about frequency of contact.

Control variables. A dummy variable was used to control for national origin because different behaviors or response patterns may be caused by cross-cultural differences or country-specific infrastructures. As individual behavior may be influenced by the organizational context, process formality assessed the level of organizational guidelines for innovation activities with four items (Cardinal, 2001). Furthermore, the ownership of the organization was captured by asking whether the respondents work in a private or public organization. Innovative user behavior may also vary by knowledge and tenure (e.g., Tietz et al., 2005), so job experience was captured in years. The respondent’s social position, which may affect behavior, was assessed with two items from Franke et al. (2014) that captured how well the respondents are connected within their own department and with other departments and professional groups. The final set of control variables on organizational size and department association were formulated specifically for the context of each study.

3.3. Properties of the scales

The scale properties were assessed for both studies separately following the same procedure. Cronbach’s alpha was used to assess the internal reliability of the multi-item measures, which all achieved acceptable levels (Hair et al., 2006). In the PTA study, one item from the expected benefit scale was removed due to low item-to-total correlation. Unidimensionality was demonstrated by principal component analyses which all extracted only one factor with an eigenvalue greater than one (Ahire and Devaraj, 2001). The factor analysis (varimax rotation) with all items also reproduced the intended number of factors and low cross-loadings. Convergent validity was analyzed with confirmatory factor analysis (CFA) including all main model parameters. The standardized factor loadings are all significant and > 0.60. At the construct level, the average variance extracted is > 0.5, and the composite reliability is > 0.68 for all constructs. In the nurse sample only, the average variance extracted from the control variable process formality was slightly below the threshold of 0.5, but it was kept in the analysis. Discriminant validity is demonstrated by the square root of the average variance extracted being larger than the correlations between that construct and any other (Fornell and Larcker, 1981). The comparative fit indices (CFI), the standardized root mean square residuals (SRMR), and the $\chi^2$/d.f. ratios also meet the recommended thresholds (Hu and Bentler, 1999). To examine whether we can combine the two subsamples from Germany and the United Kingdom, we first assessed the cross-national measurement invariance of the instruments we used. Drawing on the approaches suggested by Steenkamp and Baumgartner (1998) and de Wulf et al. (2001), we performed a set of additional CFAs to assess measurement and structural invariance in order to test for the appropriateness of combining the country subsamples, which is supported by full metric invariance, full factor variance invariance, full error variance invariance for the PTA sample and partial error variance invariance for the nurse sample (relaxing only one single constraint on one control’s error variance resolved the issue), full factor covariance invariance, and full structural invariance across countries. Tables 2 and 3 summarize the results concerning the means, standard deviations and correlations for both studies. The CFA results are reported together with the scales in Appendix 1, while Appendix 2 shows the results of the invariance tests, and Appendix 3 summarizes further tests conducted to validate the self-reported lead user characteristics.

4. Analysis and results

4.1. Description of users and their behaviors

Sample characteristics for both studies are reported in Table 4. The nurses in the sample for Study 1 originated from different departments of mainly public hospitals of all sizes. Regarding their cooperation behavior within the previous twelve months, 20.6% of the nurses reported that they had only contacted manufacturers with problems or suggestions, 11.9% had only participated in workshops, 20.6% had cooperated with manufacturers in both ways, and 46.9% had not
Table 2
Means, standard deviations, and correlation matrix (study 1)\(^a\).

| Construct                  | Mean | S.D. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. |
|----------------------------|------|------|----|----|----|----|----|----|----|----|----|-----|-----|-----|
| 1. Hospital size (beds)    | 3.09 | 1.14 |    |    |    |    |    |    |    |    |    |     |     |     |
| 2. Country (0: UK)         | .49  | .50  |    |    |    |    |    |    |    |    |    |     |     |     |
| 3. Ownership (0: private) | .91  | .28  | .19 |    |    |    |    |    |    |    |    |     |     |     |
| 4. Process formality       | 3.53 | .75  | .71 |    |    |    |    |    |    |    |    |     |     |     |
| 5. Job experience          | 2.65 | .63  | .13 | .19 |    |    |    |    |    |    |    |     |     |     |
| 6. Recognition from peers | 3.66 | .75  | .02 | .28 | .04 | .08 |    |    |    |    |    |     |     |     |
| 7. Social position         | 3.07 | .96  | .09 | .07 | .05 | .02 | .15 |    |    |    |    |     |     |     |
| 8. Expected benefit        | 2.99 | .71  | .02 | .15 | .08 | .19 | .12 | .25 | .17 |    |    |     |     |     |
| 9. Trend position          | 2.76 | .77  | .04 | .09 | .00 | .09 | .03 | .02 | .39 | .16 |    |     |     |     |
| 10. Recognition from manuf.| 2.58 | 1.07 | .07 | .45 | .01 | .19 | .07 | .40 | .06 | .23 | .10 |     |     |     |
| 11. Contact initiation     | .92  | 1.46 | .04 | .15 | .17 | .05 | .02 | .19 | .30 | .21 | .26 | .10 |     |     |
| 12. Workshop participation | .59  | 1.05 | .04 | .12 | .02 | .03 | .16 | .12 | .30 | .25 | .29 | .06 | .36 |     |

\(^a\) S.D., standard deviation. Square root of the average variance extracted reported along the diagonal.

Table 3
Means, standard deviations, and correlation matrix (study 2)\(^a\).

| Construct                  | Mean | S.D. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. |
|----------------------------|------|------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| 1. Pharmacy size (FTE)     | 2.55 | .90  |    |    |    |    |    |    |    |    |    |     |     |     |     |
| 2. Country (0: UK)         | .54  | .50  |    |    |    |    |    |    |    |    |    |     |     |     |     |
| 3. Ownership (0: private) | .44  | .50  | .17 |    |    |    |    |    |    |    |    |     |     |     |     |
| 4. Association (1: indep.) | .52  | .50  | .12 | .17 |    |    |    |    |    |    |    |     |     |     |     |
| 5. Process formality       | 3.34 | .90  | .38 | .38 | .17 | .20 |    |    |    |    |    |     |     |     |     |
| 6. Job experience          | 2.66 | .61  | .05 | .26 | .01 | .01 | .03 |    |    |    |    |     |     |     |     |
| 7. Recognition from peers | 3.83 | .89  | .04 | .11 | .11 | .14 | .13 | .07 |    |    |    |     |     |     |     |
| 8. Social position         | 2.63 | .84  | .03 | .14 | .07 | .02 | .28 | .21 | .15 |    |    |     |     |     |     |
| 9. Expected benefit        | 2.30 | .62  | .07 | .12 | .01 | .02 | .05 | .12 | .16 | .25 |    |     |     |     |     |
| 10. Trend position         | 2.58 | .81  | .10 | .29 | .06 | .05 | .30 | .13 | .11 | .41 | .21 |     |     |     |     |
| 11. Recognition from manuf.| 2.61 | 1.18 | .20 | .46 | .04 | .05 | .41 | .05 | .41 | .23 | .12 | .35 |     |     |     |
| 12. Contact initiation     | .54  | .82  | .01 | .06 | .03 | .08 | .16 | .06 | .10 | .18 | .31 | .34 | .19 |     |     |
| 13. Workshop participation | .40  | .78  | .06 | .08 | .13 | .14 | .22 | .05 | .07 | .27 | .32 | .38 | .28 | .35 |     |

\(^a\) S.D., standard deviation. Square root of the average variance extracted reported along the diagonal.

cooperated at all. The PTAs in Study 2 are uniformly distributed between private and public pharmacies and different pharmacy sizes. Compared with nurses, PTAs reported lower levels of cooperation: 17.8% of the PTAs had only contacted manufacturers, 8.2% had only participated in workshops, 16.4% had done both, and 57.5% had not cooperated. When comparing respondents who had engaged in one or both cooperative behaviors with noncooperating users, the cooperating users scored higher in both lead user characteristics, with the highest scores for those engaging in both cooperative behaviors in the previous twelve months. To further validate prior findings, we also assessed whether the respondents had independently realized innovations such as processes or techniques at work in the last year (Hinsch et al., 2014). In the survey, 23.5% of the nurses and 15.8% of the PTAs also reported having innovated independently, and they also scored significantly higher in their lead user characteristics than non-innovators. The results are summarized in Fig. 1.

4.2. Results of regression analysis

Hierarchical ordinary least squares regressions were performed to test the proposed hypotheses. For each dependent variable, Model 1 analyzes the impact of the controls, and Model 2 includes the hypothesized antecedents. The importance of the independent variables is reflected in the change in the explained variance between the two models.

Study 1: The results of the regression analyses for the nurses are summarized in Table 5. Regarding the dependent variable contact initiation, Model 1, which includes the control variables, shows that nurses in public hospitals (b = -0.15, p < .05) and in superior social positions (b = 0.28, p < .001) contact manufacturers more frequently. The model fit improves significantly when the proposed lead useriness antecedents enter in Model 2: the frequency of contact initiation increases significantly with higher expected benefits (b = 0.20, p < .01) and in superior trend position (b = 0.18, p < .01). The relevance of recognition from manufacturers and peers does not affect the intensity of contact initiation. In total, the model explains 23% of the variance (Adj. R\(^2\) = 18%) in the nurses’ intensity of contact initiation. With respect to the second investigated form of cooperation, participation in workshops, the results are quite similar. In Model 1, the individual control variable social position (b = 0.26, p < .001) has a significant positive impact. When including the proposed antecedents in Model 2, the model’s explanatory power improves significantly. The frequency of participating in workshops increases with an increase in expected benefits (b = 0.20, p < .01) and in trend position (b = 0.19, p < .01), but recognition from manufacturers and peers again has no impact. The model explains 22% of the variance (Adj. R\(^2\) = 17%) in the intensity of workshop participation.

Study 2: The same set of regressions was performed for the study with PTAs (Table 5). Regarding the frequency of contact initiation, the results for the controls in Model 1 show that PTAs in hospital-associated pharmacies (b = 0.48, p < .05) who are in a superior social position (b = 0.19, p < .05) contact manufacturers more frequently. When adding the proposed antecedents to Model 2, PTAs with higher expected benefits (b = 0.20, p < .05) and in superior trend positions (b = 0.28, p < .01) initiate more contacts, whereas recognition from manufacturers has no
impact, and peer recognition even exerts a negative effect (b = −0.19, p < .05). The model explains 26% of the variance (Adj. R² = 20%) in contacts. With respect to participation in workshops, only the control variable social position has a significant positive impact (b = 0.23, p < .01) in Model 1. When adding the main model parameters to Model 2, the frequency of workshop participation increases with an increase in expected benefits (b = .22, p < .01) and in trend position (b = 0.25, p < .01). In contrast to the previous results, recognition from manufacturers also has a significant and positive impact (b = 0.20, p < .05) on participating in workshops. Model 2 explains 28% of the variance (Adj. R² = 22%) in the dependent variable.

In summary, both empirical studies support Hypotheses H.1 and H.2.

Table 4
Sample characteristics.

| Country      | Study 1 (n = 243 Nurses) | Study 2 (n = 146 PT A) |
|--------------|--------------------------|------------------------|
|              | Total | UK    | GER | Total | UK    | GER |
| United Kingdom| 51%   | 100%  | (−) | United Kingdom| 46%   | 100% (−)|
| Germany      | 49%   | (−)   | 100%| Germany   | 54%   | (−) 100%|

| Hospital size (beds) | Pharmacy size (FTE) |
|----------------------|----------------------|
| <250                 | <5                   |
| 251–500              | 5–10                 |
| >1000                | >20                  |

| Departments       | Pharmacy association |
|-------------------|----------------------|
| Emergency         | Part of hospital     |
| Oncology          | Independent          |
| Intensive care    |                      |
| General wards     |                      |
| Ambulance         |                      |
| Operating theatre |                      |

| Ownership        | Job experience |
|------------------|----------------|
| Private          | 56%            |
| Public           | 44%            |

| Job experience   | Contact initiation |
|------------------|---------------------|
| <2 years         |         |
| 2–5 years        |         |
| >5 years         |         |

| Contact initiation | Workshop participation |
|--------------------|-------------------------|
| No                 | No                      |
| 1 time             | 1 time                  |
| 2 times            | 2 times                 |
| 3–5 times          | 3–5 times               |

| Workshop participation | Study 1: Nurses (n=243) | Study 2: PTAs (n=146) |
|------------------------|-------------------------|-----------------------|
| Percent                | Lead users (Mean)       | t-tests               |
| 23.5%                  | Expect benefit          | 3.19                  |
| Not self-innovating users | Expect benefit       | 2.82                  |
| 76.5%                  | Trend position          | 2.93                  |
|                      |                        | 2.71                  |
| Users initiating contact with and participating in workshops of manufacturers | Expect benefit | 3.25                  |
| 20.6%                  | Trend position          | 3.23                  |
| Users participating in manufacturer workshops only | Expect benefit | 3.21                  |
| 11.9%                  | Trend position          | 2.95                  |
| Users initiating contact with manufacturers only | Expect benefit | 3.27                  |
| 20.6%                  | Trend position          | 2.72                  |
| Users not cooperating with manufacturers | Expect benefit | 2.70                  |
| 48.9%                  | Trend position          | 2.53                  |

| Percent                | Lead users (Mean)       | t-tests               |
| 15.8%                  | Expect benefit          | 2.67                  |
|                      | Trend position          | 3.82                  |
| 84.2%                  | Expect benefit          | 2.25                  |
|                      | Trend position          | 2.34                  |
| Users initiating contact with manufacturers only | Expect benefit | 3.14                  |
| 16.4%                  | Trend position          | 3.14                  |
| Users participating in manufacturer workshops only | Expect benefit | 2.58                  |
| 8.2%                   | Trend position          | 3.08                  |
| Users initiating contact with and participating in workshops of manufacturers | Expect benefit | 17.8%                  |
| 11.9%                  | Trend position          | 3.08                  |
| Users not cooperating with manufacturers | Expect benefit | 57.5%                  |
| 68.9%                  | Trend position          | 2.28                  |

*p < .001; **p < .01; * p < .05; † p < .10

Fig. 1. Subpopulations by Behavior and Corresponding Lead usershess.
Table 5
Results and hypothesis tests.

| Variables                          | Study 1 Contact initiation | Study 1 Workshop participation | Study 2 Contact initiation | Study 2 Workshop participation |
|------------------------------------|-----------------------------|--------------------------------|---------------------------|--------------------------------|
|                                    | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Hospital size (beds)               | .06     | .332    | .305    | -.11    | .105    | -.10    | .107    |          |
| Hospital ownership (0: private)    | -.15 *  | .018    | -.15 *  | .018    | .07     | .288    | .07     | .241    |
| Department - Intensive care        | .04     | .695    | .05     | .598    | .00     | .973    | .01     | .936    |
| Department - Oncology              | -.05    | .616    | -.03    | .747    | -.10    | .334    | -.08    | .424    |
| Department - General ward          | .05     | .594    | .08     | .362    | -.03    | .729    | .00     | .991    |
| Department - Ambulance             | -.02    | .839    | .01     | .950    | -.10    | .238    | -.08    | .351    |
| Department - Operating theatre     | -.04    | .679    | .00     | .992    | -.19 *  | .049    | -.15    | .107    |
| Pharmacy size (FTE)                |          |         |         |         |         |         |         |         |
| Association (1: independent)       | .48 *   | .025    | .45 *   | .023    | .02     | .932    | .07     | .705    |
| Pharmacy ownership (0: priv.)      | .40     | .067    | .30     | .131    | .18     | .399    | .05     | .817    |
| Country (0: United Kingdom)        | .15 *   | .021    | .11     | .107    | .08     | .234    | .04     | .532    |
| Process formality                  | -.01    | .895    | .04     | .590    | .07     | .286    | .11     | .093    |
| Job experience                     | -.09    | .153    | -.03    | .596    | .11     | .096    | .17 **  | .010    |
| Social position                    | .28 *** | .000    | .16     | .017    | .26 *** | .000    | .14     | .038    |
| Expected benefit                   | .20 **  | .003    | .20 **  | .003    | .20     | .018    | .22 **  | .007    |
| Trend position                     | .18 **  | .007    | .19 **  | .004    | .28 **  | .002    | .25 **  | .005    |
| Recognition from manufacturer      | .00     | .980    | .00     | .957    | .00     | .957    | .16     | .106    |
| Recognition from peers            | -.10    | .138    | -.08    | .219    | -.19 *  | .028    | -.01    | .908    |
| $F$                                | 3.79 *** | 4.60 *** | 3.50 *** | 4.38 *** | 2.07 *  | 4.28 *** | 3.00 *  | 4.65 *** |
| $D_{H}F$                           | .15     | .23     | .14     | .22     | .09     | .26     | .13     | .28     |
| Adj. $R^2$                         | .11     | .18     | .10     | .17     | .05     | .20     | .09     | .22     |
| $\Delta R^2$                      | .08     | .08     | .08     | .16     | .10     | .10     | .09     | .14     |

(b, standardized beta coefficient; p, probability level).

$p < .10; *p < .05; **p < .01; ***p < .001.$

Study 1: n = 243 Nurses.
Study 2: n = 146 PTAs.
Lead userness in terms of expected benefit and trend position is a reliable predictor of both contact initiation and workshop participation across the two populations. However, the findings on the impact of recognition from manufacturers and peers are inconsistent. Hypothesis H.3a, which predicts that manufacturer recognition has a positive influence on cooperation intensity, is only partially supported, and Hypothesis H.3b, which proposes that peer recognition has a positive influence, is rejected.

In addition, we tested whether the identified main effects of the two lead user characteristics are contingent upon job experience, social position, innovation process formality, and organizational size. Only the positive impact of nurses’ trend position was strengthened by a superior social position. The absence of further moderation effects supports the generalizability of the main effects identified in the two studies.

5. Discussion

Our research is situated in the domain of lead users and their activities that are relevant for the new product development of firms. Previous studies have mainly focused on the personal characteristics of lead users, their independent innovation activities, and the attractiveness of their ideas and solutions for the market (Franke et al., 2006; Lilien et al., 2002). Although user-innovation activities are well documented, scholars have paid little attention to the transfer of ideas and solutions from lead users into the manufacturer’s domain. To date, the actual interactions between lead users and manufacturers had not been investigated, and it had remained unclear whether lead users are more or less likely to make their knowledge accessible to manufacturers and whether they differ in their willingness to transfer their ideas and solutions through cooperation with manufacturers. Our study is the first to address these questions. Based on theoretical considerations and drawing on the results of two empirical studies, we provide ample support for the claim that lead users are more likely to engage in cooperation with manufacturers than average users. In particular, users characterized by high lead userness proactively approach manufacturers with ideas and improvement suggestions more often, and they are more likely to participate in workshops hosted by manufacturers. Therefore, these findings expand the stock of lead user research by complementing the existing knowledge with a central new outcome variable associated with lead userness, namely, cooperation intensity with manufacturers. This research also emphasizes that lead users’ willingness to share ideas and knowledge is not limited to peers (Jeppesen and Laursen, 2009; Hau and Kang, 2016; Norskov et al., 2016) but can also be extended to manufacturers. These findings also contribute to the research on intermediate users, i.e., users who are employees and use products from a manufacturer in their professional activities (e.g., Morrison et al., 2004; Lettl, 2007), and the related research on innovative behavior of users who use but do not own the products themselves (Tietze et al., 2015), by showing that those employees with leading-edge status are not only more inclined to engage in independent innovation but are also more likely to reach out to manufacturers (i.e., suppliers to the employing firm) to achieve solutions that help them to improve their job performance. The investigated initial forms of cooperation might therefore be the starting point for a potentially deeper form of cooperation that might transition to cooperation between the manufacturer and the employer at the institutional level. This shifts the perspective from employees with high lead userness being those that innovate on their own to being those that initiate cooperation with manufacturers and who can play a crucial role in the initiation of institutional cooperation for innovation.

Regarding our second research question, whether recognition from manufacturers and peers increases the cooperation intensity of users with manufacturers, our results indicate that recognition is not a central motivator. Although past research has reported that recognition from manufacturers (Kankanhalli et al., 2015; Jeppesen and Frederiksen, 2006), as well as peer recognition (Jeppesen and Laursen, 2009), facilitates user innovation, the motivational effect does not apply to initial cooperation activities with manufacturers. One reason may be that users perceive less potential to display their capabilities and achievements when engaging in these forms of cooperation than they would with self-developed solutions. An alternative explanation for why recognition is not significant could be found in the nature of the health care context where recognition from manufacturers has already been shown not to be a central motivator for participating in virtual innovation activities (Füller et al., 2010). Nurses’ and PTAs’ job outcomes are closely related to patient wellbeing; therefore, they might have a greater interest in contributing to new devices than in focusing on recognition from manufacturers or peers; i.e., the central motivation for contacting manufacturers and participating in their workshops might be receiving better devices to better treat their patients. It might also be that nurses and PTAs are aware of the limitations of independently innovating in their domains, and supporting manufacturers to improve their products might be the only path to obtaining better solutions for their needs. Finally, it is also possible that the significance of recognition changes over the course of cooperation: our study investigated initial forms of cooperation—contacting manufacturers and participating in innovation workshops hosted by them—where recognition might not be a significant driver, but it seems plausible that this factor becomes more important in the later stages of the product development process where more intense involvement by and engagement of users might be required. Overall, our results indicate that the user context (product and job domain, presence of innovation barriers) and the form and stage of cooperation (initiation vs. later stages, involvement intensity) need to be considered when investigating the effectiveness of process benefits in motivating users’ cooperative behavior, and these factors might explain the inconsistent findings on the role of process benefits in prior studies (Lakhan and Wolf, 2005; Füller, 2006; Füller et al., 2010; Mack and Landau, 2020; Ihl et al., 2019).

This research also contributes to the broader field of user innovation and the diffusion of “sticky” needs- and solutions-related knowledge. Previous scholars have found that user innovations often do not reach a wider circle and remain limited to local use, even if they would be valuable to others (de Jong et al., 2015). Studies report that most user innovators (60–79%) never contact manufacturers with their solutions during or after their independent development (e.g., Bin, 2013; Kim, 2015; Luethje, 2004). This research shifts the perspective from sharing self-developed solutions with manufacturers to sharing “sticky” needs- and solutions-related knowledge at the front end of the innovation process, in which the interaction with manufacturers happens in the form of expressing needs or ideas, or participating in innovation workshops. In this stage, users seem to be more willing to share their knowledge and contribute to the manufacturer’s innovation activities: 53.1% of the surveyed nurses and 42.5% of the PTAs stated that they had interacted with a manufacturer within the last year. Thus, manufacturers’ challenges in accessing sticky knowledge seem to be more severe with respect to completed user innovations than with respect to users’ knowledge about problems and solution ideas.

Finally, this research complements the recent considerations of Raasch and von Hippel (2012), who investigated potential welfare benefits from user-initiated product diffusion, in that we show that users may also increase welfare in the front-end of new product development by adding valuable knowledge.

6. Managerial implications

The benefits of integrating lead users into the development of new products have been demonstrated in several case studies reporting on the higher market attractiveness, success rates, and development speed for such products compared to traditional projects (Urban and von Hippel, 1988; Herstatt and von Hippel, 1992; Lilien et al., 2002). Lead userness is also associated with increased creativity (Kratter and Lettl, 2008), greater domain expertise (Schreier and Pruegl, 2008), and better predictions of new product ideas’ market success (Spann et al., 2009).
Therefore, lead users are able not only to help manufacturers to understand their problems but also to find appropriate solutions for them.

Our results are relevant for manufacturers who desire to integrate lead users’ knowledge into their new product development activities beyond hiring them as embedded lead users (Schweisfurth and Herstatt, 2015). Until now, manufacturers knew about the benefits of lead users, but the central question about leading-edge users’ motivation and willingness to participate in or even proactively initiate cooperative behavior was still unanswered. The findings in this paper point toward a positive self-selection mechanism among lead users and indicate that lead users can be identified to a certain degree by their proactivity in approaching the manufacturer with their current problems and ideas. Lead users are also more responsive to a call for workshop participation than their average users. Thus, positive self-selection represents a third path toward lead user identification, along with the more complex methods of pyramiding or screening (von Hippel et al., 2009; Poetz und Pruegl, 2010). These findings also imply that manufacturers can obtain access to lead users relatively easily, although probably not with the same accuracy and heterogeneity as with screening and pyramiding. The observable initial cooperative behavior can be used as a proxy to identify lead users, which is similar to prior attempts to use media consumption and social media activities as proxies to identify user innovators (Fursov et al., 2017). However, manufacturers should ensure the elimination of potential barriers for users to proactively contact them and to articulate their needs or ideas directly and should promote their innovation workshop invitations as broadly as possible because lead users are more likely to use these channels to initiate cooperation.

Once a user follows up on a workshop invitation or contacts the manufacturer, further questions about expertise and prior user innovation behavior can be asked to validate whether the user qualifies as being leading edge. This strategy makes the traditional screening approach more efficient because fewer users need to be screened. The uncovered self-selection mechanisms also make the pyramiding approach more efficient. With the first lead users revealing themselves, they can be asked about other experts with good reputations in the same or related fields. Thus, innovation workshop invitations and contact opportunities can be used as complementary approaches to increase the efficiency of traditional screening and pyramiding (von Hippel et al., 2009; Poetz und Pruegl, 2010).

The inclination of the investigated user populations to cooperate with manufacturers also does not seem to be highly influenced by recognition. Expected outcome benefits, i.e., a strong interest in finding an adequate solution to their problems, rather than the process benefit of receiving recognition from manufacturers, facilitate initial cooperative behavior. In trying to further stimulate users to contact them and participate in workshops, manufacturers should highlight the likelihood of receiving better solutions in their workshop invitations and on their communication interfaces to their user base.

Although this research focused on the concept of lead userness, manufacturers should not only desire input from these special users. Manufacturers are encouraged to also collect and act on innovation input coming from their average customers. Expert users such as lead users support bringing the product to a higher performance level that fits their ahead-of-the-trend needs, whereas less versatile users have different problems that are more focused on comfort and ease of use (Tietz et al., 2005). Both inputs are required to successfully innovate for the broad market.

7. Limitations and future research

The empirical study conducted to test the proposed model draws on two independent samples in the health care sector. Therefore, the generalizability of our findings is limited to this context and requires further validation. The willingness of lead users to cooperate with manufacturers might also depend on their ability to realize new solutions on their own without the help of manufacturers, which depends on contextual innovation barriers they might face (Braun and Herstatt, 2008). For instance, nurses can innovate in the domain of techniques and procedures applied in the hospital (West, 1989; Hinsch et al., 2014) but lack the equipment, technological knowledge, and legal environment to innovate medical devices. The same applies to PTAs. It might well be that users in domain contexts where they can realize new solutions themselves, without the help of a manufacturer, contact manufacturers less frequently and are less willing to participate in manufacturer-hosted workshops than in contexts in which users lack the ability to innovate themselves. Case studies (von Hippel, 2005; Lettl, 2007; Lettl et al., 2006) have shown that especially in the medical equipment sector, users face different organizational, technological, and legal barriers that require them to collaborate with manufacturers in the implementation stage. We therefore encourage future research to investigate the cooperation intensity of lead users in other industries and domain contexts that consider the abilities of users to innovate independently.

Further institutional characteristics might affect the users’ willingness to cooperate as well. In the context of nurses, for instance, the tendency to support manufacturers’ innovation of medical devices and supplies might differ between nurses working in hospitals that put more or less emphasis on teaching and research. The resources available to nurses, the cultural norms and values of the work environment regarding change and renewal and the corresponding ambitions to improve care and patient outcomes might affect nurses’ tendency to cooperate. Future research could investigate the relevance of such work environment factors, particularly in the case of intermediate users applying manufacturers’ solutions at work.

Future research might also investigate additional individual characteristics. Our sample mainly includes experienced nurses and PTAs. While this distribution reflects the current state of health care, age might be an important individual factor because prior cooperation intensity, experience engaging in past cooperation, and attitudes toward cooperation might change with an increase in the age of the professionals. In addition to age, prior job engagements in other institutions or even in different professional domains might affect past and current cooperative tendencies. The proxy variable job tenure used in this study does not fully explore these personal characteristics related to job experience that future research might consider in order to further validate the investigated model.

With respect to cooperative behavior, this research captured cooperation intensity within the previous twelve months to avoid biases caused by memory and job tenure. However, future studies could investigate the relevance of prior engagements more closely because past experiences with manufacturer cooperation, e.g., satisfaction with the achieved outcomes, incentives or recognition provided, and perceived quality of social interactions with the manufacturer’s staff, might affect attitudes toward, motivation for, and intensity of cooperation.

Furthermore, this research focused on contact initiations and workshop participation—two short-term forms of cooperation at the front end of the innovation process. However, there are also deeper forms of co-development and co-creation in which users become long-term partners in innovation with manufacturers. Future research may investigate whether the identified effect of lead userness becomes stronger for co-development activities that require higher levels of commitment from the user and the manufacturer and how the complexity of user involvement in the innovation process changes over time (La Rocca et al., 2016; Hierneth and Lettl, 2017). Another promising area for further developing knowledge about the lead user-manufacturer relationship would be to investigate whether those lead users who engage in these initial, short-term and ad hoc forms of cooperation with a manufacturer later facilitate a transition to a higher level of cooperation, i.e., long-term relationships at the institutional level, such as joint projects between a medical device manufacturer and a hospital. Given the lead user’s superior network position and their connections to and effect on
peers and other departments, they would be in an optimal position to achieve the buy-in and gather the resources needed to establish such institutional cooperation projects.

Appendix 1. Measures, Scale Properties, and Model Fit

| Construct/Source/Scale/Items | Study 1 | Study 2 |
|-----------------------------|---------|---------|
|                            | Factor loading | Critical ratio | Factor loading | Critical ratio |
| Expected benefit            | AVE = .66 | c.r. = .53 | AVE = .66 | c.r. = .53 |
| (1 — does not apply at all, 5 — fully applies) | .90 | .77 | .91 | .77 |
| In terms of medical devices, supplies, and techniques I have needs that are not covered by existing solutions. | .62 | .77 | .82 | .68 |
| I frequently get annoyed by poor medical devices, supplies, and techniques. | .87 | 8.51*** | .60 | 4.51*** |
| I think most medical devices, supplies, and techniques have room for improvement. | .69 | 8.26*** | (-)³ | (-)³ |
| Trend position              | AVE = .63 | c.r. = .53 | AVE = .63 | c.r. = .53 |
| (1 — does not apply at all, 5 — fully applies) | .90 | .77 | .87 | .85 |
| Usually, I discover new medical devices, supplies, and techniques earlier than others. | .85 | .77 | .71 | 7.90*** |
| I am always up to date with respect to trends in the field of medical devices, supplies, and techniques. | .68 | 9.16*** | .71 | 7.90*** |
| I have already had benefits from the early usage of new medical devices, supplies, and techniques. | .63 | 8.67*** | .82 | 8.79*** |
| Recognition from peers      | AVE = .63 | c.r. = .53 | AVE = .63 | c.r. = .53 |
| Jeppesen and Frederiksen (2006) | AVE = .63 | c.r. = .53 | AVE = .63 | c.r. = .53 |
| (1 — does not apply at all, 5 — fully applies) | .90 | .77 | .86 | 8.22*** |
| Recognition from my peers are a great reward for me. | .67 | .77 | .87 | .85 |
| Recognition from my hospital/pharmacy is a great reward for me. | .90 | 7.35*** | .86 | 8.22*** |
| Recognition from manufacturer | Jeppesen and Frederiksen (2006) | (–) | (–) | (–) |
| Process Formality           | AVE = .47 | c.r. = .56 | AVE = .47 | c.r. = .56 |
| (1 — does not apply at all, 5 — fully applies) | .77 | .77 | .86 | 11.19*** |
| There are standard procedures for individual tasks when we propose and implement new ideas. | .62 | .77 | .79 | .81 |
| Written rules about how to initiate and execute innovation projects exist. | .66 | 7.72*** | .90 | 11.61*** |
| There is a formal place to go within the organization (e.g., people, departments, dedicated meetings), to which we should refer when we have ideas for improvements and innovations. | .67 | 7.81*** | .25 | 2.86*** |
| There is strict enforcement of written rules and procedures for submitting and exploring new ideas. | .77 | 8.32*** | .86 | 11.19*** |
| Social position             | AVE = .66 | c.r. = .56 | AVE = .66 | c.r. = .56 |
| (1 — does not apply at all, 5 — fully applies) | .74 | .80 | .89 | .81 |
| I am the hub in the social groups I belong to, e.g., the nurses of my department, the PTAs of my pharmacy | .88 | .74 | .76 | 7.03*** |
| I am the connection link between social groups that would be apart otherwise, e.g., between people of different departments, between physicians, nurses, and PTAs, etc. | .74 | 7.93*** | .76 | 7.03*** |
| Contact initiation          | (absolute number within the previous 12 months) | (–) | (–) | (–) |
| number of times you contacted manufacturers directly to complain and suggest improvements for products | (–) | (–) | (–) | (–) |
| Workshop participation      | (absolute number within the previous 12 months) | (–) | (–) | (–) |
| number of times you participated in external workshops of manufacturers to improve or generate new products | (–) | (–) | (–) | (–) |

⁴ c. r., composite reliability. AVE, average variance extracted. ***p < .001 (two-tailed).
⁵ Study 1: n = 243 Nurses; Global Fit Indices: χ²/df = 2.07; CFI = .917; SRMR = .050; RMSEA = .067.
⁶ Study 2: n = 146 PT A; Global Fit Indices: χ²/df = 2.202; CFI = .900; SRMR = .057; RMSEA = .090.
⁷ Item eliminated during scale purification.

Appendix 2
D. Globocnik and R. Faullant

In both samples, the innovators scored significantly higher in their lead user characteristics than their peers (see Fig. 5), supports the concept that the self-report measure is reliable and valid.

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