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Social innovations in healthcare provision: an analysis of knowledge types and their spatial context

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ABSTRACT
Peripheral regions face the challenge of ensuring adequate healthcare provision. As a solution to such challenges, social innovations are introduced. Knowledge exchange among diverse actors is a crucial component of successful social innovations in peripheral areas. However, little is known about the characteristics and the spatial context of knowledge in social innovations. We analyze micro-level knowledge dynamics in four social innovations in the healthcare sector of a Swiss mountain region. We distinguish three knowledge types according to the knowledge base approach: synthetic (practical and tacit), analytical (scientific and codified) and symbolic (semiotic and tacit). From innovation biographies and semi-structured interviews, we find that synthetic knowledge is the type used most throughout the social innovation process and that it is often combined with the other two knowledge types. Local actors and extra-local actors who are locally embedded contribute the most knowledge. The actors require a considerable number of craft and practical skills to apply their own analytical or symbolic knowledge, as well as to link these three knowledge types from different actors and spatial contexts. Social innovations combine locally and extra locally acquired synthetic knowledge with analytical and symbolic knowledge to solve peripheral healthcare challenges and to contribute to regional wellbeing.

Introduction

Peripheral regions face challenges concerning out-migration, demographic change and adequate healthcare provision, wherein challenges around healthcare provision may be a result of out-migration and demographic changes. In some cases, solutions to these challenges may not lie in traditional forms of innovation but rather in social innovation. Scholars are increasingly questioning the potential of traditional innovations, which narrowly focus on economic benefits and competitiveness, in tackling the global, regional and local manifestations of grand societal challenges, such as climate change, the ageing society and healthcare (Asheim, Isaksen, and Trippl 2019; Coenen, Hansen, and Rekers 2015; Coenen and Morgan 2020; Moulaert and Nussbaumer 2005a; Tödtling, Trippl, and Desch 2021). In recent years, social innovation has become one of the most widely discussed alternative forms of innovation that can be applied when addressing challenges. Such innovations are being increasingly considered and implemented in peripheral areas (Bock 2016; Neumeier 2012) and can be defined as novel solutions to (regional or local) societal challenges,

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which involve new forms of cooperation among individuals and/or organizations (Ayob, Teasdale, and Fagan 2016; Moulaert et al. 2013b; Neumeier 2012). For example, social innovations may emerge as community-designed healthcare services or regional healthcare networks. It is widely recognized that a defining aspect of social innovation is that of social actors exchanging, combining and sharing knowledge. Such interactions are crucial for the success of social innovations in peripheral and other areas (Neumeier 2017; Novy et al. 2020; Sørensen and Torfing 2015).

In the study of social innovation, analysis of knowledge requires a perspective about innovation that is largely absent in literature concerning traditional forms of innovation in peripheral areas. This literature has instead (so far) been deficit focused. Generally, it states that only a few types of actors are involved in innovation in peripheral areas due to the 'institutional thinness' of these regions (Tödtling and Trippl 2005). Moreover, traditionally innovative actors like firms compensate for the lack of knowledge and other innovation resources in these areas through extra-local linkages to core regions (Eder and Trippl 2019; Fitjar and Rodríguez-Pose 2011; Grillitsch and Nilsson 2015; Mayer, Habersetzer, and Meili 2016). In contrast to this deficit-based perspective, the literature about social innovations in peripheral regions focuses on the diversity and variety of actors, ranging from public actors, civic actors and firms to third-sector actors and others (Moulaert, MacCallum, and Hiller 2013a; Nicholls and Murdock 2012; Sørensen and Torfing 2015). This literature emphasizes that these actors use their innate innovation resources to address challenges, often through collaboration or co-creation. By analysing how the various social innovation actors use and combine different types of knowledge throughout social innovation processes in peripheral areas, we broaden our perspective about the innovative capacities of peripheral regions. More specifically, we focus on capable and knowledgeable actors, and we reveal that there are many actors in peripheral regions who interact and share locally and extra locally acquired knowledge to innovate.

Although knowledge is perceived as central to social innovation (Novy et al. 2020), there are no social innovation studies in peripheral regions with knowledge as their central object of investigation. When studies discuss knowledge (e.g. Kluvankova et al. 2021 or Nordberg, Mariussen, and Virkkala 2020), they apply a rather broad understanding of it, and generally express that social innovations depend on a combination of local and external knowledge. However, little is known about the knowledge types that the actors use in the social innovation process. How the knowledge types are combined and how they are linked to the local and extra-local context throughout the process of developing and implementing a social innovation are unclear.

Our paper addresses this gap by analysing four case studies in the Bernese Oberland, a Swiss mountain region facing the challenge of maintaining healthcare provisions due to ever-rising healthcare costs, state withdrawal and demographic change (Cerny et al. 2016; Stierli et al. 2021; Tschumi and Mayer 2020). Healthcare is a particularly suitable sector to examine knowledge dynamics, as many knowledge types from different spatial and professional contexts are combined and shared in this context. Generally, local and extra-local healthcare professionals, state actors, lay persons, citizens and volunteers provide knowledge in healthcare-related social innovations (Farmer et al. 2018; Farmer and Nimegeer 2014; Kenny et al. 2015; Roberts et al. 2014).

For our analysis, we distinguish among three knowledge types according to the knowledge base approach (Asheim and Coenen 2005; Manniche, Moodysson, and Testa 2017): synthetic (practical and tacit), analytical (scientific and codified) and symbolic (semiotic and tacit) knowledge. Analysing social innovations using this approach has sharpened our understanding of the role of knowledge in social innovations. This is because such an analysis allows knowledge to be examined in general terms and proper comparisons to be made among and within social innovation processes, thanks to the approach's distinct knowledge types.

For each social innovation case, we conducted extensive innovation biographies (Butzin and Widmaier 2016; Kleverbeck and Terstriep 2018) and semi-structured interviews. In this way, we could examine how knowledge and its spatial context develop over time in the social innovation process.

In this study, we address the following research questions:

- What type of knowledge do the actors who are involved in healthcare-related social innovations in the Bernese Oberland use?
- Where does the knowledge come from?
- What is the role of local and extra-local knowledge?
- What types of knowledge do the actors combine, and how are these types combined?
- How do knowledge types, their origins and their combinations change throughout the social innovation process?

The next section reviews the literature on social innovations and knowledge, focusing on peripheral areas. This is followed by a description of the methods and an introduction to the four social innovation case studies. After presenting our results, we discuss our findings and draw a conclusion.

Social innovation, knowledge and peripheral areas

Defining social innovations in peripheral areas

Social innovation has become a popular concept in both science and policy in recent years (Grimm et al. 2013). However, social innovations are defined and understood in highly diverse ways (Edwards-Schachter and Wallace 2017; van der Have and Rubalcaba 2016). One research strand, presented by Franz, Hochgerner, and Howaldt (2012), adopts a sociological perspective on social innovation, mainly focusing on how social practices and relations are changed in and through social innovations. Mumford (2002) focuses on the creative process of generating and implementing innovation. This strand perceives social innovations as providers of new ideas about the ways social relations can be structured to achieve a common goal, mainly within businesses.

In our study, we adopt the social innovation understanding located in one of the most significant strands: the local and regional development literature (Ayob, Teasdale, and Fagan 2016; van der Have and Rubalcaba 2016). This perspective is strongly influenced by the work of Frank Moulaert and his colleagues (MacCallum et al. 2009; Moulaert et al. 2013b; Moulaert and Nussbaumer 2005a, 2005b). These authors view social innovations as local and regional solutions to social challenges. In this vein, they discuss social innovations as solutions to the various challenges faced by rural and peripheral regions (Bock 2016; Neumeier 2012). On the one hand, such social innovations can be reactive (Steiner, Calò, and Shucksmith 2021) or adaptive (Bosworth et al. 2016), born out of necessity and often responding to local or regional gaps caused by austerity politics. On the other hand, these social innovations can be proactive (Steiner, Calò, and Shucksmith 2021) or creative (Bosworth et al. 2016) and driven by perceived opportunities. They may also be proactive and reactive at the same time (Steiner, Calò, and Shucksmith 2021). In any case, these authors emphasize new forms of collaboration among actors of different sectors and geographical scales as defining aspects of social innovations (Neumeier 2017). Following this line of thought, we define social innovations as follows: new reactive and/or proactive solutions to a regional or local social problem or societal challenge involving new forms of cooperation among individuals and/or organizations.

Knowledge in social innovations in peripheral areas

The social innovation literature recognizes knowledge 'as a factor in understanding the challenges to be addressed [by social innovation initiatives]' (Busacca 2020, 190). Still, knowledge is a relatively recent topic of interest for academics in the social innovation field (Benneworth and Cunha 2015; Busacca 2020; Moulaert et al. 2017; Moulaert and Van Dyck 2013; Novy et al. 2020). Novy (2013) and Moulaert et al. (2017) stress the role played by transdisciplinary research in bridging academic and other forms of knowledge to create social innovations. Indeed, Novy et al. (2020) view the various actors who bridge different types of knowledge as crucial to the capacity to innovate and thus to create social innovations. This stems from the fact that many types of actors – ranging from public authorities to enterprises to civil actors to third-sector organizations – with different knowledge

stocks collaborate to create social innovations to solve a challenge or problem (Sørensen and Torfing 2015).

In peripheral areas, knowledge exchange by different types of actors is a defining characteristic and success factor for social innovations (Bock 2012; Bosworth et al. 2016; Neumeier 2017). Most authors in this research area discuss the origin and spatial context of knowledge for social innovations in peripheral regions. According to Neumeier (2012), it is most likely that the initial impulses for social innovations stem from external factors. Butkevičienė (2009) and Novikova, de Fátima Ferreiro, and Stryjakiewicz (2020) argue that external actors facilitate the mobilization of local resources to develop social innovations, and Bosworth et al. (2016) indicate that sharing knowledge from local and external actors makes it more likely for social innovations to emerge. Similarly, Nordberg, Mariussen, and Virkkala (2020) highlight that the decisive factor for the success of rural social innovation projects is the involvement of local communities, whose local knowledge is nourished via interactions among local and extra-local actors. Likewise, Noack and Federwisch (2019) reveal that external urban actors help localities develop social innovations by introducing knowledge that is predominantly located in urban areas. These findings underscore Bock's statement (Bock 2016) that connectivity with urban and other areas to access external knowledge can foster social innovations. Kluvankova et al. (2021, 2018) ascertain that social innovations are mainly initiated by local actors who draw on local or external knowledge. Valero and López Marco (2019) demonstrate that social innovations integrate a considerable amount of scientific knowledge, introduced by both local and external actors. Finally, Jungsberg et al. (2020) recognize that knowledge provided by the local public sector is crucial in initiating rural social innovation initiatives in Nordic countries. All these studies demonstrate that social innovations rely on a combination of local and external knowledge.

Concerning the characteristics of local and external knowledge, Kluvankova et al. (2021) attribute tacit/implicit knowledge to local community members. They also indicate that codified/explicit knowledge originating from academic research and policy making is typically fed by external actors into the process from which social innovations emerge. Similarly, Nordberg, Mariussen, and Virkkala (2020) link extra-local knowledge to scientific, regulatory and professional knowledge. They perceive local knowledge as knowledge about local needs and resources, which can be professional, scientific, lay or of another type.

In sum, the literature reveals that social innovations depend on a combination of local and external knowledge, whereas codified/explicit knowledge is generally attributed to external sources and tacit/implicit knowledge to local sources. Nevertheless, we still lack knowledge about how these knowledge types are combined throughout the social innovation process and at which points in the process certain knowledge types are more relevant than others. In addition, it is widely unexplored how the origin of the actors who use the knowledge interacts with the origin of the actors' knowledge acquisition. We fill this gap as follows: First, we analyse the frequency and combination of knowledge types that are used throughout the social innovation process. Second, we examine the spatial context of knowledge types by considering both the origin of knowledge acquisition and actor origin. Before presenting our conceptual and methodological approach, we discuss the knowledge features of healthcare-related social innovations in the next section.

Knowledge in healthcare-related social innovations

Many types of knowledge from different spatial contexts are combined and shared to develop and implement social innovations related to healthcare. Modern healthcare provision is centred on expert knowledge from skilled healthcare professionals, such as nursing specialists or medical doctors (Berkers 2017). State actors are also important because healthcare provision is highly regulated and state-financed to a large degree (De Pietro et al. 2015). Public actors provide administrative knowledge about the legal framework conditions and the regulatory process. This is especially relevant for the successful implementation of socially innovative healthcare solutions in peripheral

regions, as these solutions must be compatible with the existing policy and regulatory regime (Farmer et al. 2018). A special feature of social innovations in healthcare in peripheral regions is that, apart from experts and state actors, local citizens – mainly lay persons and volunteers – are involved in designing rural primary healthcare services (Farmer and Nimegeer 2014; Kenny et al. 2015; Roberts et al. 2014). The co-production of socially innovative health services by both local lay persons and local healthcare professionals often requires support from external policy makers or public sector managers (Farmer et al. 2018). These findings emphasize that the combination of different types of knowledge from different spatial contexts is crucial for healthcare-related social innovations in peripheral regions. However, consideration regarding which knowledge types and combinations are more important than others at certain points in the social innovation process remains widely unexplored. Moreover, the knowledge origin and the origin of the actors applying the knowledge types are not well examined. We address this gap by analysing the knowledge types and dynamics of healthcare-related social innovations at a micro level. For this purpose, we apply the combinatorial knowledge base (CKB) approach, which distinguishes among synthetic, analytical and symbolic knowledge types. In the following section, we describe our approach and its relevance to studying micro-level social innovation knowledge dynamics.

Knowledge base approach to analyse knowledge types

Conceptual frameworks that can be used to study individual- and community-level knowledge and their dynamics have not yet been elaborated on in the social innovation literature. However, well-established approaches to conceptualizing knowledge dynamics from economic geography and innovation studies can be purposefully used to study knowledge dynamics in social innovations. In recent years, the CKB approach has gained popularity (Manniche and Testa 2018). This approach distinguishes among three knowledge bases: synthetic, analytical and symbolic. This distinction has predominantly been used for macro-level analysis of the structural conditions of firms, sectors or entire regions (Boschma 2018; Manniche, Moodysson, and Testa 2017). Studies reveal that geographical proximity is particularly important for sourcing and creating symbolic knowledge. It is less important for synthetic knowledge and least important for analytical knowledge (Martin and Moodysson 2013). Researchers have also determined that knowledge bases tend to be concentrated in regions according to the areas of knowledge that a region specializes in (Martin 2012).

However, the CKB approach can also be used to investigate the activities of individuals and groups in innovation processes, which is the aim of our study. Early adopters of the approach (e.g. Asheim and Coenen [2005] or Asheim and Gertler [2006]) already acknowledge that the distinctions among the knowledge bases assume that innovations depend on individual and community micro-level processes, such as learning modes or types of interactions among actors in creating knowledge (Manniche, Moodysson, and Testa 2017). In this vein, more recent studies have applied the typology to analyse the activities of individuals and groups of individuals in business innovation processes. Researchers have determined that innovation projects in the life science (Coenen and Moodysson 2009), food (Manniche and Testa 2018) and automotive (Strambach and Klement 2012) industries rely on a combination of different knowledge types – and that some types are more present in different innovation stages. Manniche and Testa (2010) discovered that symbolic knowledge plays an important role in developing and producing food products. Similarly, Tuitjer and Küpper (2020) discovered (from three rural craft-food case studies) that globally sourced symbolic knowledge is important at the beginning of the innovation to develop the food product. They also reveal that synthetic knowledge becomes important to produce the product and in the realization phase.

Nevertheless, while the CKB approach has been applied to study innovation processes in firms, it can also be used in other micro-level contexts. In fact, the approach is partly influenced by micro-level social learning concepts that are not linked to any specific sort of innovation (Grønning and

Fosstenløkken 2015). Many features of the knowledge bases at the micro level are general features; hence, they are applicable to any innovation process and thus also to social innovation processes. This becomes clear via the information presented in Table 1, where we delineate the three knowledge types. These three types incorporate specific learning modes, the skills that are used for creating knowledge as well as related knowledge characteristics (Manniche 2012; Manniche, Moodysson, and Testa 2017; Testa 2014).

The approach thus offers the conceptualization of distinct knowledge types while still incorporating the many attributes of knowledge. The knowledge types contribute to sharpening extant understandings of knowledge in the social innovation literature, which applies broad notions (e.g. local knowledge as knowledge of local needs and resources) or simply attributes knowledge to certain actors (e.g. public actor knowledge). Considering many knowledge attributes is particularly relevant for studying social innovations because social innovation actors are highly diverse (in their sectoral and professional backgrounds as well as in their motivations).

Based on our review of knowledge in social innovations in peripheral areas, we have derived certain expectations concerning the frequency and combination of knowledge types, as well as the origin of knowledge acquisition for each knowledge type (see Table 2). The literature reveals that social innovations in peripheral regions require combinations of (rather tacit/implicit) knowledge from local sources and (rather codified/explicit) knowledge from external sources. Codified/explicit knowledge belongs to the analytical knowledge type. It is generally suggested to be sourced in central/urban areas (Noack and Federwisch 2019) and introduced to the social innovation process by external actors who acquired it outside the locality or region where the social innovation is implemented (Kluvankova et al. 2021; Nordberg, Mariussen, and Virkkala 2020). For example, scientists from central hospitals may provide their expertise to help social innovation initiatives with demanding issues such as healthcare data management. Tacit/implicit knowledge is tied to local contextual knowledge about local traditions, norms and cultures, which is related to symbolic knowledge. It is associated with local actors, who acquire it locally (Kluvankova et al. 2021; Nordberg, Mariussen, and Virkkala 2020). These actors may be more often involved in social innovations than external actors, as the literature suggests that the latter are rather helping actors who provide their knowledge more sporadically (e.g. Jungsberg et al. 2020; Farmer et al. 2018). For instance, initial ideas for healthcare social innovations are often developed by local actors who know the local circumstances and have intimate knowledge of local challenges (Farmer and Nimegeer 2014). Implementing these ideas may require expertise regarding regulatory issues or medical evaluation procedures, for which they engage extra-local experts for a limited time period.

Table 1. Characteristics of synthetic, analytical and symbolic knowledge types.

	Synthetic	Analytical	Symbolic
Knowledge characteristics	Mainly tacit, context specific and practical with some codified components	Codified, highly abstract and universal	Strongly tacit and context specific
Competencies/skills used for creating knowledge	Craft and practical skills: concrete know-how	Scientific skills: abstraction, theory building and testing	Craft and practical skills Creative, imaginative and interpretive skills Deep understanding of the habits, norms and 'everyday culture' of specific social groupings
Applied learning practices and methods to create knowledge	Interactive learning of different actors Day-to-day activities (no planned activities) Learning by doing	Formally organized activities with outcomes documented in reports, electronic files or patent descriptions	Learning through interaction in the professional community Learning from local culture Creative processes

Source: Zukauskaite and Moodysson (2016, 592–593); Asheim (2007, 224–227); Manniche and Testa (2018); Manniche (2012).

Table 2. Expectations about frequency, origin of acquired knowledge and combinations of knowledge types for social innovations in peripheral regions.

	Synthetic	Analytical	Symbolic
Frequency of the social innovation process (Frequent, medium or seldom)	Medium to frequent	Medium	Medium to frequent
Origin of knowledge acquisition (Local or extra local)	Local and extra local? *(This is not clear from the literature. However, as synthetic knowledge has elements from both analytical and symbolic knowledge, we can expect that it is acquired both extra locally and locally.)*	Extra local	Local
Combination of knowledge types	All types are combined as social innovation actors share and exchange different forms of knowledge (Bock 2012; Bosworth et al. 2016; Neumeier 2017).		

From these assumptions, it can be expected that actors frequently use symbolic knowledge in the social innovation process, that they use analytical knowledge less frequently and that they only seldom use synthetic knowledge. However, the use of synthetic knowledge may be underestimated in the literature. Actors may often need tacit/implicit practical knowledge that requires a universal/codified component, for instance regulatory/political or medical knowledge. In healthcare social innovations, regulatory/political knowledge can be relevant in the implementation phase of the social innovation process because healthcare services need to comply with safety standards imposed by law and adapt to the regulatory context (Farmer et al. 2018). Once the services are being operated, medical knowledge becomes more relevant.

The next two sections describe our methods and provide an overview of our social innovation cases. We then present the results before discussing them and drawing some conclusions.

Methods

We have analysed the knowledge dynamics present throughout the development and implementation processes of four social innovations in the Bernese Oberland, a peripheral region in Switzerland. (Descriptions of these social innovation cases are located in the next section.) We classify these four cases as social innovations for a number of reasons. First, they emerged as a reaction to challenges present in the Bernese Oberland, such as state withdrawal and demographic change. The involved actors perceived an opportunity to tackle a relevant challenge at the local or regional level. Second, they are projects that are new for the region and – in some cases – even at the national level. Finally, they involve new forms of cooperation that are unusual in this region (Tschumi and Mayer 2020). Thus, they are also innovative in an organizational sense. Desktop research revealed that there are other healthcare-related projects in the Bernese Oberland that could probably be classified as social innovations. However, only the four cases we analysed here fulfilled the requirements for our detailed biographical analysis of the innovation process over time. For one, the social innovations could not have begun too far in the past to ensure that the actors could still reliably report on past events. However, they must also have existed long enough for changes in their process to be identified over time. Finally, they needed to involve multiple actors so that the knowledge dynamics among the actors could be examined.

The analysis of an innovation process and its knowledge dynamics requires comprehensive data concerning a period of time and the actors involved, their roles and how they interact. Therefore, we chose the social innovation biography approach. This method has been applied to analyse innovation processes from a micro-level perspective in economic geography (e.g. Graffenberger and Vonnahme 2019; James et al. 2016; Manniche and Testa 2018; Tanner 2018; Tuitjer and Küpper 2020) and in studies about social innovations (Jungsberg et al. 2020; Kleverbeck and Terstriep 2018). The key idea of the method is to use 'selected techniques to examine the dynamic nature of knowledge during a concrete innovation process from its first idea until implementation and to disclose how knowledge is moved through time and space' (Butzin and Widmaier 2016, 221).

Creating social innovation biographies involves several steps: For each of the four social innovations, we conducted a narrative interview with one of the persons who has been strongly involved in the social innovation process for a significant period of time. Based on these interviews, we created draft versions of the biographies and the actors involved in the social innovations. Extensive desktop research of websites, newspaper articles, annual reports and other documents allowed us to fill gaps in the biographies and the actor networks. To gain data on the knowledge that the social innovation actors applied during the social innovation process, we subsequently conducted 26 semi-structured interviews with central social innovation actors (i.e. five to eight interviews per case study). Based on the biographies, we could link the knowledge types to one or several event (s) or task(s) in the social innovation process.

Once the biographies were created, we determined three distinct phases that are valid across the four case studies. The three phases are based on the biographical data, and they allowed us to compare the changes in knowledge dynamics over time. In Phase 1, the social innovation idea was generated and concretized. This phase involved in-group organizing to form an organizational structure suitable for the implementation of the idea as well as an assessment of the conditions for its implementation. Phase 2 was the build-up/development phase. It involved the first steps for implementing the idea, such as searching for funding and infrastructure as well as establishing preliminary infrastructure. Often, it also contained 'public relations' tasks, such as presenting ideas to external actors and/or convincing them of the ideas. Finally, Phase 3 encompassed the operation and maintenance of the social innovation. This phase involved the implementation of the idea, making use of infrastructure, financial and other resources, such as labour. It also involved ensuring long-term financial sustainability and infrastructure, often by elaborating on formalized applications: a task prevalent in these social innovations due to the highly regulated nature of the healthcare sector (De Pietro et al. 2015).

Although the phases are linked to typical tasks, some tasks overlapped (especially in Phases 2 and 3 when the social innovations were being implemented). The time spans of the phases varied for the four social innovation cases. At the time of data collection, Phase 3 (operating and sustaining) was still running in some cases, but it had progressed enough to delineate it from the other phases and to obtain proper data. For each phase, we identified the events or actions that had a major impact on the trajectory of the social innovations. For every event, we identified the main actors involved and the knowledge they applied according to the following three categories: *knowledge characteristics*, *competencies/skills used for creating knowledge* and *applied learning practices and methods to create knowledge* (as outlined in Table 1).

Short innovation biographies of the four social innovation cases

The following descriptions were drawn from the social innovation biographies, and they are presented here to introduce the four case studies.

Case study 1: birth centre 'Maternité Alpine'

In 2015, the regional hospital in the municipality of Zweisimmen closed its maternity ward, mainly to save costs for the hospital provider. The closest maternity ward was then in Thun, at least a one-hour drive away and even further away from the mountain valleys in the west and south of Zweisimmen. As a reaction, a group of local women, who had already fought against the closure in 2014 when it was announced, began to conceive alternatives. They were strongly supported by a regionally born and locally well-embedded midwife, a non-local gynaecologist practicing in the region, a former head doctor of the local hospital, a local politician who has been active at the cantonal (department) level as well as a range of other engaged people. The innovation incorporated a novel form of cooperation across political orientations and generations. These individuals developed the idea of establishing an independent birth centre in Zweisimmen to address the need

for a maternity ward. Therefore, in July 2015, they founded a cooperative with more than 50 mostly local citizens as (passive) members. Before the opening in 2017, the most important tasks were to determine a suitable location for the centre, gain permissions to run the centre, access funding and finally equip the centre. Many different actors were involved in these tasks on a voluntary basis, from local craftsmen to former spatial planners and local housewives.

After the opening of the birth centre, many of the most engaged actors remained involved and took on tasks to support the operation of the centre. However, hired midwives and the gynaecologist played the most important roles in the operation at that time. From then on, efforts were made to integrate the birth centre into the local hospital to make processes more efficient. These efforts were largely led and performed by the local politician (now the cooperative president) and the regionally born midwife (now one of the operation directors). Again, many others, such as the medical practitioners who contributed important technical knowledge, supported them. Integrating the centre into the local hospital was not possible, so they started a pilot project through which women who gave birth by caesarean section could stay in the birth centre during the postpartum period. However, at the time of our fieldwork and writing, the members were still pursuing the plan to integrate the centre into the hospital.

Case study 2: concept of an integrated healthcare network

The future of the aforementioned regional hospital in Zweisimmen, which services two adjoining valleys of the Bernese Oberland, has been a harshly discussed topic for more than 15 years. The hospital had been operating at a deficit for more than 10 years, but its closure was not possible due to newly designed cantonal (department-wide) legal healthcare supply specifications implemented in 2013. In 2017, the hospital operator company submitted a request to the cantonal health department to take on part of the deficits for a newly planned Zweisimmen hospital, but it was rejected. The hospital situation was at a crossroad, and local municipal authorities held several conversations with the cantonal healthcare minister to find solutions. As a result of the discussions, they convened a task force with members of the cantonal healthcare ministry, members of the hospital operator company and an external healthcare/hospital expert. The task force elaborated several possible solutions for regional healthcare provision. To discuss the solutions, the task force organized a workshop in mid-2018 with a wide range of regional actors, including local authorities, civil actors, companies and healthcare providers, such as general practitioners and elderly home operators. The workshop participants decided to pursue the goal of developing an integrated healthcare network with the Zweisimmen hospital as a central hub, surrounded by other healthcare facilities, such as elderly homes and therapy offices. The participants split into working groups on different subtopics around the newly considered healthcare network. In two subsequent workshops, the working groups presented one another the results they had developed in the meantime. The whole process was moderated and monitored by the healthcare expert mentioned above.

Case study 3: multi-generation house

In 2015, the municipality of Hasliberg in the east of the Bernese Oberland launched an open workshop to discuss innovative projects for the future of the municipality. Some citizens discussed a challenge they faced. As soon as elderly people became in need of care, they had to leave the municipality (and therefore their well-known environment). This is because there was no elderly home in Hasliberg and also because their children had moved to more central locations where job opportunities are more abundant. To address the challenge, the idea arose for a multi-generation house with supporting agencies for elderly people. The house should provide space and care facilities for elderly individuals who need to move out of their homes. These homes also provide new and free living space for younger generations. A working group was created, consisting of a local farmer who was the main proponent of the idea, and other interested local people. The leader of the working

group was a locally well-embedded researcher from the lowlands, who was one of the initiators of the first workshop. Supported by external researchers, the working group conducted a local survey to gain an overview of the needs of the local population for such a house. The result of the survey demonstrated that the need was there. Subsequently, they searched for and located an adequate building area. They founded a cooperative and acquired members; then, they successfully applied for state funding. With the funding, a detailed sketch of the house could be realized with the help of external architects.

Case study 4: Berne's first responder system

Many valleys of the Bernese Oberland are too remote for an ambulance to reach them in the time required for a safe rescue. In one of the eastern valleys (from around 2005–2008), there were initiatives by civil actors and local practitioners to train local lay persons in simple first aid skills so they could help patients before the ambulance arrived. However, it was the head of the emergency services of one of the regional hospital providers who had the idea of coordinating professional ambulance services with lay persons' help. He focused on cardiovascular arrest as the disease with the most urgent need for quick help and managed to integrate the so-called first responder system into the hospital's emergency services. The system had already been introduced in other parts of the world and in Switzerland. In the Bernese Oberland, it was novel in the context of peripheral, hard-to-reach mountain areas.

The initial first responder group was founded in May 2010. Although emergency services from other hospitals in the canton of Berne took over the first responder system until 2015, the coordination between an emergency call and the lay helpers was only one-sided, as the emergency call centre would not be notified if a lay helper accepted to go to the place where the potential cardiovascular arrest was occurring. This changed in March 2015, when the regional hospital's emergency services (together with the emergency call centre) introduced a smartphone application for lay helpers. From then on, the registered lay helpers were alerted on their smartphone, and they could choose whether they would go to the emergency spot. Furthermore, relevant feedback could be reported back to the emergency call centre. This was possible because of close collaboration with the application developer company from the south of Switzerland. The company had already developed a similar product, so the implementation only took half a year. The goal of the first responder initiative is to reduce deaths from cardiovascular arrest as much as possible. Thus, the first responder group initiated several side projects with external partners from whom they received a lot of knowledge input. For instance, in 2018, they launched a digital map that indicates where all automated external defibrillators are located. The map was developed in cooperation with engineers from the cantonal office of geoinformatics. Other similar projects are planned, and an expansion of the first responder system to other parts of Switzerland is one of the future aims of the innovation.

Results

Knowledge types throughout the social innovation phases

We determined that all three knowledge types were applied with different frequencies and for varying tasks throughout the three phases of the analysed social innovations. In Phase 1, synthetic and analytical knowledge were predominantly applied in conceptual work. For instance, when preparing and writing the concept paper for the multi-generation house, a locally well-embedded farmer with many years of experience in local building construction brought in synthetic knowledge about the local way of constructing buildings and houses. He gained this knowledge as part of his farmer job and through several side jobs in the region. As such, his knowledge acquisition occurred through a practice-led, learning-by-doing process, with tacit knowledge as the result. One of the

social innovation leaders contributed analytical knowledge. He is a social-science researcher and lecturer from a major Swiss city. He had visited the region for many years and was eager to connect with the local population. He had knowledge about the correct structure, wording and format of concept papers (i.e. universal and codified knowledge, which he had gained via his research).

In Phase 2, synthetic and analytical knowledge was most frequently applied. This knowledge was mostly applied in conceptual work (as in Phase 1) and in the implementation of conceptual ideas. An example for implementation is the furnishing of the birth centre. After spending many hours conceptualizing the idea of a birth centre, writing applications for operating approval and searching for an adequate location, the centre could be equipped. A lot of craft knowledge in the areas of plumbing, carpentry and electronics was necessary. This synthetic knowledge was applied by local craftsmen, who offered to help. However, their help would have been pointless without the analytical and synthetic knowledge of one of the social innovation leaders: a midwife from the Swiss lowlands with much work experience in the region. She applied universal knowledge about the process of giving birth so that everything could be installed correctly and for safe use. She also applied synthetic knowledge that she had acquired when helping to establish a birth centre elsewhere. This involved specific knowledge about, for instance, where to place the rooms for minimal disturbance of the (expectant) mothers.

In Phase 3, synthetic and analytical knowledge was dominant in conceptual work and in the implementation of conceptual ideas. An illustrative implementation example comes from the first responder case. To quicken access to automated external defibrillators, which are used by lay persons to revive patients suffering from cardiovascular arrest, the social innovation members decided to locate nearby defibrillators on a digital map. For the map's implementation, engineers from the cantonal office of geoinformatics applied analytical knowledge. They brought their technical skills in programming and geographic information systems to the task. Practical paramedic knowledge was also necessary to programme the map in the most suitable way for active lay paramedics. The social innovation leader contributed this kind of synthetic knowledge. As a professional paramedic active in the social innovation region for many years, he gained this knowledge during countless rescue missions where lay paramedics were involved. Synthetic knowledge was also used to a notable but lesser extent in public relations tasks and the elaboration of formalized applications. In the latter, analytical knowledge was extensively applied in the birth centre and healthcare network innovations. In these cases, social innovation actors submitted applications to the health authorities or hospitals that had to adapt or improve the birth centre's services. The actors contributed expert healthcare and medical knowledge, which was needed to conform to safety and other standards imposed by law. Those who had this knowledge were local or extra-local regionally well-embedded medical doctors, midwives or researchers.

Apart from expert healthcare and medical knowledge, administrative and political knowledge was also necessary to comply with the legal standards of the application process. Such knowledge was contributed by local and extra-local part-time politicians, as well as by public officials from the cantonal health department. In this way, the actors established compatibility with existing policies and regulations, which is crucial for the successful implementation of healthcare-related social innovations in peripheral areas (Farmer et al. 2018) in a highly regulated sector like healthcare (De Pietro et al. 2015).

Symbolic knowledge gained importance in Phase 3. It was commonly applied in tasks concerned with implementing conceptual ideas and public relations. In the public relations realm, actors often used it when informing the local/regional population about progress on the social innovation. In the case of the healthcare network, one of the social innovation leaders took on this task. He is an extra-local healthcare expert who gained abundant knowledge from his access to regional opinions and understandings about the regional healthcare situation by doing home visits, talking to local people in everyday situations and attending local events.

Throughout the three phases, the overall frequency of the use of knowledge types increased. This is for two reasons. First, the types of tasks became more diverse in later phases. Thus, more

knowledge types were required to fulfil them. Second, more knowledge types were used and combined for one task type, particularly implementation tasks, in later phases. The next section delves deeper into these combinations of knowledge types.

Combination of knowledge types

The analysis revealed that the social innovation actors often combined the three knowledge types in various tasks. Which knowledge types are combined and with which frequency depend on the knowledge type and the social innovation phase. In Phase 1, analytical and symbolic knowledge were hardly ever combined, whereas analytical knowledge was often combined with synthetic knowledge in conceptual work. The combination of synthetic and symbolic knowledge was common for in-group organizing. In the starting phase of the healthcare network, for instance, the leading social innovation actors involved many different regional actors in discussing the procedure of how ideas for the network could be generated and conceptualized. Among them was the healthcare expert from the healthcare network case. He combined his symbolic knowledge about regional opinions and understandings with his moderation and mediation expertise, which he gained through many negotiations, discussions and workshops during his professional life as a healthcare consultant.

In Phases 2 and 3, synthetic and analytical knowledge were combined in implementation tasks. While the actors combined synthetic and symbolic knowledge mostly for conceptual work in Phase 2, they combined these knowledge types mainly for implementation tasks in Phase 3. Symbolic and analytical knowledge were mostly combined in conceptual work in Phases 2 and 3. This is well documented in the case of the multi-generation house, when the social innovation actors elaborated on the criteria to determine the construction area of the future house. Apart from analytical knowledge about house construction, such as adequate building size, it was crucial to know the local social context. The municipality where the multi-generation house is supposed to be constructed is made up of four separate but very closely spaced village-like clusters. Finding the right spot to construct the house required detailed knowledge about how the people living in the different areas felt about new innovative buildings. The aim was for the new building to be accepted by the community and to not arouse political opposition. The local farmer mentioned above, as well as an elderly woman who lived in the locality for more than 20 years, brought these local social context details into the process of developing the criteria to determine the construction area.

The actor constellations combining the knowledge types differ. While synthetic knowledge was often combined by the same actor with analytical or symbolic knowledge, analytical and symbolic knowledge was commonly combined by different actors. In most tasks, more than one actor was involved so that different actors were applying multiple knowledge types that complemented their own knowledge types.

Table 3 presents the frequency of each knowledge type combination and the main task type involved by social innovation phase. The frequency suggests the importance of the combinations for the successful completion of the respective phase. It seems that the combination of synthetic knowledge with another knowledge type is most important for the successful completion of each phase. The main task type indicates in what kind of activities the sharing of certain knowledge types is most relevant. These tasks require various knowledge types and skills to be successfully fulfilled.

Origin of actors and knowledge

In this section, we consider the spatial context of the knowledge types and of the actors who applied them. We determined three types of actors who contributed knowledge to the social innovation process. The first type is local actors originating from the region where the social innovation is implemented. These actors are socially well embedded in the region and have extensive and

Table 3. Combination of knowledge types: frequencies and main task types by social innovation phase.

		Synthetic-analytical	Synthetic-symbolic	Analytical-symbolic
Phase 1: Idea proposing and concretization	Frequency (frequent, medium or seldom)	Frequent	Frequent	Hardly ever
	Main task type	Conceptual work	In-group organizing	–
Phase 2: Build-up/development	Frequency	Frequent	Frequent	Seldom
	Main task type	Implementation tasks	Conceptual work	Conceptual work
Phase 3: Operating and sustaining	Frequency	Frequent	Frequent	Seldom
	Main task type	Implementation tasks	Implementation tasks	Conceptual work

longstanding knowledge of the regional circumstances. The second type is actors who do not originate from the region where the social innovation is implemented but who know the regional circumstances well because they have actively gained local knowledge, for instance, through networking or research. The third type is actors who are not embedded in the region where the social innovation is implemented. They have no or only rudimentary knowledge of the local context.

We discovered that an actor's origin (local or extra local) does not always align with the origin of the knowledge they contribute (i.e. the spatial context of knowledge acquisition). Rather, their contribution depends on the knowledge type they have. Analytical knowledge is by definition universal, codified knowledge, which is commonly acquired in institutions of higher education (Manniche 2012). We found that almost all social innovation actors who introduced analytical knowledge had acquired it at universities, research centres and firms outside the region of the social innovation. Unsurprisingly, extra-local actors without local reference (third actor type) contributed only analytical knowledge in almost all cases, like the engineers from the cantonal office of geoinformatics in the map example. What is more surprising is that extra locally acquired analytical knowledge was extensively applied by local actors (first type) and extra-local actors with local reference (second type).

Synthetic knowledge is more context specific than analytical knowledge, although it has universal, codified components, as well (Manniche 2012). We determined that local actors had mostly acquired synthetic knowledge in a local context (e.g. at a local job, like the local farmer who had gained knowledge about local building construction techniques). Extra-local actors without local reference (third type) had acquired symbolic knowledge extra locally. This only partially applies for extra-local actors with local reference (second type). In some cases, these actors had also acquired their synthetic knowledge inside the region.

Symbolic knowledge is highly tacit and context specific (Manniche and Testa 2010). Unsurprisingly, social innovation actors acquired this knowledge type in the regional context of social innovations. Mainly local actors contributed it. Extra-local actors without local reference (third type) hardly ever contributed symbolic knowledge. Extra-local actors with local reference (second type) contributed symbolic knowledge, which they acquired inside the region, as in the case of the extra-local healthcare expert who did home visits and talked to people at local events. Thus, this knowledge type is not confined to local actors.

The findings presented above imply that analytical knowledge was nearly always acquired extra locally by all actor types, that synthetic knowledge was acquired locally by local actors or extra locally by extra-local actors with local reference (second type), and that symbolic knowledge was acquired locally by all actor types. Table 4 outlines our findings regarding the spatial context of knowledge and the frequency of applied knowledge types by social innovation phase. The frequency suggests the relevance of a certain knowledge type for the success of each phase. Considering all phases together, synthetic knowledge seems to be the most relevant type, followed by analytical

and symbolic knowledge. The spatial context reveals where a certain knowledge type was mainly acquired and how well embedded the actors who used the knowledge are. The latter can indicate whether a certain knowledge type is actually available in the region or locality where the social innovation is being implemented. It can also indicate how persistent a particular knowledge type is in the region. While local actors might live permanently in the region where the social innovation is being implemented, extra-local actors might not. Knowledge held by extra-local actors may flow out of the region more easily. However, extra-local actors with local reference (second type) might be inclined to make sure that their knowledge remains in the region because they are more attached to the region compared to those without local reference (third type). These insights are made possible by analysing the spatial context through both actor origin and the origin of actor knowledge acquisition. Brought together, these two dimensions provide a more detailed spatial analysis of micro-level knowledge dynamics than most extant analyses.

Discussion and conclusion

We raised four research questions, which we explored through four social innovation case studies. Starting with the assumption that social innovations in peripheral regions are developed through the work of a variety of actors who use their knowledge, our questions addressed the following: (a) what knowledge types social innovation actors use, (b) where the knowledge comes from, (c) how the actors combine which knowledge types and (d) how knowledge types, their origins and combinations change over the social innovation process. We discovered that synthetic knowledge was used frequently throughout the whole social innovation process. Analytical knowledge was used with medium frequency in the beginning and the middle of the social innovation process, and frequently at later social innovation phases. Symbolic knowledge was seldom used in the beginning and middle of the social innovation process, and with medium frequency at later phases. Concerning knowledge type origin, synthetic knowledge was acquired locally (by local actors) or extra locally (by extra-local actors with local reference). Analytical knowledge was fully acquired extra locally and symbolic knowledge fully locally. Knowledge type origin did not change throughout the social innovation process. While the actors frequently combined synthetic knowledge with analytical or symbolic knowledge throughout the whole social innovation process, they hardly ever combined analytical and symbolic knowledge.

Our findings advance the social innovation literature in four ways: First, we show that local actors involved in social innovations often use extra locally acquired analytical knowledge. Second, not only local actors but also extra-local actors use symbolic knowledge. Third, locally well-embedded external actors extensively contribute to the successful fulfilment of the tasks involved in social innovations. Fourth and most importantly, social innovation actors require a considerable amount of synthetic knowledge (i.e. craft and practical skills) to make use of their own analytical or symbolic knowledge, as well as to link these three knowledge types from different actors and spatial contexts.

In terms of analytical knowledge, we determined that it is most often acquired extra locally, which aligns with the social innovation literature about peripheral areas (Kluvankova et al. 2021; Nordberg, Mariussen, and Virkkala 2020). However, we found that analytical knowledge is extensively applied by local actors, not external actors as the literature suggests. Thus, it seems that in a sector like healthcare, which is highly dependent on (analytical) expert knowledge (Berkers 2017), extra-local inputs of analytical knowledge are not enough to successfully fulfil the tasks involved in social innovations. Additionally, locally well-embedded actors with expert skills are involved and needed.

Our results support other findings, which reveal that locally acquired symbolic knowledge is central to social innovations in peripheral areas (Kluvankova et al. 2021; Nordberg, Mariussen, and Virkkala 2020). This stresses the importance that local citizens with locally acquired knowledge have in designing healthcare services in these areas (Farmer and Nimegeer 2014; Kenny et al.

Table 4. Frequency, main actor type involved and origin of acquired knowledge by social innovation phase.

	Synthetic			Analytical			Symbolic		
	Frequency of applied synthetic knowledge (Frequent, medium or seldom)	Spatial context		Frequency of applied analytical knowledge	Spatial context		Frequency of applied symbolic knowledge	Spatial context	
		Main actor types involved (Local or extra local with/ without local reference)	Origin of acquired knowledge (Local or extra local)		Main actor types involved	Origin of acquired knowledge		Main actor types involved	Origin of acquired knowledge
Phase 1: Idea proposing and concretization	Frequent	Local and extra local with local reference	Local and extra local	Medium	Extra local with local reference	Extra local	Seldom	Extra local with local reference	Local
Phase 2: Build-up/ development	Frequent	Local and extra local with local reference	Local and extra local	Medium	Local and extra local with local reference	Extra local	Seldom	Local and extra local with local reference	Local
Phase 3: Operating and sustaining	Frequent	Local and extra local with local reference	Local and extra local	Frequent	Local, extra local with local reference and extra local without local reference	Extra local	Medium	Local and extra local with local reference	Local

2015). What is new from our findings is that extra-local actors also apply symbolic knowledge, which they acquire locally. This result widens our understanding of symbolic knowledge as a knowledge type that is not only used by local actors.

Our results reveal that external actors with a strong local embedding are highly significant to knowledge inflows throughout the whole social innovation process. This observation is supported by other social innovation studies in rural regions, which reveal that external actors who engage in local activities and connect with local people make up most of the external actors who play a role in social innovations (Kluvankova et al. 2021). Bock (2016) mentions that temporary residents can figure importantly in social innovations by providing their skills, assets and external networks. Similarly, we found that these locally well-embedded external actors played a particularly important role by transferring extra locally acquired synthetic knowledge to the local context. These actors are the main providers of extra-local synthetic knowledge, while local actors mainly contribute locally acquired synthetic knowledge. Extra-local synthetic knowledge can figure prominently in linking locally specific symbolic or synthetic knowledge that is not available in the locality where the social innovation is developed.

Our most significant finding is the relevance of synthetic knowledge in the social innovation process. We determined that actors with symbolic or analytical knowledge also have synthetic knowledge. The actors needed craft and practical knowledge, which they had previously acquired locally and extra locally through learning-by-doing activities. They used their universal analytical knowledge or their highly context-specific symbolic knowledge in a concrete task. This is the case throughout the whole social innovation trajectory. Nonetheless, the actors also needed synthetic knowledge as a bridging type of knowledge to link analytical and symbolic knowledge from separate actors, especially in later phases. This may not come as a surprise, as synthetic knowledge is a blend of the other knowledge types. However, the amount of synthetic knowledge applied is remarkable. It indicates that the actors require a considerable number of craft and practical skills to make use of their own analytical or symbolic knowledge, as well as to link these knowledge types from different sources. This finding clearly advances the social innovation literature, which does not determine synthetic knowledge as being crucial for bridging knowledge types. Extant research merely suggests that (locally acquired) symbolic knowledge is enriched and combined with (externally acquired) analytical knowledge (Kluvankova et al. 2021; Noack and Federwisch 2019; Nordberg, Mariussen, and Virkkala 2020).

Overall, we demonstrate that there are many knowledgeable actors in peripheral regions who interact and share locally and extra locally acquired knowledge to innovate. This clearly departs from notions of traditional forms of innovations in peripheries that only few actors are involved in innovation due to 'institutional thinness' (Tödtling and Trippl 2005) and that the actors need to compensate for a lack of knowledge with extra-local linkages (Eder and Trippl 2019; Grillitsch and Nilsson 2015; Mayer, Habersetzer, and Meili 2016). We do not neglect to notice the similarities of our findings with traditional peripheral innovation studies, concerning aspects such as the importance of extra-regional knowledge sourcing (Grillitsch and Nilsson 2015), capacity to absorb external knowledge (Flåten, Isaksen, and Karlsen 2015) and actor links to central regions (Mayer, Habersetzer, and Meili 2016). Nevertheless, our paper contributes to the emerging literature on challenge-based innovation that views all peripheral actors as potentially innovative and capable of connecting various knowledge types (Asheim, Isaksen, and Trippl 2019; Coenen, Hansen, and Rekers 2015; Coenen and Morgan 2020; Tödtling, Trippl, and Desch 2021).

Our results might relate to certain regional and extra-regional preconditions, implying that our findings may not apply to other peripheral regions. The compatibility of social innovations in healthcare with existing healthcare policy regimes, practices and infrastructure is a crucial factor for social innovations to emerge in healthcare in such regions (Farmer et al. 2018). Therefore, this factor is very likely to be present in the Bernese Oberland, too. This may not be surprising, as Switzerland's mountain regions are well supplied with basic healthcare infrastructure (Cerny et al. 2016; Mitterlechner, Hollfelder, and Koppenberg 2018). This also relates to Switzerland's

regime that constitutionally guarantees basic healthcare access and transport infrastructure in these regions. These preconditions cannot be taken for granted in peripheral regions in other countries, where healthcare provision is hampered due to access barriers or a lack of staff and infrastructure (Douthit et al. 2015; Farmer, Munoz, and Threlkeld 2012; Smith, Humphreys, and Wilson 2008). For instance, in Italian alpine regions, access to healthcare is significantly lower compared to more central regions, although access is constitutionally guaranteed (Perucca, Piacenza, and Turati 2019). That said, it is questionable whether such social innovations may arise in other peripheral areas that lack these preconditions. It is also questionable if the knowledge necessary for such social innovations is available in such regions. As our results reveal, it takes highly knowledgeable actors holding several forms of knowledge to implement the social innovations successfully. They may have acquired knowledge locally or extra locally, which implies that the setting and preconditions (i.e. infrastructure, financial resources and so on) for gaining such knowledge must exist both locally and extra locally. The significant knowledge inflow from extra-local actors with strong local embedding indicates that the Bernese Oberland fulfills these preconditions.

Independent of the presence of such preconditions, our paper supports the proposition that social innovations can contribute to solving regional and local challenges in peripheral areas (Bock 2016; Neumeier 2012). By maintaining basic healthcare services, as in the cases of the birth centre and the integrated healthcare network, social innovations support the already strong use of local healthcare services by the population in the Bernese Oberland (Berchtold et al. 2014). Given that a lack of healthcare access is strongly related to other indicators of socioeconomic deprivation in peripheral regions (Perucca, Piacenza, and Turati 2019; Smith, Humphreys, and Wilson 2008; Wilkinson and Pickett 2007), these social innovations can contribute to regional well-being in realms besides healthcare. Social innovations not only help maintain services but also expand or improve them.

Although our results relate to meso- and macro-level preconditions, as well as regional development outside the realm of healthcare, our micro-level study design does not allow for a detailed analysis of the higher-level (pre)conditions for the knowledge needed in social innovations. Future research could go in this direction. For instance, the analysis of knowledge applying the CKB approach allows for macro- and meso-level analyses (Manniche and Testa 2018), since the three knowledge categories we used here imply certain spatial and organizational settings at a macro and meso level (Manniche, Moodysson, and Testa 2017). In general, the knowledge categories offer a framework to analyse how knowledge functions in innovation processes from a perspective that is broader than those taken in studies of innovation processes at the level of firms. Our findings can inspire further analyses of social innovations, including studies regarding other forms of challenge-oriented innovations.

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