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Article

Towards Digital Social Infrastructure? Digital Neighborly Connectedness as a Social Resource

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Abstract
Social infrastructure is made up of various material as well as non-material goods, ranging from venues for leisure such as movie theaters to indispensable everyday commodities, like sidewalks and streets. This is true both for urban and rural areas. However, the increasing emergence of digital aspects of social infrastructure has seemed to go unnoticed to some extent, with research specifically focusing on these digital aspects of social infrastructure being scarce at best—even though digitalization is currently a major emerging meta-development worldwide. The goal of our contribution is therefore to investigate the digital sphere and integrate it into the concept of social infrastructure. Drawing on descriptive findings from a multi-sited, community-based survey of residents in four rural areas in Germany (N = 413) as well as from 40 qualitative interviews, we present an integrative and expanded conceptualization of what we term a tangible *digital social infrastructure*. To do so, we examine digital neighborly connectedness as a social resource during the Covid-19 pandemic as a case study. We argue that digital neighborly connectedness served as both an integral part of on-site social infrastructure and as a social resource, especially during pandemic times. We discuss our results in light of current research on social infrastructure, with a specific focus on the scope of what counts as social infrastructure, as well as current discourse on social infrastructure in rural areas.

Keywords
digital neighborly connectedness; digitalization; Germany; qualitative analysis; rural areas; social infrastructure

Issue
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1. Introduction

Infrastructure is omnifarious, which simply means that it is composed of many diverse components. It is a tangible and visible part of the daily life of all people living together in communities, in urban as well as in rural environments and regions. For years, the material and economic aspects of infrastructure have been the main field of study, but in recent years the *social* facets have increasingly emerged as a significant approach in human geography and urban sociology alike (Klinenberg, 2018; Latham & Layton, 2019). "Social infrastructure" includes a whole list of goods and commodities of everyday life. These phenomena exist all over the world—and in urban and rural areas equally—although scholars have tended to focus on urban areas. Roughly defined, social infrastructure includes all those facilities, commodities, and places that contribute to the public life of cities (Latham & Layton, 2019). Although this important empirical approach has shifted the focus away from

material goods and commodities in studying infrastructure to the importance of the social one, the focus still nevertheless seems to be on *physical* infrastructure, meaning physical places and spaces in a given spatial entity, city, or community. These places include public squares, libraries, public sports facilities, etc. (Latham & Layton, 2020; van Eck et al., 2020). The prerequisite of infrastructure serving as social places is decisively shaped and mainly possible due to people *physically* being there, socializing and engaging with one another (Latham & Layton, 2019). In our contribution, however, we investigate the emergence of another sphere, or rather facet, of social infrastructure that deserves to be studied just as much as the physical one: a place where people are among other people without being physically present. We are talking about the *digital* sphere of social infrastructure. We argue that digitalization—as a current, worldwide meta-development greatly facilitated by the Covid-19 pandemic—should be considered part of the in-situ social infrastructure in any given community. In addition, we also want to stress the importance of taking into account rural areas when it comes to studying social infrastructure. To do so, we draw on descriptive findings of a multi-sited, community-based survey of respondents in four rural areas in Germany (N = 413) as well as 40 qualitative interviews with residents of these respective communities focusing on the utilization of digital neighborhood networks. We hope to more clearly understand how community-based digital social connectedness serves as both a social resource and, more importantly, an integral part of what we conceptualize as evidence for *digital social infrastructure*.

2. Basic Concepts: Social Infrastructure and Digitalization in Rural Areas

2.1. "Social" Aspects of Infrastructure

For some time, infrastructure has evolved to become one of the dominant perspectives in various fields of urban theories and studies. These include all fields occupied with investigating cities and urbanity, particularly (human) geography (e.g., Gandy, 1999; Graham & Marvin, 2001; Ioris, 2012; Latham & Layton, 2019; Silver, 2016), but also economics and development studies (e.g., Calderon & Servén, 2004; Hirschman, 1958; Nijkamp, 1986; Snickars, 1989). What the most recent and the earlier perspectives on infrastructure have in common is that infrastructure comes in various forms, shapes, and sizes. It ranges from developmental facilities such as bridges and roads to commodities (see, e.g., Swyngedouw, 2009), to public places such as libraries and squares (Latham & Layton, 2019; Stanley & Emberton, 2005). Although a few earlier works defined infrastructure more broadly, as serving both material and immaterial purposes (e.g., Nijkamp, 1986, p. 1), in recent years, fortunately, these immaterial, *social* aspects of infrastructure have been more systematically taken into account (Klinenberg, 2018; Latham & Layton, 2019). This important perspective marks a shift in studying infrastructure, especially for all those researchers occupied with studying the social aspects of urban life. However, several questions important to the current work arise: First, how exactly is social infrastructure localized? Second, which facilities, commodities, and places does it include? Finally, how should we understand the term "social" when it comes to social infrastructure?

The first two questions are closely related; it makes sense to answer them jointly. In his influential work, Klinenberg (2018, p. 17) defined basically all public institutions as part of the social infrastructure, naming educational (libraries, schools) and leisure-time facilities (athletic fields and swimming pools) in particular. In addition, he included often-overlooked social places such as sidewalks and courtyards. One interesting aspect related to our endeavor of localizing *digital* social infrastructure is Klinenberg's (2018, p. 17) definition of social infrastructure in which he stressed the importance of "an established physical space." Picking up where Klinenberg left off, Latham and Layton (2019) conceptualized all those places as part of social infrastructure that made it possible for people to meet other people. In their concept, they nearly exclusively focused on cities and city life in particular—public places and spaces located specifically in urban areas. According to Latham and Layton (2019, p. 4), facilities defined as social infrastructure also serve a specific purpose. Places and spaces regarded as social infrastructure, thus, can most concisely be defined as (a) publicly accessible, (b) physical in nature, and (c) located in an urban environment. This perspective, however, generally disregards *digital* as well as *rural* areas of social infrastructure. Both of these aspects are key to the argument that we want to lay out and empirically enrich in the chapters to come: To extend the perspective of social infrastructure to the digital sphere. Before that, however, we have to reflect on what makes social infrastructure "social."

What makes infrastructure "social," and how should the term be understood in our context? First, it seems fruitful to take a closer look at the term "social" and then, in the second step, reflect on what this means for social infrastructure. "Social" can be defined in many ways; this has been the case for decades of philosophical and sociological thought (for a detailed overview, see Dolwick, 2009). Broadly defined, "social" refers to "discourse, intersubjectivity, and meaning making, involving mainly the use of language and symbols in micro-scale, face-to-face contexts" (Dolwick, 2009, p. 22; see also Goffman, 1959). Here, the importance of communication in the "social" context is already salient. Following this communication-based perspective on the term "social," Luhmann (1995) defined communication as key and "the basic unit of analysis" (Dolwick, 2009). Of course, the term "social" also involves more than only communicational facets. Aspects such as education (e.g., Stanley & Nelson, 2012), socioeconomic

status (e.g., Evans & Repper, 2000), and health (e.g., van Ommeren et al., 2005) are a few of the important facets of what is to be understood as "social" in a broader sense. Nevertheless, our work follows the aforementioned communication-based perspective examining social connectedness mainly as a communicational phenomenon. Returning to the concept of social infrastructure and the use of the term "social," Latham and Layton (2019) emphasized that the "social" aspect of social infrastructure mainly revolves around "people being out amongst other people." They went on to state that places and spaces regarded as being part of social infrastructure "facilitate shared use and collective experience" and "facilitate social connection" (Latham & Layton, p. 9). The term "social" in their original conceptualization, then, refers to being connected while being amongst other people. Next, we give an overview of digitalization and its impact on communities and neighborhoods, and challenges in rural areas.

2.2. Digitalization in Rural Areas

Digitalization is best characterized as a global meta-development, affecting all aspects of life, basically all over the world. The consequences and upsides (and possible downsides) of digitalization have been an established field of research for some time now. This research, however, typically focuses on urban areas and has an economic focus, as best exemplified in the "digital city" concept (cf. Ishida, 1999; Leach, 2009; Mossberger et al., 2013). Undeniably, digitalization has most profoundly affected urban areas (Stokes et al., 2017), with rural areas facing several difficulties hindering digitalization. Several factors affecting rural areas more generally account for this delay. They include challenges regarding (physical) infrastructure, (economic) development, and demographic change (Bürgin & Mayer, 2020; Williger & Wojtech, 2018). The significantly different general socioeconomic conditions of urban and rural areas are described by a distinct, salient "urban–rural divide," which has become its own field of study (Salemink et al., 2017; Townsend et al., 2015). This divide also affects digitalization in rural areas, in Germany as well as most other European countries, in a severe way. Hurdles to digitalization include, for example, fewer broadband connections and fewer users (see Williger & Wojtech, 2018). However, while conditions in rural areas differ (often times severely) from urban areas, the meta-development of digitalization has by no means excluded rural areas altogether. Studies focusing on the German context suggest that the pandemic led to an increase in digitalization in most sectors, for example, the economy (Zimmermann, 2021), education (Hafer et al., 2021), and digital communication in particular (Nguyen et al., 2020).

Even though most research conducted on digitalization and its socioeconomic effects has focused on urban areas, a few studies specifically examine rural areas. These studies range from specific (mainly economic) facets of digitalization in rural areas, such as agriculture (Haggag, 2021) or the labor market (Lishchuk et al., 2021), to a broader perspective focused on digitalization and its impact on social life in rural areas (Meyn, 2020; Zerrer & Sept, 2020). Focusing on the context of German rural areas, several studies have been conducted looking at the general role of digitalization in rural areas and "digital social innovation" (DSI) more specifically (Sept, 2020; Zerrer & Sept, 2020). Sept (2020) found that digitalization has indeed profoundly affected general life in rural areas and that the role of digitalization should be understood as an inherent part of development in rural areas. Relatedly, Zerrer and Sept (2020) used two cases in Germany to investigate how digital social innovation in particular has been useful in tackling the challenges rural areas face, especially regarding sociodemographic decline and infrastructural development (Zerrer & Sept, 2020). They put forward the concept of "smart villagers," which refers to local inhabitants of rural areas concerned with finding (digital) ways to solve everyday problems. In a noteworthy study investigating digital social infrastructure, Sept (2021) examined whether a digital application used in the village of Dreis-Brück in Rhineland-Palatinate could serve as a substitute for a (closed-down) village pub. She concluded that not *all* social functions of the analogue village pub were substituted by the digital alternative. Some key functions, however, including social interaction were successfully taken over by the village app.

From discussing the issues of social infrastructure and digitalization in rural areas, we can gather several important thoughts going forward: First, social infrastructure as a concept is almost exclusively studied in urban environments. Second, places regarded as social infrastructure by definition are publicly accessible as well as *physical* in nature (see Latham & Layton, 2019). Third, while digitalization in rural areas faces severe challenges, it nevertheless does play an important role in everyday life there. In the analyses below, we attempt to address all three of these aspects empirically. To do so, we present descriptive findings of a quantitative study and delve deeper into the utilization of neighborhood networks in everyday rural life by analyzing 40 qualitative interviews and applying qualitative content analysis (Mayring, 2000).

3. Methods and Data

In the study Digitales Dorfleben (Digital Village Life) conducted at Münster University of Applied Sciences, we examined what role the digitalization of communication and digital neighborhood networks has played in everyday life in four rural communities in Germany. We applied a mixed-methods design, combining both a quantitative study (N = 413 respondents) and a total of 40 in-depth interviews conducted with local inhabitants and social stakeholders in these communities.

The four communities were Metelen and Wettringen, both located in the Federal State of North Rhine-Westphalia, and Schapen and Schandelah, located in the Federal State of Lower Saxony. The quantitative study was only conducted in Metelen and Schapen, while qualitative interviews were carried out in all four respective communities. Due to the Covid-19 situation as well as social distancing guidelines, the interviews were carried out using video software. The quantitative data were compiled via email surveys in Metelen and Schapen. Interviewees for the qualitative study included local social stakeholders, for example, club chairpersons or long-time residents. We then developed interview guidelines that would help answer our research questions. They mainly included questions involving the utilization of digital neighborhood networks, and the impact of these networks on community life and social connectedness. The interviews were digitally recorded, transcribed, and anonymized. We then used MAXQDA 2020 to conduct the qualitative content analysis (Mayring, 2000). To better illustrate our findings, we have presented quotations from our interviews (Chenail, 1995). We believe the inclusion of qualitative interviews to be vital to get a deeper understanding of the underlying social dynamics of digital neighborly connectedness as a part of a *digital* social infrastructure. In addition, in-depth interviews are much better than quantitative survey data for taking into account the purposes and social practices of utilizing digital social infrastructure. All of our fieldwork was conducted during the Covid-19 pandemic. The interviews originally were conducted in German; however, we have presented the quotations in English. The translations were verified by all authors. To ensure anonymity, no additional information on the participants is given.

4. Results

4.1. Descriptive Quantitative Findings

The first step is to present descriptive findings, which give an overview of the use of digital neighborhood networks and its effects in two of our cases, Metelen and Schapen. Figure 1 shows the proportion of people who are in digital contact with their neighbors in these two communities. For both cases, around two-thirds of the population were in digital contact with their neighbors. We also asked what platform or other digital services they used to communicate with their neighbors. By far the most common services were the messenger service WhatsApp (Metelen, n = 121; Schapen, n = 118), followed by Facebook groups (Metelen, n = 29; Schapen, n = 21); less common were digital neighborhood platforms specifically designed for contacts among neighbors (Metelen, n = 6; Schapen, n = 11). We believe the abundant utilization of messenger services is due to the fact that digital communication among neighbors in rural areas has different, rather organizational functions compared to urban areas (see Section 4.2); such functions are easier and generally more accessible with messenger services.

To shed light on the impact of digital neighborhood networks, we asked about various effects of their use (Figures 2 and 3). Again, the patterns of answers were quite similar in both cases. The descriptive findings indicate that the utilization of digital neighborhood platforms did not lead to new contacts in the neighborhood. As illustrated in more detail by the qualitative analysis (Section 4.2), we believe that one possible reason for this is that usually people need to be in personal contact before being in digital contact. We also think digital networks mainly function as an extension and easier way of neighborly social connectedness. Moreover, being in digital contact did not lead to a change in perceptions of the respondents' neighbors. Some differences between our cases concern the impression that people undertook more activities with their neighbors since they began to be in digital contact. That was the case in Metelen, but not in Schapen. Digital communication among neighbors had no clear impact on personal recognition within the neighborhood but led to a slight improvement in the perception of the overall social climate within the neighborhood.

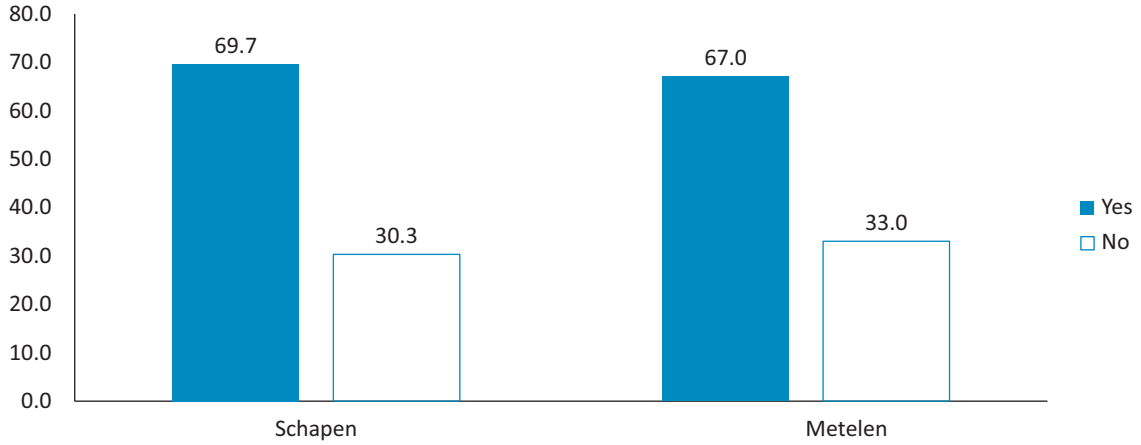

Figure 1. Are you in digital contact with your neighbors?

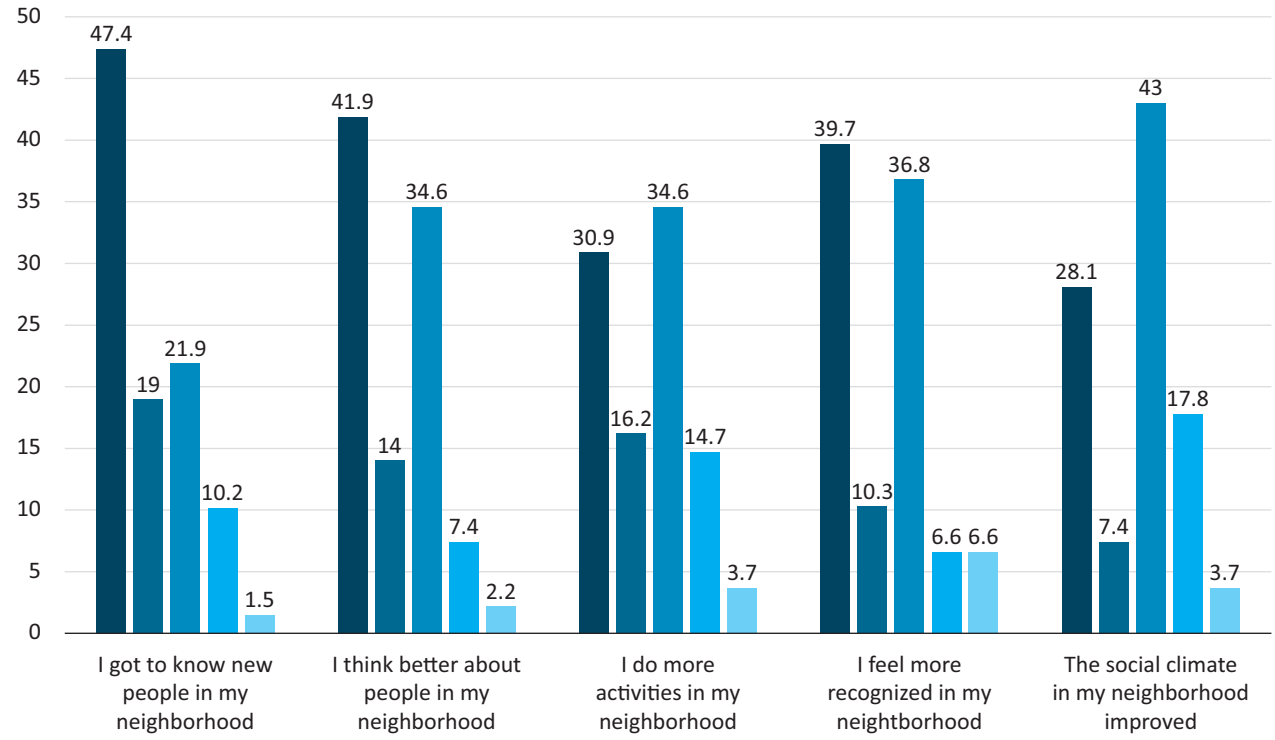

Figure 2. Metelen: By being in digital contact with my neighbors…. Note: Five-point Likert scale—I strongly disagree, I disagree, neither/nor, I agree, and I strongly agree.

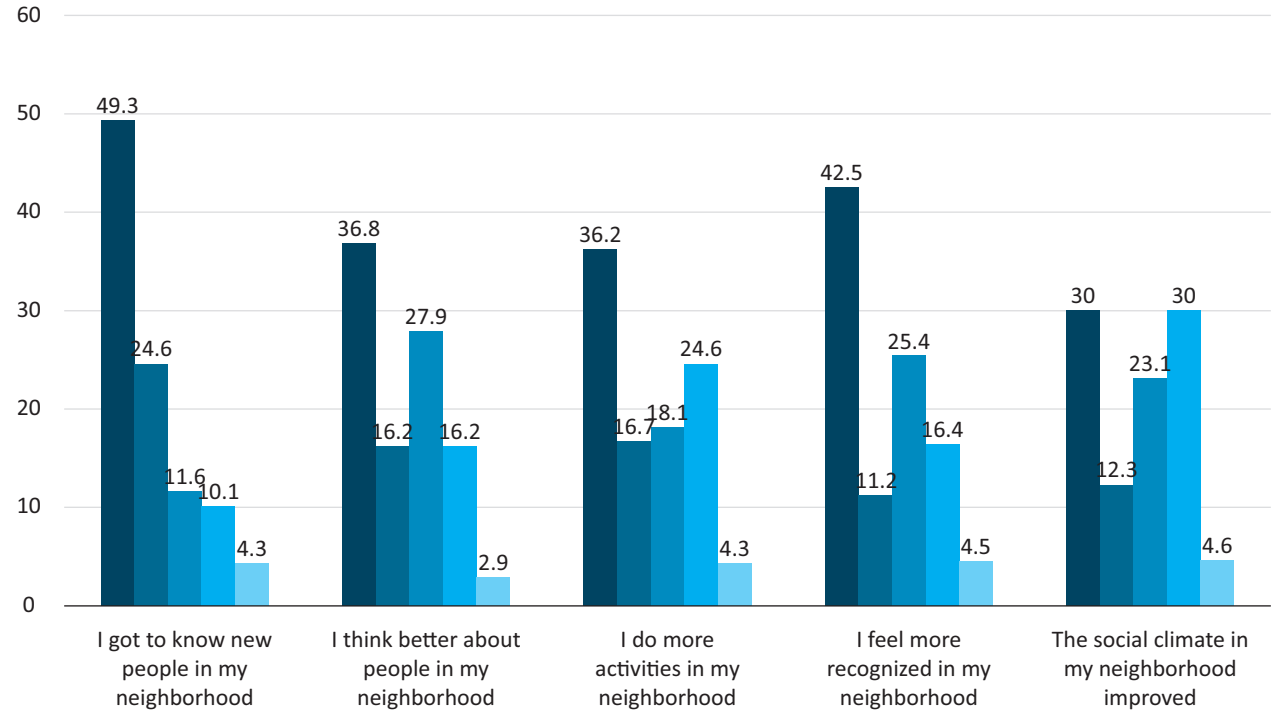

Figure 3. Schapen: By being in digital contact with my neighbors…. Note: Five-point Likert scale—I strongly disagree, I disagree, neither/nor, I agree, and I strongly agree.

The brief descriptive analysis highlights the fact that digital communication among neighbors is common in both our case studies, and there is no reason to suppose that this is somehow unusual for rural areas generally. However, it seems that digital communication mirrors the existing physical neighborly social connectedness of real life. In our data, the impact of digital neighborly connectedness seems more general in nature. While the descriptive findings show that, generally speaking, digital neighborly connectedness is rather common, they fail to sufficiently show how and for what purposes digital neighborhood networks are utilized.

4.2. Qualitative Analysis

4.2.1. The Covid-19 Pandemic as a Driver of Digital Neighborly Connectedness

The foundation of digital social infrastructure is still physical infrastructure. While some rural areas in Germany indeed suffer from a lack of digital infrastructure, particularly a lack of broadband access and fewer users (Williger & Wojtech, 2018), in our data, we found a generally high rate of digital connectedness as illustrated by the descriptive findings above (about two-thirds). This notion was also reflected in the qualitative interviews conducted in the villages under study. Mostly, interviewees reported being digitally connected to their neighbors. Moreover, they generally assessed the physical infrastructure in a positive way, as the following excerpt demonstrates:

> First of all, we are pretty much more or less well-connected here. Thanks to Covid, even a little bit better. Broadband access usually worked well. So, we were pretty quickly taken care of, which is not the case in the region as a whole. Surprisingly. And do we use digital media a lot? Yeah, we do. (Schapen 3)

Schapen 3's allusion above about the role Covid played in facilitating digital social infrastructure and digital social connectedness, in particular, is consistent with other studies (e.g., Nguyen et al., 2020). In our interviews, we also found that the Covid-19 pandemic facilitated the increased utilization of digital tools of communication in the areas studied. Due to Covid-19 restrictions and social distancing rules in Germany, most physical contact had to be reduced, with digital networks emerging as an alternative way of staying connected. This idea also came up and was reflected in our interviews, with some interviewees stating that digital networks were used to remain in contact with neighbors and friends when physical social contact could not be maintained:

> I mean, of course, because of Covid, this really increased, right? Because you just didn't meet too many people. With all the chats and Zoom….So I believe it really, really increased during the Covid pandemic. (Metelen 7)

However, while most interviewees stressed the importance of physical social contact, they also emphasized that especially during Covid-19, digital contact became more important to stay in touch with friends and neighbors. The following quote from Schandelah is characteristic of the idea that seniors in particular—often associated with less internet use, leading to the term "gray divide" (see Friemel, 2016)—enjoyed being digitally connected during pandemic times. At the same time, our interviewee acknowledged that Covid-19 generally could be understood as a driver of digital connectedness:

> If it had not been for Covid, I would not say these [digital] networks mattered, because normally you meet in person. But because of Covid, especially older people, most times it is the women who were still alive, one told me: "Oh, I am so happy when every night my cell phone flashes." You know, because this way they can be contacted from the outside. Such being the case, the importance [of digital networks] really increased. (Schandelah 1)

The aspect alluded to by Schandelah 1 reflects the positive outcomes of social connectedness: Referring especially to "older people," our interviewee gave an example of how an older senior neighbor felt connected to their neighborhood and the "outside" in general, and then ended his quote by stating that digital networks had become more important. The interrelation of social connectedness—in this case in a digital sense—and health, specifically for seniors, has been vastly studied (see, e.g., Haslam et al., 2015).

4.2.2. Extended and Easier Communication Through Digital Networks

As the descriptive findings highlighted, the most utilized digital network provider in the four areas studied was the instant messaging service WhatsApp. In the interviews with local inhabitants, we found that various groups with different purposes were established on this platform in particular. Some of these groups, mainly neighborhood groups, have been used for faster and simpler conversations, as well as rather brief conversations and information exchange that is particularly relevant to all those neighbors in close proximity. As the quote below illustrates, however, this faster and easier form of communication does not mean that personal physical contact is no longer valued:

> Many things are easier. Communicating even faster and more uncomplicated. But this does not mean personal contact would not be appreciated, you know? But it [digital communication] just made it easier, when you just quickly communicate trivial things like "cat ran away" or something like that. (Wettringen 6)

Related to the aspect of faster and easier communication via neighborhood networks is the increased frequency of social exchange. While most interviewees, again, recognized the importance of personal interaction, they also highlighted the overall increase in social exchange due to the utilization of digital neighborhood networks:

> Yes, it is positive that one communicates more. What's negative, though, is the fact that you do not have this personal, daily contact, but, instead, through digital media, you are in contact more quickly. Of course, personal exchange is still there but the little things…are digital. You are way more connected, especially in darker times of the year, when everyone drives off in the morning and comes back in the evening. You do not see each other then, in winter, and then with digital media, be it sharing soccer results or something funny, you are way more connected. Because grabbing the phone or just going over to your neighbor, calling when it is dark in the evening, is too much of a hurdle. (Wettringen 8)

It seems noteworthy that Wettringen 8 especially talked about the "little things" being exchanged digitally, meaning, while social exchange in his view overall increases due to digital networks, the content of social exchange seems to be rather mundane (or even "trivial," as one respondent put it) in nature. We believe this indicates that digital tools are used for different forms of communication: While the "little things" are discussed digitally, in higher frequency, the importance of personal contact comes up in nearly all the responses discussing the upsides of both digital and personal exchange. Discussing "little things," however, is part of social interaction and exchange. The following quote offers another example of the mundane nature of the content discussed digitally:

> Q: And with digitalization, do you recognize anything changing in the neighborhood?
> A: So, through digital media, you talk about things that you maybe would not have talked about earlier because then you would have had to meet in person or drive somewhere. But then, you sometimes discuss things where you would otherwise say: "Oh, that is not so important, driving somewhere for that. I would not do that." You know? (Wettringen 10)

Wettringen 10's quote illustrates that the content of social exchange in local digital neighborhood groups is "not so important," meaning that some of it is mundane or even trivial in nature. However, our interviewee also stated that being digitally connected to one's neighborhood increased the frequency of social interaction and simplified general accessibility, as one does not have "to meet in person or drive somewhere" to engage in social exchange. Whether this should be understood as a trade-off—meaning higher frequency of social exchange on the one hand, but its content being more trivial on the other—is a question of its own. We believe, however, that "trivial" social exchange between neighbors is not limited to the digital sphere, but on the contrary, is also empirically observable in analogous neighborly exchange.

4.2.3. Specific Neighborhood Groups

Apart from the more general neighborhood groups discussed above, we discovered groups in our interviews that were more focused on specific areas of communal life. Such is the case for organizing events, local clubs, and organizations focused on maintaining village life in general. However, this digitalization of village organization was described as being a rather recent development, again with Covid-19 serving as a facilitator, as the following quote indicates:

> Exactly. You know there are different groups. Every club, institution has a WhatsApp group, and you always know someone who is in some of these groups. So, five years ago it was not common that you used these groups or any [digital] neighborhood services and so on. It really increased in the last two years, also because of Covid, that you use these platforms. (Schandelah 8)

One vivid example of these more specific digital groups discussed in the interviews included the local female volunteer fire brigade in one of our research sites, Schandelah. In most areas of Germany, these institutions serve as important social spaces as well as actors in their respective communities and are widely regarded as part of the overall social landscape (Wenzel et al., 2016). As described in this interview from Schandelah, the local female fire brigade is organized via a digital group:

> They [the local female volunteer fire brigade] are organized in a WhatsApp group and this actually works wonderfully. Recently, the fire brigade could not meet in person because of Covid, so it is not passed on. So, the women organized everything themselves at short notice. (Schandelah 2)

In addition to specific groups on providers such as WhatsApp, in one of our research sites, Metelen, residents used a digital application specially designed to develop, maintain, and organize a community garden project in the village. It serves as both a platform to coordinate work and maintenance as well as a swap meet for gardening tools, as this quote illustrates further:

> This garden app. I do not know if you have heard…about this community garden. I am part of the committee. There is a special garden app, one that functions as a platform coordinating work and a swap meet or other activities, or just right now the building phase is not finished. The progress of all the building measures is shared in the app. (Metelen 2)

Both the examples of the local volunteer fire brigade and the garden app indicate the importance of volunteer work and its social role in the sites under study. Digital networks have played an integral role in organizing this valuable community work, which also has an administrative and community-building dimension, as the following example illustrates. Most local political and administrative representatives in the sites under study only receive a small payment for this (part-time) work. These institutions also organized their members digitally within specific groups on various platforms:

> Well, we do not have a digital group of all clubs in the village, but the village council has one, the local political parties, the gymnastics club. These are all WhatsApp groups….Or I sometimes say, "Alright, let's do JitsiMeet! I have an unresolved question that someone has to answer, or I am unsure of something, and I want to discuss with you, with the village council or whatever." You know? I can't decide on issues on my own and then it became quite funny because some people really were inexperienced with video conference stuff. I wrote down how it all worked for everybody and then it worked after all, and everyone was delighted. Like "Whoa, hello, I can see you all" [laughs]. (Schandelah 1)

4.2.4. The Limits of Organizing Village Life Through Digital Networks

While, as mentioned above, most interviewees stressed the benefits and integral importance of digital networks and groups for village life, oftentimes interviewees added that digital networks were unable to replace physical social connectedness. This notion was reflected in the descriptive findings (see Section 4.1), which in turn, was more deeply expanded upon in the qualitative interviews. The role digital networks play in organizing community life are manifold; however, as the quote below illustrates, these networks especially serve an organizing as well as a complementary role in village life:

> Whether it is an invitation, or if club committees need to engage. These things are way easier. One also can decide on certain issues via WhatsApp regarding club life or neighborhood life, and that is why a combination of these [digital] things and personal human contact is going to be important. That you are properly organized, not just by this digital force. But digitally, yeah, the cell phone certainly is essential for community life. (Wettringen 9)

Wettringen 9's quote rather nicely illustrates how digital neighborhood networks functioned in organizing community village life in the sites under study: Often, they rather serve as a preliminary basis for physical social interaction, while at the same time serving as a social space themselves. However, as noted in the quote above, digital interaction in the eyes of the interviewee could not and must not replace physical interaction completely, pointing out a distinct limit to digital social infrastructure. Another example highlighting this "preliminary" and rather organizational character that digital networks adopt in village life is discussed in the quote below by a member of a local sports club:

> Also carpooling, so who drives to the games? Who can support carpooling by taking someone with them or picking them up or bringing them back? And that is very handy because you are able to reach so many people, finding a fast solution….For sure, WhatsApp is omnipresent. If you have such digital groups to organize things, that is a fine thing. (Schandelah 9)

Besides physical digital infrastructure in the form of, for example, broadband access, a degree of digital competence is also required to utilize digital neighborhood networks as a social resource. This requirement limits access to this form of digital social infrastructure to some extent. This issue is often referred to as the "gray divide" (Quan-Haase et al., 2018), referring to age differences in usage and skill levels of digital media. Due to the challenging demographic situation in most rural regions in Germany, including in our sites under study, this also is reflected in the organizing role of digital networks, as illustrated by the quote below.

> Especially now in this time [Covid-19], digitalization helps keep contact with people, if, then, they are able to handle it. But you try to have a table of regulars at the pub, only digitally. Maybe some people will join, but I do not think that they will be welcomed the same as one who joined six or seven times in person. (Metelen 5)

Metelen 5 thus picked up on another aspect that further limits digital networks in their role as digital social infrastructure, stating clearly that digital space is not fully able to replace physical exchange. This finding of this distinct limit of digital networks is in line with other research that also specifically looked at the role of a village app as a surrogate for a village pub (Sept, 2020).

5. Conclusions

5.1. Discussion

Analyzing the social aspects of infrastructure has proven very useful in understanding how places and spaces are used by people. The prevailing definition, however, has regarded all those places and spaces as publicly accessible, urban, and physical in nature (Latham & Layton, 2019). With the current work, we have attempted to localize social infrastructure beyond this "physical" definition and have presented an extended and empirically enriched conceptualization, which we call *digital* social

infrastructure. Our analysis of four rural research sites in Germany has shown that the utilization of digital social infrastructure—facilitated by the Covid-19 pandemic—has served various roles, but most importantly these are *social* benefits. When confronted with the three characteristics of spaces regarded as social infrastructure as urban, publicly accessible, and physical in nature, we can only conclude that the definition must be modified; we clearly discovered evidence for a digital social infrastructure in our rural research sites. The descriptive findings in Metelen and Schapen illustrate a rather high general digital connectedness among local inhabitants. When only considering the descriptive findings, though, the immediate impacts of digital social connectedness among local inhabitants seem rather limited, which we believe is due to the fact that (common in rural areas) analog connectedness is highly prevalent among local inhabitants. Thus, we conclude that physical social connectedness serves as a basis for digital social connectedness. However, by taking a detailed look at how digital neighborhood networks are utilized in qualitative interviews, the picture becomes much clearer. Digital social connectedness among neighbors and community members serves as a social resource. Mainly organized in general neighborhood groups or through networks with a more specific purpose, digital connectedness contributes to extended and easier methods of communication and social exchange. Some research has suggested that social exchange through digital communication among neighbors and community members potentially leads to perceptions of more livable communities among residents (Kurtenbach et al., 2021); this corroborates the positive outcomes of utilizing digital social infrastructure. However, our results also suggest that one downside to the higher frequency of social exchange through digital ways of communication is that its content is often rather mundane or even trivial in nature. Still, we believe it is part of the everyday neighborly exchange that is not limited to the digital realm but also is observable in in-person everyday communication among neighbors. In addition, digital social connectedness is highly helpful in organizing neighborhood and community life in a general sense. As analyzed in the empirical section (Section 4), this form of digital social infrastructure nevertheless mainly has a complementary purpose as a communication and organizational tool of local social life, usually having a "preliminary" character to subsequent physical contact. Moreover, digital social infrastructure and digital networks, in particular, are unable to replace physical contact completely, as our interviewees stressed on several occasions (see Section 4). This was especially true for physical infrastructure with a purely social purpose, such as a table of regulars in a pub (see also Sept, 2020), for which personal attendance is required.

Social infrastructure mainly facilitates "people being out amongst other people." Moreover, it is made up of "spaces that facilitate social connection" (Latham & Layton, 2019, p. 9). Based on our analyses, we argue that both these main characteristics of social infrastructure, however, are not exclusive to physical spaces and places—nor are they exclusively urban phenomena. On the contrary, they can be digital in nature and easily found in rural areas. Thus, we believe we have discovered that social infrastructure is not limited to urban and physical areas but should be conceptualized as a digital as well as a rural social phenomenon as well.

5.2. Limitations

As true for all empirical studies, our current contribution is not without limitations. First, it is important to state that due to the case-study approach of our research design, we do not claim representativeness, and stress the limited generalizability of our findings. More research, both qualitative and quantitative, is needed to further our understanding of digital social infrastructure and its uses. However, we argue that this work contributes to this understanding, even though it might merely scratch the surface. Second, as stated in the empirical part of the current article, our fieldwork was conducted during the Covid-19 pandemic, which profoundly influenced experiences, actions, and perceptions throughout society, and consequently the responses of our interviewees. Third, due to our communication-based perspective on social connectedness and the term "social" more generally, we are unable to examine other potentially important aspects of digital social infrastructure. As these potential aspects are also related to future research, they will be discussed further below (see also Section 5.3). Fourth, as stated in the empirical part, in analyzing the interviews, it became clear that some content discussed in digital neighborhood groups seems mundane or even trivial in nature; this is a salient aspect. We believe this is not to be exclusive to digital communication, however. Just as in-person neighborly communication does, its digital counterpart also includes trivial and non-trivial content. In addition, while we believe the content discussed to be interesting units of analysis, we are even more interested in the *mode* of social connectedness, this being digital in nature. This aspect is interrelated to the fifth and final limitation we wish to note: Digital connectedness is not able to fully replace physical, in-person contact. One cannot utilize social infrastructure that requires mutual presence digitally, be it exercising together on a public sports ground, or going swimming at the local pool. Some facets of social infrastructure are undeniably analog and require mutual presence. The upside of digital social infrastructure, however, is easy accessibility, and it more easily incorporates people unable to do activities in person. Research suggests that while digital social connectedness is distinct from personal social connectedness (see Grieve et al., 2013), there seem to be nuances in the ways of digital communication when it comes to social connectedness: Voice or video communication is able to transport

a higher social presence than text messaging and social media (Nguyen et al., 2022).

5.3. Further Research

It would be fruitful for further research, both quantitative and qualitative, to examine rural areas more thoroughly with respect to (not only) the digital facet of social infrastructure to help enhance our understanding of where and how exactly social infrastructure can be localized. In addition, further research on (digital) social infrastructure should more systematically take into account the positive potential of digital connectedness—and not only during a worldwide pandemic. A wide range of potential benefits come to mind, both in a broader sense and on a community or neighborhood level. One benefit could be increased, more easily accessible communication between, for example, health professionals and individuals in need of care. Related to this, the benefits of (digital) social connectedness—in terms of both physical health (i.e., consultation with physicians) and inclusion (i.e., communication for its own sake)—for community members in general and especially for seniors (see Haslam et al., 2015), as some of our interviewees noted (see Section 4.2), potentially help strengthen the local social climate of a given community. This seems especially valuable for rural communities, as they are severely affected by demographic change; not only are rural areas themselves "graying," but they also need to find ways to better include these seniors in everyday community life. Another avenue of further research might focus on innovative ways of educational practices and exchange between educators and students, both in a general sense and in individual communities. All of these aspects serve as prime examples of the increased utilization of digital social infrastructure that has arisen not only during the Covid-19 pandemic, and of how the potential of digital social infrastructure can still develop.

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Conflict of Interests

The authors declare no conflict of interests.

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