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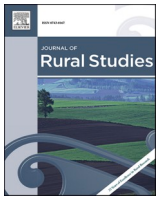

Everyday technology's interplay in the lives of people with dementia: A multiple case study in the rural North of England

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ABSTRACT

Everyday life in rural places can be hampered by many different infrastructural challenges for which technology is often considered a panacea. However, little is known about technological interactions among people living rurally with dementia, who more often live alone and make up a larger proportion of the rural population in England compared to urban. Assemblage theory in a multiple case study approach used field notes and data from a mix of instruments administered in a semi-structured interview in people's own homes. Within and cross-case analysis illuminated the rural context of the interplay between everyday technologies and everyday life situations among ten people living with dementia in a rural part of northern England. Findings highlighted participants' reactions and responses to interactions that involved Information Communication Technologies (ICT), driving and parking technologies, shopping, banking, and payment technologies. Other rural actors were involved in these interactions; staff and customers, neighbours, family members, infrastructures, policies and local service providers. Case's reactions and responses were seen to involve processes of technologising and manualising to stabilise their everyday lives and mitigate destabilising threats. The implications of this paper highlight a need to: 1) Improve access to, and support people to decide upon and use rurally befitting ICT infrastructures. 2) Create easy-to-use, sustainable and resilient banking processes in rural places that promote a sense of community. 3) Simplify access to services by considering parking and technological demands and procuring the most inclusive solutions. Meeting these needs could support rural communities to become and remain dementia-friendly in the face of continuous technological change.

1. Introduction

A gap expected to be maintained over coming decades is that the rurally dwelling population comprised of older adults aged 55+ in England is higher (estimated 39.4 % in mid-2018) compared to the population dwelling in urban areas (27.8 %) (DEFRA, 2018; Office of National Statistics, 2020). This means that an increasing proportion of people with dementia live in rural areas of the UK as incidences of dementia occur with older age, which is rapidly increasing in the numbers of cases worldwide (Prince et al., 2015). Two-thirds of people with dementia in England currently live at home, alone or with others, and are in receipt of varying levels of support (Department of Health, 2013). Dementia presents with complex problems with cognitive functioning that vary widely from person to person and go beyond memory impairments to also affect decision-making, mood, communication and more (Livingston et al., 2020). People with dementia themselves report that these difficulties can lead to changes and losses in many areas of everyday life. For example, social activities and relationships (Biggs et al., 2019), the range of places participated in outside home (Thalén et al., 2022) managing personal administration and attending appointments (Samsi and Manthorpe, 2013), driving and travelling (Liddle et al., 2016), and using everyday technology (Hedman et al., 2013).

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Understanding and mitigating the impact of dementia in rural areas is therefore a priority, particularly in combination with the unique geographical challenges of low population density. These challenges typically demand increased travel distances to health services and reliance on private transport with limited, or no, public transport options (DEFRA, 2019). Thus, issues of isolation are more tangible if a person becomes increasingly reliant on health services or supportive family networks (Stockdale and MacLeod, 2013), as is likely to occur with dementia. Additionally, the Cognitive Function and Ageing Study with 2424 people showed that the probability of relocating increased among older adults over the age of 65 who live in rural areas and increased further still if that area was also deprived (Wu et al., 2015). One of the key forces that impel rural relocation among older adults is the threat of future driving cessation which combined with a lack of alternative transport can lead to isolation and loneliness (Fischl et al., 2020; Hansen et al., 2020; Neville et al., 2018). The necessity of driving also means that appropriate access to parking can influence community engagement, including shopping activities, among older adults even those living in a well-serviced rural town (Neville et al., 2018). Information and communication technologies (ICTs), especially those that are smart and internet connected, are often proffered as solutions to overcome issues of rural isolation and reduce travel demands, particularly in relation to health and care services (Bosworth et al., 2020; Salemink et al., 2017; Zerrer & Sept, 2020, Nelson et al., 2023). However, disparities with respect to the rural-urban digital divide are projected to increase as the pace of improvements in speed and connectivity remain more rapid in the UK's cities compared to rural areas (Gerli and Whalley, 2021; Philip et al., 2017).

The use of everyday technology (ET) is increasingly important for peoples' participation in society, including in rural contexts, so that everyday life is being both simplified and complexified as a consequence of the development, diffusion and uptake of ET (Lindqvist et al., 2018). For example, paying for parking services and goods, and managing utilities and health care appointments (ticket vending machines, ATMs, and chip and PIN devices, automated telephone/internet- or app-based services). Despite the rural-urban digital lag, the smart countryside is emerging as a contextually specific counterpoint allied to smart cities, with ground up, localized digital initiatives. For example; connecting older people to local help via a smartphone app, providing internet courses, and solving rural travel issues via digital information platforms that integrate mobility options (Bosworth et al., 2020; Zerrer & Sept, 2020). Due to cognitive impairment, people with dementia typically encounter increased challenges when using ET, which may pose a risk that they become excluded from the smart countryside, aspects of public life, and services in society (Kottorp et al., 2016). Particularly since rurality has been shown to influence lower internet use among older adults in Sweden together with lower cognition, higher age, lower education and living alone (Berner et al., 2014). Since most research into older adults' use of ET has taken place in urban contexts, or without a focus particularly on the rural context, little is known about the technological everyday lives of rurally dwelling older adults with dementia.

Living well at home with dementia is contingent upon completing complex activities of daily living. Such activities increasingly involve the use of ETs both in and outside home for shopping, banking, attending appointments, self-managing health and welfare needs and so on. ET is defined as the range of technological objects and services that commonly exist in the multiple environments in which people live their everyday lives (Hedman et al., 2013). The multiple environments focused upon within research involving people with dementia have recently attended to the benefits and challenges of life in a rural landscape and the barriers to social inclusion (Hicks et al., 2019). Additionally, the technological environment outside home has been shown to be both hindering and helpful to people with cognitive impairments (Brittain et al., 2010; Lindqvist et al., 2018). Technology also provides the means to undertake activities within the home, accessing society, and health, social, and other community services through the internet, phone and smart devices, that would previously have required a person leave home. During the COVID-19 pandemic, these opportunities presented by ET were seized upon by range of sectors from the hospitality industry to home care (Ivan et al., 2023). While this paper does not focus on ETs used only for welfare purposes, health and social care provision has been rapidly technologized during this period without recourse to the rural context (Nelson et al., 2023). This disproportionately threatens people with dementia's contact with rural health and social services as the conditions of the pandemic have presented digital enforcement as the only alternative to exclusion (Seifert et al., 2021).

With respect to activities, the boundary between home and society, service and self-service has, and continues to become blurred by technology. Furthermore, the boundaries of technologies themselves become blurred as technologies are integrated into ever more areas of daily life for an increasing array of purposes. This means it is important to focus on how people with dementia utilize everyday technology for remaining active in society, whether they do that from home, or from public space. Most studies on ET have taken place outside the UK and have not looked specifically at technology's interplay with daily life in rural places. However, everyday life is profoundly shaped by context, and differences in ET use at home and in society have been highlighted between even similarly high income country groups; Japan, Sweden, Portugal, the US and England (Malinowsky et al., 2018; Patomella et al., 2018; Wallcook et al., 2020a). So, beyond the abilities of people with dementia to use technology, the context for the use of the technologies is important to consider. Logistic regression analyses involving 128 older adults with and without dementia, 30 of whom lived in a rural area of England, found that rural or urban context did not appear to moderate the association between amounts of relevant out of home technologies and the amount of places people go to (Wallcook et al., 2020b). However, rather than conclude that rurality does not influence everyday life, the authors urged deeper consideration of how people's everyday life is shaped and disrupted by technology in rural places. Such knowledge could better contribute to understanding about how to optimise technological interactions and mitigate technological disruptions in rural everyday life. This study will explore how rurality shapes technological interactions providing a new perspective that illuminates socially practical knowledge about how technology use interplays with everyday life in rural places among individuals living with dementia.

2. Aim

Consequently, this study aims to highlight the interplay between ET and everyday life situations among people living with dementia in a rural part of the North of England.

3. Materials and methods

3.1. Study design and theoretical perspective

A multiple case study design has been used in which each rurally dwelling participant with dementia forms an individual case (Yin, 2003). Each person's interactions with technologies and other components (places, proximities, other people, activities, behaviour, policies, services) form the unit of analysis. Case study designs are suited to analysing both qualitative and quantitative data gathered during data collection (Yin, 2003).

A social realist perspective recognizes the multiplicity and complexity of everyday life situations, and assemblage theory is used to support a practical view of everyday life situations as an assemblage of interrelating component parts. Parts which include, but are not limited to, ETs, housing, travel and communication infrastructures, activities, shops and so on (DeLanda, 2006). In assemblage theory, it is the capacities of the interactions between the parts that are in focus: so *how* these components interplay to shape everyday life situations as a product of their relations with one another. Focussing on this interplay

yields a view of processes that can both stabilise and destabilise everyday life situations among rurally dwelling people with dementia.

3.2. Setting

In the rural parts of the northern English county where the research was conducted, the average population density was 13 people per squared kilometre in 2017. Over 98 % of the county's population identified as white and over 50 % of the population lived in rural villages and hamlets rather than in the small number of isolated urban centres (Office of National Statistics, 2021). Geographically, parts of the county are coastal with industrial heritage, where industry - although still central to the employment market - has declined and inland parts are hilly with lakes and a strong agricultural identity. Much of the housing dates from these (pre-)industrial periods and the construction methods have precluded the possibility of high insulating standards which combined with lower income has pushed almost 11 % of households into fuel poverty. There is high internal heterogeneity within rural parts of the county with pockets of entrenched socio-economic deprivation juxtaposing a natural beauty which attracts tourists and holiday-homeowners. This natural beauty is diverse and has been shaped by the climate and the elements, most famously the rain; as an average year may contain 220 days of precipitation, which varies greatly from one valley and hilltop to the next (Met Office, 2021). Tourism has brought much needed economic diversity but has introduced a social transience that has disturbed the familiarity and routines of formerly close-knit rural communities and introduced an insecure and low wage to most workers. Rural access to public transport is limited, and a greater proportion of the population rely on driving private transport compared to the national average (Office of National Statistics, 2021). Journey times to reach essential services are also on average higher, regardless of the mode of transport (Office of National Statistics, 2021). Communications infrastructure is improving in this county, however the internet speeds particularly in sparse areas still often fail to reach the minimum standard and mobile coverage remains patchy (OFCOM, 2021).

This county's residents are older than the English national average, and the population is rapidly ageing with the proportion of residents over 65 projected to steadily increase to 37.5 % of the county's population by 2028 (Office of National Statistics, 2021). With age being a key risk factor for developing dementia, this means that the incidences of dementia diagnosis are similarly set to increase. Currently 26 % of households in the rural parts are older, although with considerable intra-area variation (from 12 to 47 %) and over half of those households are people living alone (Office of National Statistics, 2021).

Rural everyday life in this county is highly diverse and while for many the annual calendar is rich in variously networked and unnetworked agricultural activities, for others this is an alien culture. Other people are highly connected to the environment and nature in non-agricultural ways while different others barely interact with the natural beauty for which their county is famed. Some people prefer their anonymity and privacy and others greatly value and rely upon neighbourhood spirit and community activities. At one and the same stroke, there is no such thing as a rural everyday life, and yet simultaneously, there is. Viewed as an assemblage, everyday rural life at this county level is heterogenous and deterritorialised, its boundaries merging with a bigger assemblage of everyday life, one both recognisable and shared by people and communities beyond designations of rural and the borders of the county. Within the county level assemblage, innumerate inner assemblages come into view – farming, retirement, temporary and permanent communities, households, and individuals – variously territorialised, segregated and melding into one another.

3.3. Participants

Recruitment took place in 2017 with the support of local National Health Service memory clinics and the local Alzheimer Association. The first author met with representatives of the organisations to discuss the requirements of the project and gain access to local team members who had existing professional relationships with prospective participants. Those local team members shared information about the research and gained consent for the researcher to contact prospective participants directly.

Cases formed a sub-sample within a larger sample of participants recruited for statistical research (beyond this study). These participants had been required to meet the following criteria; that they were 1) aged 55+, 2) with a confirmed diagnosis of mild stage dementia (American Psychiatric Association, 2000), or major neurocognitive disorder in the mild stage (American Psychiatric Association, 2013) given by a doctor, 3) with no sensory or communication impairment that is not compensable by appropriate aids, 4) able to participate in English, 5) live in ordinary housing (i.e. not a care home). Previous studies have revealed there can be a selection bias towards ET-users who have a lot of the latest modern technologies, or who have stories to tell about how technologies have been modified to suit their needs. Consequently, access negotiators were encouraged to seek maximum variation in the breadth of participants approached to enhance the range of views (Palinkas et al., 2015). For the purposes of this study, cases were selected on the basis that they lived in a rurally defined part of the UK (Bibby and Brindley, 2013), were experienced in the phenomena of interest, i.e. they shared a willingness to express their views on the topic, and considered the topic of everyday technology and life both in and outside home important to discuss (Palinkas et al., 2015).

3.4. Ethics

Participants were recruited based on having capacity to independently consent to participating and a presumption of capacity was made by the researcher that each participant had the right to make their own decision and to consent to the research unless proved otherwise (Mental Capacity Act, 2005). In the light of participants' increased vulnerability due to their cognitive impairment, they were given information in multiple formats and had repeated occasions to consider and ask questions about the research before agreeing to take part (Nygård, 2006; Thorogood et al., 2018). Initial written consent was obtained and thereafter verbal consent was taken at each subsequent interview occasion along with ongoing assessment of capacity. Participants were informed and reminded of their right to withdraw from the study at any time without penalty. At each meeting the researcher reintroduced herself and reminded participants of the purpose for the interview and of how the data was to be used. Participants were given the option to have another person with them for support in the interview, although not for proxy reporting. Ethical approval was granted by the Health Research Authority: Southwest – Frenchay Research Ethics Committee (IRAS project ID: 215654, REC reference: 17/SW/0091) and the Stockholm regional ethics board (2017/4:3).

3.5. Data Collection

Individual interviews were based upon firstly, the Everyday Technology Use Questionnaire (ETUQ) (Nygård et al., 2016), and secondly, the Activities and Places Outside Home questionnaire (ACT-OUT) (Margot-Cattin et al., 2019) (further details below). According to individual preference, the interviews were staged between one and three occasions within two weeks, each lasting a maximum of 90 min. In addition to closed questions, these structured tools elicit open-ended comments, which together can positively impact the quality of the dialogue and made the interview highly focused on the topic at hand (Malterud et al., 2015). In total, there were 22 appointments with 10 participants, which totalled 23.5 h in the field. Interviews took place in the participants' own homes, where familiar objects were used as prompts, as this has been shown to provide richer data when interviewing people with dementia (Nygård, 2006). As participants often had

a lot to share about their situated perceptions of technological interactions (e.g. using a chip and PIN device to get cash in the post office or supermarket), the interviewing researcher encouraged the participant to continue in depth. To facilitate expression and enhance clarity of meaning, participants were invited to explain or show (gesturing to or using ETs) these situations in greater detail (Kwasnicka et al., 2015). Additionally, the participants annotated physical maps of the places they discussed in the interview together with the researcher. To minimise disruption, the researcher took only brief notes that aimed to capture a verbatim account during the interview. Upon leaving the interview location, these brief notes were immediately followed up with comprehensive, detailed notes and memos about the exchanges and scenarios that took place and the sequence, whether observational or conversational (McKillop and Wilkinson, 2004). This procedure demanded complete engagement from the researcher in the interview, yielded highly relevant field notes and was consistent with classic qualitative approaches such as grounded theory (Glaser, 1998, 2001; Holton and Walsh, 2017). The researcher had prior experience of interviewing, had received interview training, and was supervised by more experienced qualitative researchers (particularly author LN). Afterwards, the researcher gathered further secondary data relevant to each participant's interview and their physical map to supplement the information they had provided and gain a broader picture of their rural context, their community, and available amenities. This data was gleaned from district and county council, village, National Health Service, transport services, bank and post office, charity and OFCOM (Office of Communications) websites and local press. Examples of relevant secondary data include community, health, communications (i.e. television, mobile and internet) and financial (i.e. post office, bank) service availability and transport (bus, ferry, train) timetables. The use of structured tools was therefore complemented by these additional and more open data gathering procedures, which enhanced the information power that the data contributes (Malterud et al., 2015).

3.6. Interview tools

The ETUQ enquires about respondents' use of 90+ ETs in 7 categories (shown proportionally with respect to one another in Fig. 1) with options for the respondent to include additional ETs in each category (Nygård et al., 2016). The ETUQ is administered by a trained interviewer, in this case, an occupational therapy researcher (author one), who firstly identified with each person whether the technology was relevant, i.e. the person has access to that technology, *and* the person uses it now, has used it in the past, or intends to use it in the future. Secondly, based on the person's descriptions of their use of each relevant technology, the researcher rated the person's ability to use each relevant technology on a 5-step scale from; *the technology is used with no hesitation or difficulties*, through to *the technology is no longer used, or has not yet come into use*. Brief notes can be recorded in the comments against each technology listed in the ETUQ. The questionnaire closes with space to record open replies to questions about technologies that are particularly important to the respondent or that the respondent is interested to use in future. We refer to the complete inventory of items in the ETUQ as mapping a respondent's "technology room" (i.e. the ETs that are perceived as personally relevant) in relation to the "technological landscape" (i.e. the ETs that circulate widely in people's homes and in society and are commonly agreed to be socially relevant (Hagberg, 2008)). Fig. 1 seeks to depict the relationship between these two analytic concepts and how the ETUQ acts as a mapping tool. Within Fig. 1, the lines are blurred to convey the assemblage nature of these two concepts, and how their boundaries are permeable, changing and de-/stabilised by one another. Moreover, the ETUQ's lines are dotted to convey its flexibility for the respondent to add to their technology room and updated regularly as the technological landscape evolves.

The ACT-OUT is a multi-disciplinary tool developed in expert review by occupational therapists, geographers, geriatricians, social workers, Alzheimer charity representatives. The properties of the tool, which enquires about 24 places in 4 categories of places (*purchasing, administration and self-care* i.e. supermarket, bank/post office; *medical care* i.e. dentist, daycare*, social, spiritual and cultural* i.e. friend or family member's house, cemetery; *recreation and physical activity* i.e. garden, lakes/mountains/seaside), are currently under investigation. The tool can be used to ascertain which places are applicable to the respondent; i.e. the respondent goes to each place in the present, the past, or the future, with an option to include another additional place of importance (Margot-Cattin et al., 2019). Within each of the four categories, the participant

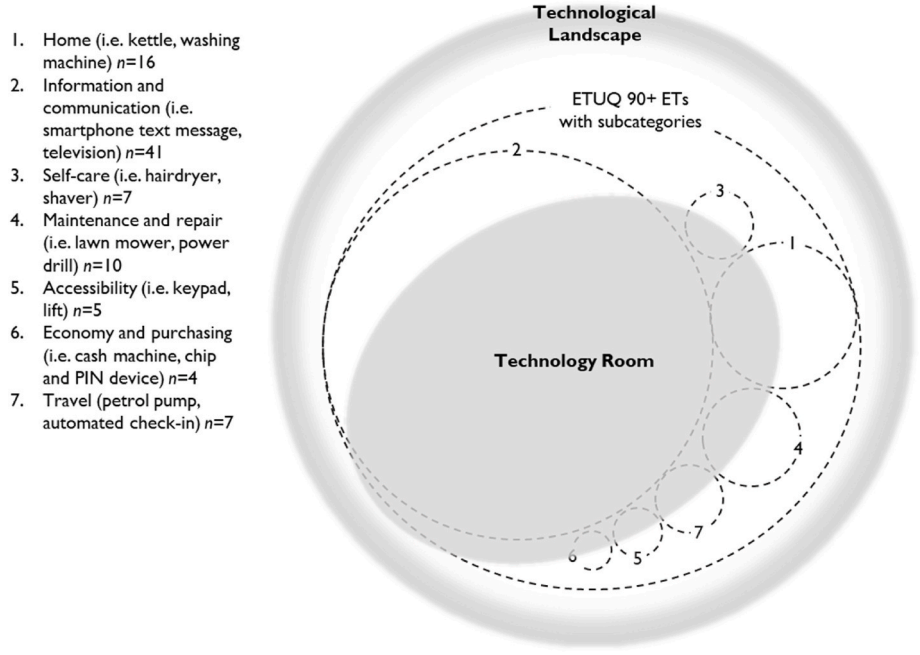

Fig. 1. Depicting the ETUQ inventory of items in relation to the assemblage of a socially relevant everyday technological landscape and the assemblage of a personally relevant technology room.

selects a place which is stable (i.e. the participant goes there now, did in the past and will in the future), and a place where a change occurred (i.e. the participant goes there now, and did in the past, but does not think they will go in future) to provide further detailed information about a maximum of eight places. This information is given in response to a mixture of closed and open-ended questions regarding the situation relating to their going to that place – the purpose for going, the activity, frequency and time of going, who goes, how they get there, how long it takes and so on.

3.7. Analysis

Detailed, anonymised case reports attending to all primary data, relevant secondary data, fieldnotes and memos were compiled for each case by the first author (Stake, 2006; Yin, 2003). These compilations also included quantitative in-text summaries of each case's technology room and pattern of places over time, also visualized using different charts (treemap, line and area charts) produced in SPSS 26 and Microsoft Excel. The adequacy of the data presented in the case reports as evidencable by the database of raw data was evaluated by co-authors LN and CM who subsequently interrogated and critiqued each stage of the analytic process (Yin, 2003). A group of people with dementia (a local Focus on Dementia Network group) consulted on extracts of the case reports that had been formulated to facilitate interpretive analytical discussion. This discussion led to further memos and new theoretical links that were included in the case reports.

The analytic strategy unfolded from initial coding explorations of each report facilitated by NVivo12. The density of these initial codes, once compiled and categorised, provided useful cross-case insights regarding the shared and unique properties of these components (Stake, 2006). Returning to a 'within case' analysis approach, a set of detailed accounts of technological interactions (with accompanying codes) were drawn from each case report yielding a total of 26 interactions (Stake, 2006). The utility of these compiled interactions was preliminarily evaluated with respect to the research question (Stake, 2006; Yin, 2003). This reflective step impelled further revision and refinement of the research question in order to pay closest attention to how cases were responding to the consequences of the interactions (Agee, 2009). This refinement better illuminated the rurally contextualised reasoning around technological interactions and the processes emergent to affect the stability of each case's everyday life. Turning to a 'cross case' approach, each technological interaction was given a memorable summary label (i.e. 'shopping gauntlet') and mapped for its utility with respect to the research questions courtesy of the collated codes (i.e. "impossible" to go alone, playing the "silly old man", choosing contactless and online) (Stake, 2006). This mapping forged connections across the 26 interactions, as the basis of the cross-case analysis to highlight five themes (i.e. options to acquire cash) which were interrogated by a group of fellow researchers in a seminar. In a cross-cutting theme matrix, the commonality and variation both in the composition of technological interactions (i.e. ATM, chip and PIN device, bank, post office or shop, parking, walking) and reactions and responses (increasing security, attuning to preferences and abilities) were highlighted (Stake, 2006). These reactions and responses were iteratively refined, returning to the original case reports and evaluating their 'within case' utility to illustrate the 'cross-case' themes (Stake, 2006). This step verified that the cross-case analysis remained grounded within the original case reports, which further highlighted the particularisation of processes as being unique to one individual's everyday life, or having the potential for analytic generalisation (Stake, 2006; Yin, 2003). As aspects of the themes overlapped, they were merged which ultimately produced two chapters, or sections.

4. Findings

The ten cases are introduced in Table 1 to briefly provide an insight into their everyday life context and highlight aspects that participants and wider analysis related to the context highlighted as relevant to the technological interactions (i.e. age, living alone, in a remote location, public transport availability). From an assemblage perspective, these

Table 1
Characteristics of each case.

Case study* (§)	Age	Impairments, health conditions, aids, MoCA score~	Years of education & work	Housing	RUC11 rural code^/ IMD decile# services/ environment	Living situation - alone or cohabiting	Driving car	Public transport available
Alf (M)	Mid 80s	Impaired mobility, hearing aids, glasses, 14	9, merchant navy crew	Council tenancy, terrace	F2/1/1	Alone	Yes	No
Tom (M)	Early 80s	Reduced mobility, glasses, 18	10, farm labourer	Private tenancy, semi-detached	F2/1/1	Cohabiting	No	No
John (M)	Early 70s	Impaired mobility, vascular condition, hearing aids, glasses, 16	10, pensions manager	Privately owned, staggered link.	D1/9/4	Cohabiting	No	Yes
Doris (W)	Late 70s	Impaired mobility, hearing aids, glasses, 16	10, housewife	Privately owned ground floor flat.	D1/10/5	Cohabiting	Yes	Yes
Mary (W)	Early 80s	Reduced mobility, anxiety, 15	11, children's nurse	Privately owned semi-detached	D1/5/8	Alone	No	Restricted
Michael (M)	Mid 70s	None, 21	13, insurance manager	Privately owned semi-detached	E1/1/2	Alone	Yes	Restricted
Gladys (W)	Mid 70s	Glasses, 15	11, care home manager	Privately owned detached	E2/3/3	Alone	Yes	No
Bill (M)	Late 60s	None, 19	11, postal worker	Privately owned detached	E1/1/5	Cohabiting	No	Yes
Elsie (W)	Mid 80s	Impaired mobility, vascular condition, 12	15, midwife	Privately owned detached bungalow	F2/3/3	Alone	No	No
Peter (M)	Early 70s	Anxiety, hearing aids, glasses, 20	10, gardener	Privately owned detached	D2/8/6	Cohabiting	Yes	Restricted

~ Montreal Cognitive Assessment, maximum score 30, scores adjusted where education <12 years to give maximum of 31, completed on one interview occasion only.
[a]Pseudonym, § Gender was self-identified by participants as M = Man or W=Woman.
[b]Rural constitutes population <10,000: D1 = Rural town fringe, D2 = Rural town fringe sparse, E1 = Rural village, E2 = Rural village sparse, F1=Rural hamlet isolated dwelling, F2=Rural hamlet isolated dwelling sparse.
[c]1 = most deprived, and 10 = least deprived 10 per cent of neighbourhoods nationally. The barriers to *services* decile includes housing, road distance to post office, primary school, general store/supermarket, GP. The living *environment* decile includes housing in poor condition, without central heating.

aspects are components of everyday life situations whose capacities shaped, or had the potential to shape, the technological interactions. On their own, the components are not important to consider, but only if they come to form part of an interaction where the emergent process de-/stabilises everyday life.

The description of the cases and illumination of their place- and technology-based contexts continues in the mappings in Table 2 and Fig. 2. Again, this can be viewed as mapping components whose properties may or may not provide reasons for the processes de-/stabilising everyday life. Table 2 shows the composition of each participant's technology room (refer back to Fig. 1 for a visualisation of this concept). That is, the amount of technologies in different categories that each case considered relevant in their everyday lives, juxtaposed with the subtotal of technologies from their room they actually used. Fig. 2 shows the overall pattern of places which each case frequented over time highlighting stability and destability in those patterns between past, present and future.

The findings are illustrated in-depth by two main cases, Alf and Michael, followed by complementary and counterpointing illustrations from cross-case analysis with the remaining eight cases.

5. Alf

Alf lived alone in the middle of a short terrace of small, thick stone-walled, rented farm-worker's cottages located in sparsely inhabited hillside. His location presented barriers of restricted access and long distances to services with a dearth of public transport, which combined with looming driving cessation threatened the stability of his pattern of places (anticipated to starkly descend from the current 11, to only 3, refer to Fig. 1). Restricted access to telecommunications services and environmental deprivation (poor insulation, open fire, unmanageable and unavoidable maintenance) hampered his technology room keeping it small and low tech (refer to Table 2). These conditions were, in part, a product of housing policy and service decisions i.e. not upgrading to central heating and keeping adjacent properties untenanted.

The interplay of these conditions compounded Alf's sense of growing social isolation, and threatened the tenability of his living situation. His vision of participation was becoming more restricted and homebound and with no help locally on hand, he had no contacts for a pendant alarm. This, in turn, increased his reliance on ICTs (particularly his landline phone and television), where his service connection was unreliable and problematic despite receiving service provider and charitable assistance. Alf saw these problems as beyond his control and irresolvable, disrupting his connection outside his home and creating security concerns.

Partly in response to the problems with the landline, a family member suggested to Alf that a computer could be used to better maintain contact. Alf was motivated by wanting to cause as little trouble to loved ones as possible and to show recognition of, and reciprocate, the care and attention shown to him. Consequently, Alf was considering accepting this computer suggestion, despite having no desire for one and no vision of himself being able to use one. He described being concerned that he may fail in fulfilling the ambitions of using such an expensive device, which led to more concern that failure may have negative ramifications in the relationship. Additionally, OFCOM data showed the broadband speeds available in his area were likely insufficient to achieve his family member's aspirations of video contact. This important prerequisite for success may not have been a consideration for Alf's city-dwelling family member, and in the future, it had the potential to cause additional confusion and complication as they sought to resolve connection issues remotely. Alf's description illuminates how more modern ICT acquisition for him was socially and emotionally driven with reciprocity at its core, since receiving this offer was also attended by Alf sacrificing his own comfort and becoming burdened by concerns.

Ultimately, Alf's daily challenges with ICTs and their associated services and infrastructure were located among other interactions that led him to discover himself as progressively less capable of sustaining his daily life in this sparse rural place. Also considering his desire to not burden others, over the course of our three appointments, he reached a decision to relocate to a retirement complex in the same well-serviced rural town as his girlfriend.

5.1. Cross-case analysis with Alf

Gladys and Elsie's everyday life shared aspects with Alf's (i.e. living alone and in sparse rural locations, see Table 1), although the consequent technological interplay was quite different. In contrast to Alf, Gladys and Elsie openly involved significant others and accepted support in their technological interactions (having contacts for a pendant alarm, calling for advice before using an automated service, accepting car rides). This meant that any burden in the situation was willingly shared, seemingly without qualms, to produce a stabilising effect on their everyday lives. This effect may have been in part motivated by both women's background in caring for others, where Mary expressly described her readiness for others to take their turn in looking after her.

Mary's assemblage shared with Alf malfunctioning ICTs, including the landline (refer to Table 2). For example; Mary described that problems with her landline were of no concern she could simply open her door to shout or ask for help from a neighbour on her street. Additionally, her mobile was carried for others to use on her behalf, and difficulties with technology created legitimacy to a social occasion by adding value and purpose to a long journey from a significant other. Finally, although Mary could not turn on her digital picture frame, the device remained relevant and reassuring since it prompted her to think of

Table 2
The composition of each case's technology room, which highlights each room's relative scale in relation to the technological landscape inventoried according to the categories of the ETUQ.

Case Study	Technology Room compositions (Relevant total/Used subtotal)								
	Home ($n = 16$)	Information and communication (ICT)* ($n = 41$)		Self-care ($n = 7$)	Repair ($n = 10$)	Access ($n = 5$)	Economy ($n = 4$)	Travel ($n = 7$)	Overall Total ($n = 90$)
Alf	11/10	7/3	-	1/0	5/3	0	1/1	1/1	26/18
Tom	7/1	6/2	M/-	2/2	5/3	1/1	2/1	2/1	25/11
John	8/7	29/16	M/T C	3/2	4/3	2/2	3/1	4/1	53/32
Doris	11/7	11/5	-/M	3/3	2/2	3/2	3/1	1/1	34/21
Mary	13/10	12/7	-/M	4/1	1/1	0	4/2	2/0	36/21
Michael	12/11	17/8	-/M C	1/1	6/3	1/1	3/3	2/2	42/29
Gladys	15/9	15/5	M C/-	0	5/3	2/1	2/1	4/1	43/20
Bill	8/7	18/13	-/M C	4/3	7/6	4/4	4/1	7/7	52/41
Elsie	11/8	7/3	–	1/0	4/1	0	1/1	1/0	25/13
Peter	5/4	15/7	M/C	2/1	10/9	3/3	0	3/3	38/27

*M = mobile phone (push button), T = tablet/touchscreen, C = computer (relevant not used/relevant used).

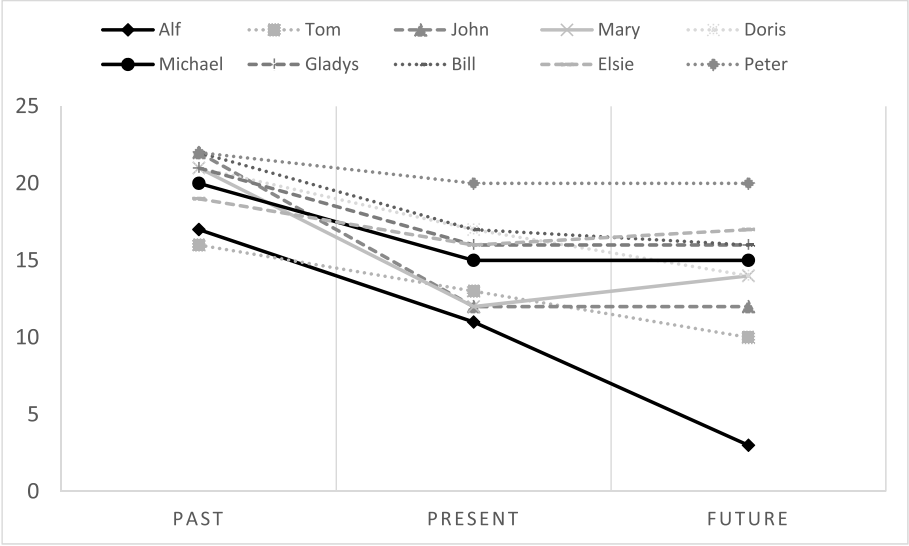

Fig. 2. The pattern (i.e the de-/stability) of the amount of places applicable to each case over time according to the ACT-OUT.

family and the photos they wanted her to see, so that she felt their care and attention. So unlike Alf, Mary did not regard malfunctioning ICTs as a threat. Instead, the problems posed opportunities for social interaction (actual or latent) which enhanced her sense of security alone at home and her connection to family at a distance and community close by.

For other cases, the involvement of a significant and cohabiting other could facilitate technological interactions to prevent any destabilising effects. For example, by providing direct help using ICTs (cases John, Tom), being the delegate who uses cash and payment technologies outside home (John, Tom, Peter, Bill), meeting the need for support in shops and public places (John, Tom, Bill) or by directly overcoming challenges attendant with not driving (John, Bill). For John, receiving support in his ICTuse afforded him the opportunity to avoid the intimacy of rural daily life, of people recognising him and seeing his embarrassment, when he wanted to go about his business unnoticed. Formerly, such encounters when shopping and banking had been part of an interaction that produced hazards and instability in John's everyday life (i.e. by provoking fear that paralysed him and curtailed his activity). Whereas the online possibilities afforded by his technology room had stabilised these situations. Refer to Table 2 and Fig. 2 which show John's use of a relatively large number of ICTs compared to a low number of public space ETs and a drop of ten places from the total he frequented in the past compared to present/future.

5.2. Michael

Michael was the only case living alone who participated in online activities (see Table 2), particularly shopping, which he had added as a complement to driving to the closest supermarket almost every day from his home 10 km away. His technological interactions were seen to contribute to a more varied everyday life and increased both the opportunities and threats within it. A third-party, surveillance parking technology surrounding the supermarket introduced instability to his shopping habits, even though his future pattern of places was perceived to be stable (see Fig. 1). This technology prompted Michael to abandon his shopping trips before they were completed as he was concerned about the consequences of overstaying in the carpark. The lack of tangible feedback and personal control that this parking system offered Michael exposed his cognitive disabilities in a way that gave him reason to adapt his activities and routines. Consequently, he described frequenting the supermarket more often to finish the unfinished shopping as a counter-process to stabilise his everyday life.

Additionally, Michael's case illuminated that, by contrast, interactions with technologies that facilitated individual control and security obtained through visual feedback produced a stabilising process. He described a preference for seeing the amount on screen (i.e. litres of fuel, goods, bank balance) and elected to pay at the fuel pump, use the self-checkout and the cash machine rather than hand over that control in a face-to-face service (refer to Table 2). This visual preference provides reasons for Michael both to drive further distances to reach those technological options and to technologise these activities within his home (i.e. shopping and banking) with the effect of optimally stabilising his everyday life.

Michael's partner lived some 2-h drive away and had initiated the use of matching push-button mobile phones as a means of offering remote support and access to information (i.e. a stored PIN number) both in and outside home. Michael, however, reasoned differently around the device and generally regarded most functions redundant. He became tearful when his own perspective was disconfirmed by noticing that his partner intended for him to do more with the phone that he was doing. Introducing this new technology to their close relationship had introduced a conflict that disrupted Michael's sense of individual control with the destabilising consequence of feeling a failure to live up to expectations. Such a consequence contrasted with the stabilising effect that the mobile phone was intended and anticipated to have on their shared and individual everyday lives at a distance. The stabilising influence of confirmation from others was also seen in Michael's description of interactions using public technologies. Here, he regarded his technology use was confirmed by perceiving or observing that other people used it the same way as him. For example, Michael would wait to use a specific cash machine rather than use the adjacent, unused machine which he considered more challenging. Although Michael perceived that his attained standard of use was questionable, he could evaluate his performance against others and be assured that the interaction achieved social acceptability.

5.2.1. Cross-case analysis with Michael

Gladys shared Michael's feeling of being confirmed in evaluating her own technological interactions against others'. She described returning to the post office counter to retrieve her payment card and finding that several other people had also forgotten to take their cards with them.

As earlier mentioned, Gladys' everyday life assemblage shared components and properties with Alf's. Whereas Alf's amenities had always been beyond walking distance, Gladys could still reach local services on foot despite a future threat due to her declining ability to walk (refer to Fig. 2). She described how components in the assemblage had

been removed (post office and bank branches had both closed) and replaced (post office service relocated in a local convenience store, banking service offered via visiting bank van), which altered, but did not necessarily destabilise how she obtained cash. Gladys instead organised her schedule around, and queued to use the bank van, for a manualised face-to-face service that involved no technology as her first preference. Her second preference was to use her card and PIN to obtain cashback at the post office counter and although Gladys had the option to use a cash machine, she described using this less and less. Service changes had the potential to destabilise the boundaries of Gladys's rural everyday life, however, by exercising her preference for face-to-face services and manualising her acquisition of cash, her interactions emerged in a counter-stabilising process.

A manualising preference was shared by other cases which motivated the use of card and PIN *only* to obtain cash (Doris) and reduction in use of pay at the pump or self-checkouts (Doris). Additionally, Elsie highlighted how manualisation (queuing in the supermarket to get cash using card and PIN) was motivated by a face-to-face interaction that mitigated risk and provided greater control and support in a vulnerable situation (i.e. personnel could act as trusted, responsible party and prompt). Other cases expressly mentioned using their card and PIN by writing their PIN down on their hand (Doris), carrying cash in the event of not remembering it (Alf), or making contactless (i.e. PIN not required) payments (Bill). Cases' processes of obtaining cash in their rural contexts illuminated instability where they deployed varied and similar strategies to stabilise this aspect of everyday life.

6. Discussion, study considerations and implications

Despite often ableist assumptions about people with dementia's technology acquisition and use, and what they can achieve with that use (Holthe et al., 2020), our findings highlight that people with dementia can and do use existing and new technologies successfully. However, our findings also illuminate complexity around how technological interactions potentially and actually stabilise and destabilise participants' everyday lives. Emphasis on the interactions' consequences challenge oversimplified conclusions that technology helps, and instead focuses on the interplay with other components. The consequences of these interactions are in some instances highly unique and in others are shared so that it becomes possible to appreciate the potential for these consequences to reoccur more widely in society. A broader picture of the impact comes into focus through the analysis of secondary data which highlights community-based challenges which may be shared by other community members. This supports analytic generalisation and reasoning around action and decisions that can be taken regarding technological interactions in the lives of rurally dwelling older people with dementia. Instead of anticipating a particular causal effect, an array of outcomes should be expected consequent to altering the interaction with technology. Data was collected prior to the COVID-19 pandemic, where the pandemic may have impacted technological interactions due to restrictions in out of home participation. Furthermore, participants were selected because of, and to highlight, the consequence of technology to their everyday lives so that the significance of technology should not be over-generalised.

In their descriptions of their own actions and decisions, participants showed how they sought to stabilise their own everyday lives. Given that their everyday life included other individuals – family, friends, neighbours, fellow customers, staff, proprietors, service personnel, public service workers, policy makers – people in general can become more aware of how interactions involving technology can give rise to instability. Using assemblage theory, this discussion will lead beyond an individual focus to illuminate the multiple levels of scale that interact with technology use and impact everyday life. While the possibility of contrary outcomes should be considered, taking action could potentially stabilise and make rural everyday life more inclusive for people living with dementia. Such inclusion may be described as contributing to a dementia-friendly community, where people participate in life as usual, have continued access and feel valued and safe (Shannon et al., 2019).

6.1. Telecommunications infrastructures

Similar to other studies (Hwang et al., 2020; Jakobsson et al., 2019), this case study highlighted that significant others were directly involved with, and enabled participants' continued use of ICT devices (i.e. managing telecommunications service provision, or taking responsibility for the service). However, participants also showed that significant others can fail to appreciate that introducing ICT to everyday life may produce instability in relationships and new, ongoing support needs. For example, technological support for setting up, teaching, software, updating, passwords (Hwang et al., 2020). ICT interactions are contingent upon appropriate infrastructure for internet and mobile connection and service, and the ability to manage such services (Damodaran et al., 2018; Hwang et al., 2020). In this regard, participants pointed to infrastructural inadequacies. However, purchasing contextually suitable services is made a more complex task by the variable standards of service intra-rurally, particularly within sparse areas (Philip et al., 2017). Alongside governments making good on commitments to advance rural telecommunications infrastructures (Esteban-Navarro et al., 2020), providers of ICT services could take stabilising action. Such action would include improving individuals' access to rurally specific, comprehensive, and reliable information. Information could be offered as community-based support that takes account of each individual situation and appraise service providers' suitability, and potential to enhance connection and ameliorate rural isolation. Stability in everyday life may then emerge through more realistic expectations about service quality, maintenance, and use among rural customers with dementia and their significant others.

There are ramifications for all other services (i.e. social, health, financial, transport services) that base aspects of rural provision upon prerequisite interactions with ICTs and telecommunications providers. Planners and designers of these services should be prepared to mitigate for problems, conflict, and potential failure in the service relationship with rurally dwelling people.

6.1.1. Banking and cash

The disproportional impact of ATM and bank branch closures to older, less well-off and rurally-dwelling individuals has been noted, and it has been argued that cashlessness could even undermine the viability of rural communities (Access to Cash Review, 2019; Langford et al., 2020). This case study confirmed findings from other studies involving older people with and without known cognitive impairments and local services' staff (Wallcook et al., 2020a; Zappella 2019, Shannon et al., 2019). Together, these studies show how bank and post office branch inaccessibility and closures, difficulties in ATM use, and lack of face-to-face, patient, and supportive customer services produced problems with acquiring cash that hindered multiple areas of everyday life. Decision-makers; those people redistributing the branches and facilities and procuring the technologies should make these decisions with a greater awareness of how they interact in, disrupt and challenge rural everyday life.

Participants highlighted the measures they take to stabilise cash acquisition, implicating local supermarket/shop staff as supervisors to their financial service interactions as they obtained cashback with payment card and PIN. Additionally, some described how they regarded selecting face-to-face services over the automated check-out as contributing to the stability of a fragile rural economy. Taking this manualised choice may therefore produce socially connective interactions that are part of co-constituting and reproducing a stable sense of neighbourhood and familiarity (Clark et al., 2020).

Becoming aware of this service dimension could motivate rural retailers and personnel to take further inclusive action towards people with dementia. Such actions could include exercising their legal

obligations in the UK to accept accessible payment and cashback options. However, based on their experience supported by quotations published from a survey of 350 disabled people, the Business Disability Forum asserted that staff in retail premises were not always aware of accessible options with exclusionary consequences (Gor and Aspinall, 2015). Participants appeared similarly unaware, since none described accessing e.g. chip and signature cards and rubber stamps via their bank which may better suit the abilities of people who describe issues with PIN numbers. Perhaps actions by rural retailers could extend to raising awareness of accessible payment forms among their customers and thereby society more broadly. Putting in place legal provisions that obligate accessible forms of payment and access to cash for people with disabilities including dementia may be needed within other countries.

6.1.2. Travelling and parking

Easy parking has logically been raised alongside driving, however, so far scant attention has been paid to customers with dementia as direct users of carparks. Instead, proprietors, landowners and carparking service providers have, at best, focussed more physical aspects of parking i.e. sufficient availability of spaces, manoeuvrability, proximity to the place (Innes et al., 2016; Neville et al., 2018; Parke et al., 2017).

Participants highlighted that parking difficulties and interactions with related technologies impacted everyday life, including essential activities such as shopping and health care. Those living sparsely and without support described the practical, emotional, economic and environmental consequences, as participants needed to repeat curtailed activities or avoid nearer-by carparks, shops, and services. Parking technologies have heterogeneous features with respect to payment systems (card, cash, mobile phone), inputting requirements (end time, numberplate), output (display ticket or none), and enforcement mechanisms (surveillance cameras, barriers, patrol). These varying features place different cognitive demands with respect to memory, attention, planning and orientation. Furthermore, they require users to understand complex instructions, rules for use and consequences for failure to comply. From 2019 in the UK, people with more severe dementia could qualify for disability parking permits on the grounds of severe psychological distress, being at risk of harm, or experiencing difficulty or inability to walk (Bayer, 2020). However, these grounds are geared towards supporting carers and are inadequately inclusive of participants' concerns and difficulties with using parking technologies and staying within time limits.

There can be assumptions that a person with dementia who experiences parking-related issues must also be unfit to drive (Byszewski et al., 2013). However, such conflations can be inaccurate due to variation in dementia presentation and progression, combined with a lifetime familiarity with driving but unfamiliarity with new parking technologies. Reasonably, proprietors, landowners and carparking service providers could simplify parking and associated technological demands, leading to more inclusive everyday life for people with dementia. This is especially important considering the often long distances to retailers and services and unavailability of alternative transportation options that are typical of rural places (Rapoport et al., 2020; Sanford et al., 2018) and the non-cognitive scope of the disability parking permit.

7. Conclusions

Changes in the technological environment are altering the assemblage of everyday life in rural communities and the ways in which these communities can holistically support and provide for one another. This continuing transformation is particularly meaningful for people with dementia, who as a more vulnerable group stand to experience negative and exclusionary impacts to their participation. The technological interactions highlighted by the rurally dwelling cases of this study have created possibilities for community and societal adjustments to improve the stability and inclusivity of rural everyday life. Ultimately, this paper suggests the following dementia-, or simply human-friendly actions: 1) Improving access to, and supporting people to decide upon and use rurally befitting ICT infrastructures and provision. 2) Creating easy-to-use, sustainable and resilient banking processes in rural places that promote a sense of community. 3) Simplifying access to amenities and services by considering parking and technological demands and procuring the most inclusive solutions.

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CRediT authorship contribution statement

Sarah Wallcook: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. **Camilla Malinowsky:** Conceptualization, Formal analysis, Project administration, Writing – review & editing. **Georgina Charlesworth:** Formal analysis, Writing – review & editing. **Charlotta Ryd:** Formal analysis, Writing – review & editing. **Louise Nygård:** Conceptualization, Formal analysis, Funding acquisition, Writing – review & editing.

Declaration of competing interest

The authors have no interests to declare.

Data availability

The data that has been used is confidential.

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