

TECHNOLOGICALLY MEDIATED SOCIOMATERIAL ARRANGEMENTS SHAPING EVERYDAY AGEING

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Abstract: *This study explores how agency in later life is enacted within everyday sociomaterial arrangements. Drawing on Actor-Network Theory (ANT) and the International Classification of Functioning, Disability and Health (ICF), the analysis is based on open-ended survey responses from older adults and healthcare professionals. The findings suggest that people, objects, spaces, and temporal rhythms collectively shape the conditions under which agency becomes enabled or constrained in daily life. Rather than framing challenges as individual deficits, the study highlights how agency emerges through the alignment, or misalignment, of diverse human and non-human elements. Agency is found to be fragile, dynamic, and context-dependent, shaped by bodily rhythms, spatial accessibility, technological mediation, and temporal coordination. Suggestions from professionals are interpreted as proposed interventions into these everyday sociomaterial arrangements. By integrating ANT and ICF, the study offers a relational understanding of functioning that challenges individualistic models and contributes to critical ageing research by showing how agency in later life can be examined as a situated and sociomaterial achievement.*

Keywords: *Actor-Network Theory, technology, ageing, agency, everyday life, sociomateriality.*



INTRODUCTION

Across societies, population ageing is profoundly reshaping daily life activities and personal care arrangements (Gangopadhyay, 2025). Especially in both developed and developing countries, the number of older adults who continue to reside in their own homes is increasing in relation to those who move to institutional settings, which has spurred a growing body of social and scientific research on ageing at home. These studies span a wide range of themes, from the older adults' capacity to manage their daily life at home, to their experience of loneliness, and the need to developing of assistive technologies designed to support independent living (Latikka et al., 2021; Turjamaa, Pehkonen, & Kangasniemi, 2019).

The causes of ageing-related decline and disease in older adults are highly individualized, reflecting substantial variation in physical, psychological, social, and cognitive functioning across individuals (Nguyen et al., 2021). In otherwise healthy individuals, functional capacity typically declines progressively with advancing age (Jenkins et al., 2022). Functional ability is internationally conceptualized and assessed through the International Classification of Functioning, Disability and Health (ICF), which offers a comprehensive biopsychosocial framework for understanding functioning (World Health Organization, 2001). Rather than focusing on medical diagnoses or impairments, the ICF emphasizes the dynamic interaction between an individual's health conditions, personal factors, and contextual elements. This approach allows for a more holistic understanding by recognizing that functioning is not merely a reflection of bodily limitations, but also of the accessibility of environments, availability of support, and the presence of enabling or disabling societal structures.

In the context of ageing, the ICF framework is particularly valuable for identifying how barriers and facilitators in the physical, social, and technological environment influence an older person's ability to perform daily activities and participate in meaningful life roles. It shifts the focus from what individuals cannot do to what they can do, if given the right conditions and supports (World Health Organization, 2001). Thus, when assessing older adults' ability to live independently, it is crucial to consider not only their individual functional capacity but also the availability and quality of support systems, such as assistive technologies and social networks, which play a vital role in sustaining autonomy and enhancing quality of life.

Much of the existing research on ageing tends to focus on individual resources, capabilities, and functional abilities (Katz, 2018; Marshall & Katz, 2016). This body of work often draws on biomedical or psychological models that frame ageing primarily as a personal challenge to be managed through individual resilience or adaptive behaviours. The literature on older adults and technology use is still primarily informed by psychological and technological disciplines, with limited engagement from sociological perspectives that could offer deeper insights into relational and structural dimensions of these interactions (Neves & Mead, 2021). Less attention has been paid to how agency in later life is constituted through relational and networked interactions embedded in everyday sociomaterial practices (Neven, 2010; Peine & Neven, 2021; Ertner, 2022). At the same time, as technological systems play an increasingly central role in ageing and care practices, there is a growing need to examine how these systems actively reshape expectations, practices, and conceptions of ageing itself. This calls for more theoretically and methodologically robust approaches, especially given

that previous studies in this field have often lacked analytical depth and reflexivity (Peine & Neven, 2020). These emerging perspectives suggest that ageing should not be understood solely as a process experienced by the individual, but rather as a dynamic and collective enactment shaped by technologies, spaces, material infrastructures, and social rhythms.

Recent analyses of public discourse have further highlighted how older adult's agency is often diminished or overlooked in societal narratives. Reframing ageing in ways that acknowledge older people's capacity to act, influence, and participate actively in society is essential for recognising how political, institutional, and cultural structures shape possibilities for later-life agency (Neves & Mead, 2021). In response to this need, an emerging body of interdisciplinary research has begun to integrate sociological theories into studies of ageing and technology, foregrounding the mutual shaping of ageing processes and technological development. This research orientation, conceptualized as socio-gerontechnology (Peine & Neven 2021), emphasizes the co-constitution of ageing and technology within sociomaterial assemblages and marks a broader shift toward more relational, reflexive, and critically informed understandings of ageing.

This study responds to recent calls within social gerontology to attend to the sociomaterial conditions under which ageing is lived, governed, and experienced in late modern societies. It builds on perspectives that understand ageing not merely as a biomedical process, but as a socially situated and materially enacted condition. This is particularly relevant in countries where ageing in place is heavily promoted yet deeply entangled with digital infrastructures, care practices, and shifting welfare arrangements. (Gilleard & Higgs, 2010.)

At the same time, questions of agency in later life are deeply embedded in broader societal arrangements. Social policies, digital inclusion agendas, and care infrastructures all shape the possibilities for older adults to act, decide, and participate in society. Thus, agency is not merely personal or interpersonal – it is also political and institutional, tied to how ageing is governed, resourced and culturally valued (Gilleard & Higgs, 2010; Kuoppamäki, Hänninen, & Taipale 2022).

Recent theoretical developments in ageing and technology studies have increasingly challenged individualistic and deficit-based models of later life, proposing instead more relational, situated, and materially grounded perspectives. Material gerontology, for example, highlights the co-constitution of ageing and materiality, drawing attention to how everyday technologies, environments, and bodily experiences shape what it means to age (Neven, 2010; Joyce & Mamo, 2006; Manchester & Jarke, 2022). Socio-gerontechnology and Science and Technology Studies (STS) further emphasize the interdependent and often invisible relations between people, practices, and infrastructures (Peine & Neven, 2020; Ertner, 2022). Together, these perspectives call for a more nuanced understanding of agency – one that accounts for the material and relational contexts in which ageing unfolds.

Empirical studies have also demonstrated the fragile and contingent nature of technological engagement in later life. For instance, Outila and Kiuru (2020), drawing on the ANT, examined how a picturephone device was adopted as an assistive technology for older adults in Northern Finland. Their study showed that the successful integration of the device into daily routines was dependent on its sociomaterial alignment with health, safety, and connectedness discourses, as well as the active participation of family members and care workers. When these networks remained stable, the picturephone supported communication

and independence. However, when disrupted by technical problems or insufficient support, use often gave way to frustration, resistance, or abandonment.

These findings underscore the importance of analysing agency as a networked and emergent phenomenon. Building on the theoretical discussion above, this study sets out to empirically investigate how agency in later life is materially and relationally enacted. It draws on qualitative material that includes both older adults' everyday experiences and professional perspectives, allowing for a multi-layered analysis of how agency is shaped across domestic and institutional contexts.

Analytically, this article draws on Actor-Network Theory (ANT) (Callon, 1986; Callon & Latour, 1981; Latour, 1999a, 1999b, 2005) to examine how agency in later life is produced in and through everyday sociomaterial arrangements. It contributes to social gerontological debates by offering an empirically grounded analysis of how technologies, spatial configurations, social relations, and temporal patterns interact to shape the lived experience of ageing. By analysing how people, objects, spaces, and rhythms come together in everyday practices, the study contributes to ongoing efforts to move beyond individualized notions of ageing. It seeks to illuminate how older adults' agency is enacted, sustained, or disrupted within complex sociomaterial configurations that shape both possibilities for action and experiences of constraint.

METHODS AND THEORETICAL FRAMEWORK

Theoretical Orientation: Actor-Network Theory (ANT)

This study investigates how agency in later life is constructed within the everyday lives of older adults, paying particular attention to its emergence through sociomaterial entanglements (Huhtasalo, 2022; Law, 1992; Latour 2005; Callon, 1986; Orlikowski, 2007; Hyysalo, 2016; Lehtonen, 2008). Research drawing on the ANT has examined diverse contexts, including healthcare (Barrett et al., 2015; Parviainen, 2020; Karhinen, 2020), education (Huhtasalo, 2019; Huhtasalo, Blomberg & Kallio, 2021), and digital infrastructures (Orlikowski & Scott, 2008; Tilson, Lyytinen, & Sørensen, 2010), demonstrating how agency emerges through the dynamic interplay of human and non-human actors, such as technologies, materials, environments, and organizational practices.

Informed by this body of work, the present study adopts a relational and performative ontological stance. From this perspective, agency is not understood as a fixed attribute residing within individuals or devices, but as a contingent and contextually negotiated effect of associations between heterogeneous entities. Social and material actions are considered co-constructive: no element – whether human or technological – operates in isolation, nor can its effects be fully understood outside the network of relations through which it acts. This implies that agency must be examined as it unfolds in practice, where meaning and function are continually shaped and reshaped through situated interactions. Accordingly, the analytical focus is not on stable units or predefined categories, but on tracing the movements, translations, and transformations that give rise to momentary configurations of agency.

Analytical Framework: Integrating ICF

While ANT informs the broader analytical framework of the study, the ICF is used as a tool to support the interpretation and coding of empirical data (World Health Organization, 2001). Its hierarchical organization provides a structured yet flexible framework for interpreting the diverse and situated accounts found in the data. The ICF framework enables the categorisation of reported challenges and support needs related to body functions, activities and participation, and environmental factors. This classification approach is applied to both older adults' and health care professionals' responses. Rather than treating the ICF as a fixed classification system, this study uses its categories as heuristic tools to explore how material and discursive elements shape participants' everyday functioning and professional perspectives.

Research Questions

To guide the analysis, the following research questions were posed:

RQ1: How do people, objects, spaces, and rhythms come together to shape agency in older adults' everyday lives?

Additionally, the study considers the perspectives of health care professionals by asking:

RQ2: What kinds of improvements do professionals suggest supporting older adults' everyday tasks, agency, and overall life experience?

Participant Recruitment

The study was introduced to participants as a needs assessment for smart textiles and smart furniture to support independent living and well-being among elderly and functionally limited individuals. The research forms part of the ReactiveTOO project, a European collaboration focused on developing technological solutions that enhance safety, daily functioning, and quality of life – particularly in later life.

An online survey was employed as the primary data collection method to facilitate participation across a broad geographical area. Recruitment targeted individuals who could be potential users of ambient assisted living (AAL) technologies – hereafter referred to as end users – regardless of their previous experience with such tools. The aim was to identify real-life needs and perceptions to inform the user-centered design of assistive smart home environments. In addition to end users, health care professionals with relevant experience were invited to contribute expert perspectives to complement user insights.

Due to the project's explicit focus on ageing and smart technologies, the survey invitation specifically encouraged older adults to participate. As a result, the sample contains a high proportion of senior respondents, which aligns with the study's aims but limits demographic representativeness. No stratified sampling based on age or other characteristics was applied. Information was shared with prospective participants via digital channels and institutional partners. Participation was voluntary, and participants were informed of their right to withdraw at any time without consequences. No prior knowledge of smart technologies was required. Informed consent was obtained from all participants before data collection.

The online surveys were available in two languages: Finnish (from April 2024 onward) and English (from July 2023 to May 2024). They were distributed through multiple channels, including the Satakunta Testbed website, LinkedIn, Facebook, the University of Wolverhampton internal newsletter, and direct personal outreach. The survey instrument was pre-tested with four participants – two end users and two healthcare professionals from Finland and the UK. Minor adjustments were made based on their feedback to enhance clarity and appropriateness. Ethical approval for the study was obtained from the relevant ethics committee.

Data Collection and Analysis

The study employed a qualitative, exploratory research design to investigate the perspectives of older adults and healthcare professionals regarding assistive technologies in everyday life. A qualitative approach was considered appropriate due to its emphasis on capturing subjective experiences and contextual factors relevant to daily functioning and perceived needs (Polit & Beck, 2021). Data collection was conducted through an online survey to facilitate participation across a wide geographical area.

The survey consisted of both structured background questions (gender, age, country, work situation, and possible disability) and open-ended questions designed to elicit rich, descriptive data on participants' daily experiences, functional challenges, and expectations regarding assistive technologies. The open-ended responses formed the primary data for qualitative analysis.

Participants responded to open-ended survey questions designed to elicit detailed insights into everyday functioning and perceived needs. Questions were tailored slightly for each participant group to reflect their lived experience or professional perspective.

The end users were asked the following:

1. *What kinds of challenges, problems, or risks do you identify as part of your daily routine (if any)? Please mention up to five challenges, problems, or risks.*
2. *What could improve your daily activities or general life experience at home?*
3. *What could improve your daily activities or general life experience outside the home and at work?*

The healthcare professionals were presented with a modified set of questions to align with their professional context:

1. *What could improve your clients' or patients' daily tasks or general life experience?*

Although ANT was not the primary analytical framework at the outset of data collection, it became increasingly relevant during the early phases of interpretation. In the first rounds of close reading, participants' responses repeatedly pointed to the entanglement of bodily conditions, technologies, spatial arrangements, social relations, and temporal coordination in everyday life. This prompted the adoption of ANT as an interpretive and sensitizing framework through which these relational patterns could be analysed more systematically. The four-part analytic structure of people, objects, spaces, and rhythms was therefore not predefined in advance, but emerged through iterative engagement with the material.

Because the empirical material consisted of open-ended online survey responses rather than interviews, observations, or ethnographic follow-up, the study did not aim to trace actor-networks in the full ethnographic sense often associated with ANT. Instead, ANT was used to

examine how participants themselves described dependencies, disruptions, alignments, and possible reconfigurations among human and non-human elements in everyday life. In this sense, the analysis focused on participant-described sociomaterial arrangements and the conditions under which agency appeared to be enabled, constrained, or redistributed.

The analysis was conducted collaboratively within the author team, with the first and second authors taking primary responsibility, and followed an abductive approach involving iterative movement between the empirical material and theoretical interpretation. The open-ended responses were first read repeatedly to identify recurring descriptions of everyday challenges, support needs, and suggested improvements. These responses were then organised with the aid of the ICF, primarily at the level of the categories of body functions (b1-b8), activities and participation (d1-d9), and environmental factors (e1-e5), while allowing more specific domains and subcategories to inform interpretation where relevant. These functions were for example d730 muscle power functions or e340 personal care providers and personal assistants. This provided a structured way of mapping functioning-related concerns across both older adults' and professionals' responses.

Initial coding and interpretive notes were prepared by the first and second authors, who took primary responsibility for the analysis. These notes focused on recurring descriptions of bodily limitations, technological difficulties, spatial barriers, temporal coordination, support needs, and proposed improvements, and also recorded analytically significant overlaps between ICF domains. Coding decisions and ambiguous cases were then discussed within the author team and resolved through analytic consensus. Rather than using formal inter-rater measures, the study emphasized collaborative interpretive consistency appropriate to its qualitative and exploratory design. Where responses were brief or crossed several domains, a primary ICF placement was used to support tabulation, while their broader relational significance was retained in the ANT-informed interpretation.

The analysis then proceeded through two interconnected phases. First, the material was examined through an inductive and ANT-informed reading that highlighted how agency emerged through dynamic assemblages of bodily, spatial, social, and technological relations. This phase emphasized the fragility and situatedness of agency as it unfolded in everyday routines and disruptions, and proposed improvements. Second, the ICF framework was used to categorise responses into structured domains, providing a systematic basis for interpreting specific aspects of functioning while preserving the relational complexity identified through the ANT-informed reading.

Some responses aligned relatively clearly with one ICF domain, whereas others crossed several domains at once. Rather than forcing all such responses into a single exclusive category, their overlap was retained in the analytic interpretation as meaningful evidence of the relational and sociomaterial character of everyday functioning. For example, responses concerning electronic identification, logging in, and access to online banking services were initially read through the ICF as environmental factors related to digital services and technology use. In subsequent ANT-informed interpretation, however, they were understood as signs of fragile sociomaterial arrangements in which bodily capacities, digital interfaces, institutional requirements, and temporal pressures had to align for action to become possible.

Within this abductive logic, professionals' suggestions were interpreted not only as functional solutions but also as proposals to reconfigure the sociomaterial conditions of agency. Suggestions concerning routines, environments, tools, collaboration, and support

were therefore analysed as possible interventions into the everyday arrangements through which agency in later life is enacted.

Disclosure of AI Tools

Artificial intelligence tool (ChatGPT) was used to support language refinement throughout the manuscript. The AI tool assisted in improving clarity, coherence, and readability of the text, but it did not generate original content, conduct coding, interpret data, shape the theoretical framing, or formulate the study's conclusions. All conceptualizations, analyses, and conclusions were produced by the authors, who are responsible for the final content.

RESULTS

A total of 19 end users participated in the survey. Participants included 11 men, 7 women and 1 identifying as other. Of these, the majority, 11, were aged 65 or older, 5 were aged 45–54, and the remaining three participants were aged 18–24, 25–34, and 35–44, one in each group. Participants aged 65 or older were mostly retired ($n = 10$) or partially retired ($n = 1$), whereas the younger participants were still employed.

Regarding nationality, 10 participants were from Finland, 5 from the United Kingdom, 2 from Poland, and 1 from Estonia. One participant did not disclose their country of residence. In terms of disability status, 6 participants identified themselves as persons with disabilities, while 13 did not.

A total of 21 professionals participated in the healthcare professionals' version of the survey. Most professionals were aged 45–54 ($n = 8$) or 35–44 ($n = 7$). Four nationalities were represented: Finland ($n = 11$), United Kingdom ($n = 7$), Portugal ($n = 2$), and Norway ($n = 1$). One professional identified as a person with a disability; the others did not.

Challenges in Everyday Life

Question: What kinds of *challenges, problems or risks* do you identify as part of your daily routine (if any)? Mention 0–5 challenges, problems or risks that you may identify.

Participants described a variety of challenges they encounter in everyday life, which, through an ANT reading, can be understood as indicators of fragile or unstable sociomaterial arrangements rather than as individual deficits. Functioning appears in the material as emerging through the alignment of bodily, environmental, social, and institutional actors. Ageing itself was also mentioned as a challenge. The responses were categorised based on the ICF (Table 1).

The most prominent components identified were Body Functions as well as Activities and Participation. Within the domain of Body Functions, participants reported experiencing pain in various parts of the body, muscle weakness, impairments in vision and hearing, difficulties with time management, and memory problems. These challenges illustrate the complex interdependence between internal physiological conditions and external temporal rhythms.

Regarding Activities and Participation, key reported difficulties included challenges in self-care, limited mobility, household tasks, outdoor movement, and maintaining social relationships. These issues extend beyond individual skills, being closely intertwined with environmental accessibility, the stability of daily routines, and opportunities for social interaction.

Table 1. Challenges Identified by Participants in Everyday Life, Categorized Using the ICF Framework

ICF Component (in functioning & disabilities and contextual factors)	Domain	Category
Functioning and disability		
Body functions	Sensory functions and pain	Seeing, hearing, pain
	Neuromusculoskeletal and movement-related functions	Muscle functions
	Mental functions	Specific mental functions
Activities and participation	Mobility	Walking and moving, moving around using transportation
	Self-care	Dressing, looking after one's health
	Interpersonal interactions and relationships	
	Major life areas	Economic life
Contextual factors		
Environmental factors	Products and technology	Products of substances for personal consumption, products and technology for personal use in daily living

Contextual Factors were predominantly mentioned as environmental barriers. Participants described challenges related to the use of technological devices and digital services, including difficulties with electronic identification, logging in, and accessing banking services. Many found that these technological difficulties interfered with or disrupted their daily routines.

Improvements Desired at Home

Question: What could improve your daily activities or general life experience at home?

Participants did not propose specific technologies but described needs pointing to relational and contextual improvements in everyday functioning. Participants' responses most frequently related to Environmental Factors (Table 2), although Body Functions were also mentioned, while relatively few responses related to Activities and Participation. One brief response captured this broader orientation as a wish to "pursue hobbies and interests", illustrating an aspiration that cut across physical, psychological, and social dimensions rather than fitting neatly into a single ICF component.

Table 2. Improvement Ideas for Daily Life at Home, Categorized Using the ICF Framework

ICF Component (in functioning & disabilities and contextual factors)	Domain	Category
Functioning and disability		
Body functions	Mental functions	Specific mental functions
	Mental functions	Global mental functions
	Neuromusculoskeletal and movement-related functions	Movement functions, muscle functions
	Functions of the cardiovascular, haematological, immunological and respiratory system	
Activities and participation	Interpersonal interactions and relationships	Particular interpersonal relationships
	Major life areas	Economic life
	Domestic life	Household tasks
Contextual factors		
Environmental factors	Support and relationships	Personal care providers and personal assistants, other professionals
	Products and technology	Products and technology for personal use in daily living
	Natural environment and human-made changes to environment	

For Body Functions, participants mentioned time management and better physical functioning. Mindfulness and relaxation were also seen as tools for improving life at home. These responses highlight individual strategies to enhance functional capacity.

Responses related to Activities and Participation were the least frequent. However, many participants noted the importance of social interaction. Additional suggestions included financial assistance and help with preparing meals, which were seen as meaningful improvements.

Most responses were categorised under Environmental Factors. In the home setting, participants proposed various forms of assistance – either through a person or a device. Human support was described in terms of personal assistants or other professionals, while suggested products and technologies included assistive devices and memory aids.

Improvements Desired Outside Home and at Work

Question: What could improve your daily activities or general life experience outside the home and at work?

Challenges in environments beyond the home – such as in public spaces or the workplace – were described as particularly complex and multilayered (Table 3). Some responses reflected integrated needs that span physical, mental, and social functioning, such as skill development, improved mobility, indoor exercise, and access to gyms. Participants also mentioned “setting goals” as a helpful improvement. Rather than belonging neatly to a single ICF category, such responses pointed to broader aspirations for continuity, participation, and self-direction in everyday life.

Table 3. Participants' Ideas for Improvement Outside the Home and at Work, Categorized Using the ICF Framework

ICF Component (in functioning & disabilities and contextual factors)	Domain	Category
Functioning and disabilities		
Body functions	Functions of the cardiovascular, haematological, immunological and respiratory system	
	Mental functions	Global mental functions
	Mental functions	Specific mental functions
Activities and participation	Interpersonal interactions and relationships	General interpersonal interactions
Contextual factors		
Environmental factors	Support and relationships	Personal care providers and personal assistants
	Service, systems and policies	
	Natural environment and human-made changes to environment	

Both mental and physical functions were frequently mentioned by participants. Under mental functions, time management and having enough time were emphasized. Under physical functions, participants highlighted the importance of maintaining physical health.

Only one response – "being active in a network" – was clearly categorized under Activities and Participation. As this phrasing itself suggests, some participants described agency less as an isolated individual capacity than as a relational state sustained through connection, mobility, and opportunities for participation. Some activities such as indoor exercise could also be interpreted as relating both to Body Functions and Participation, illustrating the fluidity between the ICF domains.

The majority of responses were categorised as Environmental Factors. Participants expressed a variety of improvement ideas, including access to personal assistants, nearby services, ease of access, and the importance of safe, natural-like environments.

Professionals' improvement ideas

Question: What could *improve your clients' or patients' daily tasks* or general life experience?

Professionals offered a wide range of improvement suggestions, which can be grouped into three interrelated areas: (1) improvements concerning the functioning of older adults, (2) improvements related to professionals' own working conditions and practices, and (3) broader technological or systemic improvements. These suggestions reflect efforts to stabilize, extend, or reconfigure sociomaterial networks surrounding ageing, care, and professional practice.

1. Improvements Related to Older Adults' Functioning (Categorized Using the ICF Framework)

- Body Functions
 - Mental functions: improvements to help nurture confidence and reassurance in daily tasks, inclusion and sense of security
- Activities and Participation

- Interactions and relationships: activities, recreational activities, good interpersonal relationships
- Environmental Factors
 - Natural environment and human-made changes to environment: improvements in environment, possibility to remain active at home
 - Products and technology: technology for security, memory disorders, adaptable furniture along the age and appropriate assistive devices
- 2. Improvements Related to Professionals' Work
 - Enhanced interprofessional cooperation across organizations
 - Timely and targeted support for clients
 - More time allocated per client
 - Improved staffing, resource allocation, and task optimization
 - Access to relevant training and professional development
- 3. Other Suggestions and System-Level Improvements
 - Broader utilization of technological solutions
 - Technologies that are easy to use
 - Monitoring and communication about fall risks

These suggestions reveal how professionals act not only as service providers but also as network mediators. Phrases such as “more time allocated per client” and technologies that are “easy to use” illustrate how proposed improvements were imagined as ways of reassembling sociomaterial configurations through human collaboration, technological mediation, and organizational adaptation.

DISCUSSION

This article has examined how agency in later life can be understood not as an individual attribute but as a relational and emergent phenomenon. Drawing on ANT, the analysis explored how agency was described in the survey material as taking shape through the interplay of people, objects, spaces, and rhythms in older adults' everyday lives. Rather than treating challenges in functioning simply as personal deficits, this perspective directs attention to the alignments and misalignments of heterogeneous human and non-human actors through which action becomes possible, difficult or interrupted (Latour, 2005; Callon, 1986; Law, 1992). This theoretical lens helps make visible the dependencies between bodily capacities, social relationships, technologies, environmental design, and temporal structures. In this material, everyday difficulties such as mobility limitations or reduced participation can be interpreted not merely as individual problems, but as signs of unstable or fragmented sociomaterial arrangements (Hyysalo, 2016; Orlikowski & Scott, 2008; Huhtasalo, 2022). For example, mobility issues appeared connected not only to physical impairments but also to spatial and technological misalignments (Teittinen, 2008; Karhinen, 2020), while difficulties in participation suggested broader problems of coordination across social and temporal arrangements (Lehtonen, 2008; Pyyhtinen, 2010).

Although not predefined, four interrelated dimensions – people, objects, spaces, and rhythms – emerged across the data as analytically useful ways of interpreting how agency was co-constituted in everyday life. These dimensions were not predefined categories, but

overlapping relational layers that became visible through iterative analysis of participants' descriptions of challenges, supports, and suggested improvements. While responses were most frequently linked to environmental factors, they also pointed to bodily conditions, social participation, and temporal coordination in ways that often crossed categorical boundaries.

Taken together, these findings suggest that ageing can be analysed as a process shaped by networked sociomaterial entanglements, where agency is contingent, situated, and negotiated rather than individually contained. Within this framework, the study addressed the following research question:

RQ1: How do people, objects, spaces, and rhythms come together to shape agency in older adults' everyday lives?

The following sections respond to this question by analysing each of these four dimensions in turn and illustrating how their interrelations may support or constrain agency in later life. From an ANT perspective, agency is approached here not as a fixed capacity but as an emergent and dynamic effect of interactions among human and non-human elements.

People: Social Networks and Interactions

The findings reveal that social agency in later life is not simply an individual capacity but a fragile and negotiated outcome of sociomaterial relations. Participants described difficulties in maintaining social relationships, participating in informal interactions, and feeling useful in everyday life. In this material, such challenges were not framed as personal shortcomings, but as consequences of broader disruptions in the networks that support social participation.

From an ANT perspective, these accounts can be understood as indicators of unstable actor-networks, where human and non-human elements – such as bodily conditions, environmental constraints, and temporal structures – fail to align. For example, chronic pain, and limited mobility (body functions) were mentioned as barriers to social engagement. However, these physiological conditions did not operate in isolation. Their impact was compounded by inaccessible environments, lack of transportation, and the absence of supportive routines or companions.

Participants also emphasized the emotional and relational dimensions of functioning. The desire to participate and contribute reflects a form of agency that is co-constructed through interaction, highlighting the participatory dimension of agency as a source of meaning and identity. From an ANT perspective, these expressions can be interpreted as calls for network reconfiguration – for the enrollment of new actors (e.g., assistive services, social technologies, or spatial modifications) that would enable social participation to be restored or sustained (Callon, 1986; Latour, 2005).

Moreover, the findings highlight how temporal misalignments, such as pain and mental functions at times or potential interaction or lack of structured opportunities for engagement, can further destabilize social agency. In this sense, social participation is not merely a matter of interpersonal connection, but a networked achievement that depends on the synchronization of bodily rhythms, spatial accessibility, and social infrastructures (Huhtasalo, 2022; Lehtonen, 2008; Orlikowski & Scott, 2008).

In addition to relational connections, some participants also saw value in setting personal goals and staying active in peer networks. These forms of engagement – whether through

hobbies, group activities, or informal learning – contributed to a sense of purpose and connectedness, highlighting the participatory dimension of agency.

In sum, the analysis suggests that social agency in later life is shaped by the dynamic interplay of people, bodies, spaces, and rhythms. When these elements are misaligned, social participation becomes difficult or impossible. However, when the network is stabilized – for example, through the introduction of assistive actors such as tailored transportation services or socially meaningful routines – agency can be reactivated and sustained. These findings thus underline that supporting social agency requires more than interpersonal care, it demands the alignment of diverse human and non-human elements that together sustain meaningful participation in later life.

Objects: Technologies and Material Supports

Although participants did not name specific technologies, their responses revealed a range of needs – such as support with time management, and emotional well-being – that indirectly point to the absence or misalignment of material supports in their everyday lives. These needs reflect gaps or instabilities in the sociomaterial network, where non-human actors such as tools, devices, and infrastructures are either missing, inaccessible, or poorly integrated (Latour, 2005; Law, 1992; Huhtasalo, 2022).

ANT emphasizes that agency is not a static capacity but an emergent and dynamic property that unfolds through interactions among human and non-human elements. These interactions are continuously negotiated and reshaped, reflecting the fluid nature of agency in everyday practices. Thus, agency is seen not merely as something supported or limited but as a co-constructed achievement of sociomaterial networks.

Participants' difficulties with organizing meals, managing time, and simplifying daily routines illustrate how cognitive and procedural complexity in later life is not merely an individual burden but a networked challenge. These everyday tasks require the coordination of multiple actors: bodily capacities, spatial arrangements, temporal rhythms, and material supports. When one or more of these actors is absent or misaligned, agency becomes fragmented. ANT allows us to see technologies not as passive tools but as active mediators that can either stabilize or destabilize everyday functioning (Orlikowski, 2007; Hyysalo, 2016; Latour, 1996).

Huhtasalo (2022) found that digital technologies in professional contexts were shown to reconfigure roles, responsibilities, and identities. Similarly, in the context of ageing, technologies such as smart furniture, ambient systems, or digital reminders have the potential to reconfigure everyday agency – but only if they are situated within everyday sociomaterial routines. As Law (1992) and Callon (1986) emphasize, technologies must undergo a process of translation to become effective actors: they must be enrolled, accepted, and coordinated with other elements in the network.

The absence of specific technological suggestions in participants' responses may also reflect a lack of familiarity, accessibility, or trust in available solutions. This highlights the importance of user-centered and participatory design that takes into account the lived realities and relational dependencies of older adults (Hyysalo, 2016). As Latour (1999a) argue, technologies are not neutral intermediaries but transformative agents that can reshape the

very conditions of action – if they are aligned with the rhythms, spaces, and social relations of everyday life.

In summary, the analysis suggests that technologies and material supports are not merely external tools but constitutive elements of human agency. Their presence, absence, or configuration within a person's sociomaterial surroundings influences what older adults are able to do and how securely they can participate in everyday life.

Spaces: Environmental Design and Accessibility

The findings indicate that spaces – both physical and social – are crucial in shaping agency in older adults' everyday lives. From an ANT perspective, spaces are not mere backdrops to human action; they are active participants in sociomaterial networks that either enable or constrain agency. Participants described environmental barriers, such as physical obstacles or unsupportive infrastructure, as sources of safety risks and diminished autonomy. These spatial conditions interfere with the orchestration of sociomaterial actors and diminished opportunities for social and functional engagement.

In the ANT framework, spaces are not neutral containers, but relational elements that co-configure agency by influencing how bodies move, interact, and connect. Participants' struggles with self-care, household chores, and outdoor movement were not presented as personal deficits but as consequences of spatial inaccessibility. A narrow hallway, a poorly lit staircase, or a missing handrail became actants with the capacity to restrict action. When spatial arrangements are misaligned with bodily and social rhythms, the actor-network loses coherence (Latour, 2005; Law, 1992).

Rather than emphasizing high-tech solutions, participants called for subtle spatial changes that could recalibrate their everyday environments. Desires for better rest, sleep, and mobility suggest a need to harmonize lived bodily experiences with spatial surroundings that support well-being. Similarly, preferences for uncluttered interiors, more accessible layouts, and improved public infrastructure point to the importance of environmental adjustment. From an ANT point of view, these spatial changes represent acts of translation – efforts to enroll new non-human actors (e.g., ramps, lighting, pathways) that restore balance and allow agency to stabilize (Callon, 1986; Law, 1992).

Participants also emphasized the value of nearby nature-like environments, accessible local services, and a general sense of safety as crucial spatial conditions that support meaningful everyday life. In environments beyond the home – such as community spaces, workplaces, or natural settings – participants described a multilayered experience of (dis)connection. Long distances to services, icy walkways, or poorly maintained public spaces became barriers to participation – not simply in terms of mobility but also in terms of social presence. These spatial frictions disrupted the continuity of everyday life and contributed to a shrinking world. Conversely, when such environments were accessible and welcoming, participants described moments of reconnection and spontaneous interaction, signalling a reactivation of social agency.

In summary, the analysis suggests that space is not merely a backdrop to ageing but an integral actor in the sociomaterial production of agency. Its qualities – such as navigability, comfort, and openness – shape how older adults orient themselves in their environment. From an ICF perspective, these findings underscore how environmental factors – including

accessible infrastructure, supportive human assistance, and assistive technologies – directly influence older adults’ capacity to function and participate in everyday life. Enhancing accessibility and reconfiguring everyday spaces thus represent not only infrastructural improvements but also critical interventions within the sociomaterial network that can recalibrate relationships and foster agency in later life.

Rhythms: Temporal Coordination and Daily Life

The findings indicate that agency in later life is not only spatially situated but temporally structured. Rhythms – both bodily and environmental – act as non-human actors that shape the conditions of agency. Participants described challenges with time management and scheduling conflicts, which disrupted their capacity to engage in everyday activities and social participation. These disruptions are not merely personal time-management issues; they are indications of temporal misalignments within the sociomaterial network that supports daily life (Orlikowski, 2007; Orlikowski & Scott, 2008; Fenwick & Edwards, 2010).

Rather than being fixed or internally determined, rhythms in ANT are understood as negotiated outcomes of interactions between people, objects, and temporal infrastructures. Participants’ ability to take part in activities or maintain social relations depended on how well energy, opportunity, and external timing came together. When these rhythms were out of phase – for example, when a community event conflicted with fatigue or transportation options – agency was weakened. Conversely, synchrony between personal needs and the timing of services or activities allowed agency to unfold more smoothly (Latour, 2005; Law, 1992).

Participants expressed a desire for greater temporal stability through routines, predictability, and adequate rest. Some also referred to practices like relaxation or mindfulness as strategies to restore everyday balance. These responses can be understood as efforts to recalibrate the temporal dimensions of their everyday arrangements. From an ANT perspective, such adjustments represent attempts to introduce new rhythms or supports that bring bodily cycles into harmony with the social and spatial tempos of daily life (Callon, 1986; Law, 1992; Fenwick & Edwards, 2010).

While many responses aligned with environmental or bodily dimensions of functioning, some expressions – such as the aspiration to “pursue hobbies and interests” – did not map neatly onto ICF categories. Some participants also highlighted the importance of maintaining both mental and physical health, such as improving stamina or ensuring sufficient rest, as key enablers of everyday functioning. These responses reflect more diffuse and temporarily situated desires that point to rhythmical and relational aspirations for continuity, engagement, and autonomy in everyday life.

In this material, rhythms should not be seen as passive or background conditions, but as active temporal formations that affect what can be done, when, and with whom. Disruptions in these patterns can erode continuity and diminish participation, while recalibrated rhythms can serve as quiet but powerful enablers of everyday agency. Rhythms – when attuned to the needs and possibilities of older adults – can act as enabling forces that sustain autonomy, engagement, and continuity across time.

Professional Visions as Network Interventions in Later Life

In addition to exploring how agency emerges through the entanglements of people, objects, spaces, and rhythms in older adults' everyday lives, as captured in their survey responses, this study also examined how professionals envision improvements that could enhance daily tasks, agency, and overall life experience.

This is addressed through the second research question:

RQ2: What kinds of improvements do professionals suggest supporting older adults' everyday tasks, agency, and overall life experience?

In this view, professionals act as mediators who intervene in the everyday networks of older adults, offering material or relational elements that may shift how agency is distributed and realized. Their improvement ideas reveal how potential actor-networks are imagined, extended, and negotiated from the vantage point of care and service provision.

From an ANT perspective, these suggestions can be interpreted as proposed network interventions – strategic enrolments of new actants such as tools, spatial arrangements, routines, or collaborative relations. Rather than simply addressing individual needs, these proposals aim to reassemble sociomaterial configurations that enable or stabilize older adults' agency.

Confidence, inclusion, and sense of security

Professionals' suggestions related to confidence, inclusion, and a sense of security illustrate how emotional and cognitive states are not solely internal experiences but are produced and stabilized within sociomaterial arrangements (Mol, 2008; Latour, 2005; Pols, 2012). This thematic cluster emerged prominently in professionals' responses and reflects a shared concern with how emotional security can be materially and relationally supported in later life. From an ANT perspective, these aspects of mental functioning emerge through networks composed of people (care staff, peers, family members), material artefacts (reminder systems, calming devices), and spatial-temporal arrangements (predictable routines, familiar environments). These suggestions can be seen as attempts to build or reinforce stable and predictable components within older adults' everyday environments – components that can anchor a sense of control and continuity (Mol, 2008; Pols, 2012).

In proposing such changes, professionals act as mediators who seek to modify the affective and cognitive atmosphere of everyday life by reshaping its sociomaterial composition. Here, agency is not enhanced through individual psychological empowerment alone, but through the careful configuration of human and non-human elements that collectively support the experience of being capable, included, and safe (Latour, 2005; Duff, 2010).

Thus, this cluster of recommendations highlights how emotional well-being and agency in later life are intertwined, enacted through concrete materialities and relational infrastructures. Rather than being abstract qualities, confidence and reassurance are assembled through interactions among memory aids, calming routines, social presence, and stable environmental cues (Greenhough, 2010). These represent intentional efforts to reconfigure everyday actor-networks to support the situated emergence of agency.

Social interaction and recreational activity

Professionals emphasized the importance of interpersonal relationships and adequate interaction time as key elements in supporting older adults' daily functioning. From an ANT perspective, these suggestions underscore how agency is co-constructed through temporal and relational linkages within care networks (Latour, 2005; Mol, 2008). The availability of time is not merely a human resource issue but a structural and material condition that shapes the rhythms of interaction and the potential for meaningful engagement (Barad, 2007; Duff, 2010; Ertner, 2022).

The notion of “having enough time with clients” can be understood as a call to stabilize and expand actor-networks in which trust, responsiveness, and attentiveness can emerge. Without sufficient time, interactions remain transactional, preventing the formation of durable relational ties that support agency. In this light, time itself acts as a non-human actor – its scarcity or availability conditions how relationships unfold and what kind of care becomes possible (Barad, 2007; Latour, 2005; Ertner, 2022).

Similarly, professionals' call for easy multiprofessional cooperation across organizations and for correctly timed and targeted support reveals a need for more integrated and responsive care infrastructures. These elements represent attempts to recalibrate network connections across organizational boundaries – aligning professionals, institutions, and information systems so that timely and person-centered responses can be enacted (Barrett et al., 2015; Parviainen, 2021).

Such adjustments reflect the inherently negotiated and collective nature of agency in later life, where outcomes depend not only on individuals but on how their support networks are assembled, coordinated, and maintained over time. These suggestions can be read as efforts to realign sociomaterial networks across care infrastructures, where professionals act as intermediaries in the translation of older adults' situated needs into stable and responsive configuration of support.

Delegated Agency and Technology as a Mediator

Professionals identified several improvements related to the physical environment and technological solutions that could support older adults' ability to manage everyday life. Suggestions such as enhancing the indoor environment to support orientation to the time of day, improving rest, and enabling activity at home indicate an understanding of how spatial and temporal conditions affect daily functioning. From an ANT perspective, these proposals can be seen as efforts to reconfigure the material and sensory elements of the living environment to align more effectively with bodily and cognitive rhythms (Duff, 2010; Manchester & Jarke, 2022). These environmental adjustments are not neutral background features but are actively involved in shaping the conditions under which agency becomes possible.

In addition, professionals suggested the use of various technological solutions – including voice-activated tools, reminder systems, adaptable furniture, and devices designed to prevent wandering or locate lost items. These technologies can be interpreted as non-human actors within care networks that are intended to extend or redistribute agency (Callon, 1986; Parviainen, 2020; Parviainen, 2021; Peine & Neven, 2021). Rather than simply

assisting older adults, these devices participate in reorganizing how tasks are carried out, by providing cues, structuring actions, or compensating for memory or mobility challenges.

The growing reliance on technological solutions reflects an effort to stabilize care practices by reconfiguring sociomaterial networks. These proposals alter how roles, timing, and control are distributed within everyday life, sometimes repositioning older adults from active participants to recipients of delegated actions. Many of the suggested devices – such as reminder systems, voice prompts, or tracking tools – are designed to act on behalf of older adults, signalling a shift from co-activity to substitution within the network. In this model, agency is not expanded through shared engagement or support for self-directed activity, but is delegated to technological systems that monitor, prompt, or intervene (Latour, 1999b; Karhinen, 2020).

While such systems may reduce risk or compensate for cognitive or physical limitations, they also reconfigure the structure of agency: they create networks in which the human actor is positioned as dependent, and where non-human elements assume a proactive, sometimes even supervisory role (Peine & Neven, 2021). This shift toward delegation reflects a broader logic of substitution, where technologies are designed to fill gaps or prevent failure, rather than to enhance interaction or enable the user to develop new competencies. Importantly, these solutions construct older adults less as active agents and more as nodes to be managed within a network of surveillance, reminders, and preventive action.

Recognizing this tendency invites critical reflection on how care technologies are imagined and implemented. While risk reduction and safety are essential, an overemphasis on delegation may overlook opportunities to design systems that engage older adults as co-actors, enabling their continued participation in meaningful everyday practices. ANT helps to illuminate how these sociotechnical arrangements do not merely assist but also shape the boundaries and dynamics of agency itself.

CONCLUSION

This study suggests that agency in later life is not a stable individual trait, but a contingent outcome of sociomaterial arrangements. By analysing how people, objects, spaces, and rhythms were described in the survey material, the study indicates that agency is not only supported or constrained, but also continually assembled, disrupted, and negotiated within actor-networks. This perspective challenges individualistic models of ageing and reframes agency as a collective, situated, and material achievement.

A key insight of the study is that everyday breakdowns in agency often result not from individual limitations, but from misalignments within sociomaterial arrangements – for example, when bodily rhythms, environments, technologies, and institutional demands fail to align. Such moments point to the limits of approaches that place the burden of adaptation primarily on the individual.

The professionals' suggestions analysed in this study further indicate how proposed interventions – technological, procedural, or relational – can be understood as attempts to reconfigure the conditions under which agency is enacted. Recognizing this dynamic opens space for more reflexive and participatory approaches to support design, including

approaches that position older adults not merely as recipients of care or technology, but as participants in shaping the sociotechnical conditions of everyday life.

Recent contributions from material gerontology offer valuable conceptual tools that extend and enrich the ANT-informed approach employed in this study. While both perspectives challenge individualistic understandings of ageing and agency, material gerontology introduces further emphases on intra-action (Barad, 2007) and response-ability (Haraway, 2008) to describe the ethically charged entanglements of human and non-human actors. For example, Manchester and Jarke (2022) argue that response-able design foregrounds care and affect within participatory sociomaterial arrangements – emphasizing that the affective qualities of everyday infrastructures are integral to supporting older adults' agency.

This perspective also resonates with earlier ANT-informed research such as Outila and Kiuru (2020), who showed that older adults' use of a picturephone depended on the stabilization of sociomaterial networks shaped by discourses of safety, connectedness, and usability. When those networks faltered – due to technical issues, lack of support, or value dissonance – agency was diminished, and resistance or non-use emerged. Their findings echo ours: agency in later life is not a given, but a contingent effect of successful translations and alignments within complex actor-networks.

Ultimately, this study proposes that ageing can be understood as a negotiated and infrastructurally mediated process. It shifts the analytical focus from individual capacity to sociotechnical alignment, inviting scholars, designers, and practitioners to ask what kinds of networks are being assembled, for whom, and with what consequences for agency in later life.

IMPLICATIONS FOR THEORY AND PRACTICE

This study offers several novel contributions to Human Technology research by reframing later-life agency as a sociotechnical and relational achievement rather than an individual capacity. The integration of Actor-Network Theory with the ICF framework provides an innovative analytical lens that reveals how agency emerges through the alignment of heterogeneous human and non-human actors. This theoretical contribution advances ageing research by showing how bodily conditions, technologies, spaces, and temporal rhythms co-constitute everyday functioning in ways that extend beyond existing individualistic or biomedical models. The study further introduces a new four-dimensional analytic framework – people, objects, spaces, and rhythms, that captures the dynamic and often fragile sociomaterial arrangements shaping later-life agency.

For practice, the findings demonstrate the importance of designing technologies and services that support co-agency rather than delegating action to automated systems. Technological interventions must be embedded within older adults' everyday routines, spatial arrangements, and relational networks to stabilize agency effectively. The results underscore the need for participatory, context-sensitive, and rhythm-aware design approaches that align with lived experiences, rather than imposing standardized solutions. Strengthening agency in later life thus requires reconfiguring sociomaterial infrastructures, technical, spatial, and temporal, so that older adults remain active contributors within their everyday lives.

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