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Prototyping longevity services: Tech-driven or human-assisted service?

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ABSTRACT

The study investigates the design of longevity services through an experimental comparison of tech-driven and human-assisted service encounters, focusing on six key features: learnability, efficiency, safety, trustworthiness, confidence, and satisfaction. The controlled experiment, which involved 12 gender-balanced participants from Boston, USA, employed four qualitative methods, including surveys, the Think-aloud technique, semi-structured interviews, and transcript analysis supported by computer-assisted qualitative data analysis software (CAQDAS) and its AI-empowered coding function. The study concluded with two insights: 1. Tech-driven services can improve safety, trust, confidence, and satisfaction; and 2. both service encounters are context-sensitive, shaped by participants' demographics, personality, culture, and environmental factors. Although the small sample size limits the study's generalizability, the participants' stories and perceptions offered valuable insights into their implicit needs and subtle behaviors in learning, experiencing, and addressing sensitive, private, and vulnerable topics related to longevity planning.

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Longevity service, financial planning, service design, design for social impact, tech, human-assisted

1. Introduction

With emerging technologies, accessible healthcare, and governmental policies, people's lifespans and healthspans have been extended (Justice 2019; Lee, Yang, de Weck, Lee, Coughlin, and Klopfer 2023; Norman 2024; Schwab 2016). In WHO (2022), The World Health Organization (WHO) estimated that the world's population over 60 years old will approximately double from 12% to 22% between 2015 and 2050. The concept of longevity services has

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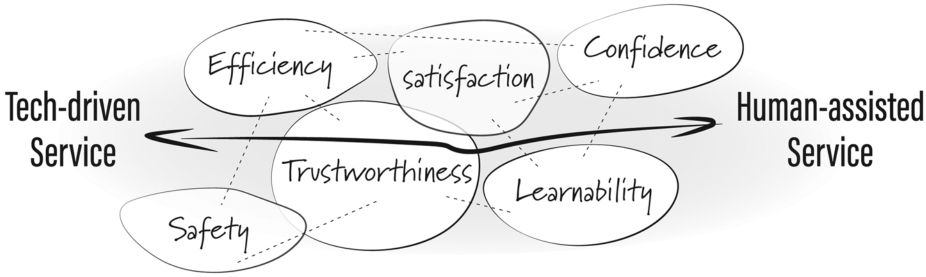

Figure 1. High level relationship between six features of a longevity service with two service encounters: tech-driven and human-assisted.

become increasingly popular (Albrecht et al. 2014; Barone 2021; Heye 2023; Stanford Center on Longevity 2022). A longevity service should lead to a better quality of life, with physical and mental health, mobility, financial freedom, and purpose, with family and community support. The study investigated the relationship between six features of a longevity service with two service encounters: tech-driven and human-assisted (Figure 1).

Aging societies with multi-generational workforces and environments face social and economic challenges in adapting to demographic shifits (Coughlin and Lau 2006). This transformation is shaping our lives and work, replacing the traditional 'born, learn, and retire' model with new values suited to a multigenerational society. For example, Bank of America Merrill Lynch provides a life plan product with 18 defined life stages addressing diverse needs beyond finance. The firm hired a financial gerontologist to enhance products for longevity challenges, while generating an estimated $7-$8 trillion in business (Golden 2022). Similarly, Warby Parker Inc. launched lifelong eyecare services targeting the $10-$15 billion longevity consumer market in the U.S. (Golden 2022). Longevity planning services have redefined aging, recognizing it as a progression through multiple life stages rather than a simple numerical value (Lim and Gandini 2022; Welch and Krystopowicz 2023).

1.1. Research question

The experiment aimed to explore the research question: "How can we design a good longevity service?" A 'longevity coach' was defined as the individual providing longevity knowledge and services. The term "coach" was chosen over "advisor" to emphasize the broader scope beyond finances.

We defined six hypotheses, each correlated to features of high-quality longevity services—learnability, efficiency, safety, trustworthiness, confidence, and satisfaction. Our hypothesis is that each feature can be enhanced by one of two service encounters: 1. a tech-driven service: service recipients don't need human interaction to accomplish goals; and 2. a human-assisted service: service recipients rely on a human's (longevity coach) input to

Table 1. Defining two service encounters for prototyping a longevity service with five factors.

Factors	Tech-driven service	Human-assisted service
Facilitation	**Self:** Service recipients don't need human interaction to accomplish tasks (e.g. ATM).	**Guided:** Service recipients rely on human input to accomplish tasks (e.g. cashier).
Human interaction	**Low:** program-driven	**High:** coach-driven
Autonomy	**High:** controlled by participants	**Low:** facilitated by a coach
Privacy	**High:** owning a personal space	**Low:** sharing a space with a coach
Business cost	**Low:** easy to scale a service	**High:** cost on coach training

accomplish goals. For example, tech-driven service is similar to an ATM; it's a fully automated and self-guided service without human interaction. In contrast, a human-assisted service is similar to visiting a bank teller. These services rely on experts as the service providers. In the experiment, two service encounters were designed and built by applying script theory to experiment with longevity services (Kollar, Pilz, and Fischer 2014; Victorino, Verma, and Wardell 2013). Script theory, introduced by Schank and Abelson (1977), provides a psychological framework for understanding how individuals use structured sequences of behaviors, thoughts, and emotions to navigate social situations. Later research (e.g. Schank 1986, 1990) expanded the theory to encompass cognitive processes.

We proposed six factors in Table 1. Facilitation distinguishes between experimental conditions in which participants are self-guided, using a provided clicker, versus those guided by a coach. Human interaction assesses whether the experimental environment is driven by a program, as opposed to interaction with a coach. Autonomy pertains to the degree of control exercised by participants. In the tech-driven group, participants had full control; in the human-assisted group, the coach co-facilitated the experience. Privacy concerns the level of personal space afforded to participants. In the tech-driven group, participants maintained personal space; in the human-assisted group, space was shared with a coach. Business cost evaluates the investment to scale the experience. Tech-driven services rely on programs, reducing costs compared to human-assisted services, necessitating investment in training coaches.

To investigate the impact of tech-driven vs. human-assisted longevity services, we proposed six hypotheses based on the six features (Table 2). The hypotheses were formulated from a preliminary literature review and the authors' discussions (Lee et al. 2024).

1.2. Design features

The six features were modified from Nielsen's usability framework (Nielsen 2010) and SERVQUAL, a service quality measurement scale assessing reliability, responsiveness, assurance, empathy, and tangible evidence (Parasuraman, Zeithaml, and Berry 1985), to develop the six hypotheses in Table 2. Features

Table 2. Six hypotheses associated with six features.

#	Hypothesis (H)	Features
H1	A human-assisted service can help first-time clients learn new concepts or knowledge about longevity more easily than a tech-driven service.	Learnability (ease of first-time use)
H2	A tech-driven service can help clients get the task done as quickly and accurately as possible, enhancing their capabilities to adapt to complexity better than a human-assisted service.	Efficiency (ability to adapt to complexity or recover from error)
H3	A human-assisted service can easily create a safe and reliable personal space that enables clients to better expose their vulnerable side with comfort than a tech-driven service.	Safety (feeling safe and comfortable to be vulnerable)
H4	A tech-driven service can more easily build trust with a client than a human-assisted service.	Trustworthiness (perceived accuracy)
H5	A human-assisted service can empower clients with the confidence to grow and explore the unknown better than a tech-driven service.	Confidence (ability to extend/explore)
H6	A tech-driven service can provide better-perceived service quality to meet client's satisfaction and expectations than a human-assisted service.	Satisfaction (participant perceived service quality)

Table 3. The definitions of six features.

Feature	Definition
Learnability	**Ease of first-time use:** How learnable is the service? Which service encounter is easier to learn for a first-time user?
Efficiency	**Speed of accomplishing tasks:** Once learned, how efficient is the service? Which encounter is more efficient?
Safety	**Sense of safety and control:** How safe does the service make you feel? Is the environment hygienic? Does the encounter help you understand what is expected of you and give you a sense of control and agency?
Trustworthiness	**Perceived accuracy:** Which service encounter do you trust more? Which is more reliable or accurate?
Confidence	**Ability to extend and explore:** Which service encounter inspires more confidence in your ability to grow and explore? How empowering is the service?
Satisfaction	**Participant-perceived service quality:** How satisfying is the service? Which service encounter is more enjoyable??

definitions are provided in Table 3. The aim is to understand service encounters impact service quality.

2. Related works

2.1. Service encounters

A service encounter is an interaction between service providers (financial advisors) and service recipients (clients) in a designated context (Giebelhausen et al. 2014; Soderlund, Oikarinen, and Tan 2021; Victorino, Verma, and Wardell 2008; Victorino, Bolinger, and Verma 2012). In hospitality field, human-assistance is used to improve service interactions (Solnet et al. 2019). Technology (tech) is viewed as a substitute of the human-assistance (Bolton et al. 2018). Tech-driven and human-assistance can be used to meet different operational and customer needs to shape service encounters based on the context (Wu et al. 2022).

The Service Encounter 2.0 addresses the value of considering a tech-human balance (Larivière et al. 2017). It shows how to engage stakeholders through high-tech, high-touch, or hybrid approaches. For example, Lavallee et al. (2014) mentioned that high-tech solutions have become popular because of the Internet, whereas approaches, such as in-person interviews, we considered high-touch. Leite, Hodgkinson, and Volochtchuk (2023) applied a high-tech and low-touch approaches to transform public services with assistive technologies in digital social care. Dolata et al. (2019) experimented to explore how to enhance high-touch advisory services with technology by supporting physical rituals for advisory services and implementing features to enable advisory services to better leverage technical possibilities, such as FinTech and robot advisor, pushing the boundaries of rituals (Mazumdar and Jyoti 2019).

Service encounters can be analyzed through the lens of an information technology (IT) service delivery channel (Apte 2014), a system through which providers deliver services and customers access them. Apte highlights human intermediaries and IT. He uses financial services to demonstrate this, noting that complex services like investment counseling benefit from high-touch approaches, while simpler services like ATM are more effectively managed through high-tech methods (Figure 2).

2.2. Aging and retirement planning

The longevity and service-based economy era has arrived (Coughlin 2017; Pine and Gilmore 2020). Experience-driven services and products have transformed industries and user experiences (Golden 2022). The 8000-Day Framework, developed by the author, reframes views of aging by dividing the life into four stages, each approximately 8,000 days long. We adapted this

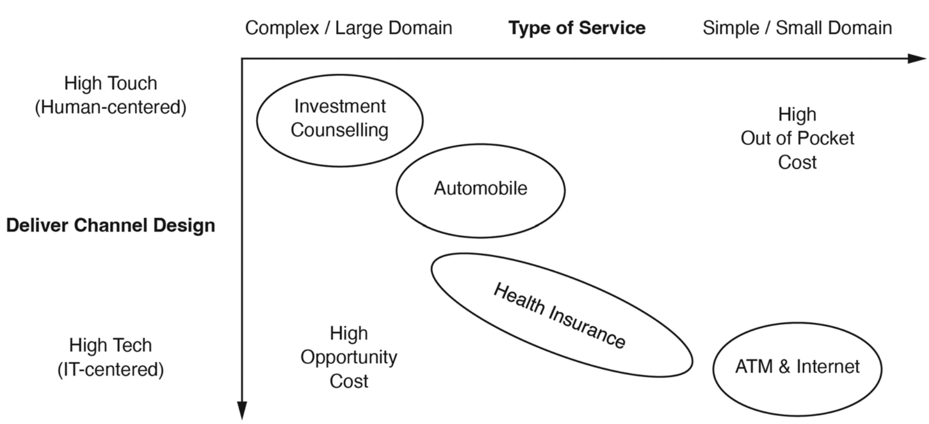

Figure 2. The four financial services in relation to channels and service types (adapted from Apte 2014).

Table 4. Four stages of longevity planning with associated eight questions.

Stage	Managing ambiguity	Making big decisions	Managing complexity	Living solo
Questions	How will you manage your health? Where do you live?	What will you do on Tuesday morning? Who will you have lunch with?	How will I get an ice cream cone? How will you provide care?	Who will change your light bulbs? Who will care for you?

Figure 3. The 12 longevity planning blocks.

framework to longevity service by proposing four new stages: managing ambiguity, making big decisions, managing complexity, and living solo. Two life-relevant questions were created for each stage (Table 4). The titles of the four stages and the eight questions were displayed in the designated Longevity Planning Block (LPB) shown in Figure 3.

By employing LPBs, the goal is to stimulate individuals' interest in longevity planning while fostering trust. For instance, when participants engage with the question, "How will you get an ice cream cone?" a coach seeks to uncover aspects of the participants' living situation, such as whether they have someone who can purchase ice cream for them, which may suggest whether they live independently or with family. A coach may explore whether participants have health conditions such as chronic diseases that could affect their ability to consume ice cream. The question may reveal mobility issues preventing them from obtaining the food they desire. This study applied this framework and used 12 LPBs to prototype a longevity service (Lee 2024; Lee, Coughlin, Balmuth, et al. 2023; Lee, Coughlin, Yang, et al. 2023; Turkle 2007).

3. Methodology

The longevity service experiment was adapted from Dolata et al.'s study (2019), which integrated touch and tech approaches in financial services. The experiment was co-designed with a university lab and financial advisors from Raymond James, Edward Jones, and Teachers Insurance and Annuity Association of America to ensure relevant research methodologies.

3.1. Participant recruitment

A total of 12 participants (50/50% male/female, average age 33.1 years old) were recruited through authors' connections located in Boston: 45.5% of participants' backgrounds are in arts, design, and media; 18.2% are from computer and science and others are from business and finance. Four participants have financial planning experience. Seven participants were assigned to a tech-driven group, and five were assigned to a human-assisted group. Their pre-tax household income and investable assets were both in the 80,000–99,999 USD range. As the pilot test recruitment was sourced from personal network, future studies should ensure greater control over variables in age, occupation, and financial experience.

3.2. Experiment procedure

The experiment consisted of pre-experiment, experiment, and post-experiment phases. We administered a 10-minute pre-experiment survey to collect data on financial conditions, literacy, and demographics before an hour-long in-person session was then conducted in a lab. In the post-experiment phase, participants completed a 10-minute semi-structured interview and a survey (Figure 4).

The experiment space was designed (Figure 5) to prototype a client's simulated experiences (Buchenau and Suri 2000; Miettinen et al. 2012; Simo et al. 2012). The LPBs were arranged on the table in front of a participant. A stack of Post-its and a Sharpie were provided for notetaking. The number of Post-its used can indicate engagement level by questions generated by a participant. The controlled pilot test aimed to study the relationships between the six features and a longevity service by experimenting with two service encounters. The experiment was designed to ensure 12 participants in either tech-driven or human-assisted group had the same amount of information. The participants were briefed to be users in a longevity service for possible clients with limited or no financial planning experience.

The human-assisted and tech-driven service encounters were identical, except for facilitation. In the human-assisted group, the coach stayed in the room and guided the participant through the digital canvas: advancing slides, playing videos, and relaying the written exercise prompts and instructions

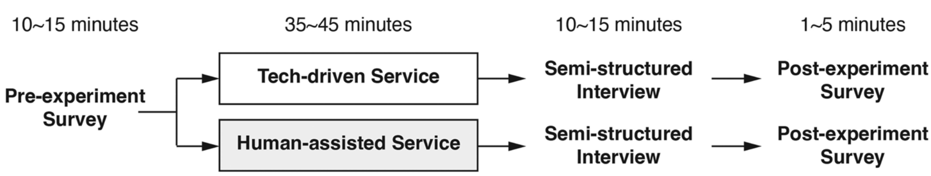

Figure 4. The study flow.

Figure 5. The study environment.

Table 5. The definitions and intentions of the four datasets.

Dataset	# qu	# touch	# Post-it	ED
Definition	Number of questions asked by participant in transcripts per session.	Frequency of participant interactions with LPBs (e.g. touch, play, move) per session.	Number of Post-its used by participant per session.	Experiment duration in minutes per participant.
Intention	Indicates participants' interest in the longevity planning concept.	Reflects participants' engagement with tangible artifacts.	Reveals questions or ideas generated by participants.	Measures the time required for participants to engage.

regarding how to use the LPBs. In the tech-driven group, the participant used a clicker to advance slides and decipher the written exercise prompts and instructions on their own. The digital canvas was defined as the interface for engaging with a virtual coach. Following a 45-minute experiment, participants underwent a 15-minute recorded interview and they were encouraged to think aloud about their experiences (Eccles and Arsal 2017; Someren, Barnard, and Sandberg 1994).

3.3. Measurement

We proposed four datasets (Table 5) to understand individual behavior and assess service quality: number of questions asked per session (# qu), frequency of interactions with LPBs per session (# touch), number of Post-its used per session (# Post-it), and experiment duration (ED) in minutes per participant.

3.4. Analysis

The verbal and behavioral data of the participants were recorded in a controlled environment. We conducted qualitative data analysis to code participants' actions and processes. Action coding involved analyzing how

Figure 6. The interface was captured from ATLAS.ti by applying Open AI to code.

participants responded to longevity planning, while process coding identified how they related the concept to themselves, families, and communities. ATLAS.ti, a CAQDAS, was used to analyze transcriptions and code behavioral data from the recordings. Coding is a valuable tool for clustering and analyzing information (Charmaz 2006). CAQDAS is extensively used in social sciences (Friese 2014). It now incorporates AI to improve coding efficiency and accuracy. ATLAS.ti's AI Lab services leverage the Open AI to offer advanced coding functions, significantly enhancing precision. We implemented this new feature in the study to improve the coding (Figure 6).

Co-occurrence values are used to analyze whether two or more codes form patterns within the same context (Stewart 2023). We can visualize connections strength using a Sankey diagram, which employs a co-occurrence coefficient (c-coefficient) ranging from 0 to 1, where 0 indicates no co-occurrence and 1 indicates full co-occurrence. The c-coefficient is calculated as follows:

$$c = \frac{n_{12}}{(n_1 + n_2 - n_{12})}$$

$$n_{12} = number\, of\, co-occurrences\; for\; code\; n_1\; and\; n_2$$

4. Result

The results included the pre-experiment demographic results and integrated post-experiment data with interview material to form a focused, context-rich analysis of participants' narratives. In this section, we focused on analyzing 12 video transcripts, extracting data from the four datasets, as outlined in Table 6. The research emphasizes coding results, focusing on participants' actions (e.g. responses to a longevity concept) and processes (e.g. extending a longevity concept to families and communities) from the verbal and behavioral data.

Table 6. Participants' demographics and data: FPE = financial planning experience, avg. = average, ED = experiment duration, T = Tech-driven group, H = Human-assisted group.

#	Gender	Age	FPE	Group	# qu	# touch	# Post-it	ED (minutes)
P1	F	27	N	T	54	25	20	33.13
P2	M	70	Y	T	51	84	9	25.15
P3	F	30	N	H	9	55	8	42.43
P4	F	34	Y	H	31	13	13	38.26
P5	M	48	Y	T	78	16	6	23.17
P6	M	24	N	H	23	36	5	34.12
P7	M	27	N	T	49	32	16	30.25
P8	F	25	N	H	17	42	6	27.59
P9	F	21	N	T	55	66	6	47.18
P10	M	29	N	H	20	16	6	32.09
P11	M	31	Y	T	47	65	6	28
P12	F	31	N	T	42	26	21	38.12
Total avg.					39.67	39.67	10.17	33.29
Tech-driven service avg.					61.00	44.85	12.00	32.14
Human-assisted service avg.					20.00	32.40	7.60	34.90

4.1. Verbal data

Using transcripts, an AI-empowered coding by ATLAT.ti and Open AI, and interviews and observations, two integral actions were generated: 1. coding the top five keywords from tech-driven and human-assisted service groups and 2. selecting top five keywords from both groups to visualize the co-occurrence results as a Sankey diagram.

The c-coefficient (*c*) values of tech-driven and human-assisted service in relation to its top five keywords were analyzed in Table 7. Figure 7 presents the co-occurrence analysis of two keywords: clarity and learning. According to seven tech-driven service groups, we synthesized from interviews and identified that clarity (tech-driven $c = 0.19$) and learning (tech-driven $c = 0.20$) have a stronger impact than in human-assisted group.

4.2. Behavioral data

From 12 participants' videos, observations were made about three behaviors: the use of the tablespace, the placement of and interaction with the LPBs, and the number of used Post-it. Participants in the tech-driven group leveraged the tablespace with the LPBs and Post-its significantly more than the participants from the human-assisted one. Reviewing the seven videos, we observed participants put their hands and arms on the table to play with the LPBs. During P11's interview, he even excitedly coined the term "learning table". Though this contrast with human-assisted participants could be a result of the fact that tech-driven participants didn't share tablespace with a coach, we believe that interaction with LPBs and the tablespace could result in a high level of engagement with the longevity service. While participants from the tech-driven group used the entire tablespace, the five participants from the human-assisted service were more likely to lean their hands against the edge of a table while conversing with their coach. The tabletop served as an information displacement space shared by participant and coach.

Table 7. The verbal data from two service encounters and the c-coefficient values.

Top 5 Tech-driven keyword *from 372 quotes in 7 videos*	# codes	Tech-driven *c*	Human-assisted *c*
1. Uncertainty	132	0.35	0.05
2. Learning	74	0.20	0.06
3. Clarity	72	0.19	0.26
4. Perception	71	0.19	0.11
5. Technology	63	0.17	0.09
Top 5 Human-assisted keyword *from 129 quotes in 5 videos*	**# codes**	**Tech-driven c**	**Human-assisted c**
1. Various factors	34	0.04	0.26
2. Skepticism	27	0.05	0.21
3. Adaptability	22	0.03	0.17
4. Reflection	17	0.03	0.13
5. Happiness	15	0.02	0.12

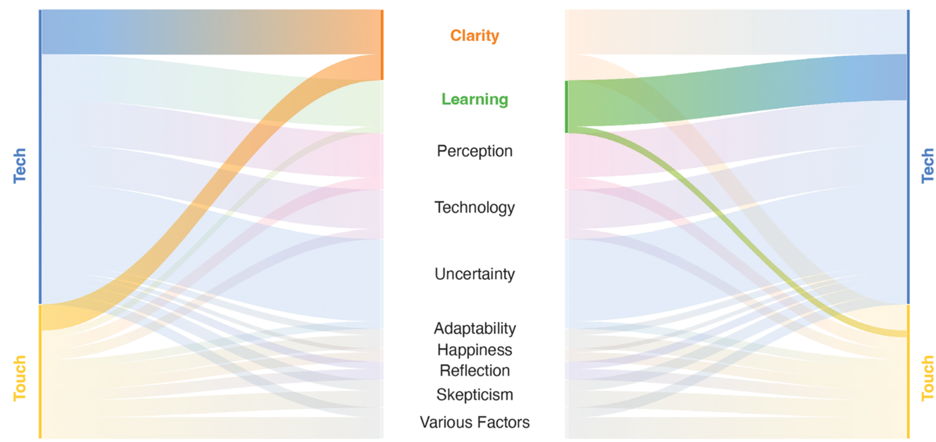

Figure 7. A Sankey diagram generated from the top five keywords per each service encounter.

The way participants used tablespace also impacted how they interacted with the LPBs. For the tech-driven group, most participants played with multiple LPBs at a time. From the top-view videos, most placements of the LPBs were more dynamic and creative: participants grouped and stacked the LPBs. The interview indicated that they liked to use LPBs to discover their "pattern". In contrast, in the human-assisted group, participants' behavior was more inexplicit: they considered and read the LPBs mostly one by one in order. From the videos, most engagement with the LPBs was predictable and straightforward: participants picked up a LPB, read it, and put it back.

We measured how many times each participant touched the LPBs to help us understand the engagement level of using LPBs. The average number of touches in the tech-driven service was 44.85 per participant, almost 14% higher than the average number of touches per participant in the human-assisted service: 32.4. For the tech-driven service, the average number of used Post-its is 12 per participant, which is 4.4 more than the average number of notes used in the human-assisted service: 7.6 notes per person.

Table 8. Observations from two service encounters.

Tablespace	Tech-driven service	Human-assisted service
Observations	Participants often placed their arms on the table to move LPBs perceiving it as a 'learning table' for exploration.	Participants often leaned hands against the table's edge, viewing it as a shared space with a coach.
Touch		
Average (touches per participant)	44.85	32.40
Observations	Participants played with multiple LPBs at a time, creating a creative layout from a topview. They exhibited freedom to discover pattern and move LPBs to form various configurations.	Participants read LPBs sequentially, resulting in a more predictable layout. With a coach, they followed instructions closely and interated less with LPBs.
Post-it		
Average (notes per participant)	12	7.6

This may be because participants did not have a chance to questions a coach during the experiment, so they accumulated ideas and questions on Post-its until the end. However, it could also, alongside the counts of touches, considered evidence to help us understand how participants process the information and possibly evaluate the quality and engagement of the longevity service (Table 8).

5. Discussion

5.1. Tech-driven service

When a coach was not in the room with the participant, we defined the group as a tech-driven service. Observations from videos and interviews demonstrated that participants alone in the room, with the projection light dimmed, remained focused on the content without any disruptions by a coach. The digital canvas used animated graphics and videos to introduce longevity concepts, allowing participants to explore at their own pace based on their ability and curiosity to grasp concepts.

Participants with some degree of financial planning experience felt that the self-guided slides and LBPs reinforced familiar concepts and gave them a new framework to consider their future. They tended to use more Post-its to document the questions and showed an eagerness to have the follow-up conversation with a coach in person. One finding was that safety was enhanced by tech-driven service. Our hypothesis was that human guidance, over the inhuman digital service, would offer participants a feeling of safety and encourage them to open up when dealing with sensitive topics; however, based on the observation, it was the opposite. Participants without human guidance felt that they had dedicated time and space for learning. Further, they appreciated the time they had alone to explore. With the projection on and the lights dimmed, there isn't anything to do but immerse yourself in the experiment. The low lights and clear sense of purpose create a calming effect. For longevity services, where sensitive matters about future vulnerabilities come up, it is useful to know that technology can help us create intimate spaces for reflection.

5.2. Human-assisted service

The human-assisted service included facilitation by a coach, who remained in the room and facilitated the conversation throughout the experiment. An advantage we learned from the experiment was that a participant could ask questions during the process to a coach. This resulted in casual conversations. However, these conversations were not noteworthy for being intimate. We found that most participants in the human-assisted group needed time to warm up to a coach before they felt safe enough to behave naturally. For example, P10 started with crossed arms and legs, but finished the study in a more relaxed posture.

Another observation was that the majority of participants demonstrated they understood the value and complexity of longevity planning, and opportunities facilitation offers. The experience was “emotionally charged” (P1) and “could explore topics beyond money” (P4), the questions got progressively more “complex” (P3), and a coach could act as a “counselor” (P9) to support. The main takeaway is that the experiment design was successful in introducing and conveying the value and complication of longevity service as distinct from financial planning. Other findings linked to tech-driven and human-assisted service encounters are included in the Appendix (Table 9).

5.3. Future study

The discussion highlights the primary aspects of two service encounters, emphasizing technology’s role in supporting autonomy and learning in longevity planning. It also underscores the value of small-scale prototyping for understanding interaction dynamics. Future research can explore the nature of service encounters and the integration of tech-driven onboarding services with curated human-assisted touchpoints throughout the longevity service.

6. Conclusion

Designing effective longevity services requires shifting from financial planning (Downe 2021; Mager 2009; Meroni and Selloni 2022) to a holistic model that accommodates evolving life stages. This approach address health, aging-in-place, safety, financial security, family dynamics, social well-being, and complex socio-economic challenges. This study examined how tech-driven and human-assisted service encounters influence user experiences, focusing on six features: learnability, efficiency, safety, trustworthiness, confidence, and satisfaction. The controlled experiment utilized four qualitative methods: surveys, Think-Aloud approach, semi-structured interviews, and transcript analysis using CAQDAS with AI-empowered coding.

Effective longevity services must evolve with users, reflecting changes in financial circumstances, health, and relationships, ultimately helping them achieve long-term goals. Survey and interviews results revealed that participants prioritized health, retirement, safety, and financial security in longevity planning. Compared to financial planning, longevity services offer a more layered approach, shifting focus from financial value to human value.

The study yielded two key insights: 1. Tech-driven services can enhance safety, trust, confidence, and satisfaction, and 2. both tech-driven and human-assisted services are context-dependent, influenced by participants' demographics, personality, culture, and other factors. Although the small sample size limits generalizability, the narratives of the 12 participants provide valuable insights into implicit needs and behaviors in longevity planning.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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