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Technology adoption among silver tourists: A cross-cultural configurational comparison of Greece and the United Kingdom☆

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ABSTRACT

Silver tourism is a rapidly growing segment of global tourism, yet older adults face persistent digital divides when engaging with smart travel platforms. This study examines technology use intentions among 800 silver tourists in Greece (Athens) and the UK (Birmingham) through a complexity-informed bounded Rational Choice Theory framework. Integrating fuzzy-set Qualitative Comparative Analysis (fsQCA) with Necessary Condition Analysis (NCA), the study identifies sufficient configurations of six conditions namely perceived usefulness, ease of use, subjective norms, cognition, trust, and perceived competence alongside city-specific necessary conditions. Subjective norms emerge as necessary in Athens (collectivist, digitally uneven), while trust and perceived competence are necessary in Birmingham (individualist, digitally mature).

In total, the analysis identified three acceptable pathways: one shared pathway, the Cognitive-Competence users which was valid in both Greek and British contexts, and two context-specific pathways, namely the Usage-Norm Consumers in Greece and the Cognitive Trust-in-Competence users in the UK. Post-evaluation interviews with six tourism managers confirmed the ecological validity of the identified pathways and strengthened the practical relevance of the findings. Findings extend digital divide theory, Rational Choice Theory, and complexity theory, offering culturally tailored guidance for inclusive tourism technology design.

1. Introduction

The global population aged 60 and older will exceed 2 billion by 2050, doubling from 2020 levels (World Health Organization, 2024; Age UK, 2024). This demographic shift presents both a challenge and a strategic opportunity for the tourism industry, as the "silver" generation becomes an increasingly prime and relevant target group (Bernini and Cracolici, 2015). Recent academic and policy literature calls for the digitalisation of tourism ecosystems to enhance service quality, competitiveness, and inclusiveness (Bekele and Raj, 2025; UN Tourism, 2025). However, a persistent digital divide remains (e.g., Shin and Baek, 2023) as many silver tourists face barriers when accessing and using smart travel platforms (Seifert and Schlomann, 2021). Addressing these barriers is critical for sustainable service innovation as it allows tourism providers to tailor offerings to the distinct needs and bounded rationalities of older adults (Moxley et al., 2022). By examining how configurations of social, cognitive, and structural factors drive adoption, this current study provides valuable and real-world oriented insights for designing inclusive and culturally relevant digital tourism experiences.

Representing a rapidly expanding market segment (Bernini and Cracolici, 2015), silver tourists possess considerable leisure time, particularly following retirement, and demonstrate a heightened appreciation for its value (Moxley et al., 2022). Yet, despite this importance, technology adoption lags due to perceived effort, risks, and

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capability gaps, in which rational responses to bounded cognition and cultural contexts are more likely than mere resistance (Bekele and Raj, 2025; Chen and Chan, 2014; Shie et al., 2025). Cultural context shapes how older adults evaluate and respond to technology, with national culture systematically moderating the relationships among effort expectancy, social influence, and adoption intention in ways that render single-context models non-transferable (Srite and Karahanna, 2006). Greece and the United Kingdom offer a theoretically grounded comparative setting to examine these dynamics; both are major tourism economies confronting rapid population ageing, yet they diverge substantially in digital infrastructure maturity and in the collectivist versus individualist value orientations known to amplify or attenuate perceived effort and risk (Jan et al., 2024; Shie et al., 2025). Yet, existing studies examine technology adoption, silver tourism, or cross-cultural effects separately, but rarely their intersections via complexity-informed Rational Choice Theory where boundedly rational seniors evaluate multi-dimensional utilities and constraints (see, Simon, 1955). Digital divide work highlights access disparities (Shin and Baek, 2023) yet ignores how configurations moderate rational non-adoption among older tourists. This gap leaves managers without actionable pathways to tailor platforms culturally and policymakers without evidence for inclusive digital strategies.

Beyond advancing technology adoption research among older tourists via configurational settings, this study also reflects into technological innovation and its management field by examining how digital self-service and platform-based tourism technologies diffuse among ageing consumers in two mature markets, Greece and the UK. Drawing on complexity theory, we conceptualise silver tourists as part of broader tourism innovation ecosystems where heterogeneous actor interactions and co-evolution shape the success of digitally mediated service offerings and platforms for seniors (Ritala and Almpanopoulou, 2017). At the same time, by adopting a rational choice perspective on cross-cultural differences in perceived benefits, risks, and cognitive evaluations of technology, we illuminate how configuration-level insights can inform the design and governance of more inclusive tourism technology platforms and service innovations, thereby contributing to the literature on inclusive and demand-side innovation in service ecosystems, which increasingly depends on collaborative, trust-based configurations among the actors that jointly deliver digital services (Dalenogare et al., 2023).

This study addresses these gaps by applying fsQCA and NCA to survey data from 800 silver tourists (400 each in Athens and Birmingham), identifying sufficient configurations and necessary conditions for technology use intentions. Grounded in bounded Rational Choice and complexity theory, it tests six tenets to validate multi-causal pathways (Pappas, 2023). Cross-cultural comparisons between Greece (collectivist, digitally uneven) and the UK (individualist, digitally mature) highlight the added explanatory value of configurational analysis over linear assumptions, indicating that Greek seniors tend to place greater weight on social norms amid access barriers, whereas British seniors tend to place greater emphasis on trust and perceived competence (Hofstede, 2001). Regression-based approaches (e.g., TAM extensions) assume compensatory effects and homogeneity, missing conjunctural causation, equifinality, and asymmetry in complex decisions (Marzi et al., 2023). Accordingly, with this study we attend into innovation adoption and diffusion research by (i) Theoretical, extending Rational Choice Theory within the innovation adoption literature by specifying how culturally contingent configurations of adoption drivers (rather than isolated net effects) determine whether digital tourism platforms diffuse successfully among silver tourists in collectivist versus individualist contexts (Marzi et al., 2023; Du et al., 2024); (ii) methodological, demonstrating the integration of fsQCA and NCA as a rigorous configurational toolkit for cross-cultural tourism and innovation research, advancing beyond the compensatory, linearity-assuming approaches that dominate TAM and UTAUT extensions; and (iii) practical, providing concrete innovation design levers (norm-ease bundles in Greece and trust-competence thresholds in UK) that equip platform developers, destination managers, and policymakers with evidence-based pathways for accelerating inclusive digital adoption among silver tourists. To enhance real-world relevance, the configurational findings were also discussed with tourism managers after the analysis, providing an additional practitioner-based validation of the results.

2. Theoretical foundations

2.1. Rational choice, bounded rationality, and complexity in services research

Rational Choice Theory (RCT) offers a foundational ground for understanding how individuals select among alternative courses of action by comparing expected benefits and costs under constraints (Ostrom, 1998). In its classical formulation, RCT assumes that actors hold stable, transitive preferences, possess sufficient information about options and consequences, and have the cognitive capacity to evaluate all alternatives while selecting the option that maximises expected utility (Becker, 1976; Coleman, 1990). In services and tourism contexts, such models imply that consumers compare alternative channels and choose the one yielding the highest net subjective value, incorporating monetary outlays, effort, time, and perceived risk alongside non-monetary benefits such as convenience and psychological comfort (e.g., Hechter and Kanazawa, 1997; Chen and Chan, 2014).

Behavioural economics and psychology challenge the strong assumptions of complete information and unlimited cognitive capacity, showing that real decision-makers are boundedly rational rather than perfectly optimising (Tversky and Kahneman, 1989; Thaler and Sunstein, 2009). Simon's notion of bounded rationality emphasises that attention, memory, and computation are limited, so individuals satisfies by selecting satisfactory options that meet aspiration levels instead of searching exhaustively for global optima (Simon, 1955, 1956, 1997). In tourism and service technologies, silver tourists similarly adopt solutions that are “good enough” given their skills, support, and risk perceptions, rather than surveying all smart tourism options available (Moxley et al., 2022; Tuomi et al., 2023). Simon further distinguishes substantive rationality (alignment with an externally defined optimum) from procedural rationality, which is the reasonableness of the decision process under cognitive and informational constraints (Simon, 1976), a distinction that aligns with recent service and innovation studies emphasising process quality and decision effort in technology adoption (e.g., Marzi et al., 2023). Subsequent work on bounded rationality highlights fast-and-frugal heuristics as simple decision rules that deliberately ignore part of the available information yet perform well in environments with stable regularities (Gigerenzer and Gaissmaier, 2011; Wang et al., 2022). In tourism and service innovation, such heuristics help explain how consumers, especially older adults, rely on cues like brand reputation, word-of-mouth, or visible trust signals rather than complex attribute trade-offs when choosing digital travel services (Geremew et al., 2024; Sun et al., 2026). Behavioural decision theory further documents loss aversion, reference dependence, and probability weighting (Kahneman, 2003), reinforcing that senior tourists' technology choices follow bounded and context-dependent trade-offs rather than fully optimising calculations.

These developments have led to contextualised rationality frameworks in which individuals remain goal-directed but their preferences, beliefs, and feasible choice sets are shaped by psychological, social and material contexts (Hedström and Stern, 2018). In tourism and innovation research, such frameworks show that technology adoption depends on configurations of access, skills, support, and cultural expectations rather than on single attitudinal predictors, particularly for older adults navigating smart tourism environments (Tuomi et al., 2023; Geremew et al., 2024; Hu and Wen, 2025). However, empirical tests often rely on regression-based or structural models that assume linearity and homogeneity, limiting their ability to capture heterogeneity,

context-dependency, and non-linear decision processes across diverse groups of older adults (Moxley et al., 2022; Lin et al., 2025). Ageing research indicates that age-related declines in processing speed, working memory, and executive functioning constrain the complexity of strategies that older adults can deploy, while rich crystallised knowledge and affective experience can partially compensate for cognitive limitations (Salthouse, 2010; Mata et al., 2012). Older adults often use simpler decision strategies that prioritize emotional comfort, perceived safety, and social support, without necessarily lowering decision quality (Seifert and Schlomann, 2021). In tourism and digital service use, complex choice architectures can overwhelm their cognitive resources and make it rational to limit options or rely on heuristics, whereas environments designed with clear trust cues, simple navigation and social support can enable effective heuristic-based decisions (Hanoch and Rice, 2006; Tuomi et al., 2023). This underscores the importance of designing tourism technologies and policies that recognise bounded and contextualised rationality in later life (Guo et al., 2025; Hu and Wen, 2025).

Complexity theory complements bounded rationality by conceptualising social systems as characterised by multiple interacting causes, feedback loops, and emergent outcomes (Woodside et al., 2018; Furnari et al., 2021). Instead of assuming each determinant as independent, complexity theory emphasises three principles: conjunctural causation that is the effect of a given condition depends on what other conditions co-occur, equifinality that takes into account different combinations of conditions can produce the same outcome, and causal asymmetry which is the configurations leading to the presence of an outcome are not simply the mirror opposite of those leading to its absence (Ragin, 2008; Ordanini et al., 2014; Olya and Mehran, 2017; Pappas and Woodside, 2021). Complex adaptive dynamics have similarly been shown to reshape design and performance outcomes in innovation-intensive settings where there are joint interactions among structural and cognitive elements, rather than any single driver, determine whether an innovation succeeds (Chiva-Gomez, 2004; Dean et al., 2022; Jancenelle, 2021). Within a complexity-informed rational choice perspective, individuals still aim to maximise subjective utility, but utilities and constraints are multi-dimensional and interdependent, making configurations of conditions more informative than single predictors (Keeney and Raiffa, 1993; Fishburn, 1970; Woodside et al., 2018). In the context of silver tourists' technology adoption, the antecedents of perceived usefulness, ease of use, social approval, decision support, trust and perceived competence jointly define the net utility and feasibility of adopting digital tourism technologies (Davis, 1989; Venkatesh and Davis, 2000). Different individuals and cultural groups face different rational choice environments: one group may adopt when social approval and low effort are present despite modest usefulness, while another adopts only when trust and competence are high even if norms and ease are weaker (Guo et al., 2025). These heterogeneous rational regimes map directly onto the equifinal configurations that configurational methods seek to uncover, and they align with Rational Choice Theory's emphasis on how individuals weigh perceived benefits against costs and constraints to maximise expected utility in technology-related interactions between tourists, platforms, and intermediaries.

Methodologically, fuzzy-set Qualitative Comparative Analysis (fsQCA) and Necessary Condition Analysis (NCA) operationalise this complexity-informed rational choice perspective. fsQCA treats conditions and outcomes as sets with graded membership and uses set-theoretic logic to identify combinations of conditions that are sufficient for an outcome, making it suitable for capturing conjunctural causation and equifinality in heterogeneous samples (Ragin, 2008; Pappas and Woodside, 2021; Geremew et al., 2024; Du et al., 2024). In tourism and hospitality, fsQCA has been gaining importance and used to examine multi-causal decision-making (e.g., Olya and Al-Ansi, 2018; Kumar et al., 2024). NCA complements fsQCA by identifying conditions that must exceed certain thresholds for an outcome to be possible at all, even when they are not sufficient on their own, thereby capturing non-compensatory constraints or bottlenecks (Dul, 2016a, 2020; Nguyen et al., 2025). For silver tourists, NCA identifies bottleneck thresholds of perceived usefulness, ease of use, subjective norms, cognition, trust, and perceived competence below which technology adoption among silver tourists remains suboptimal given prevailing cost–benefit trade-offs, then, fsQCA uncovers multiple sufficient configurations of these conditions leading to adoption, consistent with rational choice theory's view that individuals pursue utility-maximising actions subject to binding informational and social constraints.

2.2. *Technology adoption in silver tourism as rational choice under constraints and the digital divide*

Silver tourism, defined as leisure travel among individuals aged 55 and older, has emerged as a major segment in global tourism, yet technology adoption within this segment remains uneven and context-dependent (Bernini and Cracolici, 2015). The silver population itself is heterogeneous: young-old (55–64) often maintain strong ties to the labor market and have greater exposure to workplace technologies; middle-old (65–74) may experience transitional changes in income, health, and routines; and old-old (75+) frequently encounter significant sensory, cognitive, and mobility challenges (Hummert et al., 1994). These life-course differences translate into substantial variation in digital skills, confidence, and perceived relevance of technology (Seifert and Schlomann, 2021).

The digital divide concept captures disparities in access to and engagement with digital technologies (Fang et al., 2019). For older adults, many adoption patterns are rational responses to asymmetric access, skills and support rather than simple technological “lag”, as the tourism sector still designs many digital offerings around younger, digitally fluent users (Van Dijk, 2005; Van Deursen and Van Dijk, 2019; Minghetti and Buhalis, 2010). Recent work shows that this divide increasingly reflects differences in access, use and outcomes: complex smartphone-based travel services are adopted unevenly across age groups, with older travelers often excluded by perceived complexity and irrelevance, and by design choices that do not account for their needs (Shin and Baek, 2023). In cultural tourism, seniors’ use of digital tools is further constrained by software design, hardware limitations, cultural norms and fears of harassment, all of which enter their rational evaluation of whether digital participation is “worth it” (Tuomi et al., 2023).

Evidence on silver users' technology decisions is highly consistent with rational choice under constraints. Quantitative work shows that older adults' willingness to adopt technologies is primarily predicted by perceived value, perceived impact on quality of life and confidence in being able to use the technologies, with these relationships shaped by perceived effort, optimism, incentives and perceived need for help (Moxley et al., 2022). Longitudinal studies indicate that computer self-efficacy and early use experiences are stronger predictors of long-term adoption than initial beliefs about ease of use or usefulness (Czaja et al., 2018). Qualitative and review studies converge on the importance of perceived need, perceived control and perceived risk: older adults may judge technologies “not worth it” when expected benefits do not compensate for effort, risk and dependence on others, and in such cases non-adoption can represent a rational decision given their constraints (Seifert and Schlomann, 2021; Kuerbis et al., 2017; Hu and Wen, 2025). In tourism and mobility-related technologies, rational-choice patterns similarly dominate high-involvement, multi-attribute decisions, even when affective and dual-process models are considered (Lindberg and Stemmer, 2022; Stylos, 2022). Building on this background, the six focal conditions in this study, perceived usefulness, perceived ease of use, subjective norms, cognition, trust and perceived competence, can be interpreted as core components of silver tourists’ rational evaluations and constraints when considering tourism technologies.

Perceived usefulness reflects expected functional utility: older tourists' beliefs that booking websites and travel apps will save time, reduce

hassle, provide better prices or broaden options. Studies with older adults consistently find that perceived usefulness or value is a primary driver of adoption intentions, although its effect is moderated by perceived need and self-efficacy (Chen and Chan, 2014; Moxley et al., 2022; Seifert and Schlomann, 2021). Perceived ease of use captures effort and cognitive costs, with interfaces requiring multiple steps, complex navigation or extensive text entry imposing high burdens that can outweigh benefits even when usefulness is high (Czaja et al., 2018; Kuerbis et al., 2017; Tena et al., 2024). Subjective norms represent social utilities and pressures from adult children, peers and professionals; recent UTAUT-based studies show that social influence and facilitating conditions significantly shape older adults' intentions to adopt eHealth and related public services, often more strongly than performance and effort expectancies (Ajzen, 1991; Abbasi et al., 2015; Lin et al., 2025; Lu and Tsai-Lin, 2024). Cognition reflects the decision-support benefits of tourism technologies in structuring information, enabling comparison and reducing uncertainty (Marzi et al., 2023). Older adults value systems that organise information clearly and reduce decision complexity, rather than simply providing more data (Nguyen et al., 2025; Schroeder et al., 2023). Trust models perceived risk and expected loss: concerns about fraud, data breaches, hidden costs and service non-delivery are especially salient in digital tourism, and trust consistently predicts technology adoption while risk perceptions and anxiety reduce intention (Tuomi et al., 2023; Lin et al., 2025; Felber et al., 2024; Zhang, 2023). Perceived competence captures perceived control and success probability; self-efficacy and related antecedents have repeatedly been shown to predict older adults' technology adoption and continued use, with low competence triggering expectations of failure, embarrassment or dependence that lower expected utility even when functional benefits are large (Compeau and Higgins, 1995; Czaja et al., 2018; Seifert and Schlomann, 2021; Moxley et al., 2022).

Systematic evidence suggests that these six conditions do not combine linearly and compensatorily in older adults' technology decisions. Threshold effects and interaction patterns are repeatedly observed – for example, no level of usefulness can compensate for extremely low self-efficacy or very high technology anxiety; conversely, individuals with high competence and positive prior experience can tolerate complexity that would deter less experienced peers (Czaja et al., 2018; Kuerbis et al., 2017; Seifert and Schlomann, 2021). From a bounded rational choice and complexity perspective, some conditions therefore function as soft costs that can trade off while others operate as hard constraints or bottlenecks. For example, very low trust or competence may rationally preclude adoption. Identifying which conditions act as non-compensatory constraints and how they combine into distinct sufficient configurations is the core task addressed by the configurational analysis in this study.

2.3. Theoretical dimensions of cross-cultural innovation adoption

Cultural values systematically moderate the rational-choice environments in which older adults operate, dictating the relative salience of the conditions necessary for technology adoption (Srite and Karahanna, 2006). In the framework of bounded rationality, culture functions as a cognitive filter that narrows the set of perceived alternatives and determines which decision cues are evaluated as providing sufficient utility (Simon, 1955). In individualist societies, the rational evaluation of technology is primarily characterized by an emphasis on personal autonomy, perceived self-efficacy, and institutional trust (Ghorayeb et al., 2021; Hofstede, 2001). For silver tourists in such contexts, adoption is often driven by a goal of maintaining individual control and minimizing personal risk, making cognitive competence and systemic trustworthiness the primary bottlenecks in the decision process (Lu and Tsai-Lin, 2024; Schroeder et al., 2023).

On the other hand, in collectivist contexts, rational decision-making is deeply embedded within broader social structures, where norms of mutual support, familial endorsement, and the preservation of social identity become central to the utility calculation (Abbasi et al., 2015). In these environments, technology adoption is not merely a functional choice but a social one; the perceived benefits of digital tools are heavily conditioned by whether they align or are supported by the possible adopter/user's kinship network (Lin et al., 2025).

Tourism decision-making research similarly indicates that while rational evaluation of attributes is common across cultures, the salience of specific attributes and the choice strategies employed vary with cultural and situational context (Ji et al., 2023; Lindberg and Stemmer, 2022; Stylos, 2022). Moreover, these cultural orientations do not merely shift the "mean level" of adoption; they transform the causal structure of the decision process itself (Ji et al., 2023). By viewing these cultural dimensions as moderators of bounded rational choice, this study argues that the pathways to adoption within the specific configurations of conditions that lead to technology use intention are qualitatively different across cultural regimes. This theoretical perspective provides the foundation for our comparative analysis, allowing us to examine how individualist and collectivist contexts create divergent rational-choice regimes for navigating digital tourism ecosystems.

2.4. Conceptual framework and research approach

Drawing together Rational Choice Theory, bounded rationality, and complexity theory, this study proposes a complexity-informed bounded rational choice framework. Four core propositions guide the framework. First, silver tourists evaluate tourism technologies through multidimensional utility and constraint components: perceived usefulness and cognition represent expected gains in functional efficiency and decision quality; ease of use represents effort and cognitive cost; subjective norms contribute social utility or disutility; trust reflects risk and expected loss; and perceived competence captures expected success probability and emotional costs (e.g., anxiety, embarrassment). These components jointly determine the subjective expected utility of adopting digital tourism channels relative to traditional alternatives.

Second, these components do not combine in a single linear, compensatory fashion. Instead, specific configurations of high and low levels across the six conditions are sufficient to yield high technology use intention, and different configurations reflect different bounded rational choice regimes. For example, a regime dominated by high social utility and low effort (norms + ease), another by high decision-support and competence (cognition + competence), and another by high security and competence (trust + competence). Third, some components may function as non-compensatory constraints or bottlenecks, imposing threshold requirements that must be met for adoption to be feasible at all: below certain levels of trust, subjective norms or perceived competence, older adults may rationally exclude the digital option regardless of its functional benefits (Dul, 2016a; Nguyen et al., 2025). Fourth, culture and context moderate both sufficiency configurations and necessity constraints: a Greek collectivist, digitally uneven environment is expected to favour configurations that heavily weight norms, ease and access, whereas a British individualist, digitally mature environment is expected to favour configurations emphasising trust, competence and cognition (Abbasi et al., 2015; Ji et al., 2023).

To empirically test this framework, the study integrates fsQCA and NCA. fsQCA is used to identify sufficient configurations of the six conditions associated with high technology use intention in each city, capturing conjunctural causation and equifinality (Ragin, 2008; Pappas and Woodside, 2021; Geremew et al., 2024). NCA is used to determine whether any of the six conditions (or combinations thereof) operate as necessary conditions, defining bottleneck thresholds that bound the space of successful configurations (Dul, 2016a, 2020; Nguyen et al., 2025). Following recent tenet-based guidelines for configurational research (see, Gabay-Mariani et al., 2024), the analysis examines whether each condition appears in at least one configuration, whether multiple distinct configurations exist, whether no single condition or configuration dominates all cases, and whether the solutions preserve

heterogeneity across contexts (e.g., Woodside, 2013; Furnari et al., 2021). By situating silver tourists' technology decisions within this bounded, culturally embedded rational choice and complexity framework, and by interpreting norms and trust through rational choice theory, the study moves beyond linear, technology-centric models toward a richer understanding of how older adults in different contexts rationally weigh benefits, costs and constraints when navigating digital tourism ecosystems.

2.5. Study of the tenets

This study examines the service sector by investigating technology adoption intentions for tourism among individuals aged 55 and older. The application of "tenet" principles in services research addresses the complexity inherent in respondents' decision-making processes (Pappas, 2023). According to Pappas and Woodside (2021), this approach moves beyond linear hypothesis testing and consistency measures to assess outcomes emerging from complexity and their corresponding validity. Drawing on configurational theory, multiple factor combinations can produce identical outcomes (Ordanini et al., 2014). Consequently, this study adopts the frameworks proposed by Gabay-Mariani et al. (2024) and Woodside (2013), which establish six tenets that must be addressed and validated for research findings to be considered robust:

T1: Every simple condition (perceived usefulness; ease of use; subjective norms; cognition; trust; perceived competence) must appear in at least one configuration capable of producing technology use intention for tourism.
T2: Recipe Principle – Each sufficient configuration leading to technology use intention for tourism must contain two or more simple conditions.
T3: Equifinality Principle – The analysis must identify at least two distinct sufficient configurations that produce technology use intention for tourism.
T4: Contrarian Case Analysis – No single antecedent (perceived usefulness; ease of use; subjective norms; cognition; trust; perceived competence) should appear in all sufficient configurations with consistently high outcome scores.
T5: No individual sufficient configuration should account for all high outcome scores.
T6: No single sufficient configuration should encompass all examined cases.

3. Methods

3.1. Research context and site selection

This study adopts a cross-cultural comparative design to examine how technology adoption intentions among silver tourists vary across contrasting cultural and digital environments. Athens (Greece) and Birmingham (United Kingdom) were selected because they offer analytically relevant differences in value orientation and digital maturity, while both remain important contexts for examining the implications of population ageing for tourism and the visitor economy (Hofstede, 2001; Patterson, 2017; Gaušas et al., 2025).

Within these two national contexts, Athens and Birmingham were chosen as the empirical field sites because they provide large urban settings in which older adults actively engage with tourism and service ecosystems, while also reflecting broader differences in digital inclusion, social influence structures, and technology-use environments described in prior research (Seifert and Schlomann, 2021; Eurostat, 2022). Athens offers a suitable setting for examining technology adoption under relatively more collectivist and digitally uneven conditions, whereas Birmingham provides a suitable setting for examining adoption under relatively more individualist and digitally mature conditions (Hofstede, 2001; Srite and Karahanna, 2006). Population-wise, Athens hosts approximately a third of the overall number of inhabitants in Greece (3.2 million [World Population Review, 2026] and 9.8 million respectively Worldometer [2026]), while Birmingham is the second largest city in the UK with an analogous population of Athens (3.1 million [Statista, 2026]). The population analogy permits the comparison between those two cities. However, the purpose of selecting them was not to claim that either city statistically represents the entirety of the respective country. Rather, the research design follows a theoretically informed comparative logic in which two contrasting urban contexts are used to explore how different cultural and structural environments shape configurational pathways to technology use intention among older adults. This design is therefore context-sensitive rather than nationally representative.

3.2. Participants and data collection

Data collection took place in central public spaces within Athens, Greece, and Birmingham, UK, specifically Syntagma Square and Victoria Square, respectively, between January and February 2026. The study targeted permanent residents aged 55 and older who had lived in their respective cities for a minimum of three years and had utilised technology for holiday planning or booking within the previous year.

Researchers approached potential respondents directly, offering a concise overview of the study objectives and emphasising the voluntary nature of participation. Purposive sampling was implemented, with data gathered across different times of day and various days of the week, encompassing both weekdays and weekends, to ensure participant diversity (Teddlie and Yu, 2007).

Self-administered questionnaires were distributed in person, as this approach effectively preserves respondent anonymity whilst achieving relatively high response rates (Blair et al., 2014). This in-person approach was particularly appropriate because the target population consisted of older adults, among whom levels of internet use and digital familiarity remain uneven across European contexts, making online-only recruitment more likely to exclude relevant respondent groups (Seifert and Schlomann, 2021; Eurostat, 2022; Alexandrakis et al., 2020). Questionnaire completion required approximately 10 min on average, and consistent with Raghunathan (2020), incomplete questionnaires were excluded from analysis through listwise deletion, which represents a robust approach for managing missing data in survey-based research.

3.3. Sampling

Following established methodological guidelines (Akis et al., 1996; Sekaran and Bougie, 2020), this research established a confidence level of 95% with a corresponding maximum error margin of 5%, while the cumulative probability (Z) was set at 1.96. Furthermore, Akis et al. (1996) recommend that when respondent perspectives are unknown, the response distribution should adopt the most conservative estimate of 50/50 (equal proportions of positive and negative responses). Accordingly, the sample size calculation was determined as follows:

$$N = \frac{Z^2 \left(\text{hypothesis} \right)}{S^2} \Rightarrow N = \frac{1.96^2(0.5)(0.5)}{0.05^2} \Rightarrow N = 384.16$$

As Kumar et al. (2020) note, sampling error is independent of population size, being determined instead by the magnitude of the sample itself. The target sample was established at 800 fully completed questionnaires (400 per city). To achieve 400 useable questionnaires in each city, researchers approached 710 individuals in Athens and 687 in Birmingham, yielding response rates of 56.3% and 58.2% respectively.

3.4. Measures

The questionnaire comprises 35 statements measured on a five-point

Likert scale (1: Strongly disagree; 5: Strongly agree), drawn from previous research. Specifically, perceived usefulness items were adapted from Sun et al. (2026), whilst ease of use statements originated from Tena et al. (2024). Subjective norms items were derived from Farmaki et al. (2022) and Nimri et al. (2020), and cognition-related statements were adopted from Marzi et al. (2023). Trust items were sourced from Reis et al. (2025) and Ullah et al. (2022), whereas perceived competence statements came from Liao et al. (2024). Tourism-related technology use intention was measured using items from Kim and Rha (2025). Additionally, a socio-demographic question categorised respondents into three silver tourism age segments: Young (55-64), Mature (65-74), and Elder (75 or over).

For assessing configurational complexity, Olya and Al-Ansi (2018) recommend fsQCA as the most suitable mixed-method approach, enabling qualitative inductive reasoning to be applied to quantitative data. Following Woodside and Zhang (2013), the study also examined negated conditions. Non-parametric analysis was selected due to the presence of general asymmetry (Table 1). According to Skarmeas et al. (2014), general asymmetry exists when all correlation coefficients among antecedents remain below .6. Consistent with their framework, a configuration is deemed sufficient when raw coverage ranges between .25 and .75 and consistency exceeds .74. This research examines tourism-related technology use intention among individuals aged 55 and older in Athens (Greece) and Birmingham (UK) by analysing six simple conditions: perceived usefulness, ease of use, subjective norms, cognition, trust, and perceived competence.

3.5. Algorithms

Following Ragin (2008), membership for each causal condition was calibrated from zero (full non-membership at 5%) to one (full membership at 95%), with the crossover point established at 50%. Given that statements were measured on a five-point scale, thresholds were set at two, three, and four (Pappas and Woodside, 2021). Consistent with Wagemann (2017), fuzzy-set calibration was employed to minimise information loss. Moreover, a robustness range of ±.25 was applied to the non-membership, crossover, and full membership thresholds (Xie and Wang, 2020). In both contexts the technology use intention of the participants was examined through the fuzzy-sets of perceived usefulness, ease of use, subjective norms, cognition, trust, and perceived competence.

4. Results

Table 2 displays the distribution of silver respondents across age cohorts in Athens, Greece and Birmingham, UK, revealing comparable proportions among the three examined age groups. Table 3 presents the measurement items employed in this study alongside descriptive statistics for each variable (see Table 4).

Table 2
Profile of silver age groups.

Silver Age Groups	Athens		Birmingham	
	N	*%*	*N*	*%*
55-64 (Young)	163	40.8	179	44.8
65-74 (Mature)	159	39.8	160	40.0
75+ (Elder)	78	19.4	61	15.2
Total	*400*	*100*	*400*	*100*

As all measurement items were adapted from previous studies, the analysis proceeded with Confirmatory Factor Analysis (CFA). In both datasets, all examined items produced adequate factor loadings (L), exceeding the minimum threshold of .4 (Norman and Streiner, 2008). Furthermore, each simple condition demonstrated satisfactory internal consistency, with Cronbach's alpha (A) values surpassing the recommended minimum of .7 (Nunnally, 1978). Convergent validity was evaluated through Average Variance Extracted (AVE), which exceeded the .5 threshold across all antecedents (Cheah et al., 2018). Additionally, Composite Reliability (CR) values for all simple conditions surpassed their corresponding AVE values, fulfilling established validity criteria (Pappas and Glyptou, 2021).

4.1. Sufficient configurations

Throughout this section, we distinguish two related but analytically distinct terms: sufficient configurations denote the fsQCA solutions meeting standard consistency (>.74) and coverage (.25–.75) thresholds that are independent of necessity considerations, whereas acceptable pathways denote the subset of these sufficient configurations that additionally satisfy the necessary conditions identified through NCA (Dul, 2016b, 2022), and are therefore retained for substantive interpretation in the remainder of the paper.

Complexity analysis conducted through fsQCA identified four sufficient configurations for Athens and five sufficient configurations for Birmingham (Table 5). Following robustness checks, the key acceptable configurations remained stable under ± 10 threshold variations. To improve interpretive clarity, the acceptable configurations are hereafter discussed as named pathways based on their dominant profiles rather than only by numerical order.

In Athens, configuration 2 is labelled the Usage-Norm Consumers Pathway (A2) because it combines ease of use and subjective norms, together with the age-group condition. Configuration 3 is labelled the Cognitive-Competence users' pathway (A3) because it combines subjective norms, cognition, trust, and perceived competence, again

Table 1
Correlation matrix.

	Athens	1	2	3	4	5	6	7
1	Perceived Usefulness	1						
2	Ease of Use	.270	1					
3	Subjective Norms	.044	.157	1				
4	Cognition	.209	.326	.132	1			
5	Trust	.156	.215	.076	.261	1		
6	Perceived Competence	−.001	.027	−.041	.047	.085	1	
7	Technology Use Intention	.157	.216	−.005	.124	.221	−.278	1
	Birmingham	1	2	3	4	5	6	7
1	Perceived Usefulness	1						
2	Ease of Use	.103	1					
3	Subjective Norms	−.065	.038	1				
4	Cognition	.078	.140	−.007	1			
5	Trust	.077	.104	.029	−.050	1		
6	Perceived Competence	.110	.097	.032	−.011	.082	1	
7	Technology Use Intention	.122	−.042	.070	.028	.165	.045	1

Table 3
Descriptive statistics.

Statements		Athens		Birmingham	
		Mean	*SD*	*Mean*	*SD*
Perceived Usefulness					
PU1	The use of technology helps me to decide which reservation to make.	3.16	.716	3.56	.576
PU2	The use of technology helps me reduce my overall booking time.	3.32	.705	3.51	.601
PU3	The use of technology reduces the anxiety when I book.	3.02	.774	3.42	.714
PU4	The use of technology makes my life easier because I do not need to spend too much time searching for information.	3.47	.735	3.42	.628
Ease of Use					
EU1	It is easy to use the technology for travel bookings.	3.34	.816	3.11	.587
EU2	It is easy to use the technology for accommodation bookings.	3.20	.825	3.11	.667
EU3	It is easy to use the technology for finding destination information.	3.42	.828	3.36	.747
EU4	It is easy to learn how to use the technology for tourism-related purposes.	3.18	.859	3.40	.722
EU5	It is easy to acquire the skills needed for using the technology for tourism-related purposes.	3.04	.959	2.87	.783
EU6	Overall, I find the easy to use the technology for tourism-related purposes.	3.25	.787	3.10	.610
Subjective Norms					
SN1	Most people who are important to me believe I should use technology for tourism-related purposes.	3.77	.804	3.88	.597
SN2	Most people who are important to me would want me to use technology for tourism-related purposes.	3.96	.830	4.02	.668
SN3	People whose opinion I value would prefer that I use technology for tourism-related purposes.	3.93	.800	3.70	.720
SN4	Most people who are important to me will use technology for tourism-related purposes.	4.09	.829	3.77	.601
SN5	Most people whose opinion I value will use technology for tourism-related purposes.	3.93	.824	3.72	.711
Cognition					
C1	I use technology for tourism-related information checking In order to be sure I have the right facts before making decisions.	3.31	.783	3.94	.747
C2	Technology assists me to make tourism-related decisions in a logical and systematic way.	3.46	.843	3.74	.827
C3	Technology provides me the decision-making ability to carefully consider my tourism-related options.	3.47	.881	3.60	.942
C4	When making a tourism-related decision, I use technology to consider various available options.	3.25	.767	3.87	.705
C5	By using technology I generally make tourism-related decisions that feel right to me.	3.36	.762	3.85	.704
Trust					
T1	I trust using technology for tourism-related purposes.	3.21	.798	3.21	.715
T2	Using technology for tourism-related bookings is financially secure.	3.11	.814	3.12	.719
T3	When I use the technology I am not worried about the security of tourism-related bookings.	3.02	.846	3.14	.734
T4	I am confident in the use of technology for tourism-related purposes, since I feel that it works well.	3.07	.853	3.04	.745
T5	I feel safe that when I rely on technology I will get the right answers.	2.84	.851	3.21	.871
T6	Technological applications can perform the task better than a novice human user.	2.85	.829	3.35	.924
T7	I like using technology for tourism decision-making.	3.36	.859	3.09	.802
Perceived Competence					
PC1	I was trained in order to use technology for tourism-related purposes.	2.33	.740	2.59	.658
PC2	I am experienced in using technology for tourism-related purposes.	2.62	.847	2.66	.769
PC3	I know very well how to use technology in order to make a travel booking.	2.77	.869	2.78	.777
PC4	I know very well how to use technology in order to make an accommodation booking.	2.79	.849	2.84	.809
PC5	I know very well how to use technology in order to search information for a tourist destination.	2.97	.913	3.00	.939
Technology Use Intention					
TUI1	I am willing to use technology for tourism-related purposes in the near future.	3.40	.701	3.50	.715
TUI2	I plan to use technology for tourism-related purposes in the near future.	3.26	.719	3.38	.865
TUI3	I anticipate to use technology for tourism-related purposes in the near future.	3.26	.746	3.20	.930

alongside the age-group condition.

In Birmingham, configuration 1 is labelled the Cognitive-Competence users' pathway (B1) because it combines subjective norms, cognition, trust, and perceived competence, together with the age-group condition. Notably the same configuration (A3, B1) is shared across both contexts. Configuration 4 is labelled the Cognitive Trust-in-Competence users' pathway (B4) because it combines cognition, trust, and perceived competence, also alongside the age-group condition.

The remaining configurations are retained in Table 5 as sufficient configurations produced by fsQCA, but they are not treated as acceptable pathways in the subsequent discussion because acceptability depends on the necessity conditions identified through NCA. Accordingly, the manuscript distinguishes between sufficient configurations produced at the fsQCA stage and acceptable pathways retained after integrating necessity analysis.

4.2. Necessity analysis

Necessity analysis was performed using Necessary Condition Analysis (NCA). Table 6 reports the effect sizes (d) and p-values (p) for all antecedents, while Fig. 1 illustrates the corresponding NCA plots for both contexts. According to Dul (2020), an antecedent is deemed necessary when it demonstrates a statistically significant effect size (d) accompanied by a p-value below .05. Moreover, Dul (2022) emphasises that when evaluating sufficient fsQCA configurations, a viable solution requires the inclusion of at least one necessary condition. Within necessity logic, a configuration may produce an acceptable outcome even when some of its constituent elements are not necessary conditions (Dul, 2022). However, conditions identified as necessary must be present in the pathways for those configurations to be considered valid (Dul, 2016b).

Each panel in Fig. 1 plots the fuzzy-set membership scores of the focal antecedent (x-axis) against technology use intention (y-axis), with the ceiling line (CE-FDH) marking the empirical upper boundary of attainable outcome levels at each level of the antecedent. A steep ceiling line indicates that low levels of the antecedent constrain, or bottleneck, the maximum attainable outcome, which is consistent with necessity,

Table 4
Factor analysis.

Statements	Athens				Birmingham			
	L	*A*	*AVE*	*CR*	*L*	*A*	*AVE*	*CR*
Perceived Usefulness		.900	.742	.920		.887	.678	.894
PU1	.898				.895			
PU2	.895				.760			
PU3	.834				.810			
PU4	.816				.824			
Ease of Use		.932	.714	.937		.887	.643	.915
EU1	.938				.876			
EU2	.841				.830			
EU3	.815				.827			
EU4	.831				.735			
EU5	.769				.724			
EU6	.865				.807			
Subjective Norms		.901	.711	.924		.866	.660	.906
SN1	.852				.930			
SN2	.910				.772			
SN3	.764				.801			
SN4	.908				.785			
SN5	.770				.761			
Cognition		.936	.755	.939		.881	.684	.915
C1	.949				.941			
C2	.852				.813			
C3	.847				.774			
C4	.894				.844			
C5	.796				.749			
Trust		.934	.698	.942		.867	.567	.901
T1	.922				.891			
T2	.848				.777			
T3	.898				.785			
T4	.794				.749			
T5	.811				.677			
T6	.747				.695			
T7	.816				.672			
Perceived Competence		.883	.682	.914		.832	.596	.879
PC1	.678				.687			
PC2	.917				.597			
PC3	.822				.907			
PC4	.911				.812			
PC5	.776				.820			
Technology Use Intention		.896	.792	.919		.726	.623	.829
TUI1	.927				.634			
TUI2	.869				.840			
TUI3	.873				.872			

whereas a flat or low ceiling line indicates that the antecedent does not impose such a constraint. The substantive evidence for necessity therefore lies in the empty space above the ceiling line rather than in the density of the scatter itself. For example, Subjective norms are necessary in Athens; trust and perceived competence are necessary in Birmingham (Fig. 1).

NCA identified subjective norms as a necessary condition in the Athens study. Conversely, the Birmingham analysis revealed two necessary antecedents: (i) trust, and (ii) perceived competence. Subsequently, only the second and third configurations from Athens, the Usage-Norm consumers (A2) and the Cognitive-Competence users (A3), are considered acceptable, as the first and fourth solutions lack the necessary condition of subjective norms and are therefore excluded from further analysis. In contrast, the first and fourth configurations from Birmingham, the Cognitive-Competence users (B1) and the Cognitive Trust-in-Competence users (B4), are deemed acceptable, whilst the remaining three (second, third, and fifth) are excluded due to the absence of a necessary condition. Comparing findings across the two datasets, only one acceptable pathway is shared, the Cognitive-Competence users, corresponding to Athens' A3 and Birmingham's B1.

Table 5
Sufficient configurations.

	Sufficient Pathways				
Athens	*A1*	*A2*	*A3*	*A4*	
Perceived Usefulness	●	⊗		⊗	
Ease of Use	●	●	⊗	⊗	
Subjective Norms	⊗	●	●		
Cognition	●	⊗	●	●	
Trust		⊗	●	●	
Perceived Competence	⊗		●	●	
Socio-demographic					
Age		●	●	●	
Consistency	.84562	.83546	.81038	.79203	
Raw coverage	.34029	.33126	.28481	.32034	
Unique coverage	.06039	.09392	.07947	.08302	
Solution consistency	.81735				
Solution coverage	.35035				
Birmingham	***B1***	***B2***	***B3***	***B4***	***B5***
Perceived Usefulness		●	●	⊗	⊗
Ease of Use	⊗	⊗	●	⊗	●
Subjective Norms	●	●			●
Cognition	●	●	●	●	⊗
Trust	●	⊗	⊗	●	
Perceived Competence	●	⊗	⊗	●	⊗
Socio-demographic					
Age	●			●	●
Consistency	.83923	.81927	.80392	.78038	.77391
Raw coverage	.31592	.28293	.32910	.31864	.29629
Unique coverage	.08437	.05920	.07546	.06835	.08280
Solution consistency	.80569				
Solution coverage	.34028				

Note: A2 = Usage-Norm Consumers; A3 = Cognitive-Competence Users; B1 = Cognitive-Competence Users; B4 = Cognitive Trust-in-Competence Users.
●: Membership.
⊗: Non-membership.
Blank: Irrelevant.

Table 6
Size effects.

	Athens			Birmingham		
	ce_fdh	*cr_fdh*	*p*	*ce_fdh*	*cr_fdh*	*p*
Perc. Usefulness – Techn. Use Intention	.125	.063	.054	.083	.059	.161
Ease of Use – Tech. Use Intention	.115	.057	.404	.016	.008	.920
Subject. Norms – Techn. Use Intention	.146	.098	.010	.121	.061	.377
Cognition – Techn. Use Intention	.117	.082	.098	.079	.049	.152
Trust- Techn. Use Intention	.098	.066	.303	.169	.109	.040
Perc. Compet. – Techn. Use Intention	.066	.033	.546	.142	.110	.006

Each city also retains one additional, context-specific acceptable pathway (Athens: Usage-Norm Consumers; Birmingham: Cognitive Trust-in-Competence users), which, although present as a sufficient configuration in the other dataset, fails to meet acceptability criteria there due to the absence of that dataset's necessary conditions. Accordingly, subsequent interpretation focuses only on the acceptable pathways: the Usage-Norm Consumers and the Cognitive-Competence users in Athens, and the Cognitive-Competence users and the Cognitive Trust-in-Competence users in Birmingham.

5. Discussion

5.1. Confirmation of tenets

Tenet confirmation is examined from fsQCA results (i.e., the

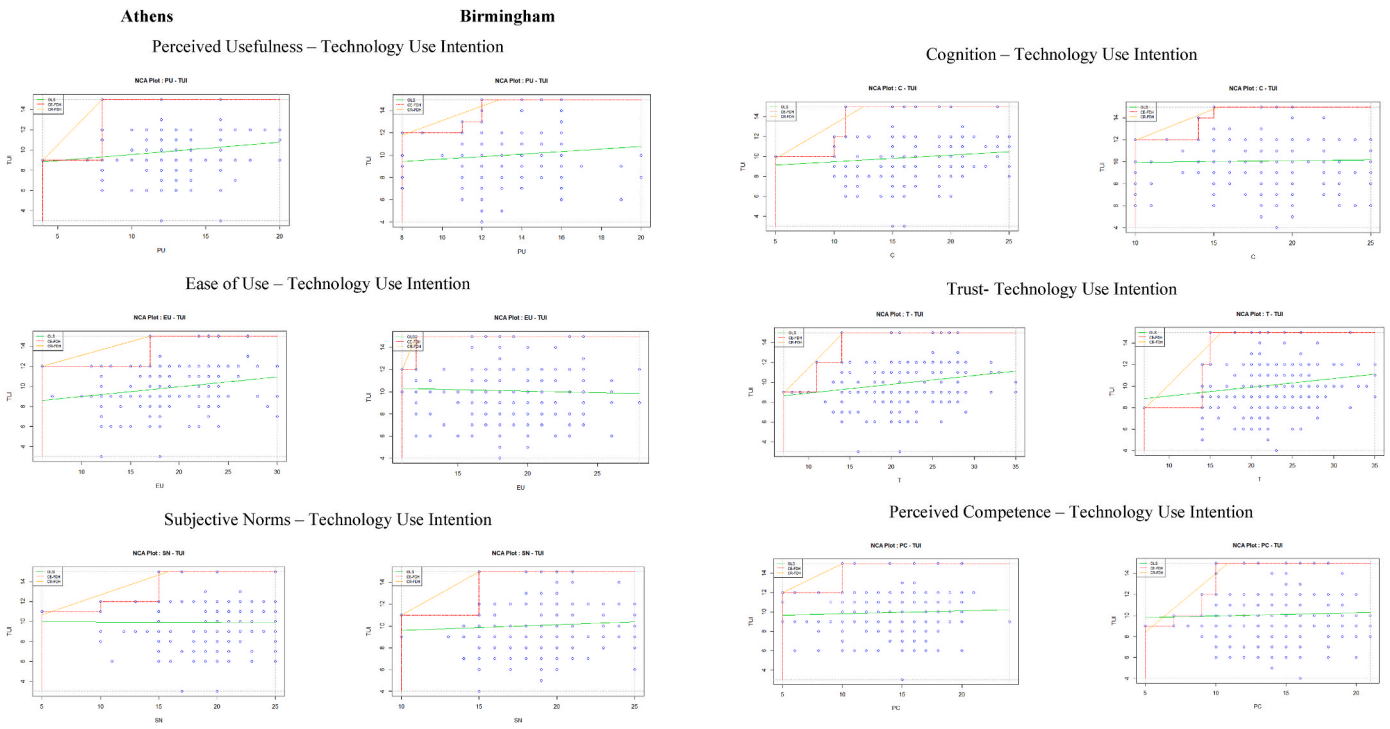


Fig. 1. NCA plots, the ceiling lines for the six antecedents of technology use intention among silver tourists in Athens and Birmingham.

identification of sufficient pathways) and should not be conflated with necessity analysis outcomes (Pappas, 2023; Pappas and Woodside, 2021). Accordingly, all six tenets are confirmed in both contexts. Specifically, each examined antecedent (i.e., perceived usefulness, ease of use, subjective norms, cognition, trust, perceived competence) appears in at least one sufficient pathway leading to technology use intention in both datasets, confirming T1. Conversely, following the contrarian case analysis, none of these antecedents are present across all four (Athens) or five (Birmingham) configurations, confirming T4. All generated pathways in both datasets incorporate at least two simple conditions, confirming the recipe principle (T2). Collectively, all configurations derived from both contexts can produce the desired outcome (technology use intention), confirming the equifinality principle (T3). The highest unique coverage (.09 for Athens; .08 for Birmingham) does not constitute a high outcome score, confirming T5. Furthermore, the highest raw coverage (.34 for Athens; .32 for Birmingham) demonstrates that no single pathway captures all examined cases, thus confirming T6.

These confirmations align with complexity theory's emphasis on multi-causality, equifinality, and causal asymmetry (Ragin, 2008; Ordanini et al., 2014; Olya and Mehran, 2017; Pappas and Woodside, 2021), reinforcing that silver tourists' decisions emerge from configurations of conditions rather than from any single dominant predictor. In rational choice terms (Simon, 1955), older travelers evaluate bundles of benefits and constraints, and that different boundedly rational "regimes" of evaluation can lead to the same intention to use tourism technologies (Simon, 1997).

5.2. Acceptable pathways

The integrated fsQCA-NCA results identify two acceptable pathways in each dataset. In Athens, the first acceptable pathway concerns the Usage-Norm Consumers, which combines ease of use and subjective norms. This pathway indicates that, in the Greek context, technology use intention becomes more plausible when digital tools are perceived as manageable and when important social referents support their use. In line with prior literature, ease of use reduces cognitive and effort-related barriers, while subjective norms provide the social endorsement that older adults often rely upon when evaluating unfamiliar technological options (Ajzen, 1991; Fang et al., 2019; Van Dijk, 2005; Van Deursen and Van Dijk, 2019).

Another acceptable pathway is shared in both Athens and Birmingham, the Cognitive-Competence users, which combines subjective norms, cognition, trust, and perceived competence. This pathway suggests that social endorsement alone is not sufficient; technology use intention is strengthened when older adults also perceive themselves as capable of using digital tools and able to rely on them for structured and meaningful decision support. In this sense, cognition and perceived competence reinforce the rational attractiveness of technology by reducing uncertainty and increasing users' confidence in their own ability to make satisfactory tourism choices (Marzi et al., 2023; Seifert and Schlomann, 2021). However, such shared results still should be interpreted in conjunction with the local necessity structure, where, for example in the UK, trust and perceived competence operate as non-compensatory conditions.

The final acceptable pathway in Birmingham is related with the Cognitive Trust-in-Competence users, which combines cognition, trust, and perceived competence. This pathway indicates that in a more individualist and digitally mature context, older adults are more likely to intend to use tourism technologies when they believe the technology supports informed decision-making, can be trusted, and is within their capabilities to use successfully. Trust is especially important here because digital tourism decisions involve uncertainty, financial risk, and service intangibility, all of which heighten the need for secure and credible digital environments (Tuomi et al., 2023; Czaja et al., 2018).

Taken together, these acceptable pathways demonstrate that technology adoption among silver tourists is configurational and context-sensitive rather than driven by isolated net effects. In Athens, the acceptable pathways give greater prominence to social endorsement, consistent with a context in which collective influence and digital unevenness shape the rational evaluation of tourism technologies. In Birmingham, the acceptable pathways place greater emphasis on trust and competence, reflecting a context in which personal control, confidence, and perceived reliability more strongly structure adoption intentions.

The cross-context overlap of the Cognitive-Competence users'

pathway is also theoretically important. It suggests that some bounded rational-choice logics are robust across cultural settings, while others remain context-dependent in their composition and necessity structure. Thus, the findings do not suggest that the same factors matter equally everywhere; rather, they show that technology use intention emerges through different combinations of conditions whose salience depends on the cultural and structural environment in which older adults make tourism decisions.

5.3. Post-evaluation of findings

In accordance with recent methodological guidance in configurational research, and consistent with a long-standing tradition of engaging practitioners directly in the validation of management findings (Ottosson, 2003), a post-evaluation of the findings was conducted through six semi-structured interviews with tourism enterprise managers, three from Greece and three from the United Kingdom, in order to assess the practical plausibility and ecological validity of the acceptable pathways identified through the integrated fsQCA-NCA analysis (Pappas and Woodside, 2021). Each national group of managers was asked to assess only the acceptable pathways derived from its own country context, on the grounds that respondents were expected to possess stronger contextual knowledge of operational realities in their domestic market than in the other national setting under study. Each interview lasted between 30 and 45 min. After receiving a brief overview of the research, participants were presented with the acceptable pathways and invited to comment on whether these reflected the actual conditions shaping silver tourists' technology use intentions in practice.

Overall, the interview data supported the contextual plausibility of the retained pathways. Rather than challenging the configurational results, the managers largely confirmed that the identified combinations captured realistic patterns in how older adults approach tourism-related technologies, thereby strengthening the ecological validity of the findings. The interviews were particularly useful in clarifying how the statistically derived pathways translate into recognizable managerial problems and intervention points within each national context.

With regard to the Greek setting, all three managers emphasised that older tourists often encounter significant practical barriers when attempting to use digital tourism tools, and they noted that these difficulties become more pronounced among the oldest respondents. The managers also stressed that social influence remains highly important in shaping adoption decisions, especially when older adults rely on family members or trusted peers for encouragement and informal assistance. This interpretation is consistent with the Athens Usage-Norm Consumers, which suggests that technology use intention becomes more likely when ease of use is reinforced by social endorsement, and with the Athens Cognitive-Competence users, where confidence and decision-support benefits operate within a socially influenced environment (Simon, 1955; Abbasi et al., 2015; Marzi et al., 2023).

More specifically, two of the Greek managers indicated that older travelers are much more willing to engage with digital booking and information systems when those systems are perceived as simple and when close social referents signal that their use is appropriate or beneficial. A third manager added that some older adults are willing to use technology more independently, but only when they feel capable of navigating it and when the system helps them compare options and reduce uncertainty. These observations do not merely restate the statistical findings; they illustrate why the identified Athens pathways are managerially credible in a context where social support and usability remain deeply intertwined with digital adoption among older adults (Van Dijk, 2005; van Deursen and Van Dijk, 2019; Seifert and Schlomann, 2021).

In the Birmingham setting, the managers supported the interpretation that the importance of trust and perceived competence as central conditions shaping silver tourists' willingness to engage with digital tourism technologies. Their comments strongly supported the Birmingham Cognitive-Competence users and the Cognitive Trust-in-Competence users, particularly by emphasising that older adults are unlikely to rely on digital channels unless they perceive them as both manageable and trustworthy. In this respect, the interview evidence aligns closely with the necessity analysis, which identified trust and perceived competence as non-compensatory conditions in the Birmingham dataset (Dul, 2016a; Dul, 2022).

Two of the UK managers further argued that trust carries particular weight in tourism because travel purchases are costly, uncertain, and discretionary, making security, reliability, and transparency especially salient for older consumers. One manager also suggested that the interplay between trust and competence shapes how older adults cognitively evaluate whether a platform is worth using at all, because even a potentially useful system may be rejected if it appears risky or difficult to control. In addition, some managers observed that the Cognitive-Competence users may be especially visible among younger segments of the silver market, who remain more exposed to technology through everyday routines, although another interviewee noted that this pathway can also apply to older cohorts when sufficient familiarity and confidence are present.

Taken together, the post-evaluation interviews add an important layer of external interpretive support to the configurational analysis. They indicate that the acceptable pathways are not only statistically defensible but also recognizable to practitioners who work directly with older tourism consumers in the two contexts. Accordingly, the post-evaluation strengthens confidence that the identified pathways capture practically meaningful adoption logics rather than abstract set-theoretic artefacts, thereby enhancing the overall credibility of the study's cross-cultural findings (Pappas and Woodside, 2021).

5.4. Theoretical implications

The findings advance bounded Rational Choice Theory (RCT) by demonstrating how silver tourists make technological decisions through culturally contingent configurations of utilities and constraints, rather than linear net effects (Simon, 1955; Becker, 1976; Hechter and Kanazawa, 1997; Ostrom, 1998). Classical RCT assumes exhaustive optimisation, but our results show bounded satisficing: technology adoption occurs via equifinal pathways where conditions like ease, norms or cognition, trust, and competence jointly yield satisfactory net utility (Simon, 1997; Chen and Chan, 2014). Athens's norm-heavy pathways reflect social utilities dominating in collectivist settings (Hofstede, 2001; Erumban and De Jong, 2006), while the Birmingham's trust-competence focus illustrates individualised risk-benefit trade-offs in mature digital ecosystems (Czaja et al., 2018). The acceptable configurations show that older adults adopt tourism technologies when specific bundles of perceived usefulness, ease, norms, cognition, trust and competence cohere into "good enough" options that satisfy aspiration levels within their cognitive and infrastructural limits, consistent with satisficing and fast-and-frugal heuristics (Gigerenzer and Gaissmaier, 2011; Mata et al., 2012).

Complexity theory is enriched by confirming tenets of conjunctural causation, equifinality, and asymmetry (see, Ragin, 2008; Pappas and Woodside, 2021). No single condition suffices alone (T1/T4), multiple configurations exist (T3), and necessities like norms (Athens - Greece) or trust/competence (Birmingham - UK) impose non-compensatory thresholds (Dul, 2016a, 2020). These patterns are consistent with multi-causal emergence in adoption decisions and support the interpretation that compensatory models such as TAM may understate the conjunctural nature of technology adoption (e.g., Venkatesh and Davis, 2000).

Beyond Rational Choice and complexity perspectives, the findings refine digital divide theory in tourism by demonstrating that divides among older adults are configurational rather than purely additive (Fang et al., 2019; Minghetti and Buhalis, 2010). In Greece, low ease of use combined with weak supportive norms renders digital channels an

unattractive, irrational option despite moderate access, while in the UK, trust and perceived competence necessities create persistent divides when security and self-efficacy constraints bind even amid high infrastructural maturity, both aligning with research framing non-adoption as rational responses to asymmetrical skills, support, and risks (Van Dijk, 2005; Chen and Chan, 2014; Czaja et al., 2018; Seifert and Schlomann, 2021). Overall, the study shows that silver tourists' digital inclusion or exclusion emerges from culturally contingent combinations of structural, social and psychological conditions, extending existing models that treat these influences largely in isolation.

Methodologically, the research illustrates the value of combining fsQCA and NCA in cross-cultural service studies of technology adoption. FsQCA alone would have suggested a relatively large set of empirically sufficient configurations, but the integration with NCA enables a more disciplined selection of acceptable pathways by imposing necessity constraints, thus avoiding over-interpretation of configurations that lack theoretically critical conditions. This two-step approach answers recent calls (see, Dul, 2022; Pappas and Woodside, 2021; Geremew et al., 2024; Kumar et al., 2024) in configurational research to move beyond sufficiency-only analyses and to explicitly model bottlenecks that define the feasible space of outcomes in complex consumer decisions.

5.5. Practical implications

The findings provide clear, context-specific levers for tourism managers and platform designers seeking to increase digital adoption among silver tourists. Because adoption intentions are driven by different configurational pathways in Athens and Birmingham, managerial strategies must be culturally and structurally tailored to the specific necessity constraints and sufficient conditions identified in each context. In collectivist, digitally uneven environments such as Athens, interventions should focus on the Usage-Norm consumers and the Cognitive-Competence users. Practically, this implies:

Leverage social influence mechanisms: Since subjective norms are a necessary condition for adoption in this context, platform developers should embed social proof directly into the user interface. This includes features like "family-recommendation" widgets, testimonials from peers, or shareable booking summaries that allow older adults to seek informal validation from family or friends before committing to a purchase.

Simplify for the "Usage-Norm Consumers pathway" consistency: To support the Usage-Norm Consumers pathway, tourism platforms should prioritize interface minimalism. Reducing the number of steps, increasing font sizes, and providing clear, low-friction navigation are essential because they combine with social norms to make adoption a "good enough" rational choice.

Co-delivered training: Recognizing that cognitive competence is a necessary component of the Cognitive-Competence users, destination managers and local tourism associations should provide digital training that is co-delivered with family members or peer groups. This approach reinforces both the perceived ability to use the tools and the social approval of doing so.

In individualist, digitally mature settings such as Birmingham, interventions should focus on the Cognitive-Competence users and the Cognitive Trust-in-Competence users. The managerial priorities here are fundamentally different:

Prioritize trust-building mechanisms: Since trust is a necessary condition, platforms must treat transparency as a core design feature rather than an afterthought. This involves prominently displaying security certifications, offering unambiguous money-back or cancellation policies, and providing clear, verifiable information about the tourism provider. For a silver tourist navigating a potentially risky high-value purchase, these trust signals are not optional—they are the bottlenecks that determine whether the technology is considered a viable option at all.

Support self-efficacy through "assisted digital" channels: The Cognitive-Competence users' pathway indicates that technology intention is higher when users believe they can manage the process. To bridge gaps in self-efficacy, platforms should offer "assisted digital" features—such as one-click access to a human assistant or a step-by-step "senior mode" overlay that guides the user through the booking process without overwhelming them with data.

Communicate structured decision support: Because the Cognitive Trust-in-Competence users' pathway relies on cognition, marketing and design should emphasize how the tool helps the user compare options logically. Highlighting comparative tools, price alerts, and transparent reviews helps older adults use the technology to structure their own travel decisions, which satisfies the rational need for control and reliable outcome prediction typical of this individualist cultural context. Because the Cognitive-Competence users pathway is the only configuration retained as acceptable in both Athens and Birmingham, it carries a further managerial implication: interventions that jointly reinforce perceived competence and cognition-supportive interface design, such as structured comparison tools paired with light-touch digital training, are not confined to a single cultural context but constitute a transferable design principle. Evidence on collaborative digital service ecosystems similarly indicates that trust-based configurations among service actors can be replicated across markets (Dalenogare et al., 2023), suggesting that platform providers could pursue alliance-based scaling strategies of the kind documented in other technology sectors (Yasuda and Iijima, 2005) when extending this shared pathway to additional European contexts, alongside the context-specific layers discussed above (norm--based social proof in Athens; trust signalling in Birmingham).

For both contexts, the overarching practical insight is that silver tourists are not a monolithic block. Destination managers and developers must move away from "one-size-fits-all" digital design. By mapping interventions onto these named pathways, they can design service ecosystems that respect the specific bounded rationalities and cultural constraints that make technology adoption a rational, beneficial choice for older tourists.

5.6. Study limitations and future research

The study has several limitations that open avenues for future research. First, even if mitigated by post-evaluation interviews, the data are cross-sectional and capture intentions rather than actual behaviour, which constrains causal inference and may not fully reflect how older adults adapt their technology use over time or across specific trips. Longitudinal or experience-sampling designs could track how repeated interactions with tourism technologies reshape perceived usefulness, trust, and competence, and whether the identified configurations remain stable as cohorts age and digital literacy increases.

Second, the urban empirical focus on Greece and the UK, while theoretically motivated as contrasting rational-choice contexts, limits generalisability to other cultural and infrastructural settings. Future research could replicate the design in additional countries and city types (e.g., rural destinations, emerging economies, or highly digital "smart cities") to test whether similar or new configurations emerge, and to examine whether the identified necessary conditions (subjective norms vs. trust and competence) hold elsewhere. Third, the study concentrates on six core conditions and does not explicitly model other potentially relevant antecedents such as technology anxiety, health status, income constraints, or specific platform features. Subsequent configurational work could incorporate these variables, or use multi-method designs combining fsQCA with in-depth qualitative studies, to capture how structural vulnerabilities and interface design choices interact with the present conditions. Finally, although the post-evaluation interviews with tourism managers enhance ecological validity, customers' and caregivers' perspectives on the proposed pathways remain underexplored; future studies could triangulate managerial, user, and caregiver views to refine and prioritize interventions aimed at inclusive digital tourism for ageing populations.

6. Conclusion

This study examined how silver tourists in Athens and Birmingham form intentions to use digital tourism technologies, interpreting their decisions through a complexity-informed bounded Rational Choice framework. By integrating fsQCA and NCA, the analysis moved beyond linear net-effect models to uncover the distinct, context-sensitive configurations that structure technology adoption in two major tourism markets with differing digital maturity and cultural orientations.

The configurational analysis identified two acceptable complex solutions per context: the Usage-Norm consumers' pathway and the Cognitive-Competence users' configuration in Athens, and the Cognitive-Competence users' pathway and the Cognitive Trust-in-Competence users' configuration in Birmingham. These findings validate that technology adoption among older tourists is not driven by a single dominant predictor, but rather by culturally contingent pathways of perceived usefulness, ease of use, subjective norms, cognition, trust, and perceived competence. Importantly, the necessity analysis revealed that subjective norms function as a critical bottleneck in the collectivist Athens context, whereas trust and perceived competence act as non-compensatory constraints in the individualist Birmingham context.

Theoretically, the study advances bounded Rational Choice Theory and digital divide literature by demonstrating how utilities and constraints combine in non-linear ways to make technology use a "satisfactory" rational option for ageing adults. Methodologically, it demonstrates the rigor of integrating sufficiency and necessity logics to identify practically meaningful pathways, providing a robust toolkit for future cross-cultural configurational research. Practically, the results equip destination managers and platform developers with concrete, context-tailored levers: in Athens-type contexts, interventions should prioritize interface simplicity and social-endorsement mechanisms, whereas in Birmingham-type contexts, the focus must shift to building institutional trust and reinforcing user competence.

By situating these insights within a broader complexity-informed framework, this study closes by returning to the three contributions signposted at the outset. Theoretically, the findings extend bounded Rational Choice Theory and digital divide scholarship by showing that technology adoption among ageing tourists follows culturally contingent configurations rather than linear, compensatory logic. Methodologically, the integration of fsQCA and NCA, reinforced by post-evaluation interviews with practitioners, offers a replicable template for future cross-cultural configurational research on inclusive innovation. Practically, the study equips destination managers and platform developers with culturally differentiated, and in one case cross-market, intervention levers for designing more inclusive digital tourism ecosystems. Future research may extend these findings by tracking how these configurations evolve as digital literacy increases across ageing cohorts, or by replicating this study in diverse cultural and infrastructural environments to further refine the global understanding of inclusive digital tourism.

CRediT authorship contribution statement

Andrea Caputo: Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Seckin Celik:** Writing – review & editing, Writing – original draft. **Christina Karadimitriou:** Writing – review & editing, Writing – original draft, Validation, Investigation. **Mariya Kargina:** Writing – review & editing, Writing – original draft. **Nikolaos Pappas:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of generative AI in manuscript preparation

In the course of preparing this manuscript, the authors employed Claude.ai (Sonnet 4.6 Thinking) for language refinement. All outputs were carefully reviewed and revised by the authors, who assume full responsibility for the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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