



Technological identity and basic psychological needs in the use of new technologies: A two-wave cross-national survey study

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ABSTRACT

AI and smart technologies are increasingly embedded in almost all aspects of everyday life, and their usage might inevitably affect individuals' self-concept and psychological and social well-being. Evidently, cross-national and longitudinal analyses of this phenomenon and its mediating factors are required. To this end, our study examined how in-group identification with new technology users influences individuals' satisfaction of the basic psychological needs of autonomy, competence, and relatedness in the context of new technology use. We used longitudinal two-wave data collected from 18- to 75-year-old adult populations in Finland ($N = 1541$), France ($N = 1561$), Germany ($N = 1529$), Ireland ($N = 1112$), Italy ($N = 1530$), and Poland ($N = 1533$). Based on hybrid multilevel regression models, we found consistent evidence across these six European countries that individuals' in-group identification with new technology users is positively associated with relatedness but negatively associated with autonomy and competence. Our results suggest that the level of social identification with other technology users is a meaningful social context that shapes the well-being outcomes of new technologies.

1. Introduction

The role of artificial intelligence (AI) and smart technologies in everyday life is on the rise (Dwivedi et al., 2021; Ooi et al., 2025). They are not only capable and autonomous in executing various complex tasks but are increasingly embedded in almost every aspect of modern life (Chataut et al., 2023; Maslej et al., 2024). These new technologies are characterized by intensified human–technology interactions, as people now can, more than ever before, share their agency and collaborate with technologies (Cornelio et al., 2022). Individuals regularly use technologies and devices that include AI solutions—virtual agents, smart home devices, chatbots, wearable health monitors, and so on—which connect them with others, help them perform everyday tasks, offer and filter information, and entertain them. At best, using these technologies can improve and simplify everyday life, but they can also pose a threat to human autonomy and well-being (Schmager et al.,

2025). Increasingly common use of AI and smart technologies inevitably affects how individuals perceive themselves and others while simultaneously influencing one's psychological and social well-being (Büchi, 2024; Ozmen Garibay et al., 2023). The following question then emerges: How is the usage of these technologies associated with individuals' sense of self and digital well-being?

Although past research has investigated the impact of advanced technologies on users' well-being (Li et al., 2023; Pataranutaporn et al., 2021; Schmager et al., 2025), they have yielded both positive and negative findings (Malodia et al., 2021; Yang and Aurisicchio, 2021) and significant knowledge gaps remain, particularly in terms of how emerging technologies integrate as part of personal and social identities and everyday lives of users' in different contexts. Specifically, the satisfaction of basic psychological needs in the use of new technologies, such as AI-driven applications, has been highlighted as an important but so far underexplored research area (Bingley et al., 2023; Moradbakhti

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et al., 2022).

Our study aimed to fill this gap and explore the association between in-group identification with new technology users and the satisfaction of basic psychological needs for autonomy, competence and relatedness in new technology use. Identification with a social group has been demonstrated to relate with psychosocial well-being (Haslam et al., 2018; Jetten et al., 2017), but this association has not been studied in the context of technologies. We also consider it important to understand the phenomenon of technological *newness*. What users perceive as new can vary in time and between people, but the drive for novelty is often crucial in technological changes involving high-end technology users. Therefore, understanding self-identification with other similarly minded users is essential when investigating new technologies and their impacts.

In our two-wave longitudinal and cross-country study across six European countries, we analyzed whether social identification as a user of new technologies promoted or hindered satisfaction with autonomy, competence, and relatedness. Since countries have varying technological infrastructures (Eurostat, 2023), it may diversify how individuals of different countries interact and identify with new technologies. Thus, conducting a cross-national inquiry allowed us to better understand the broader impact of technologies across different cultural contexts and norms, as the variations can have different implications for well-being.

1.1. Self-determination approach

According to self-determination theory (SDT), which is an empirically validated and widely applied theory of human behavior, wellness, and motivation (Ryan & Deci, 2000; Ryan & Deci, 2017), the fulfillment of an individual's three basic psychological needs—autonomy, competence, and relatedness—is fundamental for their well-being. The social context and environment are crucial, as they determine whether needs can be fulfilled or thwarted. SDT describes autonomy as the experience of willingness and volition in one's actions. It embodies self-endorsed behavior that is in line with one's values and aspirations. Competence refers to feeling efficient and masterful when performing tasks and pursuing desired goals. Relatedness is about feeling socially connected, having a sense of belonging, caring for others, and being cared for by others. These three needs are equally important; each must be fulfilled for a person to flourish (Ryan & Deci, 2000). Need frustration is then linked to vulnerability, maladjustment, and reduced well-being (Vansteenkiste and Ryan, 2013; Vansteenkiste et al., 2023). The role of autonomy, competence, and relatedness needs has been found to be universal across cultures and individual differences (Chen et al., 2015).

Basic psychological needs theory (BPNT), one of the six mini-theories of SDT, has a unifying role: It interconnects theories on intrinsic and extrinsic motivation, internalization of self-regulation, personality differences, goal contents, and social relationships (Vansteenkiste et al., 2023). SDT and BPNT have been studied in various fields, such as education, health, and work life (Deci et al., 2017; Howard et al., 2021; Ntoumanis et al., 2021). Past research has also investigated the role of psychological needs satisfaction in engagement with technology. For instance, the satisfaction of basic needs has been shown to associate positively with acceptance and adoption of technologies, and the motivation to use them (Lu et al., 2019; Nikou & Economides, 2017; Sahin & Sahin, 2022). They have also been found to predict AI attitudes (Bergdahl et al., 2023).

Recently, research has increasingly utilized the self-determination approach to study the impact of technologies on individual needs satisfaction and implemented this understanding to design technologies that better support subjective well-being. Peters and colleagues (2018) were the first to present the model of Motivation, Engagement, and Thriving in User Experience (METUX), which assumes that basic psychological needs are the key mediators between technology and human well-being. The model acknowledges five different spheres within which technology influences psychological needs satisfaction: when a technology is adopted, when interacting with its interface, as a result of

engagement with technology-specific tasks as part of the technology-supported behavior in one's overall life, and, finally, beyond user experience, through indirect effects as well as non-user experiences of technologies in the overall society.

The METUX model is based on the idea that interaction with technologies shapes the possibility of needs satisfaction at a variety of levels. For instance, human autonomy and competence can be supported when technologies help people remove obstacles and achieve their self-endorsed goals, thus providing them with a sense of personal accomplishment (Moradbakhti et al., 2024; Peters et al., 2018). However, autonomy can be thwarted when a user does not feel in control of the technology and its use, or when they experience external pressure to use technology (Peters et al., 2018). Technologies may hinder competence when they make people feel less efficient and lack mastery (Peters et al., 2018). Accordingly, technologies can help people connect with others and maintain social relationships, but they can also make users feel socially isolated and lonely (Marikyan et al., 2019; Murari et al., 2024). The METUX model proposes that impacts of technologies are both technology- and sphere-dependent. A study of Burnell et al. (2023) showed that technologies (Facebook, TikTok, Blackboard, and Moodle) varied in how they were able to fulfill psychological needs in different spheres. Users' evaluations of the technologies were also found to be associated with need satisfaction, especially in the life and behavior spheres, which highlight technologies' broader-than-fleeting effect on people's lives (Burnell et al., 2023).

Studies have demonstrated mixed findings on emerging technologies' influence on well-being and need satisfaction. For example, smart homes can boost self-esteem, adaptability, and competence yet also increase social isolation (Marikyan et al., 2019), with research largely focused on older adults. Moreover, it has been systematically shown that conversational agents in health care settings decrease their users' psychological distress and promote positive mental health (Li et al., 2023; van Agteren et al., 2021). Generally, virtual assistants have been found to enhance social well-being to some extent; however, in the long term, they struggle to fulfill social needs, such as maintaining a sense of closeness (Croes and Antheunis, 2021; McLean & Osei-Frimpong, 2019).

The satisfaction of basic psychological needs has also been explored in the interface, task, and behavior spheres of user experience. For example, a study on the use of wearable activity trackers found an increase in autonomy and competence when the trackers helped users achieve their goals (Karapanos et al., 2016). Activity trackers were also found to support relatedness when they connected their users to online communities composed of people with similar goals and with family and friends who used the same trackers. However, the study showed that in the long-term trackers' positive impact faded (Karapanos et al., 2016). Yang & Aurisicchio (2021), who focused on conversational agents, discovered that users felt more competent when they had complete knowledge of the agents' capabilities and when the conversations with them were effective and smooth. The users' autonomy was influenced by their perceived control over the conversations, as inconsistent and unpredictable answers caused frustration with autonomy. Personalized experiences and the ability to control data however supported autonomy. The study showed mixed findings on relatedness. When users wanted to keep in touch with their family and friends, they did not prefer conversational agents—they were only considered useful for connecting with larger social channels and communities as well as for facilitating social activities (Yang & Aurisicchio, 2021). Finally, research on in-vehicle technologies further demonstrated that different types of technologies have different kinds of impacts on the fulfillment of drivers' basic psychological needs (Stiegemeier et al., 2024). For example, infotainment and navigation systems enhanced users' relatedness; however, assistance systems—perhaps because drivers felt a loss of control when using them and preferred their own actions—lowered satisfaction of each need, autonomy, competence, and relatedness.

1.2. Technological social identity

Technologies shape our self-perceptions and identities when they are an integrated part of everyday life, important tasks, and our social networks. Past research on identity and technology has primarily explored self-identification with technology. [Carter and Grover \(2015\)](#) defined information technology (IT) identity as “the extent to which an individual views use of an IT as an integral part of his or her sense of self,” with identification ranging from weak to strong. They proposed that individual IT identity forms when a user interacts regularly with a certain technology, and when it is beneficial in a personally significant situation. The embeddedness of technology and identity are thus dependent on the regularity and context of technology use.

The strength of one’s IT identity influences one’s technology use. For example, those with strong IT identities use technology more diversely and are more willing to discover new ways to use it ([Carter et al., 2020a](#); [Carter et al., 2020b](#)). This body of identity and technology research suggests that the question of identity is crucial for understanding the impact of new technologies. As social beings, people inherently seek a sense of belonging with like-minded others. When it comes to learning and adopting new behaviors, such as technology use, the influence and example of others are likely to play a significant role. Individuals might also adopt technologies to fit into a desired social group ([Malodia et al., 2021](#)). However, regarding the social identity of technology users, only limited knowledge exists.

Group-level research on technologies, especially concerning social media usage, has shown that social identification with online communities affects one’s behavior through group norms and is associated with increased and problematic social media use ([Marino et al., 2016](#)). Moreover, individuals are more prone to participate in certain online activities when the activities align with the expectations and norms of an in-group ([Zhou, 2011](#)). Overall, social identification with online communities and other in-group members within technology users has been found to not only offer social support but also encourage problematic behaviors, such as addictive behavior ([O’Connor et al., 2015](#); [Savolainen et al., 2019](#); [Travaglino et al., 2020](#); [Vepsäläinen et al., 2024](#)).

The social identity approach (SIA), grounded in social identity theory and self-categorization theory ([Tajfel and Turner, 1979](#); [Turner, 2010](#)), outlines the significance of group memberships and group dynamics for human behavior. The minimal group experiments conducted by [Tajfel \(1970\)](#) demonstrated how even minimal cues of group membership can influence social behavior and shape how people think and feel about themselves and others. Social identities are built on social categorization and social comparison ([Tajfel & Turner, 1979](#)). Social identification refers to an individual’s self-definition, which is made up of their memberships in social groups and categories. Through the process of in-group identification, a social identity is incorporated into one’s sense of self ([Abrams & Hogg, 1998](#); [Stets & Burke, 2000](#)).

The significance of a particular social identity depends on one’s own definition of belonging to a certain group and how much one considers this group membership emotionally important. According to [Turner \(2010\)](#), when a person is a member of a social category, they create certain beliefs about how members of that in-group and perceived out-groups behave and what separates them. Further, when this group membership is relevant and psychologically central, people tend to behave in accordance with group norms and emphasize the similarities with other group members ([Turner, 2010](#)). Social identities are, however, not static. The salience of a group membership fluctuates based on whether it is useful and relevant in a given situation and context ([Turner & Onorato, 1999](#); [Zinn et al., 2022](#)). Group members can also aspire to leave their group or make their group more positively distinct if the group is not satisfactory for them ([Tajfel & Turner, 1979](#)).

Social identification concerns individuals’ relationships with a social group rather than their relationships with other group members. Thus, following [Tajfel \(1970\)](#), social identification can be defined as assigning positive emotional value to the relationship between a certain in-group

and one’s self ([Postmes et al., 2013](#)). In this study, technological social identity is referred to as one’s in-group identification with new technology users. Following the social identity approach, we assume that self-categorization as a group member of new technology users may become an internalized part of oneself, shaping how one interprets the role of new technologies in their life. Thus, we highlight other technology users, implied or actual, as a meaningful cognitive reference group that may further affect how one engages with and experiences the use of new technologies and their impacts.

1.3. Integrating in-group identification and psychological needs in the context of technology use

SDT, as already mentioned, explains how individuals’ well-being is affected by their social contexts. In-group identification as a technology user can be a meaningful social context that affects one’s satisfaction with one’s basic psychological needs while using technology. Generally, social identification has been recognized as playing a significant role in subjective well-being ([Greenaway et al., 2016](#); [Haslam et al., 2009](#); [Haslam et al., 2018](#)). Empirical studies have shown that having a positive social identity is linked to feeling higher social support, belonging, self-esteem, meaningfulness, control, and efficiency ([Cruwys et al., 2014](#); [Jetten et al., 2017](#)). On the other hand, groups can also harm one’s well-being if they are unsupportive, stigmatized, or promote unhealthy norms, cause stress, and make their members feel excluded, incapable, or unworthy ([Haslam et al., 2018](#); [Häusser et al., 2020](#); [Wakefield et al., 2019](#)). Group memberships influence well-being, particularly because they are psychologically internalized as part of one’s sense of self ([Jetten et al., 2017](#)). Moreover, beyond mere identification, its degree has been shown to be consequential: the more one identifies with a group, the more their membership affects their well-being, both positively and negatively ([Haslam et al., 2018](#); [Sani et al., 2012](#)).

Group memberships can also be considered significant social contexts that shape the possibility of satisfying one’s basic psychological needs ([Kachanoff et al., 2020](#)). Group identification has been found to be positively associated with psychological constructs related to autonomy, competence, and relatedness ([Amiot & Sansfaçon, 2011](#); [Easterbrook & Vignoles, 2012](#); [Greenaway et al., 2015](#); [Greenaway et al., 2016](#); [Legault and Amiot, 2014](#); [Vignoles et al., 2006](#); [Ysseldyk et al., 2018](#)). At the group-member level, [Kachanoff et al. \(2020\)](#) reasoned for the integration of SDT and SIA by explaining that how individuals identify with and relate to members of their groups affects their satisfaction with their needs. For example, individuals seem to experience more autonomy when they identify with a group; they are more willing and prone to follow group customs and norms, as they personally value doing so ([Amiot & Aubin, 2013](#); [Amiot & Sansfaçon, 2011](#); [Amiot et al., 2012](#)). Accordingly, related to SDT’s concept of competence, [Greenaway et al. \(2015\)](#) found systematic evidence that personal control—the “perceived ability to alter events and achieve desired outcomes” (p. 55)—is predicted by in-group identification. Theoretically, [Greenaway et al. \(2015\)](#) and [Kachanoff \(2023\)](#) interpreted this association by explaining that groups help individuals feel more capable of pursuing their goals since a group’s collective experiences of agency and efficacy can be internalized on a personal level. Individuals who identify as group members can thus feel more competent and powerful. In addition, the satisfaction of the relatedness need has been shown to be associated with identifying with both immediate and larger social groups: When one identifies with a specific social group, they feel an increased sense of belongingness and a connection to relevant extended others ([Easterbrook & Vignoles, 2012](#); [Ysseldyk et al., 2018](#)).

Despite growing evidence on how perceived group memberships affect the satisfaction of personal psychological needs ([Kachanoff, 2023](#)), research on technology-related group identification and psychological needs fulfillment is limited. Recently, [Bingley et al. \(2023\)](#) introduced the Social Self-Determination Model (SSDM), which explains how AI systems can treat people differently depending on their group

memberships, and how this impacts both collective and individual basic psychological needs satisfaction. Bingley et al. (2023) suggested that AI systems are able to make some group memberships more salient and psychologically relevant by treating people as members of certain groups. In this way, AI systems can make an individual feel more like a member of a group; at the same time, they tend to act in a way that reflects society’s attitudes toward that group. This can harm, for example, the satisfaction of marginalized groups’ basic psychological needs. Overall, SSDM highlights the importance of understanding social contexts as a crucial determinant that shapes human–technology interactions.

1.4. Cross-national context

Cross-national dimensions are important for understanding technology use and the related dimensions of identity and well-being. While our primary goal was to examine whether identifying as a new technology user is associated with satisfaction of the basic psychological needs for autonomy, competence, and relatedness in technological contexts, the cross-national context provided a rich setting for exploring potential differences between countries that represent the diverse contexts and cultures of Europe, and informing about basic psychological needs fulfilment in different technological and cultural contexts. In our data, six countries represent different regions of Europe, including Northern (Finland), Central (France and Germany), Western (Ireland), Southern (Italy), and Eastern Europe (Poland). We recognize that digital well-being is potentially influenced by countries’ digital infrastructures, welfare policies, and cultural norms. To this end, we have compared countries according to the levels of digitalization of firms, welfare regimes, and cultural values. The main differences are summarized in Table 1.

First, the level of technological development varies across these six countries (Eurostat, 2023; Turja & Oksanen, 2019). Brodny & Tutak (2021) compared European countries in terms of the development of enterprises in big data analysis, cloud computing, 3D printing, robotics, integration of internal processes, integration with customers or suppliers, supply chain management, internet accessibility, and digital skills (ICT training). Considering the overall level of digitalization, the results showed that Finland ranks the top among the EU-27 countries, while Poland ranks significantly lower. Italy was also in the bottom third, while Germany and France were in the middle. In Ireland, digitalization is more advanced than in most European countries. The Stanford Institute’s Global AI Vibrancy comparison (2025) reveals a similar pattern. In terms of per-capita comparison, Finland ranks the highest with strong AI-enabling infrastructure and high public spending on AI, followed by Ireland, and with Poland scoring considerably lower. These differences in digital transformation potentially influence how citizens perceive and identify as users of new digital technologies. Significantly, both rankings

are in line with Eurostat (2023) showing the percent of citizens of the countries with at least basic overall digital skills, Finland ranking the highest (79 %) and Poland (43 %) the lowest. In terms of newer technologies, Ireland, Finland, and France rank higher while Germany, Italy, and Poland rank lower compared to the percent of EU citizens in total using internet-connected home devices (Eurostat, 2023).

Second, the countries represent different models of welfare policy according to the traditional welfare state regime model (Esping-Andersen, 1999; Kammer et al., 2012): Finland from the social democratic model, France and Germany from the continental model, Ireland from the liberal model, and Italy from the southern model. Poland represents a post-communist country in which the welfare state has clearly evolved toward a conservative model since the 1990s (Aspalter et al., 2009). The social democratic model has the highest level of redistribution, with more investment in benefits, pensions, and social insurance with higher taxation. Other models are based on lower taxation, but they organize welfare in other ways: the conservative model is based on insurance-based provision, the southern model stresses the importance of family structure, and the liberal model focuses on individual responsibility and the central role of the market (Kammer et al., 2012).

Finally, beyond digital infrastructure and welfare policy, countries have different cultures and values, with Finland and Germany representing Protestant Europe, France, Poland, and Italy representing Catholic culture, and Ireland representing the English-speaking world (Inglehart and Welzel, 2005; World Values Survey Association, 2023). Hofstede’s cultural model provides a valuable framework for a more in-depth understanding of country differences, and it has been a validated measure for understanding country differences, particularly in the cross-cultural management literature (Hofstede, 1980; Hofstede, 2011; Minkov and Kaasa, 2022; Rubino et al., 2020). On a scale of 0–100, the model describes how the average citizen of a country ranks on different cultural dimensions.

Countries with higher power distance scores (e.g., France and Poland) tend to have centralized authority and top-down decision-making, while countries with lower scores (e.g., Finland and Ireland) have more egalitarian structures. Individualism scores show that Germany, Finland, and France emphasize self-reliance and personal responsibility, while Italy and Poland tend toward collectivism, valuing group loyalty. Most countries show masculine traits that emphasize competition, achievement, and success, with the exception of Finland, which is based on feminine values such as social welfare and quality of life. In terms of uncertainty avoidance, Poland and France prefer clear structures and strict rules, while Ireland shows a more relaxed attitude toward uncertainty. France, Finland, and Germany score high in long-term orientation, suggesting pragmatic and forward thinking, while Italy and Poland are more traditionalist and skeptical of social change. Finally, Ireland and Finland have higher scores in indulgence, indicating

Table 1
Research context: differences between countries in digitalization, welfare policy and cultural dimensions.

Country	EU-27 Ranking in the Digitalization of Firms ^a	Traditional Welfare regime ^b	Hofstede’s Cultural dimensions: ^c					
			Power distance	Individualism	Masculinity	Uncertainty avoidance	Long-term orientation	Indulgence
Finland	1	Nordic	33	75	26	59	63	57
Ireland	7	Liberal	28	58	68	35	51	65
France	10	Continental	68	74	43	86	60	48
Germany	12	Continental	35	79	66	65	57	40
Italy	16	Southern	50	53	70	75	39	30
Poland	18	Post-communist /continental	68	47	64	93	49	29

^a Brodny, J., & Tutak, M. (2021). Assessing the level of digitalization and robotization in the enterprises of the European Union Member States. *PLoS one*, 16(7), e0254993.

^b Esping-Andersen, G. (1999). The three political economies of the welfare state. In *The study of welfare state regimes* (pp. 92–123). Routledge.

^c Data collected from: <https://www.hofstede-insights.com/product/compare-countries/>. On a scale of 0–100, the score describes how the average citizen of each country ranks on different cultural dimensions. Higher number indicates higher position.

greater latitude when it comes to people's enjoyment of life and fulfillment of their desires, whereas Poland and Italy have lower scores, suggesting more restrained societies.

1.5. This study

In this cross-national longitudinal study, we investigated how individuals' in-group identification with new technology users influences their satisfaction with autonomy, competence, and relatedness in the context of new technology use. Though previous studies have found a positive association between social identification and psychological needs in various fields (e.g., Easterbrook & Vignoles, 2012; Greenaway et al., 2015; Greenaway et al., 2016; Legault & Amiot, 2014), research on these associations in the context of new technology use is missing. In light of this, we investigated whether this positive relationship is similar within the use of AI and smart technologies, and whether social identification as a new technology user is a meaningful social resource linked to the satisfaction of basic psychological needs. The results of this study provide a perspective on the role of technological social identity in shaping the user experience and engagement with new technologies, while acknowledging three distinct but essential dimensions that constitute digital well-being. The results offer valuable insights for practitioners to consider the overlooked social identity aspect when implementing new technologies in people's lives.

The combination of longitudinal and comparative approaches enabled us to analyze the temporal relationship between in-group identification and technology-related satisfaction of basic psychological needs at the individual level across different cultural contexts. Additionally, the two-level analysis of longitudinal data helps control for multiple unobservable individual-level factors by design, increasing the validity of associations within respondents and facilitating future studies aiming to establish direct causality. Meanwhile, we were able to consider a range of factors that might explain the observed association within respondents but also affect differences between respondents. Our models controlled attitudes toward AI and the previous use of new technologies, as they were considered important factors in prior research on technology acceptance and use (Venkatesh et al., 2003; Venkatesh, 2022). Moreover, technological integration and technology use impact both social relationships (Sutcliffe et al., 2018) and happiness (Twenge, 2019), and these constructs are closely linked to the satisfaction of psychological needs (Baumeister & Leary, 1995; Ryan and Deci, 2017; Sapmaz et al., 2012). We also accounted for these variables to comprehensively understand the association between one's technological identity and the satisfaction of one's basic psychological needs. Thus, the research questions are as follows:

RQ1: Is higher in-group identification with new technology users associated with higher technology-related autonomy?

RQ2: Is higher in-group identification with new technology users associated with higher technology-related competence?

RQ3: Is higher in-group identification with new technology users associated with higher technology-related relatedness?

2. Methods

2.1. Participants and procedure

The cross-national survey data was collected at two time points (T1 2022 and T2 2023) from adult populations aged between 18 and 75 years in Finland (T1 $n = 1541$, T2 $n = 1094$), France (T1 $n = 1561$, T2 $n = 1014$), Germany (T1 $n = 1529$, T2 $n = 900$), Ireland (T1 $n = 1112$, T2 $n = 587$), Italy (T1 $n = 1530$, T2 $n = 1099$), and Poland (T1 $n = 1533$, T2 $n = 967$). Regarding age and gender, the samples represented the populations of the respective countries (Eurostat, 2024).

The two-timepoint datasets were collected between October and November 2022 and 2023 as part of the Self & Technology -research project (PI: Atte Oksanen). The research and the questionnaire were

designed by the research group. Norstat, a data solutions provider, collected data from all the countries. The questionnaires were translated from English by professional translators into the main language of each country: Finnish for Finland, French for France, German for Germany, Italian for Italy, and Polish for Poland. A back-translation method involving native speakers was also used to ensure the accuracy of the translations.

At T1, Norstat invited the participants via email from their voluntary participant panels to fill out the structured online survey. One year later, the T1 participants were again asked to respond to the survey. The response rate at T2 was 71 % in Finland, 65 % in France, 59 % in Germany, 53 % in Ireland, 72 % in Italy, and 63 % in Poland. The average questionnaire response time was 18.5 minutes in Finland, 16.3 minutes in France, 17 minutes in Germany, 18 minutes in Ireland, 15.6 minutes in Italy and 20.1 minutes in Poland.

The local academic ethics committee reviewed the study protocol in September 2022 and confirmed that all the ethical considerations of the Self & Technology -project were fully met.

2.2. Measures

Autonomy, competence, and relatedness. Our measures, modified to target the satisfaction of basic psychological needs while using new technologies, were based on items from the Technology Effects on Need Satisfaction in Life (TENS-life) scale. Introduced by Peters et al. (2018), this measure was grounded on the validated Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015). Based on their experiences with new technologies, the participants rated 10 statements on a scale from 1 (*does not describe me at all*) to 7 (*describes me completely*). Four of the items measured autonomy (e.g., "The new technologies end up making me do things I don't want to do"). One item that measured autonomy was dropped to gain a better fit value in the confirmatory factor analysis conducted with structural equation modeling. Three items measured both competence (e.g., "Using the new technologies had made me feel less capable in my life") and relatedness (e.g., "Using new technologies has helped me feel a greater sense of belonging to a larger community"). The autonomy and competence items were reverse coded to ensure that higher scores indicated higher need satisfaction. Three-item variables for autonomy, competence, and relatedness were then created, and the final scores for each of the three variables ranged from 3 to 21. The reliability of the scale ranged from good to excellent in every country at both time points using McDonald's ω coefficient (the values ranged between 0.81 and 0.94). See the appendix for all the items we used.

In-group identification with new technology users. Our measure of the participants' in-group identification with new technology users was based on the hierarchical model of in-group identification introduced by Leach et al. (2008). The model differentiates five components of in-group identification (individual self-stereotyping, in-group homogeneity, satisfaction, solidarity, and centrality). We utilized the satisfaction component because a positive evaluation of a certain group is associated with in-group identification (Ellemers et al., 1999). More generally, positive feelings toward a group and one's membership in it have been acknowledged as central indicators of in-group identification (Tajfel & Turner, 1979). We modified the satisfaction component to target in-group identification with new technology users. The participants rated four statements (e.g., "I am glad to be a user of new technologies") on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). One item was dropped to attain an RSMEA lower than 0.08, and the final scale ranged from 3 to 21. The scale reliability was excellent in all countries, and at both time points, with values ranging from 0.92 and 0.96.

AI positivity. We measured the participants' attitudes toward AI using a shortened version of the General Attitudes toward Artificial Intelligence Scale (GAAIS), developed by Schepman and Rodway (2020; 2023). We included four items that measured positive attitudes toward

AI (e.g., “Much of society will benefit from a future full of artificial intelligence”). The statements were rated by participants on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale ranged from 4 to 28. The reliability of the scale ranged from good to excellent in all countries, and at both time points, with values varying between 0.82 and 0.90.

Use of smart technologies. To assess the extent to which individuals use technologies that are increasingly popular but still not traditionally widespread in the general population, we asked the participants how often they used smart technologies such as a) mobile robots or intelligent devices (e.g., robot assistants or vacuum cleaners); b) virtual assistants (e.g., Siri, Alexa); c) wearable smart devices (e.g., smart rings, smart watches); d) augmented reality technologies; and e) virtual reality technologies. The answers were rated on a scale from 0 to 4 (0 = *I do not use*; 1 = *less than weekly*; 2 = *weekly*; 3 = *daily*; and 4 = *many times a day*). These categories were selected to represent technologies that, while becoming more prevalent, may still be perceived as new by individual users. For each response greater than 0, a point was earned. We summarized all the items to create a composite score capable of reflecting our participants’ overall use of smart technologies. Given the five categories of technologies for which each could earn a point, the final score ranged from 0 to 20. The reliability of the scale ranged from 0.68 to 0.79 in all countries and at both time points.

Use of well-being and health technologies. We measured our participants’ use of well-being and health technologies by asking them the following question: “How often do you use the following technologies to track your well-being and health?” The items involved the following: a) smart phone health or well-being app; b) well-being coaching app; c) fitness tracker or watch; and d) smart ring. The answers were rated on a scale from 0 to 4 (0 = *I do not use*; 1 = *less than weekly*; 2 = *weekly*; 3 = *daily*; and 4 = *many times a day*). We summarized all the items together to track the participants’ overall use of health technologies. The scale

ranged from 0 to 16, and its reliability ranged from 0.69 to 0.81.

Close relationships. We used the Social and Emotional Loneliness Scale for Adults (SELSA) developed by DiTommaso and Spinner (1993) to measure the participants’ close social relationships with family and friends. They rated nine statements (e.g., “My family really cares about me” and “I have friends with whom I can talk about the pressures in my life”) on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), resulting in final scores ranging between 9 and 63. The reliability of the scale was good in all countries, and at both time points, with values ranging between 0.81 and 0.86.

Happiness. We measured the participants’ happiness with a broadly used single item (Abdel-Khalek, 2006; Raudenska, 2023): “All things considered, how happy would you say you are?” The response options varied from 1 (*extremely unhappy*) to 7 (*extremely happy*).

Social comparison. We measured the participants’ tendency for social comparison using the Iowa-Netherlands Comparison Orientation Measure (Schneider & Schupp, 2014). The participants rated six statements (e.g., “I always pay a lot of attention to how I do things compared with how others do things”) on a scale of 1 (*strongly disagree*) to 7 (*strongly agree*). One item was reverse coded to indicate a higher social comparison like the other items. The values ranged from 6 to 42; the reliability of the scale was good in all countries, and at both time points, with values varying between 0.80 and 0.85.

Sociodemographic variables. As control variables, we included age, gender, and technological degree. For gender, the options were “female,” “male,” and “other.” We created two dummy variables: one reflecting male vs. other genders (0 = *not male gender*, 1 = *male gender*) and one reflecting obtaining a degree from a technological field (0 = *no*, 1 = *yes*) to account for individuals’ potential formal academic or professional background in technology.

Table 2

Descriptive statistics. *W-P, SD = within-person differences, standard deviation.

	Range	Finland				W-P, SD*	France				W-P, SD*	Germany				W-P, SD*	
		M	SD	M	SD		M	SD	M	SD		M	SD	M	SD		
Continuous variables																	
Autonomy	3–21	16.37	3.96	17.01	3.69	1.77	14.97	4.59	15.58	4.44	2.03	15.73	4.67	17.07	4.17	1.97	
Competence	3–21	17.33	4.04	17.49	3.94	1.72	15.65	4.74	15.55	4.83	2.17	16.93	4.51	17.35	4.48	1.81	
Relatedness	3–21	8.84	4.53	7.67	4.20	1.98	9.30	4.84	8.39	4.77	2.00	8.52	4.81	7.28	4.57	2.02	
In-group identification	3–21	9.78	4.88	8.90	4.71	1.85	11.26	4.97	10.46	5.06	1.83	10.90	5.34	9.62	5.26	1.91	
AI positivity	4–28	19.22	4.95	19.14	4.78	1.82	17.05	5.08	16.99	5.15	2.03	17.91	5.46	17.80	5.57	1.96	
Tech use	0–20	2.35	2.62	2.18	2.44	0.79	2.77	3.30	2.36	3.05	0.99	3.20	3.41	2.74	3.08	0.89	
Health tech use	0–16	3.26	3.25	3.21	3.24	1.02	2.47	3.21	2.09	2.97	0.99	2.77	3.28	2.22	2.94	1.00	
Close relationships	9–63	47.89	11.78	48.33	11.67	3.51	43.11	11.64	43.14	11.68	3.85	46.84	12.07	46.28	12.51	3.64	
Happiness	1–7	4.84	1.22	4.91	1.18	0.44	4.68	1.29	4.65	1.24	0.48	4.64	1.41	4.59	1.45	0.61	
Social comparison	6–42	18.44	6.20	17.97	6.11	1.87	17.79	6.03	16.96	6.09	2.38	17.70	6.34	16.85	6.24	2.22	
Age	18–75	46.35	16.34				46.88	15.84				47.36	15.16				
Categorical variables		n	%				n	%				n	%				
Male	0/1	766	47.71				744	47.66				761	49.77				
Tech degree	0/1	314	20.38				659	42.22				330	21.58				
		Ireland					Italy					Poland					
Continuous variables																	
Autonomy	3–21	15.41	4.55	16.37	4.07	1.91	14.85	4.35	15.56	4.36	1.96	15.65	4.38	16.36	4.23	1.95	
Competence	3–21	16.98	4.39	17.28	4.32	1.92	15.78	4.77	15.77	4.75	2.17	16.27	4.59	16.19	4.69	2.04	
Relatedness	3–21	9.37	4.90	8.16	4.76	2.00	11.37	4.88	10.67	4.89	2.07	9.26	4.95	8.62	4.90	2.21	
In-group identification	3–21	11.44	4.88	10.70	4.65	1.74	11.64	5.04	11.12	5.05	1.92	11.31	5.12	10.87	5.21	2.06	
AI positivity	4–28	17.39	5.29	17.82	4.98	2.03	18.06	5.55	18.46	5.33	2.20	18.14	5.26	18.99	4.86	2.09	
Tech use	0–20	3.44	3.24	3.15	3.10	0.93	3.93	3.70	3.87	3.53	1.20	3.59	3.65	3.17	3.26	1.31	
Health tech use	0–16	3.93	3.56	3.50	3.35	1.04	3.58	3.73	3.30	3.60	1.31	3.84	4.08	3.46	3.92	1.40	
Close relationships	9–63	47.36	11.65	47.53	11.99	3.32	45.67	11.70	46.58	11.69	3.88	44.55	11.95	44.80	12.10	4.01	
Happiness	1–7	4.83	1.36	4.91	1.37	1.28	4.58	1.37	4.65	1.30	0.50	4.69	1.37	4.73	1.33	0.56	
Social comparison	6–42	19.60	5.65	18.98	5.55	1.97	21.49	5.13	21.12	5.06	2.26	19.28	5.89	18.89	5.78	2.27	
Age	18–75	46.77	14.49				47.67	15.34				45.69	15.41				
Categorical variables		n	%				n	%				n	%				
Male	0/1	540	48.56				749	48.95				744	48.53				
Tech degree	0/1	285	25.63				273	17.84				708	46.18				

2.3. Statistical techniques

We performed our analyses using Stata 17. Table 2 shows the descriptive statistics of all variables. For longitudinal data analysis, we utilized hybrid multilevel regression modeling, as hybrid models enable us to analyze the relationships between the independent and dependent variables by dividing the effects of time-varying variables into within- and between-person categories and by also including the random intercepts for persons (Twisk & de Vente, 2019). In practice, this means that there are two versions of each time-varying variable in the model: the respondent-specific means (between) and the respondent-specific deviations (within) from these means. We conducted our analyses using the xthybrid command, which is a shell of the meglm command for mixed-effects generalized linear models (Schunck & Perales, 2017). In our models, all the independent variables were standardized (z-scores) to increase their comparability. We report the regression coefficients (B), their standard errors (SE), and p-values for statistical significance; moreover, we report the within- and between-person effects for variables measured at two time points (autonomy, competence, relatedness, in-group identification, AI positivity, use of smart technologies, use of health technologies, close social relationships, happiness, and social comparison). Age, gender, and technological degree were measured only at T1 and handled as between-person level variables in the models (see Tables 3, 4, and 5).

3. Results

Detected at two time points, the descriptive results revealed that new technology-related autonomy varied in six countries at T1: from 14.85 in Italy to 16.37 in Finland. At T2, the mean of autonomy was slightly but significantly higher in each country, ranging from 15.56 in Italy to 17.07 in Germany. The mean of new-technology-related competence varied at T1 from 15.56 in Italy to 17.33 in Finland. At T2, competence ranged from 15.55 in France to 17.49 in Finland. The only statistically significant change over time was found in Germany, where the mean of competence increased over time from 16.93 (T1) to 17.35 (T2). The new-technology-related relatedness varied in six countries at T1 from 8.52 in Germany to 11.37 in Italy. At T2, the mean of relatedness decreased significantly in each country, varying from 7.28 in Germany to 10.67 in Italy. In-group identification with new technology users ranged at T1 from 9.78 in Finland to 11.64 in Italy. At T2, in-group identification decreased in each country, varying from 8.90 in Finland to 11.12 in Italy. The changes in the means of relatedness over time were statistically significant in all countries except Poland.

3.1. Autonomy

The within-level associations revealed that increased in-group identification with new technology users was negatively associated with new-technology-related autonomy in all the six countries (Finland B = -0.91; France B = -1.60; Germany B = -1.57; Ireland B = -1.14; Italy B = -1.55; Poland B = -1.56; all p < .001). The model showed a

Table 3
Hybrid models showing within-person and between-person effects of in-group identification and control variables on autonomy. All independent variables standardized.

Autonomy	Finland			France			Germany				
	B	SE	p	B	SE	p	B	SE	p		
Within-person effects	Male	-0.50	0.09	0.000	-0.06	0.10	0.539	-0.32	0.10	0.001	
	Tech education	-0.21	0.09	0.019	-0.18	0.09	0.057	-0.13	0.10	0.204	
	Age	-0.05	0.09	0.539	0.29	0.10	0.004	0.19	0.10	0.054	
	In-group identification	-0.91	0.14	0.000	-1.60	0.19	0.000	-1.57	0.21	0.000	
	AI positivity	0.15	0.15	0.307	0.01	0.17	0.973	0.25	0.19	0.172	
	Tech use	0.16	0.20	0.420	-0.22	0.22	0.321	0.25	0.26	0.338	
	Health tech use	-0.36	0.20	0.068	-0.05	0.21	0.824	-0.10	0.24	0.685	
	Close relationships	-0.12	0.18	0.493	-0.05	0.24	0.825	0.02	0.21	0.928	
	Happiness	0.37	0.16	0.020	0.00	0.18	0.982	0.12	0.14	0.385	
	Social comparison	-0.48	0.19	0.011	-0.49	0.17	0.003	-0.84	0.20	0.000	
Between-person effects	In-group identification	-0.87	0.13	0.000	-0.80	0.16	0.000	-1.19	0.15	0.000	
	AI positivity	0.95	0.11	0.000	0.40	0.14	0.004	0.74	0.13	0.000	
	Tech use	-0.39	0.15	0.008	0.00	0.17	0.998	-0.10	0.15	0.493	
	Health tech use	-0.07	0.14	0.631	-0.74	0.17	0.000	-0.82	0.14	0.000	
	Close relationships	0.18	0.10	0.087	-0.05	0.12	0.698	0.29	0.11	0.008	
	Happiness	0.06	0.11	0.575	0.30	0.12	0.016	0.29	0.11	0.008	
	Social comparison	-0.82	0.10	0.000	-1.11	0.12	0.000	-1.09	0.11	0.000	
	Constant	16.63	0.08	0.000	15.20	0.09	0.000	16.22	0.09	0.000	
	Within-person effects	Autonomy	Ireland			Italy			Poland		
			B	SE	p	B	SE	p	B	SE	p
Male		-0.28	0.12	0.017	-0.32	0.09	0.000	-0.07	0.10	0.454	
Tech education		-0.17	0.11	0.121	-0.14	0.09	0.118	-0.15	0.09	0.107	
Age		0.57	0.12	0.000	0.42	0.10	0.000	0.39	0.10	0.000	
In-group identification		-1.14	0.25	0.000	-1.55	0.21	0.000	-1.56	0.18	0.000	
AI positivity		0.95	0.24	0.000	0.16	0.18	0.386	0.63	0.18	0.000	
Tech use		-0.51	0.33	0.127	-0.49	0.20	0.015	-0.07	0.18	0.700	
Health tech use		-0.45	0.29	0.119	-0.34	0.18	0.056	-0.19	0.22	0.374	
Close relationships		0.42	0.28	0.142	0.42	0.20	0.034	0.06	0.22	0.784	
Happiness	-0.08	0.19	0.686	-0.03	0.19	0.874	-0.24	0.15	0.123		
Social comparison	-0.36	0.23	0.119	-0.27	0.15	0.065	-0.16	0.15	0.301		
Between-person effects	In-group identification	-0.66	0.17	0.000	-1.28	0.16	0.000	-0.48	0.15	0.001	
	AI positivity	0.63	0.15	0.000	1.00	0.14	0.000	0.66	0.13	0.000	
	Tech use	-0.33	0.19	0.080	-0.46	0.15	0.003	-0.66	0.17	0.000	
	Health tech use	-0.21	0.18	0.247	-0.50	0.15	0.001	-0.16	0.16	0.324	
	Close relationships	0.15	0.14	0.262	0.26	0.12	0.025	0.40	0.12	0.001	
	Happiness	0.40	0.15	0.007	0.15	0.11	0.180	0.17	0.12	0.170	
	Social comparison	-0.83	0.14	0.000	-0.41	0.12	0.001	-0.93	0.11	0.000	
	Constant	15.69	0.11	0.000	15.11	0.09	0.000	15.90	0.09	0.000	

Table 4

Hybrid models showing within-person and between-person effects of in-group identification and control variables on competence. All independent variables standardized.

	Competence	Finland			France			Germany			
		B	SE	p	B	SE	p	B	SE	p	
Within-person effects	Male	-0.29	0.10	0.003	0.04	0.11	0.709	-0.16	0.11	0.131	
	Tech education	-0.10	0.10	0.302	-0.20	0.11	0.065	-0.17	0.11	0.113	
	Age	-0.38	0.10	0.000	0.13	0.11	0.244	0.20	0.11	0.055	
	In-group identification	-0.45	0.15	0.003	-0.87	0.23	0.000	-0.88	0.20	0.000	
	AI positivity	0.16	0.15	0.287	0.34	0.23	0.132	0.35	0.20	0.072	
	Tech use	0.21	0.18	0.231	-0.04	0.22	0.865	0.37	0.23	0.101	
	Health tech use	-0.05	0.19	0.805	0.20	0.20	0.328	-0.24	0.17	0.177	
	Close relationships	0.03	0.18	0.874	-0.17	0.23	0.459	0.36	0.24	0.141	
	Happiness	0.27	0.15	0.081	0.29	0.20	0.146	0.02	0.15	0.906	
	Social comparison	-0.31	0.18	0.088	-0.41	0.21	0.05	-0.67	0.19	0.000	
Between-person effects	In-group identification	-0.55	0.13	0.000	0.39	0.16	0.018	-0.29	0.16	0.059	
	AI positivity	1.01	0.12	0.000	0.72	0.16	0.000	0.81	0.14	0.000	
	Tech use	-0.42	0.16	0.007	-0.11	0.18	0.535	-0.15	0.15	0.337	
	Health tech use	0.30	0.15	0.039	-0.65	0.18	0.000	-0.51	0.15	0.001	
	Close relationships	0.30	0.12	0.010	0.00	0.13	0.971	0.53	0.12	0.000	
	Happiness	0.24	0.12	0.046	0.42	0.13	0.001	0.26	0.13	0.038	
	Social comparison	-0.97	0.11	0.000	-1.20	0.13	0.000	-1.30	0.12	0.000	
	Constant	17.41	0.09	0.000	15.66	0.10	0.000	17.10	0.10	0.000	
			Ireland			Italy			Poland		
		Competence	B	SE	p	B	SE	p	B	SE	p
Within-person effects	Male	-0.20	0.12	0.097	-0.08	0.10	0.430	0.06	0.11	0.547	
	Tech education	0.02	0.11	0.868	-0.13	0.10	0.191	-0.09	0.10	0.399	
	Age	0.39	0.12	0.001	0.23	0.11	0.046	0.06	0.11	0.584	
	In-group identification	-0.74	0.21	0.000	-1.07	0.23	0.000	-0.97	0.21	0.000	
	AI positivity	0.57	0.25	0.025	0.33	0.20	0.090	0.59	0.20	0.004	
	Tech use	-0.29	0.34	0.394	-0.44	0.23	0.059	0.02	0.19	0.899	
	Health tech use	0.01	0.27	0.970	-0.31	0.22	0.149	0.07	0.23	0.764	
	Close relationships	0.51	0.33	0.115	0.37	0.24	0.114	0.07	0.21	0.736	
	Happiness	-0.01	0.18	0.973	0.06	0.23	0.784	-0.31	0.18	0.085	
	Social comparison	-0.62	0.25	0.014	-0.12	0.18	0.520	-0.25	0.18	0.153	
Between-person effects	In-group identification	-0.27	0.17	0.111	-0.54	0.18	0.003	-0.04	0.16	0.816	
	AI positivity	0.63	0.16	0.000	1.26	0.17	0.000	0.82	0.14	0.000	
	Tech use	-0.01	0.19	0.973	-0.54	0.17	0.002	-0.49	0.18	0.006	
	Health tech use	-0.14	0.18	0.433	-0.38	0.17	0.025	-0.07	0.17	0.665	
	Close relationships	0.30	0.14	0.031	0.46	0.14	0.001	0.46	0.13	0.000	
	Happiness	0.47	0.15	0.002	0.06	0.13	0.639	0.42	0.14	0.002	
	Social comparison	-0.96	0.14	0.000	-0.50	0.13	0.000	-0.98	0.12	0.000	
	Constant	17.06	0.11	0.000	15.78	0.10	0.000	16.26	0.10	0.000	

negative association in the between-person comparison as well: as the mean level of identification as a new technology user increased, autonomy decreased in all the countries (lowest B = -0.48 in Poland; highest B = -1.28 in Italy; all p < .001; except Poland p = .001).

We found other significant within-level associations between in-group identification with new technology users and new-technology-related autonomy. AI positivity was positively associated with increased autonomy in Ireland (B = 0.95; p < .001) and Poland (B = 0.63; p < .001). In Italy, the frequent use of smart technologies was negatively associated with decreased autonomy (B = -0.49; p = .015); however, it was positively associated with closer relationships with family and friends (B = 0.42; p = .034). In Finland, increased happiness was positively associated with autonomy (B = 0.37; p = .020). In addition, increased social comparison was negatively associated with autonomy in Finland (B = -0.48; p = .011), France (B = -0.49; p = .003), and Germany (B = -0.84; p < .001).

We also detected several between-person associations according to the control variables. AI positivity was found to be associated with increased autonomy in all the six countries (highest in Italy B = 1.00 and lowest in France B = 0.40; all p < .001, except France, p = .004). Smart technology usage was found to be negatively associated to autonomy in Finland (B = -0.39; p = .008), Italy (B = -0.46; p = .003), and Poland (B = -0.66; p < .000). Health technology usage was negatively associated to autonomy in France (B = -0.74; p < .001), Germany (B = -0.82; p < .001), and Italy (B = -0.50; p = .001). We found a positive association between close social relationships and autonomy in Germany (B = 0.29; p = .008), Italy (B = 0.26; p = .025), and Poland (B = 0.40;

p = .001). Happiness had a positive association with autonomy in France (B = 0.30; p = .016), Germany (B = 0.29; p = .008), and Ireland (B = 0.40; p = .007). Social comparison and autonomy had a negative association in all the six countries (from B = -0.41 in Italy to B = -1.11 in France; all p < .001, but Italy p = .001).

In addition, our analyses of the demographic variables revealed that male gender was negatively associated with new-technology-related autonomy in Finland (B = -0.50; p < .001), Germany (B = -0.32; p = .001), Ireland (B = -0.32; p = .017), and Italy (B = -0.32; p < .001). In Finland, having a degree from the technological field was negatively associated with autonomy (B = -0.21; p = .019). Age was positively associated with autonomy in France (B = 0.29; p = .004), Ireland (B = 0.57; p < .001), Italy (B = 0.42; p < .001), and Poland (B = 0.39; p < .001).

3.2. Competence

In our model, the within-level associations revealed that increased in-group identification with new technology users was negatively associated with new-technology-related competence in all the six countries (lowest B = -0.45 in Finland; highest B = -1.07 in Italy; all p < .001, except Finland p = .003). The between-level associations did not show similar consistent evidence. Increased in-group identification and competence had negative associations in Finland (B = -0.55; p < .001) and Italy (B = -0.54; p = .003) but a positive association in France (B = 0.39; p = .018).

When analyzing other within-level associations, we found that AI

Table 5

Hybrid models showing within-person and between-person effects of in-group identification and control variables on relatedness. All independent variables standardized.

	Relatedness	Finland			France			Germany			
		B	SE	p	B	SE	p	B	SE	p	
Within-person effects	Male	0.04	0.08	0.653	-0.10	0.08	0.170	-0.06	0.08	0.488	
	Tech education	-0.06	0.07	0.414	0.11	0.08	0.139	0.08	0.09	0.389	
	Age	0.23	0.08	0.005	-0.24	0.08	0.003	-0.11	0.09	0.231	
	In-group identification	2.43	0.16	0.000	2.90	0.18	0.000	2.53	0.19	0.000	
	AI positivity	0.08	0.14	0.543	0.22	0.17	0.196	0.08	0.18	0.656	
	Tech use	-0.25	0.22	0.250	0.14	0.20	0.458	-0.01	0.34	0.975	
	Health tech use	0.39	0.22	0.070	0.20	0.18	0.262	0.27	0.25	0.280	
	Close relationships	0.00	0.18	0.979	-0.08	0.18	0.655	0.25	0.22	0.252	
	Happiness	0.02	0.14	0.880	-0.20	0.15	0.197	-0.09	0.14	0.514	
	Social comparison	0.27	0.18	0.139	0.37	0.16	0.018	0.35	0.18	0.056	
Between-person effects	In-group identification	2.80	0.12	0.000	2.29	0.13	0.000	2.58	0.14	0.000	
	AI positivity	-0.01	0.10	0.908	0.33	0.11	0.003	-0.06	0.11	0.618	
	Tech use	0.01	0.13	0.919	0.24	0.15	0.116	0.18	0.13	0.182	
	Health tech use	0.20	0.08	0.106	0.48	0.15	0.001	0.39	0.13	0.003	
	Close relationships	0.03	0.07	0.713	-0.14	0.10	0.144	-0.16	0.10	0.109	
	Happiness	-0.02	0.08	0.848	0.01	0.10	0.888	0.03	0.10	0.733	
	Social comparison	0.51	0.16	0.000	1.05	0.10	0.000	0.83	0.11	0.000	
	Constant	8.37	0.14	0.000	8.95	0.07	0.000	8.06	0.08	0.000	
			Ireland			Italy			Poland		
		Relatedness	B	SE	p	B	SE	p	B	SE	p
Within-person effects	Male	0.13	0.10	0.198	-0.08	0.07	0.265	-0.22	0.08	0.009	
	Tech education	-0.07	0.10	0.520	-0.09	0.07	0.181	0.06	0.09	0.471	
	Age	-0.06	0.11	0.552	0.02	0.08	0.821	0.08	0.09	0.373	
	In-group identification	2.31	0.23	0.000	2.79	0.20	0.000	2.57	0.19	0.000	
	AI positivity	0.15	0.23	0.505	0.26	0.16	0.109	0.06	0.15	0.715	
	Tech use	0.70	0.32	0.030	0.37	0.17	0.028	0.23	0.19	0.217	
	Health tech use	0.35	0.26	0.174	0.21	0.16	0.195	0.43	0.21	0.038	
	Close relationships	-0.33	0.27	0.224	-0.07	0.17	0.666	0.09	0.23	0.682	
	Happiness	0.12	0.17	0.472	0.30	0.15	0.046	0.19	0.16	0.247	
	Social comparison	0.15	0.25	0.557	-0.05	0.13	0.723	0.15	0.16	0.336	
Between-person effects	In-group identification	2.69	0.16	0.000	3.19	0.13	0.000	2.63	0.15	0.000	
	AI positivity	0.02	0.15	0.901	0.39	0.12	0.001	-0.17	0.13	0.192	
	Tech use	0.17	0.16	0.313	0.15	0.12	0.201	0.43	0.16	0.007	
	Health tech use	0.22	0.16	0.173	0.22	0.12	0.071	0.43	0.15	0.004	
	Close relationships	-0.09	0.12	0.462	0.14	0.10	0.154	-0.21	0.11	0.060	
	Happiness	-0.05	0.13	0.709	-0.10	0.09	0.281	0.02	0.11	0.882	
	Social comparison	0.77	0.13	0.000	0.35	0.10	0.000	0.73	0.11	0.000	
	Constant	9.00	0.10	0.000	11.08	0.07	0.000	9.00	0.08	0.000	

positivity had a positive association with increased new-technology-related competence in Ireland (B = 0.57; p = .025) and Poland (B = 0.59; p = .004). Social comparison was negatively associated with competence in Germany (B = -0.67; p < .001) and Ireland (B = -0.62; p = .014).

We also detected several significant between-level associations. Our analyses showed that AI positivity was positively associated with new-technology-related competence in all six countries (lowest B = 0.63 in Ireland; highest B = 1.26 in Italy; all p < .001). The use of smart technologies was negatively associated with competence in Finland (B = -0.42; p = .007), Italy (B = -0.54; p = .025), and Poland (B = -0.49; p = .006). Moreover, a negative association was found between the usage of health technologies and competence in France (B = -0.65; p < .001), Germany (B = -0.51; p = .001), and Italy (B = -0.38; p = .025). In Finland, this association was positive (B = 0.30; p = .039). We found that close relationships were positively associated with increased competence in Finland (B = 0.30; p = .010), Germany (B = 0.53; p < .001), Italy (B = 0.46; p = .001), and Poland (B = 0.46; p < .001). Also, increased happiness and new-technology-related competence were positively associated in all countries except Italy (Finland B = 0.34, p = .046, France B = 0.42, p = .001, Germany B = 0.26, p = .038, Ireland B = 0.47, p = .002, and Poland B = 0.46, p < .001). In all six countries, the model showed there was a negative association between increased social comparison and competence (lowest B = -0.50 in Italy, highest in -1.30 in Germany, all p < .001).

In terms of sociodemographic variables, we found a negative association between male gender and new-technology-related competence

in Finland (B = -0.29; p = .003). Age was negatively associated with competence in Finland (B = -0.38; p < .001) but positively in Ireland (B = 0.39; p = .001) and Italy (B = 0.23; p = .046).

3.3. Relatedness

The within-level associations showed that increased in-group identification with new technology users was positively associated with new-technology-related relatedness in all six countries (lowest B = 2.31 in Ireland; highest B = 2.90 in France; all p < .001). The model showed a similar positive association in the between-level comparison: as the mean level of identification as a user of new technology increased, relatedness also increased in all the countries (lowest B = 2.29 in France; highest B = 3.19 in Italy; all p < .001).

Our analyses also showed other significant within-person associations with relatedness. We found that the use of smart technologies was positively associated with relatedness in Ireland (B = 0.70; p = .030) and Italy (B = 0.37; p = .028). In Poland, there was a positive association between health technology usage and relatedness (B = 0.43; p = .038). In France, we found that increased happiness (B = 0.30; p = .046) and social comparison were positively associated with new-technology-related relatedness (B = 0.37; p = .018).

When detecting the between-level associations, our model revealed a positive association between AI positivity and increased relatedness in France (B = 0.33; p = .003) and Italy (B = 0.39; p = .001). In Poland, the use of smart technologies was positively associated with relatedness (B = 0.43; p = .007). The use of health technologies had a positive

association with relatedness in France ($B = 0.48$; $p = .001$), Germany ($B = 0.39$; $p = .003$), and Poland ($B = 0.43$; $p = .004$). In addition, we found that social comparison was positively associated with relatedness in all six countries (lowest $B = 0.15$ in Poland; highest $B = 1.05$ in France; all $p < .001$).

Finally, we found a negative association between the male gender and new-technology-related relatedness in Poland ($B = -0.22$; $p = .009$). Moreover, age was positively associated with relatedness in Finland ($B = 0.23$; $p = .005$) but negatively in France ($B = -0.24$; $p = .003$).

4. Discussion

4.1. The main results

In this two-wave, cross-national study, we analyzed how one's in-group identification with new technology users is connected to the satisfaction of one's three technology-related basic psychological needs. We based our research questions on previous research, which indicated that higher in-group identification is associated with higher satisfaction with autonomy, competence, and relatedness (e.g., Easterbrook & Vignoles, 2012; Greenaway et al., 2015; Greenaway et al., 2016; Legault & Amiot, 2014). However, we acknowledged that group membership can also cause greater stress and lower well-being (Haslam et al., 2018; Häusser et al., 2020; Wakefield et al., 2019). The aim of this study was to investigate which association holds in the context of previously unexamined technologies.

Our hybrid multilevel regression analyses revealed consistent findings across all six countries in both between- and within-person level associations: In-group identification with new technology users was negatively associated with new-technology-related autonomy. Competence related to technology was also found to have negative associations with in-group identification, although a significant association was observed only in within-level associations. Analyses showed that in-group identification with new technology users was positively associated with technological relatedness. Our findings thus indicate that in-group identification with new technology users negatively influences satisfaction of autonomy and competence but positively influences satisfaction of relatedness in the context of new technologies. Hence, when individuals' social identification with new technology users increased, their satisfaction with technology-related autonomy and competence decreased, but relatedness increased.

4.2. Cross-cultural evidence of group identity's role in technological context

Findings of this study suggest that identification with new technology users shapes the outcomes of technology-related psychological needs satisfaction, and these associations are observed in culturally different contexts. Previous research has shown that people do not experience technologies and their impacts similarly (Beyens et al., 2020; Büchi, 2024). The results of our study thus provide support for considering social identification as a significant mediator between technologies and the fulfillment of psychological needs. Our findings somewhat contradict previous research on technology-enabled need fulfillment, which has suggested that technologies can satisfy the needs for autonomy and competence (Karapanos et al., 2016; Yang & Aurisicchio, 2021). Prior literature has been mixed on the role of technology in relation to relatedness. In this study, we systematically found that identifying with technology users was associated with satisfaction with the need for relatedness in technological contexts across different countries.

Of all the variables included in our analyses, only in-group identification was consistently associated with satisfaction of technology-related basic psychological needs across all countries. This result indicates the salient role of identity despite differences within societies, cultures, and levels of technological development in Finland, France,

Germany, Ireland, Italy, and Poland. Our findings further demonstrate that, despite unique cultural dimensions, the core psychological processes related to technology use and its outcomes remain consistent. This suggests that the satisfaction of basic psychological needs is a key driver of user behavior and technology acceptance across different cultural settings, also strengthening the theoretical model and reflecting broader, universal patterns. Even the degree of current smart technology use did not steadily predict needs satisfaction. It is possible, however, that the differences with previous research stem from individuals' previous exposure to technology (e.g., frequency of use or comfort level using technology) and variations in adoption across contexts and individuals. Those with less experience or a steeper learning curve may feel more challenged or overwhelmed when using technology. In contrast, relatedness needs may be more easily satisfied through a sense of belonging achieved by simply identifying as part of the in-group.

4.3. Theoretical and practical implications

Our study offers novel findings on the role of technological identity in the satisfaction of basic psychological needs in the context of new technologies. In recent years, the application of Deci and Ryan's (2000), (2017) self-determination theory has become widely popular in technology research (Burnell et al., 2023; Peters et al., 2018). Distinct from the majority of such research, our study did not focus on the impact of user interfaces of specific technologies, or the tasks performed with them. Instead, we focused on how in-group identification with new technology users as a social context is connected to the overall satisfaction of technology-related basic psychological needs in life. By integrating SDT with the social identity approach, we aimed to widen the understanding of how social psychological processes, such as group identification, influence how new technologies, such as AI applications and other intelligent devices, impact users' subjective well-being. The social context is a crucial determinant of technological impact and is thus an important research area (Bingley et al., 2023).

Our results imply that in-group identification with new technology users is a consequential factor that influences the satisfaction of basic psychological needs in the context of new technologies. Since previous research (Carter & Grover, 2015; Carter et al., 2020a,b) has examined an individual's identification with technology and its effects on technology use, we moved beyond this and focused on an individual's social identification with other technology users. Our point of departure was the notion that technological identity is constructed in relation to other technology users (in-group) and those who do not identify as technology users (out-group). Since Carter and colleagues (2020a,b) found that an IT identity impacts one's technology use, we explored whether social identification as a member of a new technology user is significantly associated with satisfaction with one's technology-related basic psychological needs. Our results suggest that in the context of new technology use, in-group identification is connected to one's need satisfaction both positively and negatively. The strong positive connection between identification with technology users and relatedness suggests that technology not only fulfills individual needs but also shapes collective identity and group belonging. This expands the application of SDT and SIT to modern technology use and highlights the dual role of technology in meeting both individual and social needs.

Regarding autonomy and competence, our study indicates that, instead of acting as a positive psychological resource, social identification with new technology users might turn against itself and decrease one's experience of new-technology-related autonomy and competence. Typically, the negative and positive consequences of group membership are traced back to the group's qualities, such as a lack of social support or the promotion of detrimental norms (Häusser et al., 2020; Wakefield et al., 2019). Based on our findings, we cannot claim how people perceive a group of new technology users to be like. However, our findings indicate that identifying with such a group has some aspects that can reduce one's volition and willingness and their perceived ability

to achieve goals and feel capable when using new technologies.

Previous empirical studies have emphasized that when people identify with social groups, they feel more autonomous, as they follow group customs and norms based on their own values and aspirations (Amiot & Aubin, 2013; Amiot & Sansfaçon, 2011; Amiot et al., 2012). A group's norms thus become internalized as personally valued ways of behaving; as Turner (2010) noted, the more an individual identifies with a group, the more they behave normatively, reflecting the group's norms. Among the social group of new technology users, the use of new technologies is, we assume, highly expected and normative. When there are constantly many new applications and devices to use and adopt, one might thus feel pressurized to use technologies beyond one's own preference—this could be one aspect that reduces the group members' new-technology-related autonomy. This finding aligns with research showing that people are more prone to participate in certain online activities when they are in line with the norms and expectations of an in-group (Zhou, 2011), and people with stronger IT identities employ richer forms of technology use (Carter et al., 2020a,b). Furthermore, identification with online communities and their norms has been shown to predict compulsive social media use (Marino et al., 2016). Another study also found that perceived social support is the mediator between social identification with other gamers and Internet users and problematic gaming and internet use (Travaglino et al., 2020).

A further possible explanation is that algorithmic-driven usage influences decision-making, and automated functions reduce users' sense of control over their interactions with technology, creating a feeling of passiveness rather than empowerment and autonomy. In addition, the investigated sphere is likely to affect the outcomes. One might experience needs satisfaction in the interface with technologies but need frustration in life overall (Burnell et al., 2023). Particularly in the life sphere, the long-term well-being impacts of technologies are the most visible (Peters et al., 2018).

Similarly, identification with other technology users predicted a decrease in technology-related competence. Moreover, when an individual's in-group identification with new technology users increased, their technological competence decreased over time. Although this result differs from much of the past research (Greenaway et al., 2015; Kachanoff, 2023), this negative association can be interpreted as consistent with Turner and Reynolds (2010), who noted that group members are prone to comparing themselves to prototypical members of their in-group. Comparing oneself with the image of an ideal technology user might decrease one's feeling of personal competence, especially when there are increasingly more and more advanced technologies to master. Perhaps in the context of our study, the lower satisfaction with technological competence could be explained by in-group identification, which makes people compare themselves to other, perceivably more efficient, technology users. The fast-paced changes in the field of new technologies, and the active users' knowledge of these continuous developments can also make them feel inadequate and perceive themselves as lacking competence, even if their digital skills are objectively high. The negative association with competence may also reflect a steep learning curve associated with some advanced technologies. When users encounter complexity or usability issues, they may feel frustration and inadequacy, hindering their sense of mastery and effectiveness, which are central to their competence. This experience may be particularly distressing if the individual identifies themselves as a member of the technology users' group.

Our study emphasizes that the social psychological context of technology users should be considered when designing and implementing new technologies, such as AI and intelligent smart technologies. We propose that in-group identification as a technology user is a meaningful social context that influences the satisfaction of new-technology-related basic psychological needs in one's overall life and, hence, one's digital well-being. Social identification with other technology users can support social belonging but also hinder autonomy and competence related to new technologies, which are, in an increasingly digitalized world,

equally important domains for human thriving and well-being.

Our results contradicted past offline research on social identification and basic needs satisfaction, highlighting the uniqueness of the digital context and the need for more research on the continuously changing landscape of new technologies in everyday life. The current study can inform policy-making, organizational strategies, and long-term interventions to take into account the role of technological identity when implementing new technologies in people's everyday lives. The present study however suggests that boosting users' social-technological identity may not only lead to positive outcomes. Hence, the qualities and dynamics of the technology users' group should be considered as well as the way new technologies are developed and promoted. The study also informs product design to enhance ease of use and focus particularly improving the satisfaction of technology users' competence and autonomy needs, incorporating social features to foster relatedness, and addressing potential risks of over-consumption. As new technologies increasingly become a central part of human life, technological identity might become an even more salient aspect of people's identities and self-concepts. More knowledge is required on how a group of technology users is perceived, how people relate to it, and the people the group includes and excludes.

4.4. Strengths and limitations

A major strength of our study is the large cross-national and longitudinal data we collected from six European countries using the same study design. The cross-national data represented the demographic adult populations of each country, which increased the reliability and comparability of the results. In addition, the longitudinal data allowed us to track changes within people at two time points. Our study offers a fresh understanding of the impact of new technologies on psychological need satisfaction and, thus, digital well-being. Moreover, our longitudinal data made it possible to investigate the relationship between social identification and the satisfaction of basic psychological needs over time.

Our study, however, is restricted to self-reported data and is specific to the European context. While our data are comprehensive, we recognize the need to study these phenomena globally as well, as patterns may differ in other countries and continents. Additionally, to draw more reliable conclusions on the relationship between technological social identification and psychological needs satisfaction, a more detailed understanding is required of how people perceive a group of technology users and themselves as members of such a group, for example, through qualitative investigation.

5. Conclusion

Since increasingly competent and autonomous new technologies, such as AI and smart technologies, are rapidly becoming more common, there is a need for more knowledge on their impact on human well-being and the factors that mediate this relationship. We explored whether in-group identification with other new technology users is a meaningful social-psychological factor associated with the satisfaction of one's new-technology-related basic psychological needs. Our results emphasize that in addition to the properties of technologies affecting digital well-being, the social context shapes how people perceive and experience technologies and leads to varied well-being outcomes.

CRediT authorship contribution statement

Moona Heiskari: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Aki Koivula:** Writing – review & editing, Writing – original draft. **Magdalena Celuch:** Writing – review & editing, Writing – original draft, Data curation. **Atte Oksanen:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition,

Formal analysis, Data curation, Conceptualization. **Iina Savolainen:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization.

Ethical approval

The ethics committee of the Tampere region in Finland declared in their 2022 statement that the protocol of this study did not present any ethical issues (Statement 115/2022).

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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.

Appendix A. Measurement items

Effects of new technologies on need satisfaction in life (modified from TENS-Life; [Peters et al., 2018](#))

Autonomy

- I spend more time on the new technologies than I feel I should.
- The new technologies end up making me do things I don't want to do.
- The new technologies intrude in my life.

Competence

- Using the new technologies has made me feel insecure about my abilities.
- Using the new technologies has made me feel less capable in my life.
- Using the new technologies has lowered my confidence.

Relatedness

- Using the new technologies has helped me feel a greater sense of belonging to a larger community.
- Using the new technologies has helped me feel close and connected with other people who are important to me.
- Because of these new technologies, I feel closer to some others.

In-group identification with new technology users (satisfaction component modified from the hierarchical model of in-group identification by [Leach et al., 2008](#))

- I am glad to be a user of new technologies.
- It is pleasant to be a user of new technologies.
- Being a user of new technologies gives me a good feeling.

AI positivity (a shortened version of General Attitudes towards Artificial Intelligence Scale (GAAIS) by [Schepman and Rodway, 2020](#))

- Artificial Intelligence can provide new economic opportunities for this country.
- Artificial Intelligence can have positive impacts on people's wellbeing.
- There are many beneficial applications of Artificial Intelligence.
- Much of society will benefit from a future full of Artificial Intelligence.

Appendix B. Reliability figures

McDonald's omega

Measure	Finland		France		Germany		Ireland		Italy		Poland	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Autonomy	0.82	0.83	0.84	0.85	0.85	0.85	0.84	0.81	0.81	0.85	0.81	0.83
Competence	0.92	0.92	0.90	0.90	0.90	0.92	0.92	0.94	0.93	0.92	0.93	0.94
Relatedness	0.89	0.89	0.89	0.92	0.89	0.91	0.90	0.92	0.90	0.92	0.92	0.94
In-group identification	0.94	0.94	0.93	0.94	0.95	0.94	0.93	0.93	0.95	0.96	0.92	0.94
AI positivity	0.89	0.88	0.82	0.85	0.86	0.88	0.87	0.87	0.89	0.90	0.82	0.82
Tech use	0.70	0.68	0.79	0.79	0.73	0.71	0.73	0.69	0.78	0.77	0.78	0.77
Health tech use	0.69	0.69	0.78	0.77	0.75	0.72	0.71	0.68	0.81	0.79	0.76	0.77
Close relationships	0.86	0.85	0.81	0.82	0.82	0.83	0.82	0.86	0.84	0.85	0.85	0.86
Social comparison	0.85	0.85	0.83	0.84	0.83	0.83	0.80	0.81	0.80	0.80	0.82	0.84

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