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SEGMENTATION OF THE YOUNG ELDERLY BASED ON TECHNOLOGY READINESS

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Abstract We examine the young elderly's technology readiness in order to understand the propensity to adopt and use technology for personal use. We use the Technology Readiness Index 2.0 as segmentation basis to segment a sample of mainly young elderly individuals. Our aim is to find meaningful segments within this demographic group regarding their technology readiness, and to contrast the segments with previous research. Our findings based on 538 retirees revealed a similar segmentation profile as found within working-age populations, and a surprisingly different profile than previous research with a mature target group. We identified five distinct segments portraying the young elderly as diverse technology users, ranging from 'pioneers' to 'hesitators'. The findings give rise to discussion regarding the impact of age on the technology readiness of individuals and the importance of age as a predictor of technology use. We propose that commonly held views on age as an inhibitor of technology use are becoming outdated as the diffusion of technology reaches a certain level of maturity in a market.

Keywords:

young elderly, technology readiness, technology readiness index, digital technology, physical activity, market segmentation, technology segmentation, lifestyle segmentation, attitude segmentation

1 Introduction

It is often claimed that elderly people are technology averse and that a project is doomed if it introduces digital services for this group of consumers. It is not unusual that elderly people think that they are too old to use digital technology. Studies have shown (Czaja and Lee, 2007, Villarejo et al. 2019) that there are indeed those elderly who can be portrayed as technophobic i.e., who fear, dislike, or avoid technology. Studies have also shown the opposite. For example, Neves (2012) found that the elderly do not think that they are too old for digital technology nor do they see themselves as technophobic. Several studies have also shown that the elderly are willing as well as competent to use digital technology (Czaja and Lee, 2006, 2007, Sell et al. 2011, 2017).

Research on elderly people's use of technology has focused on adoption behavior, e.g., Deng et al. (2014), attitudes towards technology, e.g., Mitzner et al. (2010), evaluations of wellness-supporting applications or devices e.g., Scandurra and Sjölander (2013), and Mercer et al. (2016). Several studies have investigated how mobile technologies can be employed to support the care of individuals with dementia-related diseases. The technology user in such studies is either the caregiver (Maiden et al. 2013; Zachos 2013) or the patient herself (Upton et al. 2011; Yamagata et al. 2013). The technology is utilized to e.g., aid communication, support reminiscence/recall and provide stimulation. These studies and mobile technologies are not as such applicable to the cognitively healthy and independent young elderly. As technology users, a digital divide seems to exist between younger and older adults, visible in lower usage of and experience with technology in general, as well as computers and the Internet (Czaja et al. 2006, sample aged 60-91 years, and König et al. 2018, sample aged 50+). The divide widens when combined with a lower education level, i.e., older adults with a lower education level are less likely to use different technologies (Czaja et al. 2006; Vroman et al. 2015; König et al. 2018). On the other hand, it has been suggested that digital technology can protect older adults from the digital divide (Hill et al. 2015).

When examining initial adoption decisions, it has been found that subjective norm and perceived behavioral control are more important for older adults than younger (Morris and Venkatesh 2000); subjective norm loses its significance with prolonged usage as domestication occurs. Heart and Kalderon (2013) followed up on the study

by Morris and Venkatesh (2000) thirteen years later (sample aged 60-90+), finding that the health status of the elderly person is a strong moderating factor regarding technology use; healthy older people are much more likely to be technology users. Nevertheless, age was still found to be a barrier to ICT use by Heart and Kalderon (2013) and based on their findings the authors concluded that older adults are not yet ready to adopt health-related ICTs. Other studies have identified facilitating conditions to be of special importance for older adults' decisions to adopt technology, such as Barnard et al. (2013) (samples aged 58-78 and over 65, mean age 68) and Nägle and Schmidt (2012) (sample aged 50-90). Marital status has also been found to be of importance; those living alone (and/or single, widowed, divorced etc.) are less likely to adopt technology. Finally, a positive and optimistic disposition is related to a higher likeliness to adopt technology (Vroman et al. 2015). In summary, research indicates that younger age, better health, higher education and not living alone are features associated with a higher likeliness to adopt and use technology. Some of these factors, i.e., age and education are also related to technology readiness (Blut and Wang 2020).

DigitalWells is an ongoing interactive research and development program with the aim to build sustainable systematic technology-supported physical activity (PA) programs for young elderly. The focus on the young elderly is a new approach for digital services, a market for which there has been little interest to develop digital value services (Bouwman et al. 2014, Carlsson and Walden 2012). The PA programs are based on self-tracking, meaning that the participants use an application on their mobile phone to log and keep track on their physical activities. It is also possible to use wearables that automatically collect the physical activities which can be synchronized to the mobile app, i.e., no manual keying is needed.

In this study we concentrate on how well prepared the young elderly are to accept and use technology in the DigitalWells program. This is carried out by using the technology readiness index (TRI) 2.0 by Parasuraman and Colby (2015) with the aim to find out technology-related beliefs. These beliefs are not easy to change within a short time frame which make them especially suitable to study.

Thus, our aim is to find meaningful segments within this demographic group with regard to their technology readiness, and to contrast the segments found in this age group with the segments found by Parasuraman and Colby (2015) in a sample

representing ages 18-65+. We assume that the young elderly differ in their technology readiness, and, if so, then it is most essential to understand the needed support of the participants in the PA-program in order for them to feel comfortable with the digital technology.

2 Technology Readiness Index 2.0

Technology readiness is defined based on Parasuraman's seminal work (2000 p. 308) as "*people's propensity to embrace and use new technologies for accomplishing goals in home life and work*". Following Parasuraman's study we recognize that there are both positive and negative feelings that describe the domain of technology readiness. The positive feelings push people towards technologies whereas the negative may have the opposite direction, i.e., holding them back (Parasuraman 2000). These feelings Parasuraman (2000) sees as mental motivators and inhibitors that collectively determine a person's predisposition to use new technologies. The mental motivators can be categorized into two dimensions, optimism and innovativeness and the mental inhibitors as well into two dimensions, discomfort and insecurity. The dimensions are defined in the following way: *Optimism* is defined as "*a positive view of technology and a belief that it [technology] offers people increased control, flexibility, and efficiency in their lives*" (Parasuraman & Colby, 2001, p. 34). It generally portrays positive feelings about technology. *Innovativeness* is defined as "*a tendency to be a technology pioneer and thought leader*" (Parasuraman & Colby 2001, p. 36). This dimension generally measures to what degree individuals perceive themselves as being at the forefront of technology adoption. *Discomfort* is defined as "*a perceived lack of control over technology and a feeling of being overwhelmed by it*" (Parasuraman & Colby 2001, p. 41). This dimension generally measures the fear and concerns people experience when confronted with technology. *Insecurity* is defined as a "*distrust of technology and skepticism about its ability to work properly*" (Parasuraman & Colby, 2001, p. 44). This dimension focuses on concerns people may have in face of technology-based transactions.

Optimism and innovativeness are drivers of technology readiness. A high score on these dimensions will increase overall technology readiness. Discomfort and insecurity, on the other hand, are inhibitors of technology readiness. Therefore, a high score on discomfort and insecurity dimensions will reduce overall technology readiness (Parasuraman, 2000).

Parasuraman and Colby (2001) emphasize that the four dimensions are fairly independent, indicating that each of them make a unique contribution to an individual's technology readiness. An individual can for example score high on motivations simultaneously mitigated by strong inhibitions which would be considered as a "*paradoxical state*" (Parasuraman and Colby, 2001 p. 61).

3 Segmentation studies based on technology readiness

It is suggested that using attitudes and lifestyles as segmentation bases can be useful when segmenting technology users (Sell and Walden 2012, Sell et al. 2014). Technology readiness represents an individual's technology-related beliefs, and it has been used as a basis for segmentation in several research projects. Parasuraman and Colby (2001) originally found five segments which they named explorers (high motivation, low inhibition), pioneers (high motivation, high inhibition), skeptics (low motivation, low inhibition), paranoids (moderate motivation, high inhibition) and laggards (low motivation, high inhibition). Using another method (latent class analysis) and a streamlined 16-item scale for segmenting the consumers Parasuraman and Colby (2015) again found a five-cluster solution being the best and similar to the prior TR-based segmentation (2001). The segments were labeled and described as follows: (i) *skeptics, a detached view of technology, with less extreme positive and negative beliefs;* (ii) *explorers, a high degree of motivation and low degree of resistance;* (iii) *avoiders, a high degree of resistance and a low degree of motivation;* (iv) *pioneers, both strong positive and negative views about technology;* and (v) *hesitators, a low degree of innovativeness* (Parasuraman and Colby 2015, p.71).

Tsikriktsis (2004) replicated and extended the taxonomy proposed in 2001 by Parasuraman and Colby. He found that there are both similarities and differences between the two segmentation studies. Four segments had a good match but the fifth segment – paranoids – could not be identified in his study. Victorino et al. (2009) explored the use of a ten-item abbreviated version of TRI (Parasuraman and Colby 2001) for hotel customer segmentation and found that it was a reliable method for segmenting customers. A three-cluster solution came out as the best. The segments they found were similar to the explorers/pioneers, paranoids, and laggards.

One of the few studies researching the TRI-profile of mature consumers is by Rose and Fogarty (2010). They use the abbreviated technology readiness scale by Parasuraman and Colby (2001) in order to segment Australian consumers over 50 years of age. They found support for the original five segments by Parasuraman and Colby (2001). Mature consumers in their study were more likely to belong to the skeptic and laggard segments (34% and 23% respectively), and less likely to belong to the explorer and pioneer segments (16% and 13%) than the general population sample their results were contrasted to (22% skeptics, 17% laggards, 19% explorers and 26% pioneers). Demographic analysis of segments revealed that older, female, and less educated individuals were more likely to be in the laggard segment, mirroring previous research (Czaja et al 2006, König et al 2018).

Kim et al. (2018) used the TRI 2.0 to segment users of sports wearables and found three distinct groups of users, explorers, laggards and pioneers. The method they used was a two-stage cluster analysis in contrast to latent class analysis which was used by Parasuraman and Colby (2015). In a recent article Wiese and Humbani (2020) applied TRI 2.0 for segmenting the mobile payment market in South Africa. They found four segments of which three shared similarities with pioneers, paranoids and explorers and the fourth - hesitant-skeptics - had no similarities with the original ones. Ramirez-Correa et al. (2020) validated the TRI 2.0 in Chile and used LCA for segmentation. They found that four segments are similar compared to the study by Parasuraman and Colby (2015) whereas the segment of skeptics is different. There are also differences in the size of the segments as hesitators and pioneers together count for more than 80% of the Chilean sample.

All the above-mentioned studies have both similarities and differences. They are targeting different countries with different technology adoption stages and different contexts that most probably explain some of the variation in the outcomes.

4 The study

Our study is carried out in Finland which repeatedly has been named as one of the most technologically advanced countries in the world. Further, according to the European Commission (2020), Finland is leading the EU in digital competence and use of internet services amongst its population. We are targeting a group of people which we call the young elderly, 60 to 75 years of age. There are few studies that

focus on technology readiness amongst elderly or young elderly and technology readiness-based segmentation, thus our study is to our knowledge one of the first of its kind.

Our study is divided into several waves, depending on when the participants joined the DigitalWells research program. In the first wave which we report here are 575 participants who joined the program in 2019-2020. All participants are retired, they are members of a local retiree's association, they have volunteered to be in the program and a prerequisite is that they have a smart phone, i.e., they need to have a mobile internet connection in order to be able to participate in the program. When we first start working with the participants, we do not require that they have deep knowledge in digital technology as we give them hands-on guidance. However, it is vital for the program to measure their readiness for technology and for that purpose we used the Technology Readiness Index 2.0 by Parasuraman and Colby (2015). The TRI 2.0 questions were translated to Finnish and Swedish by a team of researchers and then translated back to English by another team of researchers. We aim at having the participant feel confident about and comfortable with the digital technology used in the project. As pointed out by Parasuraman and Colby (2015, p. 61) technology readiness is “...an individual-level characteristic that does not vary in the short term...” and another notable aspect is that it does not change suddenly in response to a stimulus. Several researchers have also found that higher technology readiness levels are correlated with higher adoption rates of cutting-edge technologies, more intense use of technology, and greater perceived ease in doing so (Kuo 2011, Fisk et al. 2011, Massey et al. 2007) which would all contribute to the success of the DigitalWells program.

The demographics of the participants are as follows. 62% of the participants are women and the mean age of the participants is 68,2 years (range 48-83¹), median value being 68 years (n=528). The great majority of the participants (68,5%) are married, 10,1% are divorced, 8,2% are widowed, 9,7% are common-law married and the remaining 3% are single. Many of the participants (67,2%) live in a small city (less than 20.000 inhabitants) or in a rural area. The mother tongue of the participants is Finnish 82% or Swedish 18%. Roughly one-fourth of the respondents

¹ In our sample, a few of the respondents were younger or older than the young elderly age range of 60-75. However, all respondents are retirees and belong to a retired persons' association.

(25,3%) have a university degree or a degree from university of applied sciences, but there are a lot of missing values concerning education (n=226).

At the onset, we had 575 observations. After cleaning out respondents who (i) had no answers on one of the four TRI dimensions, (ii) had only answered eight or less of the TRI statements, or (iii) only had one answer on one or more of the TRI dimensions, we ended up with 538 usable observations. Remaining missing values were replaced with mean value for the sample.

5 Results

We calculated the Technology Readiness Index and its components following Parasuraman and Colby (2015), table 1 below. For comparison, we include the mean values for the TRI components in the Parasuraman and Colby study (*P&C* in table 1). The scale ranges from strongly agree 5.0 to strongly disagree 1.0. The overall technology readiness index mean score is 3.01, close to the scale's midpoint 3.0. The participants are generally optimistic (OPT) about technology, mean score being 3.42. Innovativeness (INN) score is below midpoint. The participants are on discomfort (DISC) below the midpoint and insecurity (INSEC) above the midpoint. Distribution of the scores is near-normal, as skewness values are all between -0,5 and 0,5 and kurtosis values between -1 and 1. As expected, correlation between motivating factors (optimism and innovativeness) is positive and correlation between inhibiting factors (discomfort and insecurity) is also positive. Correlations for motivator-inhibitor combinations are negative.

Table 1: Summary statistics for Technology Readiness Index 2.0 and its components

<i>Components</i>	Mean values					Correlation coefficients			
	<i>Current study</i>	<i>P&C</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>	<i>OPT</i>	<i>INN</i>	<i>DISC</i>	<i>INS</i>
OPT	3,42	3,75	0,80	-0,41	-0,06	1,00			
INN	2,89	3,02	0,94	0,05	-0,76	0,53	1,00		
DISC	2,88	3,09	0,85	-0,03	-0,64	-0,39	-0,45	1,00	
INSEC	3,41	3,58	0,91	-0,37	-0,25	-0,36	-0,31	0,53	1,00
Overall TR score	3,01	3,02	0,66	0,10	-0,42	0,74	0,77	-0,78	-0,73

We employed exploratory factor analysis with Varimax rotation to examine whether the factor structure of the original four TRI dimensions can be found in this dataset. We utilized principal axis factoring with Varimax rotation requesting a four-factor solution. After examining initial factor loadings, we decided to remove one of the variables on the Insecurity scale (INSEC4) from further analysis, as it did not load correctly on the Insecurity dimension and its communality was below 0.5. Our subsequent factor analysis (without the INSEC4 item) explains 59.2% of the variance. The eigenvalues of the first three factors surpass 1, the eigenvalue of the fourth one being 0.93. Examining a scree plot confirmed the suitability of a four-factor solution. Also, each of the four factors explains a significant part of the variance: 16.7%, 16.1%, 14.1% and 12.2% respectively. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.891 and Bartlett’s test was significant ($\chi^2_{(105)} = 2324.0, p < 0.000$).

The four-factor solution aligned well with the four technology readiness dimensions, with only one item (DISC2) with a standardized factor loading just below 0.5 at 0.475. Remaining items loaded from 0.584 to 0.771. There is one significant cross-loading, with INN4 cross-loading on the Optimism dimension. The same cross-loading is reported by Parasuraman & Colby (2015) in their validation of the TRI 2.0 scale. Factor loadings and Cronbach’s α for each of the sub-scales can be seen in table 2.

Table 2: Factor loadings and reliability analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Cronbach's α^a
OPT 1	.771				.756
OPT 2	.598				
OPT 3	.715				
OPT 4	.741				
INN 1		.763			.770
INN 2		.699			
INN 3		.749			
INN 4	.426	.596			
DISC 1			.727		.708
DISC 2			.475		
DISC 3			.584		
DISC 4			.702		
INSEC 1				.767	.725
INSEC 2				.710	
INSEC 3				.769	

a. For reliability analysis, discomfort and insecurity statements were reverse-coded.

At the following stage, K-means cluster analysis in SPSS 24 was used to create a five-cluster solution. The five resulting segments were analyzed and found to be similar to the five segments found by Parasuraman and Colby (2015) in a sample of 878 respondents with a median age of 51 years and ranging from 18 to 65+ (exact upper range not reported). Hence, we have named the clusters with the same monikers as Parasuraman and Colby. A description of the segments can be found in chapter 3.

In the following we present the segments and highlight similarities and differences to those presented by Parasuraman and Colby (2015). In table 3, the segments are described through the mean values of each segment for the four technology readiness dimensions, as well as the TR score for each segment, the size of the segment and the rank of the segment based on the TR score (TR scores were calculated according to Parasuraman and Colby 2015). TR score, percentage per cluster and rank is provided also for the Parasuraman and Colby (2015) sample for the sake of comparison.

Table 3: Mean values, TR scores, size and rank

Clusters	OPT	INN	DISC	INSEC	N	TR SCORE	%	RANK	Parasuraman and Colby (2015)		
									TR SCORE	%	Rank
Pioneers	3,75	3,37	3,12	3,63	137	3,09	25 %	3	3,05	16 %	3
Skeptics	3,16	2,49	2,35	2,77	83	3,13	15 %	2	3,06	38 %	2
Hesitators	3,04	1,78	3,53	3,88	117	2,35	22 %	4	2,74	13 %	4
Avoiders	2,59	2,54	3,49	4,27	80	2,34	15 %	5	2,13	16 %	5
Explorers	4,16	3,94	1,92	2,57	121	3,90	22 %	1	3,92	18 %	1

In our sample, the *Pioneers* is the largest segment, comprising 25% of the total respondents, compared to 16% in the Parasuraman and Colby (P&C) study. In P&C, *Skeptics* are the largest segment with 38% of total respondents, whereas in our study, only 15% of respondents fall into the *Skeptics* segment. Both *Avoiders* and *Explorers* are similarly sized segments in the two studies, but a clearly larger proportion of our respondents fall into the *Hesitators* segment (22%) than in the P&C study (13%). When looking at the ranking of the segments, based on the mean TR scores, the two

studies exhibit the same ranking, with *Explorers* showing the highest mean TR score and the *Avoiders* the lowest. Interestingly, the mean TR scores are higher for the *Pioneers*, *Skeptics* and *Avoiders* in our study, higher for *Hesitators* in P&C, and roughly the same in both studies for *Explorers*.

When looking at the segments through the lens of the four technology readiness dimensions, some interesting observations can be made. We visualize the segments from our study in figure 1. The Pioneer, Skeptic and Explorer segments present similar profiles in our study and in that by P&C. The profiles for Pioneers and Skeptics are very similar on all dimensions, but the scores are lower for the Skeptics in our study. The Hesitators, characterized by their low level of innovativeness, present a distinctly higher level of optimism in the P&C study than in our study. The Avoiders show a markedly lower level of innovativeness in the P&C study than in our study.

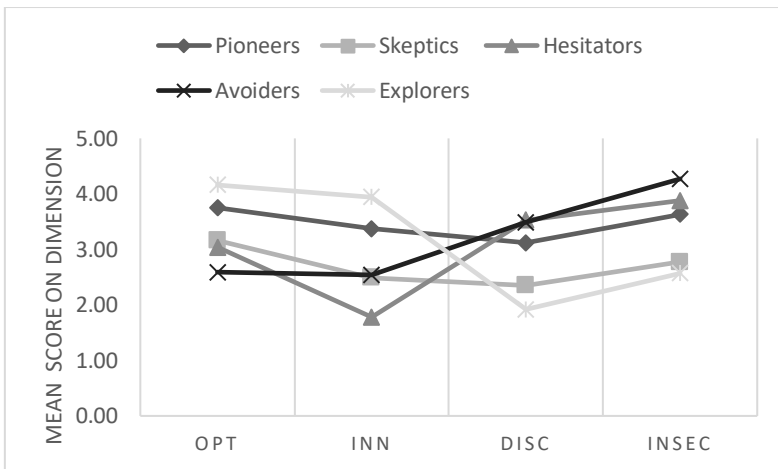


Figure 1: Mean values for technology readiness dimensions per segment in current study (n=538)

In table 4 we outline the demographic characteristics of the five TRI-based segments derived from our data. Age is excluded, as there were only negligible differences in age between the segments. Due to missing data, it was not possible to analyze the segments according to their level of education. We notice that the biggest segments are Pioneers, Explorers and Hesitators. Contrasted to the age division in the entire sample (68% female), we can see that women are underrepresented in the Pioneer and Explorer segments. *Pioneers* and *Explorers* as segments are also characterized by

a proportionally high proportion of city-dwellers. In the *Skeptics* we find a relatively high proportion of women and a somewhat high proportion of persons who belong to the Swedish-speaking minority. *Hesitators* are predominantly female and have a higher percentage of individuals living alone.

Table 4: Demographic characteristics of the segments

	Female (%)	Living alone (%)	Large or medium city (%)	Swedish minority (%)
Pioneers (137)	55,6	20,9	38,8	14,6
Skeptics (83)	69,9	17,5	29,6	22,9
Hesitators (117)	70,1	28,7	30,2	14,5
Avoiders (80)	65,4	23,4	28,6	18,8
Explorers (121)	52,5	22,2	33,3	21,5

6 Discussion and conclusions

The aim of this study was to find meaningful segments within the young elderly cohort with regard to their technology readiness, and to contrast the segments found in this age group with the segments found by Parasuraman and Colby (2015) in a sample representing ages 18-65+. We underline the fact that Parasuraman and Colby collected their data in year 2012 whereas our data is collected in 2019-2020.

In this study we used the 16-item scale and could validate the presence of all four technology readiness dimensions in the dataset. We successfully identified five segments similar to the segments found by Parasuraman and Colby. This is noteworthy as our data covers the young elderly cohort; thus, this supports the allegation that the mature consumer market is not homogeneous and suggests that the mature technology consumers are similar to working age technology consumers regarding their technology readiness. However, the size of the segments differs. The Pioneers is the biggest segment in our study compared to the Skeptics in the Parasuraman and Colby study. The smallest group found by Parasuraman and Colby was the Hesitators, whereas the proportion of Hesitators in our material was higher. Previous research suggests that the level of innovativeness in information technology is overall lower for mature women, which might explain this finding. A plausible explanation for the higher proportion of Pioneers in our study could be

derived from the fact that Finns are frequent users of the internet. In year 2020, the proportion of internet users in the 16-89 years age group was 92% and of those 82% used the internet several times per day. The proportion of internet users among those aged 65-74 is 88% and of those 62% use the internet several times per day (Statistics Finland 2020).

The ranking of the segments was the same in both studies. When looking at the segment profiles, the Pioneer, Skeptic and Explorer segments are very similar. The Hesitators in both studies show a low level of innovativeness, but in our study also a markedly lower level of optimism. Conversely, the Avoiders in our study exhibit a higher level of innovativeness than in the Parasuraman and Colby (2015) study. Overall, the segments are surprisingly similar in the two studies; we would have expected the segments in the young elderly sample to show at least partially different profiles.

Apart from comparing our findings to Parasuraman and Colby (2015), we also contrast the results with a study by Rose and Fogarty (2010) as their study was specifically focused on mature consumers in Australia and also utilized a TRI-based segmentation. We observe some similarities and differences. Both studies found a five-segment solution, but the segments differ content wise and in size. Mature Australian consumers are contrary to our findings less likely to be explorers or pioneers (29,5%) but adopters at late growth or decline stage (57.7%). Skeptics and Laggards (equals to Avoiders) are the biggest segments in the Australian study and the smallest in our study. The results from these two studies on mature technology consumers differ significantly which warrants discussion. A partial explanation can be the differences in the technology development/infrastructure, as the 'second generation' mobile phone systems were introduced in 1990s and achieved early on a high penetration rate in the Finnish working age population, meaning that the Finnish young elderly in our study were technology users long before turning 60 years old. Also, the Australian study was done more than a decade ago; the mature technology consumer market changes rapidly as the proportion of technologically experienced individuals entering retirement constantly rises. Rose and Fogarty found that the Explorers and Pioneers are younger whereas the Laggards are older. This is a notable difference as age did not describe the segments we found. We propose that the importance of age as a predictor of technology use gradually loses its significance as the diffusion of technology reaches a certain level of maturity in a market.

The findings from our study support the four technology readiness dimensions and the five-segment solution. It provides interesting profiles of young elderly and a unique knowledge of this age group's technology beliefs in the different segments.

Note. The Technology Readiness Index 2.0 survey research scale is copyrighted by A. Parasuraman and Rockbridge Associates, Inc., 1999, and is used with written permission. TRI items from Parasuraman (2015) were translated into Finnish and Swedish.

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