

# The Consumption Behaviour Patterns of Consumers 60+ in the Aspect of Purchasing a Selected Technological Product: Comparative Empirical Research in Poland and Slovenia

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**Abstract** The paper presents a proposal to identify and analyse consumer purchase behaviour patterns using self-learning GNG neural networks. The employed method is a highly effective tool for analysing multidimensional data sets and e.g. examining purchase patterns. The results suggest that three specific consumer patterns of purchase behaviour exist among the Polish and Slovenian respondents. The findings deepen the knowledge concerning the purchasing behaviour of consumers at the age of 60+. Parallely, they may be used in shaping international marketing strategies for this consumer group.

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# 1 Introduction

Contemporary marketing faces a new challenge. It concerns a global demographic trend of a worldwide population ageing. As the United Nations (2015) highlighted the process is observed both in well-developed and developing countries. It is generally caused parallelly by increasing life expectancy and falling fertility (United Nations, 2015) or in some cases by massive out-migration of young people (Wilk, 2016). Thus, the process of ageing must be reflected in the global market as well, e.g. in a form of emerging of a new market segment, the so-called “silver” or “gray” one. The European Commission (2015) proposed to pay more attention to exploit economic opportunities arising from the “Silver Economy”. Some researchers suggest that in particular in Central Europe a research gap concerning knowing and understanding the elderly consumers’ behaviour and the existence of the specificity of the elderly consumers’ profiles, especially towards e.g. high-tech products, innovations, etc. does exist Badowska et al (2016) Migdał-Najman and Badowska (2017) Moreover, the outcomes of the cross-countries studies of these issues seem to be still highly-limited or even unavailable, which results in a lacuna of contemporary knowledge supporting the international marketing field. Therefore, this research aims to identify the specificity of the purchase behaviour patterns of consumers 60 + of a high-tech product in Poland and Slovenia. The scientific problem is to find answers to the following questions: Are there any consumers’ behaviour patterns regarding a high-tech product among the consumers at the age of 60 +? And, are there any differences between the Polish and Slovenian populations regarding a high-tech product among the consumers at the age of 60 +? To reach the investigation goal, a self-learning GNG neural network was used. Some evidence show that the GNG is an effective tool for analysing multidimensional data sets and it is widely employed in grouping, classifying, and searching for patterns. The primary data collected during the survey carried out among participants of Third Age Universities in Poland and Slovenia were used. This paper is organized as follows: In Section 2 the literature review is provided in brief. Next, in Section 3 the authors present the research methodology, and subsequently the results are described and discussed in Section 4. Conclusions with practical implications are illustrated in Section 5.

## 2 Literature review

Aging is a universal and global process. In 2015 the estimated number of people at the age of 60+ was 901 million, constituting 12% percent of the world's population. It is expected that in 2050 the number of the elderly at the age of 60+ will be at least doubled reaching 2.1 billion constituting up to 21.5% of the 9-billion world community (United Nations, 2015). It is hard to point out one definition of ageing. Following Zivna and Weitzl (2016), ageing is grouped at least into 3 categories: biological, psychological and social (Gregoire, 2003; Yoon et al, 2009; Moschis, 2012). However, age-related factors are also connected with 2 more categories: Life events influencing lifestyles and consumption patterns (Andreasen, 1984; Mathur et al, 2008) and life circumstances shaping shopping habits and affecting consumption patterns of individuals in the older age (Moschis, 2012). It is as important to understand consumption patterns among older consumers as well as the evaluative criteria they use in decision making and to understand changes in silver markets consumption behaviour in general (Ong et al, 2008). To identify consumer profiles or/and consumption patterns, different tools are applied, e.g self-learning neural networks (Decker, 2006; Migdał-Najman, 2010, 2012; Migdał-Najman and Najman, 2013; Videla-Cavieres and Rios, 2014). One well-known neural network is the GNG (Growing Neural Gas) proposed by Fritzke (1994). It is mostly employed to analyse multidimensional data sets. The GNG is now used in a variety of disciplines and fields, and, e.g. in marketing, this type of network is applied for grouping, recognizing shopping habits and consumer behaviour patterns (Decker and Monien, 2003; Decker, 2005; Migdał-Najman, 2011). Many products failed on the market due to the fact of not being adapted well enough to the local context. Following Truong (2013), the reason seems to be a strong belief among marketers that due to globalization, consumer behaviour in different countries is approaching general common patterns, especially in innovations (Yalcinkaya, 2008). Additional evidence shows that national values, norms and culture differences determine consumer motivation and behaviour (Markus and Kitayama, 1991; Park et al, 2012; Truong, 2013).

### 3 Methodology

This research aims to identify and analyse the specificity of the purchase behaviour patterns of the consumers 60+ of a high-tech product in Poland and Slovenia. The reason to select Poland and Slovenia derived from the fact that both countries share common characteristics:

1. Becoming the oldest societies of the world (the average age ratio in 2015 was 39.6 for Poland and 43.1 for Slovenia. It will be in 2050: 51.8 and 49.3 respectively (United Nations, 2015);
2. Belonging to Slavic cultural circle;
3. Having post-communist and transformative experiences.

The research subject concerns the following three issues:

1. A general behaviour pattern of consumers while purchasing a new product;
2. A general behaviour pattern of consumers while purchasing an innovating product;
3. A general behaviour pattern of consumers while purchasing a smartphone.

The survey questionnaire was adapted from the studies of Venkatesh et al (2003), Szmigin and Carrigan (2000), and Truong (2013). After the linguistic adaptation to the local contexts the questionnaires were designed. 10 items of the research construct were measured on a five point Likert-scale ranging from (1) strongly disagree, to (5) strongly agree. The selective quota sampling procedure was employed. The characteristics (quotas) covered by the research were: Gender and age. To collect the primary data, the study employed paper-and-pencil interviews for targeting the smartphone users at the age of 60+ in Poland and Slovenia. The questionnaires were distributed among the participants of the selected Third Age Universities in both countries (7 in Poland and 9 in Slovenia). Only the participants who attended lectures on the survey days were tested. Therefore, ultimately 846 questionnaires were collected (524 in Poland at the turn of 2014-2015 and 322 in Slovenia in 2017). Finally, this effort resulted in 205 female respondent owners of smartphones (80 in Poland

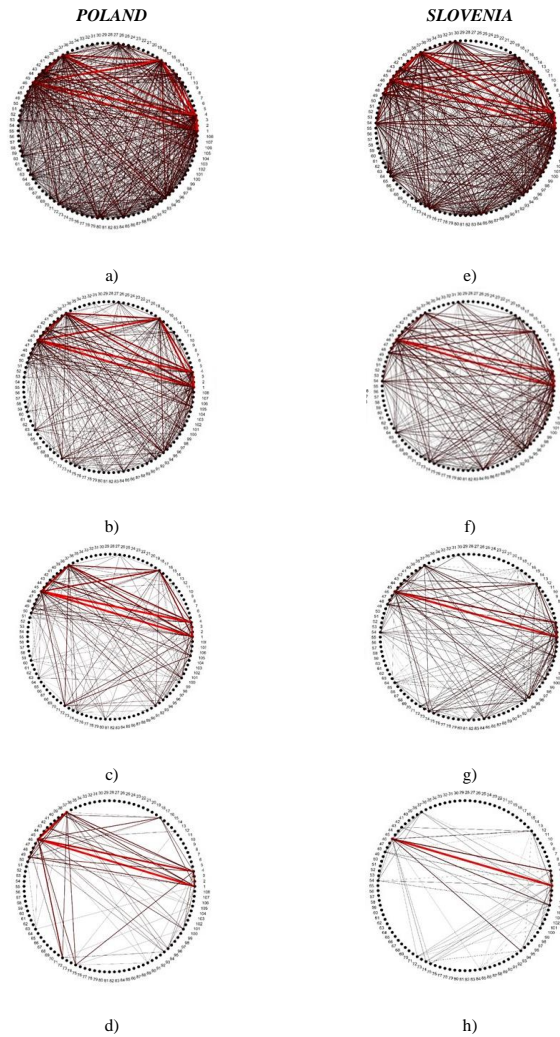
and 125 in Slovenia). Among the Polish elderly female smartphone users, 85 % of them were at the age between 60-69 and 15 % between 70-79. Among the Slovenian ones, 80 % were at the age between 60-69, 19 % between 70-79 and 1 % at the age 80 and more years. To identify and analyse the purchasing behaviour patterns of both national samples, the GNG network was used. This network begins the process of self-learning from two neurons and increases the number of neurons by Lambda iterations, increasing its structure. Neurons map the spatial structure of grouped objects changing their location. The learning neuron, as well as all the neurons connected with it, change their location in space by the value of the learning ratio. Non-learning neurons are removed from the network after maximum connection age iterations. The network parameters are presented in Table 1.

**Table 1:** GNG network parameters for the Polish and Slovenian samples

Sample	Lambda	Maximum age of connections	Learning ratio	Learning ratio of neurons connected with winner one	No. of neurons
Slovenian	160	255	0.05	0.006	53
Polish	190	255	0.05	0.006	79

## 4 Results

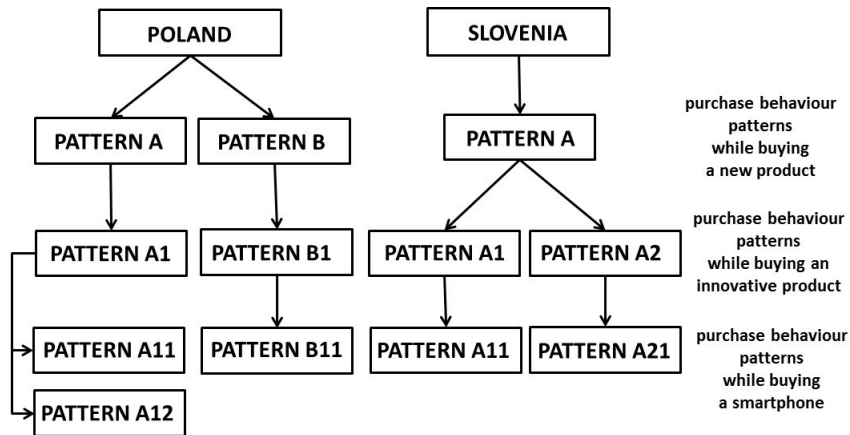
First of all, among the participants of the Third Age University both in Poland and Slovenia, women at the age of 60-69 with university degree are users of smartphones. The population of the Polish sample is a woman who is a white collar employee with a monthly income of 350 to 460 euros. The Slovenian one is depicted by a white collar employee as well (mostly employed in administration), however, with an average monthly income of 600 to 1000 euros.



**Figure 1:** Purchase behaviour of consumers at the age 60+ in Poland and Slovenia (Source: Authors' development).

To illustrate the consumption behaviour of these elderly people, network graphs have been applied. They allow to identify the links between all the analysed variants of the examined features (108 variants (dots) per grid graph, Figure 1). For example, the digit 1 is assigned to a variant of gender: woman, digit 2 illustrates gender variant: male, (...), digit 13 is responsible for the characteristic of education: higher education with a master’s degree, etc. All these variants have been combined and presented in the network graph. If the linking variants are “thicker”, then these variants coexist with each other more often. To facilitate visualization (especially if many variants of features have been examined), it is also possible to eliminate those groups of variants that are least relevant to the others, or have no connections at all.

Figures 1 a) and 1 e) show all the connections for the 108 examined variants. The graphs 1 b), c), d) and 1 f), g), h) present the elimination of relations occurring less frequently. Finally, to analyse purchase behaviour of consumers at the age 60 + in Poland and Slovenia, only these connections which are characterized by the highest frequency have been employed (Figure 1 d) and 1 h)). Finally, only the most frequently appeared connections are left for both populations and describe the specific consumption patterns. The identified purchase behaviour patterns of the Polish and Slovenian consumers at the age of 60 + are presented in Figure 2.



**Figure 2:** The purchase behaviour patterns concerning buying a new product, an innovative product and a smartphone.

The purchase behaviour patterns concern:

1. Buying a new product;
2. Buying an innovative product;
3. Buying a smartphone.

**Table 2:** Consumer purchase patterns for a new product .

Poland		Slovenia
Pattern A: “thoughtful decision”	Pattern B: “habitual decision”	Pattern A: “thoughtful decision”
As a rule, the decisions about purchasing <b>new</b> , unknown products <b>last a long time</b> , and are preceded by <b>considerations and discussions</b> with family and / or friends, as well as <b>searching for information</b> in a variety of sources: the press, radio, TV, the Internet.	As a rule, purchasing new, unknown products is the result of a <b>purchase of common</b> , e.g. the desire to have the latest version of the product.	As a rule, the decisions about purchasing <b>new</b> , unknown products <b>last a long time</b> , and are preceded by <b>considerations and discussions</b> with family and / or friends, as well as <b>searching for information</b> in a variety of sources: the press, radio, TV, the Internet.

### **Purchase behaviour patterns while buying a new product (Tab.2).**

Among the Polish consumers at the age of 60+, two different purchase patterns have been identified (Table 2). For the purpose of this research, they have been the so-called A pattern (“thoughtful decision”) and B pattern (“habitual decision”). Among the Slovenian consumers of 60+, only one pattern A (“thoughtful decision”) is recognized, which is the same as the Polish patterns.

### **Purchase behaviour patterns while buying an innovative product (Tab.3).**

Among the Polish and Slovenian consumers who represent pattern A (“thoughtful decision”), the pattern of behaviour A1 (named as “verified”) has been observed



(Table 3). However, for the Slovenian ones, the second purchase behaviour pattern A2 (“short thoughtful decision”) has been identified in addition. Moreover, the Polish consumers are recognized as the pattern B, and in relation to the innovative product, it has been recognized as B1 (“lack of a unique typical decision pattern”).

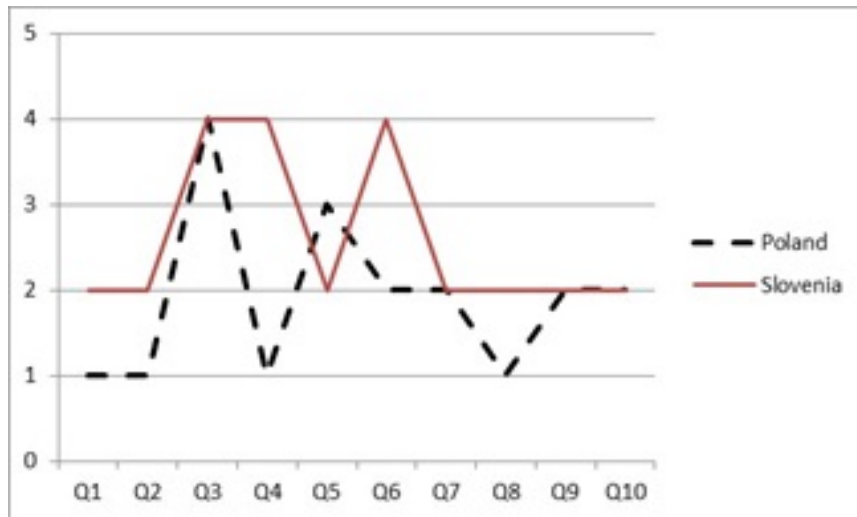
**Table 3:** Consumer purchase patterns for an innovative product.

Poland		Slovenia	
Pattern A	Pattern B	Pattern A	
Pattern A1: “verified”	Pattern B1: “Lack of unique typical purchase pattern”	Pattern A1: “verified”	Pattern A2: “short thoughtful decision”
As a rule, I only buy innovative products after a period of time when friends/ acquaintances/ family have already <b>purchased and tested</b> , and then <b>recommended</b> them to me.	---	As a rule, I only buy innovative products after a period of time when friends/ acquaintances/ family have already <b>purchased and tested</b> , and then <b>recommended</b> them to me.	As a rule, I buy innovative products quickly after they have appeared on the market, but my <b>earlier considerations</b> have preceded buying it.

**Purchase behaviour patterns while buying a smartphone. (Fig.2)**

. For the Polish respondents, the behaviour pattern of consumers 60 + towards the smartphone as an innovative product can be divided into two schemes: pattern A11 and pattern A12. For the pattern B1, one pattern of behaviour has been recognized the so-called pattern B11. Among the Slovenian respondents, for the A1 pattern, the purchase behaviour the so-called A11 pattern has been identified (the same one has also been identified among the Polish respondents). For the pattern A2, the pattern behaviour concerning the smartphone as an innovative product has been defined as A21 (Fig 2). Among the consumers who

represent the A11 pattern (both Polish and Slovenian respondents), the decision to purchase an innovative product, e.g. the smartphone, lasts a long time, and is preceded by considerations and discussions with family and/or acquaintances, as well as searching for information in various sources: in the press, radio, TV, the Internet (“thoughtful decision”). Among the consumers who belong to the A12 pattern (only the Polish respondents), users, who received the smartphone as a gift exist. They declare, they did not bear the costs of the smartphone purchase. The Polish consumers of the B11 pattern point that the decision to purchase the smartphone is a result of a purchase of common (“habitual decision”) e.g. they usually want to have the latest version of a product. This identified group is generally interested in novelties in the mobile telephone product category. Among the Slovenian consumers belonging to the A21 pattern, the none of the one unique typical behaviour towards smartphone purchase has been recognized. Finally, the typical smartphone purchase behaviour of consumers 60+ in Poland and Slovenia has been examined and recognized in 3. In the statistical sense, the dominant features of the respondents’ responses, presented on a scale of 1 to 5 have been illustrated. Among the Polish respondents, the negative (“strongly disagree” (1) or “disagree” (2)) statements dominate. Especially, it concerns those respondents who indicated no interest in the latest versions and new functions of smartphones as well as visiting shops dealing with this product. Among the Slovenian respondents, the dominant is shifted to the other variants (“disagree” (2) or “agree” (4)) on the scale of 1 to 5. These answers are also negative but not as intensively critical as those presented by the Polish respondents. The biggest difference between the answers appeared for the Q4 question: I would consider buying the latest version of a touch screen mobile phone called “smartphone”, even if I have not known its new functions, look and way of using. Most of the Slovenian respondents declare the variant: “agree” (4), but among the Polish ones the variant “strongly disagree” (1) has been chosen more often.



**Figure 3:** Typical smartphone purchase behaviour of the consumer 60+ in Poland and Slovenia  
 Legend: Likert's scale: 1 – strongly disagree, 5 – strongly agree.

Q1 - In general, I am among the last ones in my circle (family/friends/acquaintances) to buy/start using a touch mobile phone called a "smartphone"; Q2 - If I heard that a new version of a touch mobile phone called a "smartphone" was available in shops, I would be interested in buying it; Q3 - Compared to my friends/family/ acquaintances/ I seldom buy/use a newer version of a touch mobile phone called a "smartphone"; Q4 - I would consider buying a new version of a touch mobile phone called a "smartphone", even if I haven't known its new functions, look and way of using; Q5 - In general, I am the last in my circle (family, friends, acquaintances) to use the latest/newest version of a touch mobile phone called a "smartphone"; Q6 - I know about new versions of touch mobile phones before other people of my circle (family, friends, acquaintances) do; Q7 - Overall, I'm interested in the latest technology of touch mobile phones; Q8 - I often visit a section with touch mobile phone products in a department store or supermarket; Q9 - I know more about touch mobile phones than other people do; Q10 - If I needed to use a touch mobile phone called a "smartphone", I would buy the latest one available..

## 5 Conclusions

This paper confirms the utility of employing the self-learning GNG network to identify and explore consumer purchase behaviour patterns. It has strong potential in recognizing consumer profiles and examining their differences. Applying the GNG network, some findings have been obtained. Generally, three different purchasing patterns: "thoughtful", "habitual" and "verified" decisions

have been identified. First, while buying a new product, a “thoughtful decision” scheme seems to be a general consumer behaviour pattern common for both the national samples. However, the “habitual” one is also recognized among the Polish respondents. Second, while buying an innovative product, both patterns (“thoughtful” and “verified”) exist among the Slovenian respondents, but only one (“verified”) is specific for the Polish sample. Third, while buying a smartphone, a general behaviour pattern is “thoughtful decision” for both these groups of participants, but the “habitual” one exists also among the Polish respondents. Recapitulating, the sub-populations with slightly different purchase patterns have been identified in both samples. What is more, the Polish elderly respondents present stronger attitudes towards technological products than the Slovenian ones. The outcomes may also suggest the Slovenians are more interested in new technological products. What stands as a further research question is whether the differences are only typical for the elderly market segment or such a type of behaviour and attitudes can be observed in other segments of the above studied populations (eg. the “Millennians”). These issues will constitute the future research work of the authors. The findings have a practical value. It emphasizes the importance of taking into account the influence of national culture on the attitude towards technological innovations, which seems to be crucial in international marketing. As well, it sheds a light on the need to adapt retailing strategies, to increase the chances of success of a new product or service in local geographical markets (e.g. marketing communication). Lastly, it should be stressed that with a view to both the samples used and the size of the respondents’ groups, the obtained outcomes are specific only for the tested groups. There are some assumptions that the results might have differed, if the tested respondents had been selected among other groups which were not sampled among the Third Age Universities participants.

## References

- Andreasen A (1984) Life status changes and changes in consumer preferences and satisfaction. *Journal of Consumer Research* 11(3):784–794. DOI: 10.1086/209014.
- Badowska S, Zamojska A, Rogala A (2016) Impact of performance expectancy and effort expectancy on the elderly consumers’ behaviour regarding acceptance and use of technological products : an empirical research in Poland. *Smart and Efficient*

- Economy: Preparation for the Future Innovative Economy : 21st International Scientific Conference Economics and Management : May 19-20, 2016, Brno, Czech Republic : proceeding of selected papers, pp. 174–181.
- Decker R (2005) Market basket analysis by means of a growing neural network. *The International Review of Retail, Distribution and Consumer Research* 15(2):151–169, Routledge. DOI: 10.1080/09593960500049332.
- Decker R (2006) A Growing Self-organizing Neural Network for Lifestyle Segmentation. *Journal of Data Science* 4:147–168.
- Decker R, Monien K (2003) Market Basket Analysis with Neural Gas Networks and Self-organising Maps. *Journal of Targeting, Measurement and Analysis for Marketing* 11(4):373–386. DOI: 10.1057/palgrave.jt.5740092.
- European Commission (2015) Growing the Silver Economy. Background paper. URL: <https://ec.europa.eu/digital-single-market/en/news/growing-silver-economy-background-paper>.
- Fritzke B (1994) Growing cell structures of self-organizing network for unsupervised and supervised learning. *Neural Networks* 7(9):1441–1460. DOI: 10.1016/0893-6080(94)90091-4.
- Gregoire Y (2003) The impact of aging on consumer responses: What do we know? *Advances in Consumer Research* 30:19–26. URL: <http://acrwebsite.org/volumes/8729/volumes/v30/NA-30>.
- Markus H, Kitayama S (1991) Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review* 98(2):224–253. DOI: 10.1037/0033-295X.98.2.224.
- Mathur A, Moschis G, Lee E (2008) A longitudinal study of the effects of life status changes on changes in consumer preferences. *Journal of the Academy of Marketing Science* 36(2):234–246. DOI: 10.1007/s11747-007-0021-9.
- Migdał-Najman K (2010) Zastosowanie samouczącej się sieci neuronowej typu SOM w analizie koszykowej. *Taksonomia 17, Klasyfikacja i analiza danych - teoria i zastosowania, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu* 107:305–315.
- Migdał-Najman K (2011) Analiza porównawcza samouczących się sieci neuronowych typu SOM i GNG w poszukiwaniu reguł asocjacyjnych. *Taksonomia 18, Klasyfikacja i analiza danych - teoria i zastosowania, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu* 176:272–281.
- Migdał-Najman K (2012) Poszukiwanie wzorców zakupowych klientów. *Marketing i Rynek* 6:17–23.
- Migdał-Najman K, Badowska S (2017) Wykorzystanie samouczących się sieci neuronowych w analizie zachowań zakupowych i identyfikacji ich wzorców wśród konsumentów w wieku 60 lat i więcej. *Zarządzanie i Finanse* 15:295–307.
- Migdał-Najman K, Najman K (2013) Samouczące się sztuczne sieci neuronowe w grupowaniu i klasyfikacji danych: teoria i zastosowania w ekonomii. Wydawnictwo

- Uniwersytetu Gdańskiego, Gdańsk. ISBN: 978-8-378651-11-6.
- Moschis G (2012) Consumer behavior in later life: Current knowledge, issues, and new directions for research. *Psychology and Marketing* 29(2):57–75. DOI: 10.1002/mar.20504.
- Ong F, Kitchen J, Jama A (2008) Consumption patterns and silver marketing: An analysis of older consumers in Malaysia. *Marketing Intelligence and Planning* 26(7):682–698. DOI: 10.1108/02634500810916663.
- Park J, Gunn F, Han S (2012) Multidimensional trust building in e-retailing: Cross-cultural differences in trust formation and implications for perceived risk. *Journal of Retailing and Consumer Services* 19(3):304–312. DOI: 10.1016/j.jretconser.2012.03.003.
- Szmigin I, Carrigan M (2000) The older consumer as innovator: Does cognitive age hold the key? *Journal of Marketing Management* 16(5):505–527. DOI: 10.1362/026725700785046038.
- Truong Y (2013) A cross-country study of consumer innovativeness and technological service innovation. *Journal of Retailing and Consumer Services* 20(1):130–137. DOI: 10.1016/j.jretconser.2012.10.014.
- United Nations (2015) World Population Prospects, the 2015 Revision. World Population Prospects Series. vol. ESA/P/WP.241. URL: <http://www.un.org/en/development/desa/publications/world-population-prospects-2015-revision.html>.
- Venkatesh V, Morris M, Davis G, Davis F (2003) User acceptance of information technology: Toward a unified view. *MIS Quarterly* 27(3):425–478. DOI: 10.2307/30036540.
- Videla-Cavieres I, Ríos S (2014) Extending market basket analysis with graph mining techniques: A real case. *Expert Systems with Applications* 41(4):1928–1936. DOI: 10.1016/j.eswa.2013.08.088.
- Wilk J (2016) Application of classification trees in the analysis of the population ageing process. *Archives of Data Science, Series A* 1(1):57–76. DOI: 10.5445/KSP/1000058747/04.
- Yalcinkaya G (2008) A culture-based approach to understanding the adoption and diffusion of new products across countries. *International Marketing Review* 2:202–214. DOI: 10.1108/02651330810866281.
- Yoon C, Cole C, Lee M (2009) Consumer decision making and aging: Current knowledge and future directions. *Journal of Consumer Psychology* 19(1):2–16. DOI: 10.1016/j.jcps.2008.12.002.
- Zniva R, Weitzl W (2016) It's not how old you are but how you are old: A review on aging and consumer behavior. *Management Review Quarterly* 66(4):267–297. DOI: 10.1007/s11301-016-0121-z.