



Web Page Design Based on Generation  
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# Webpage Design Based on Generation Differences Using Hesitant Fuzzy Sets

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## Abstract.

Online shopping has a vital place in shopping behavior. Various factors have an impact on individuals' motivations for online shopping. In this study, the online shopping motivation of individuals who have experienced that earlier has been evaluated with regards to the Technology Acceptance Model, Diffusion of Innovation Theory, and Extended Unified Theory of Acceptance and Use of Technology. An integrated model is developed by using the innovativeness and relative advantage factors from the Diffusion of Innovation Theory; perceived usefulness, perceived ease of use, attitude towards use and usage intention factors from Technology Acceptance Model and finally habit, hedonic motivation and social influence from Extended Unified Theory of Acceptance and Use of Technology.

All those factors and relationships between factors were tested using PLS-SEM. The model was employed to test the online shopping behavior of Generation X, Y, and Z and revealed the differences among those 3 groups. After finding out differences and significant relationships among generations, the hesitant fuzzy set method is used to explain how webpage design should be for each generation. The study, finally, has explained which factors are given priority when building a webpage for target generation based on factors of the proposed model.

**Keywords:** Generation Cohort, Hesitant Fuzzy Sets, Web-Page Design, PLS-SEM

## 1 Introduction

Shopping via internet or online shopping has crucial impact on our lives. Shoppers want to go through more alternatives and reduce their shopping time. In 2019, e-commerce retailing market size in Turkey was approximately \$31.5 billion dollars and it has grown nearly 42% compared to 2018 [1]. Goods and services are sold by the company to consumer directly through internet, this system called B2C e-commerce or retailing e-commerce [2]. In the light of growth B2C e-commerce in Turkey this paper is about online shopper behavior and web-page design suggestions

by considering online shopping behavior. Online shopping behavior has been tested with an integrated model which is proposed by using factors of diffusion of innovation theory [3], technology acceptance model [4] as well as, finally, extended unified theory of acceptance and use of technology [5]. In order to run model, after the data collection, online shoppers are classified based on their generations. Generations are determined as Generation X (Gen X), Generation Y (Gen Y) and Generation Z (Gen Z) based on generation cohort theory.

The structure of the paper is as follows. Section 2 presents diffusion of innovation theory (DOI), technology acceptance model (TAM) and unified theory of acceptance and use of technology (UTAUT) and factors which are used in the proposed model. Gen X, Y and Z is also explained in this section. Section 3 explains the fundamental concept of research model, sample data, partial least squares structural equation modelling (PLS-SEM) and hesitant fuzzy cognitive mapping (HFCM). Scenarios are generated and suggestions are given regards to scenarios towards web-page design and results obtained from PLS-SEM are shown in Section 4. Concluding remarks are presented in Section 5 some future suggestions are given about web-page design and online shoppers behavior.

## 2 Literature Review

DOI explains spreading of new idea or new technology on social system via which channels [6]. Rogers claims that innovation itself, communication, time and social system have an impact on the diffusion of innovation. An innovation goes through the information, conviction, decision, implementation and verification phases. [7] In this study two factors are used which are defined in DOI namely innovativeness and relative advantage.

TAM is the model which explains the adoption of new technologies [4]. TAM is derived from Theory of Reasoned Action [9]. Main skeleton of the model which is proposed in this study is TAM. All factors of TAM are used.

Unified Theory of Acceptance and Use of Technology (UTAUT) is adapted from TAM and (UTAUT2) is broad version of UTAUT. UTAUT2 tries to measure adoption of new technologies or ideas. In this study, hedonic motivation, habit and social influence factors are used from UTAUT2.

### 2.1 Factors

In this section, general concept of factors which are used in this study are explained briefly. Attitude towards use (ATU) is the degree to which shoppers like online shopping idea [10]. Behavioral Intention (BI) is intent or determination towards online shopping [11]. In this study, BI is defined as urge to continue online shopping. Hedone is a word which comes from ancient Greek era and means pleasure [14] and hedonic motivation (HM) is to take pleasure in doing something [5]. From online shopping perspective HM is the degree of pleasure that customers take from online shopping. Habit (HBT) is an act that a person performs automatically after many

learnings [5]. In this paper, operational definition of HBT is adapted to want to shop online because of past experiences. Adopting a new idea before any other person in a social system [6] or making a decision without affected from others [8] is called innovativeness (IN). Perceived Ease of Use (PEoU) defined as “the degree to which a person believes that a particular system would be free of effort.” [4]. From online shopping perspective, PEoU is perception of customer how easy shopping in online [10]. Perceived Usefulness (PU) defined as “the degree to which a person believes that using a particular system would enhance his or her job performance.” [4]. From online shopping viewpoint, PU is a sense of fulfilment or benefit when shopping in online [12 -13]. Relative advantage (RA) is defined as “the degree to which an innovation is perceived as being better than the idea it supersedes.” [6]. In this study, RA is, in this case, adapted as the degree of favoring the online shopping idea over any other online shopping methods. Social Influence (SI) is an effect upon individual that comes from other people [5].

## 2.2 Generations

According to Karl Mannheim, generations can be classified as the individuals are born with same era, who are affected from same historical and social phenomenon. Individuals within same group have similar acts, opinion and attitude. In this study covers three generations: Gen X, Gen Y and Gen Z.

Members of Gen X are born between 1964-1979. Compared to the western world, members of Gen X in Turkey do not meet with technology on their early age. Gen X are characterized as individualistic and pragmatist [16-17].

Members of Gen Y are born between 1980-1996. Most of the members Gen Y who are born in Turkey grow with same technology level as peers that live in western world. [15-16-17]

Members of Gen Z are born in 1996 and later. Gen Z has born in high level technology and digital era. Gen Z is very good at using technology and see the technology as their limbs. [16-18]

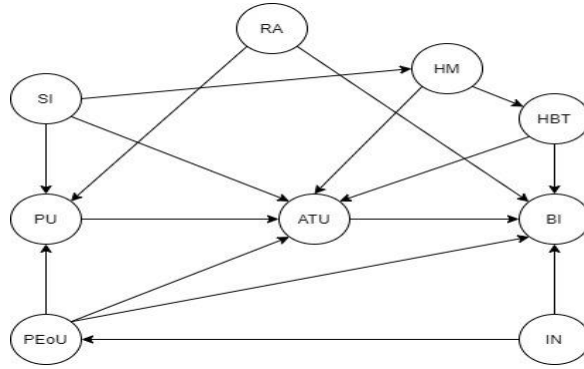
## 3 Research Model and Methodology

This study builds on the question that “what is the motivation of online shoppers to continue online shopping?” and “what is the differences between generations?” After determining the factors impact on online shopping study, the aims to make suggestion upon web-page design using these factors.

### 3.1 Research Model and Sample Data

In order to test consumer behavior for online shopping, the model is developed. The proposed model consists of 9 factors which are borrowed from DOI, TAM and UTAUT2. All nine factors are adapted to context of this study. Figure 1 shows that relationships between factors. The arrows show that relationships and points out the

relationship direction. For instance, increase on SI has an impact on HM degree. This structure is valid for every relationship presented in the model. All relationships are constituted as a result of the literature review and a new model has been revealed.



**Fig. 1.** Research Model

After the model construction, data collection procedure started. A questionnaire is prepared based on the measurement question of the literature. The questionnaire which consists of 38 questions and 7 likert scale consists of 38 questions and 7 points Likert scale is prepared based on the measurement question on the literature. 1 indicates full disagreement and indicates full agreement. 822 responses are obtained, 111 of which are invalid and 711 of which are valid. Generational breakdown of participants is as follows: 86 for Gen X, 426 for Gen Y and 199 for Gen Z.

### 3.2 Methodology

PLS-SEM and HFCM methods are used to cover main purposes of the study. PLS-SEM is used to reveal the significance of relationships between factors and HFCM is used to make suggestions towards web-page building.

#### PLS-SEM

To analyze hypotheses which are represented by arrows in Figure 1 and validity of proposed integrated model, PLS-SEM method is used. The method consists of two steps. In first step reliability and validity are checked. If all reliability and validity values higher than minimum expected value, the hypotheses are decided to be examined in second step [19]. The model data should ensure internal consistency reliability, convergent validity and discriminant validity.

#### Hesitant Fuzzy Cognitive Maps

HFCM is an approach that enables to make interpretation about uncertain conditions. There are 4 steps; development of the model, collecting suggestion from ex-

perts, development of fuzzy envelope for hesitant fuzzy linguistic sets and operation of HFCM [21].

In the, study network model development and casual relationships between factors are determined by using literature. Figure 1 in section 3 represents the network model and casual relationships. To compare relationships among factors,  $f^2$  values are employed instead of expert suggestion. The  $f^2$  values, which can be seen at Table 1 in section 4, have been transformed to linguistic terms and these linguistic terms have been used to generate trapezoidal membership function through fuzzy envelope operation.

## 4 Results

**Table 1.** The significance of hypotheses and  $f^2$  values.

Generation X			Generation Y			Generation Z		
Hypothesis	$f^2$	Significance	Hypothesis	$f^2$	Significance	Hypothesis	$f^2$	Significance
PU → ATU	0,183	Significant	PU → ATU	0,118	Significant	PU → ATU	0,154	Significant
PEoU → ATU	0,001	Non-significant	PEoU → ATU	0,12	Significant	PEoU → ATU	0,087	Significant
PEoU → PU	0,101	Significant	PEoU → PU	0,064	Significant	PEoU → PU	0,221	Significant
PEoU → BI	0,002	Non-significant	PEoU → BI	0,015	Significant	PEoU → BI	0,026	Significant
RA → BI	0,004	Non-significant	RA → BI	0,002	Non-significant	RA → BI	0	Non-significant
RA → PU	0,718	Significant	RA → PU	0,374	Significant	RA → PU	0,352	Significant
IN → BI	0,002	Non-significant	IN → BI	0,001	Non-significant	IN → BI	0,013	Non-significant
IN → PEoU	0,084	Significant	IN → PEoU	0,106	Significant	IN → PEoU	0,013	Non-significant
HM → ATU	0,087	Significant	HM → ATU	0,072	Significant	HM → ATU	0,087	Significant
HM → HBT	0,152	Significant	HM → HBT	0,316	Significant	HM → HBT	0,21	Significant
HBT → BI	0,012	Non-significant	HBT → BI	0,003	Non-significant	HBT → BI	0,002	Non-significant
HBT → ATU	0,064	Non-significant	HBT → ATU	0,008	Non-significant	HBT → ATU	0,038	Significant
SI → HM	0,173	Significant	SI → HM	0,16	Significant	SI → HM	0,113	Significant
SI → ATU	0,041	Non-significant	SI → ATU	0,083	Significant	SI → ATU	0,055	Significant
SI → AF	0,055	Non-significant	SI → AF	0,054	Significant	SI → AF	0,108	Significant
ATU → BI	3,374	Significant	ATU → BI	1,847	Significant	ATU → BI	1,605	Significant

The hypotheses significance and strength of relationship namely  $f^2$  are shown at Table 1. 8 out of 16 relationships for Gen X, 12 out of 16 relationships for Gen Y, and 12 out of 16 relationships for Gen Z are statistically significant. Relationships between  $I \rightarrow BI$ ,  $HBT \rightarrow BI$  and  $RA \rightarrow BI$  do not show statistical significance for all generations.

$f^2$  values represent the impact between casual relationships. Definition of  $f^2$  values in a manner of linguistic terms as these:  $<0.02$  represents there is almost no impact;  $.02-0.015$  represents there is weak impact;  $0.15-0.35$  represents there is average impact and  $>0.35$  represents high impact between relationships [20]. From this point of

view general structures of HFCM is created. The following part consists of the simulation of divergent scenarios under HFCM model and suggestions towards the web-page design. The scenarios have been run under hyperbolic tangent function and  $\lambda$  value, which represents time dependent changes, is taken as 0.25. For each generation a scenario has been generated. For Gen X “what if PEOU lacks for the web-page?” and for Gen Y “what if HM lacks for the web-page?” and for Gen Z “what if SI lacks for the web-page?” are the questions that have been asked.

#### 4.1 Scenarios

This scenario is generated for Gen X and simulates the lack of PEOU at a web-page. Figure 2 shows lack of PEOU condition. The lack of PEOU decreases ATU which represents positive idea towards online shopping, in the beginning and BI which represents the intention to shop decreases afterwards. With regards to this scenario, the web-page has to seem wieldy and emphasise and convince Gen X web-page is easy shopping.

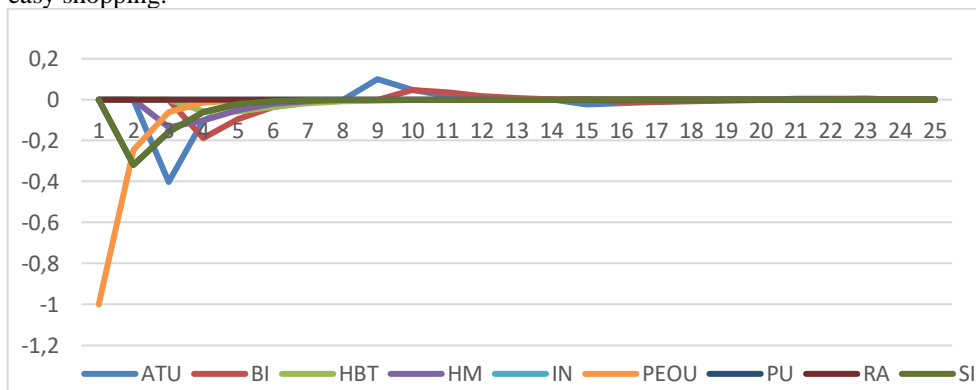


Fig. 2. HFCM simulation for Gen X.

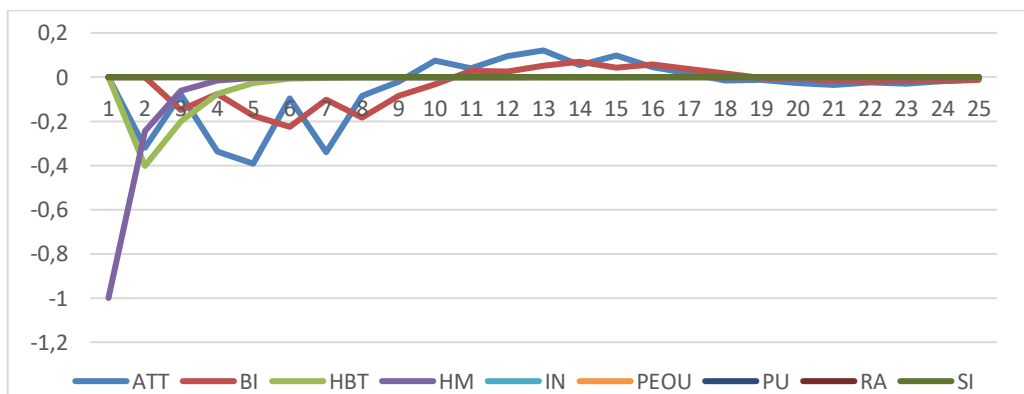


Fig. 3. HFCM simulation for Gen Y.

The second scenario is about Gen Y and HM. Figure 3 shows lack of HM situation. When HM does not exist for shopping Gen Y does not want to shop online. ATU and BI decrease rapidly in short term. To attract Gen Y more, a web-page should contain hedonic items. Gen Y has to be entertained when they are shopping online.

Third scenario is simulated for Gen Z. Figure 4 shows absence of SI case. The lack of SI decreases ATU after first iteration and BI following ATU at other iteration. To increase attractability of web-page for Gen Z, Gen Z has to be convinced about most of the people use this web-page. For that purpose influencer may be usefull to affect Gen Z.

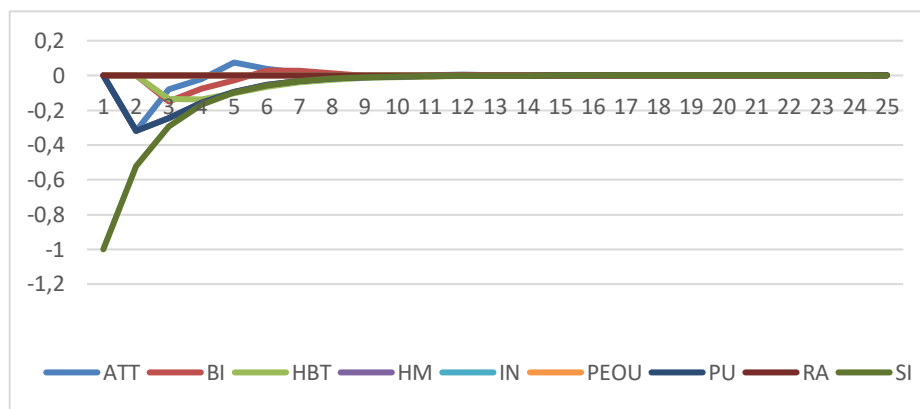


Fig. 4. HFCM simulation for Gen Z.

## 5 Conclusion

In this study, we focused on factors that affects online shopping and web-page design. For these purposes, we used PLS-SEM and HFCM methods. First of all, we developed 9-factor-model which is gathered from 3 main models. We examined their relationships and we found statistically significant relations for each generation separately. Solutions which obtained from PLS-SEM is used to generated scenario. Effect size between significant relationships were transformed to linguistic terms for HFCM method. For each generation a different scenario was generated. One factor is taken away from the model which affects the ATU and BI. Simulation has been shown and result of simulation interpreted briefly for each generation separately.

Although the study analyzes various possible conditions, it has several limitations. Increasing sample size may changes the either relationship between factors or simulation of absence of PEOU for Gen X. To construct HFCM, PLS-SEM results were used.

Future studies may also construct the HFSM construction with an expert opinion. And also, future research may remove factors from the model that are non-significant for all factors and additional factors may be add in the model.



## References

1. Göl, H., İlhan E., & Ot, İ. (2019). E-Ticaretin Gelişimi, Sınırların Aşılması ve Yeni Normlar. TUBİSAD
2. Turban, E., King, D. R., Liang T. P., & Turban, D. C. (2015) *Electronic Commerce: A Managerial and Social Networks Perspective*. Cham: Springer.
3. Rogers, E. M. (1962). *Diffusion of Innovation*. New York: Free Press of Glencoe.
4. Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly* (13), 319-340.
5. Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly* (36), 157-178.
6. Rogers, E. M. (1983). *Diffusion of Innovation*. New York: Free Press.
7. Demir, K. (2006). Rogers'ın Yeniliğin Yayılması Teorisi ve İnternette Ders Kaydı. *Kuram ve Uygulamada Eğitim Yönetimi* (47), 367-391.
8. Lee, S. (2013). An integrated adoption model for e-books in a mobile environment: Evidence from South Korea. *Telematics and Informatics* (30), 165-176.
9. Lingyun, Q., & Dong, L. (2008). Applying TAM in B2C E-Commerce Research: An Extended Model. *Tsinghua Science and Technology* (13), 265-272.
10. Vijayarath, L. R. (2004). Predicting consumer intentions to use on-line shopping: the case for an augmented technology acceptance model. *Information & Management* (41), 747-762.
11. Crespo, A. H., & Rodriguez, I. A. (2008). Explaining B2C e-commerce acceptance: An integrative model based on the framework by Gatignon and Robertson. *Interacting with Computers*, 212-224.
12. Lestari, D. (2019). Measuring e-commerce adoption behaviour among gen-Z in Jakarta, Indonesia. *Economic Analysis and Policy* (63), 103-115.
13. Liébana-Cabanillas, F., & Alonso-Dos-Santos, M. (2017). Factors that determine the adoption of Facebook commerce: The moderating effect of age. *Journal of Engineering and Technology Management* (44), 1-18.
14. Tilley, J., J. (2018). Hedonism. *Encyclopedia of Applied Ethics* (Second Edition, s. 566-573). San Diego: Academic Press.
15. Lissitsa, S., & Ofrit, Kol. (2016). Generation X vs. Generation Y – A decade of online shopping. *Journal of Retailing and Consumer Services* (31), 304-312.
16. Kurz, C. J., Li, G., & Vine, D. J. (2019). Are millennials different? *Handbook of US Consumer Economics* (s. 193-232). San Diego: Academic Press.
17. İlhan, Ü. D. (2019). Kuşaklar Arası Çalışma Değerleri Algısı ve Örgüte Duygusal Bağlılık: X ve Y Kuşaklarının Farklılıkları Üzerine Bir Araştırma. (Doctoral dissertation). Retrieved from YÖK Ulusal Tez Merkezi. (Accession No: 560693).
18. Priporas, C. V., Stylos, N., & Fotiadis, A. K. (2017). Generation Z consumers' expectations of interactions in smart retailing: A future agenda. *Computers in Human Behavior* (77), 374-381.
19. Anderson, J. C., & Gerbing, D. W. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin* (103), 411-423.
20. Nunnally, J. C., & H., B. I. (1994). *Psychometric Theory*. McGraw-Hill: New York.
21. Çoban, V. & Onar, S. Ç. (2017). Analysing of Solar Energy Generation Capacity Using Fuzzy Cognitive Maps. *International Journal of Computational Intelligence System* (10), 1149-1167