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Research Article

The Effects of Multitasking and Tools Carried by Travelers Onboard on the Perceived Trip Time

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Travelers conduct onboard activities while using the tools they bring with them onboard to convert part of their travel time to a productive time. Productive travel time contributes to the reduction in the disutility of travel time. This paper discusses the influence of travelers' onboard activities and the tools carried by travelers on the perceived trip time. 10 onboard activities and 12 tools carried by travelers are introduced and studied in this work. A questionnaire focusing on the main trip of each respondent in urban areas is conducted, where a sample size of 525 participants is collected. Statistical methods such as central tendency, chi-square, exploratory factor analysis (EFA), rank-based nonparametric test, and multivariate analysis of variance (MANOVA) are applied. The main findings are the following: almost all of the onboard activities and the tools carried by travelers impact the trip time positively (i.e., the perception is enhanced). For each transport mode, the most frequent onboard activities that impact the trip time positively is obtained, and the connection between each onboard activity and each tool carried by travelers is found (i.e., moderate to strong association). EFA uncovers the underlying relationship between those onboard activities and those tools carried by travelers that influence travelers' perception. In this case, instead of the full list, fewer onboard activities and tools carried by travelers are produced to simplify the finding of their impacts on the perceived trip time. The participation in onboard activity is ranked across certain groups, such as the tendency of women to be engaged in onboard activities is higher than men's tendency. Regarding the positive impact on trip time, a statistical difference is demonstrated between groups, where the use of the tools carried by travelers is varied across the transport mode, trip purpose, and trip time, gender, age, education, and job variable. Besides, the involvement in onboard activities is statistically dependent across the transport mode, gender, income, and car ownership variable. The output of this study helps decision-makers and mobility planners in understanding the behavior of travelers onboard in more detail, such as the availability of onboard tools affecting the choice of transport mode.

1. Introduction

Travel behavior is affected by the advancement of technology, such as the availability of information and communication technology (ICT) tools which offer possibilities that have not existed before, e.g., working remotely or conducting activities during traveling [1]. Lyons and Urry [2] show the importance of ICT in influencing the mobility of people across the information age. The authors use a set of possible time uses activities onboard of train mode in the UK to demonstrate the usefulness of travel time. Wardman and Lyons [3] demonstrate that the travel time is worth to be evaluated in the digital age because the digital revolution reduces the disutility of travel time, which has an economic consequence for the transport sector. They show the need for further research on finding the factors that impact the quality of travel time for business and nonbusiness travelers. Due to the tools carried by travelers, a part of the travel time can be converted into a productive time, which results in a more enjoyable travel [4]. Moreover, advancement in ICT decreases the number of movements due to the possibility to work remotely (i.e., from home) [1, 5]. Travelers are willing to pay for the use of a particular transport mode to save time or to reduce the negative impact of the travel [3]. The availability and advancement of ICT motivate travelers to conduct onboard activities, which have an impact on their mobility [2, 6]. Lyons and Urry [2] state that the continuous advancement in ICT triggers more activities to be conducted onboard. Other studies conclude that using ICT is impacted by the trip characteristics. Varghese and Jana [7] state that accesses to ICT (i.e., Internet bundle and smartphone) onboard influences the perceived travel time positively because travelers use them in conducting activities. The authors do not reveal a detailed list of ICT tools as well as the association between different types of ICT tools and multitasking. The result of their study is built based on the connection between ICT tools to reading, using social media, and gaming. Keseru et al. [8] demonstrate that the trip purpose impacts the use of ICT. Pawlak [6] concludes in his literature review that ICT tools are used to make traveling more productive and enjoyable. He demonstrates that researchers focus on the digital activities more than nondigital activities, where people can do activities without access to the ICT tools, such as eating using nondigital tool (i.e., food). Pawlak [6] also shows that there is a lack in studies that connect the provision of tools onboard and the propensity of engaging in digital activities during travel.

Based on the importance of the travel, people usually assign an indirect monetary value to travel time [9]. People tend to pay money to compensate for the uncomfortable parts of the travel [10]. The cost of time that a traveler spends on a transport mode is called the value of travel time (VOT) [11]. The valuation of travel time is neither equal for all travelers nor constant with time due to the influence of such factors as the possibility to multitask, the use of ICT, the trip purpose, the demographics, the transport mode, the travel condition, the geographic location, and the time of conducting the trip (e.g., seasons, working days, off days, and holidays) [12, 13]. Krueger et al. [14] state that based on the individual and trip characteristics, such as age, gender, trip purpose, and trip time, people conduct productive and nonproductive activities during their travel. The authors state that their results are based on six onboard activities, in which travelers use only public transport, and ridesharing vehicles. Malokin et al. [15] say that young adults are more involved in onboard activities than older adults. The authors list 15 onboard activities and 11 tools. The authors mention that the result would change due to the rapid advancement in ICT tools because of the old data that they used (i.e., before around 10 years). Rhee et al. [16] and Mokhtarian et al. [17] show that multitasking during the travel affects the travelers' feeling positively. The authors focus on the feelings of travelers onboard during travel by examining whether a traveler experiences fatigue or unpleasant journey. Varghese et al. [18] find that crowding impacts the perceived travel time negatively in trains of the Japanese capital. The authors divide the activities into passive and active in which the trip purposes are associated with ICT or not. Other transport modes are not considered in this study as well as the study considers only the main onboard activities. A study in France by Mokhtarian et al. [17] presents the variables that impact travelers negatively, such as tiring trips, mental fatigue, physical fatigue, or unpleasant journey. They prove that onboard activities impact the disutility of traveling positively based on only four onboard activity types. Banerjee and Kanafani [19] show that the travelers involved in onboard activities are exposed to a lower VOT compared to those who are not engaged in any activities because paid work is based on the access to the wireless in trains. The authors do not consider other transport modes and do not consider different types of activities. Ettema and Verschuren [20] show that travelers who find enjoyment in doing onboard activities have less VOT. The researchers conclude that the VOT is affected by the aim of doing onboard activities, such as listening to music makes traveling more enjoyable, and consequently, the VOT lessens. It is worth mentioning that the authors focus on finding travelers who conduct more than one activity onboard without focusing on the carried tools by travelers. The research does not include the impact of each onboard activity because they are grouped in polychronic time use. Molin et al. [21] find that the VOT of those travelers who conduct activity (possibility to read onboard) while traveling is smaller than that of those who do not conduct activities during the travel. The scholars state that the reduction in the VOT due to conducting onboard activities is converted into monetary value for activities. The intention is to reduce the VOT, which can be done by the travelers who convert their unwanted travel time into a productive time as a result of involving themselves in onboard activities. Having an enjoyable travel time onboard indicates the level of comfort, while having a high comfort level onboard of a transport mode impacts the VOT positively (i.e., less VOT) [22, 23]. Molin et al. [21] state that facilitating onboard activities by enhancing the use of ICT inside vehicles might influence the choice of transport mode, as in the case of autonomous vehicles which rely on high technology [24]. Singleton [25] studies 23 onboard activities that commuters conduct in different transport modes. He shows that commuters using riding modes are engaged in larger activities than not riding modes. The author focuses only on home-work trips, and the study focuses on total trips (i.e. not only in-vehicle time). Singleton [26] studies the travel-based multitasking using two categories of multitasking (i.e., passive and active) in commuting adults in Portland, where 23 onboard activities are studied. The author finds that participation in activity influences the travel time positively, for example, travelers who do not involve in onboard activities (i.e., passive activities) view their travel time a waste. Besides, the author classifies the transport mode based on travel time usefulness. Furthermore, the authors group the use of ICT tools to texting, using social media and reading electronically while other activities cannot be done without ICT such as talking, listening, and trip navigating. Banister et al. [27] discuss the reasonable travel time on a train, where the quality of service and the speed of train are traded. They found that the quality of service and the increase in the speed of train contribute in setting priorities when budgets are limited.

Previous studies examine the effects of onboard activities, and digital tools (i.e., ICT) on travel behavior, such as Pawlak [6] and Keseru and Macharis [28]. Almost all studies focus on the ICT tools, and there is no unified use for multitasking onboard. In addition, some scholars focus on specific transport modes and traveler groups while neglecting others. Furthermore, Keseru and Macharis [28] highlight the need for a study that formulates the onboard activities in a way that combines all activities people usually conduct onboard, while Pawlak [6] summarizes previous studies on multitasking and ICT and shows the lack of exhaustive conclusion on the impacts of multitasking and ICT due to the absence of consensus about the definition of multitasking as well as the continuous advancement in ICT. This research, on the other hand, presents a new way to introduce onboard activities and to study not only ICT tools but other tools carried by travelers (i.e., not ICT tool), such as work document, food, drink, food, and book (i.e., leisure). Besides, the satisfaction of travelers associated with traveling to their primary trip purposes (i.e., the study focuses exclusively on the main trip of travelers) within urban areas is analyzed, where each onboard activity and tool carried by travelers are considered. The main trip of travelers is selected by themselves. The research covers the most common onboard activity types and carried tools that travelers can conduct and use onboard. Besides, it is not limited to a specific mode of transport but considers all main transport modes. In addition, this study uses travel data collected in Budapest, Hungary, which enables a novel empirical application of the developed methods. This is a unique added value because of the lack of similar studies in the Central European region.

The main contributions of this work include analyzing the effects of onboard activities and the tools carried by travelers on the perceived trip time while considering the main trip purpose of travelers in urban areas (i.e., short trips). Different demonstrations of onboard activities for the sake of finding a unified presentation of those onboard activities that travelers usually conduct are presented based on their positive impacts on trip time. Besides, analyzing the onboard activities with the tools carried by travelers (i.e., tools that travelers bring with them to the travel to their main trip purposes in urban areas) based on their positive impacts on trip time is presented. Moreover, the framework of this study is on the main trip purpose (i.e., destination) of a traveler and on urban areas (i.e., travelers are asked to record their main trips, and the study is conducted in an urban area).

Based on the impact on perceived trip time, the contributions are summarized in four objectives as follows: (1) examining the relationship between onboard activities, the tools carried by travelers, and trip characteristics (i.e., transport mode, trip purpose, and trip time), (2) ranking transport modes per those onboard activities that influence the trip time positively, (3) analyzing the onboard activities, the carried tools, and trip time across sociodemographic, economic, and trip variables to examine differences across groups, and (4) finding an underlying relationship in onboard activities' and in the tools carried by travelers' sets to uncover the underlying structure of each set in estimating the impact on the trip time.

In this paper, the first section (Section 1) is the introduction, while the second section (Section 2) presents a literature review. The methodology is presented in Section 3, where the methods of analysis are discussed. The results are included in Section 4, which presents the analysis and the outputs. In the fifth section (Section 5), the discussion of the results and future works are shown. Finally, the conclusion is presented in Section 6.

2. Literature Review

Travelers plan their daily travel in a way to maximize their benefits. It is found that travelers are willing to pay money to reduce the time spent on traveling, thus maximizing their utility [9, 29]. In the time allocation theory, travel time is considered as a consumption, which means an expense rather than the gaining of money, just like in the case of activity time [23]. Reduction in the travel time suggests an increase in the opportunity cost (i.e., the obtained benefit from choosing other alternatives) generated from the allocated time to the work to increase the income [30–32]. Factors that make the perceived travel time worth less, such as the carried tools that travelers bring onboard and multitasking, are discussed in this paper.

Keseru et al. [8] study the travel time utilization by focusing on measuring multitasking activities. The researchers state that the age, the gender, the trip purpose, and the transport mode have significant impacts on conducting auxiliary activities (i.e., other than main activities). Besides, the presence of a companion (i.e., friend or family) during a trip determines the type of activity onboard. It is worth mentioning that the travelers who engage in one or more onboard activities during their travel to important destinations (i.e., high utility) could have a productive journey with better utility compared to other destinations [12]. Moreover, multitasking onboard is influenced by the availability of ICT since some onboard activities cannot be conducted without ICT tools. Keseru et al. [8] find that the travel distance, the companion, and the gender factors influence the multitasking and using of ICT more than the transport mode. Frei et al. [33] find that ICT tools reduce the disutility of waiting time based on a study conducted in public transport. The authors do not study the nondigital tools and they focus only on digital tools and their impact in engaging people in multitasking. The advantages and disadvantages of conducting onboard activities while commuting are studied by Shaw et al. [34]. The scholars find that the transport mode impacts on the utility of travelers, where the utility is either positive or negative depending on the taste and the condition heterogeneity. The authors do not concentrate on impact of each type of activity or type of ICT tool on the travel time but on the perceived benefit of travelers (e.g., trip enjoyment and stress). Varghese and Jana [7] find that individual characteristics, travel characteristics, and access to ICT tools impact the multitasking onboard. The researchers reveal a mismatch between preferences and participation in activity during the travel, and travelers are eager to involve themselves in onboard activities rather than doing nothing. Varghese et al. [18] study the impact of crowding in trains on onboard activities. The scholars highlight the importance of seat availability in public transport, where seat is considered as a sign of crowding level. The result of the study demonstrates that seat availability is positively associated with multitasking options. Singleton [25] divides multitasking into two groups considering using ICT or not. The researcher studies different transport modes rather than public transport alone. The results show that travelers of car and bicycle are engaged in fewer activities than passengers (i.e., public transport and car-as-a-passenger users). Singleton [26] studies travel-based modeling and its usefulness on the utility of travelers. The scholar finds that participation in activity influences the travel time. Moreover, those travelers who travel on foot or use bicycle see the travel more productive than others. The authors conclude that the importance of travel is determined by the individual rather than by the sociodemographic characteristics.

Holley et al. [35] show that 31% of the business travelers work or study during the travel, while 49% are involved in other activities than working or studying. The output of this study is valid only for business trips where workers time is paid, and the study needs update due to the old data (i.e., 2004) where technology has been developed since that time. Hislop [36] shows that phone calls are predominantly made by business travelers. Moreover, the researcher demonstrates the importance of long-distance journeys when travelers can have uninterrupted time to multitask. The author presents the importance of onboard technology, such as whether the cellphone is smart or not. This study focuses only on car-journey where business travelers are the concern while other types of trips and travelers are not studied. Gustafson [37] studies business travels and demonstrates that half of the business travelers is involved in onboard activities related to their work during travel. The study is conducted in Sweden, where the work onboard during traveling might be paid by the employer while in others not. Moreover, it is shown that the transport mode is an important factor once a traveler is interested in conducting work activities onboard. Besides, travelers conduct different activities based on the direction of their travel (e.g., to home or from home). For instance, in "to work" journeys, part of the travel time is used for working purposes, while "from work" journeys are more used for relaxation. Gustafson [37] highlights the importance of ICT on multitasking, as well. The author concludes that based on the onboard offers, travelers choose the transport mode on which they can utilize their travel time (e.g., particular business trips).

The travelers' feelings are affected by the onboard activities, as stated by Rhee et al. [16] and Mokhtarian et al. [17]. Rhee et al. [16] show that multitasking onboard arises positive feelings for drivers, car passengers, and public transport users. The scholars show that car users have a better feeling than car passengers, and public transport users conduct more activities than car users. The availability of ICT is an essential factor, which contributes to the positive feelings of the travelers because ICT enables them to engage in several activities. In more detail, reading a book emerges a negative feeling; short trips have a positive feeling compared to long trips [16]. Mokhtarian et al. [17] show that the trip purpose impacts on the feelings of the travelers; for example, working trips are mentally tiring. Furthermore, the scholars find that longer trips, departure time at night, and work purpose journeys affect the feeling of a traveler. For example, a leisure trip is not so much mentally tiring as a work trip, and avoiding late time (i.e., nighttime) departures makes a trip less mentally tiring. Mokhtarian [38] highlights subjective well-being as a new concept in studying the perceived satisfaction of travelers. The scholar shows that conducting onboard activities and using ICT tools impact the subjective well-being. To measure the subjective well-being, Singleton [39] studies the satisfaction of travelers across three transport modes (i.e., car, public transport, and nonmotorized modes). The researcher shows that nonmotorized modes tend to have higher scores than other modes of transport. Clayton et al. [40] demonstrate that conducting onboard activities makes the journey pleasant and the perceived travel time shorter than the real travel time. Moreover, the authors suggest vehicle manufacturers design a suitable onboard environment by paying attention to several details, such as ICT availability. The authors build their findings based on one transport mode (i.e., bus mode) where multitasking options onboard of it are diverse. Moreover, the findings are built based on the subjective feelings of travelers in which no specific onboard activities are defined. Gamberini et al. [41] study the underground transport mode in the UK where the trips are relatively short. They state that the environment surrounding the traveler affects the conducted activities regardless the length of the trip, such as the availability and ease access of tools like newspapers at stations and Internet on a transport mode defines the onboard activity whether the trip is short or long. The authors study the observed activities where ICT-based activities are grouped in one activity. Russell et al. [42] observe that people are more convenient in doing activities on train than on bus, and train users read and use their headphones more often than travelers of a bus. The researcher includes all possible onboard activities in the comparison between bus and train. Berliner et al. [43] study the onboard activities that commuters conduct. The researchers find that the trip time impacts on multitasking (i.e., more positive impact as the trip time increases), while public transport has a negative effect when a traveler is involved in doing more than one activity at the same time. In addition, it is revealed that travelers are affected by the availability of ICT and the trip purpose when they want to multitask.

Travelers aim to decrease the travel time if they are exposed to a longer travel time than they expect [2]. The percentage of travel time which a traveler spends on multitasking on a transport mode determines the most suitable transport mode for multitasking (e.g., reading) [2]. Thus, people might not mind having a longer travel time onboard a suitable transport mode. The availability of ICT determines which activity is possible on the board of a transport mode during the travel [2]. Athira et al. [44] show that the reduction in travel time motivates travelers to use the saved time for conducting additional leisure activities. The researchers present that the job, the travel time, and the cost of the travel are the main significant variables that have an impact on travel behavior. Perk et al. [45] show that travel behavior differs from one person to another, and more interestingly, it is changeable even for the same person depending on the time and the external factors. Cirillo and Axhausen [46] state that travelers are willing to extend their travel when they find some kind of benefits or pleasure onboard. Additionally, the scholars find that travel behavior does not follow a fixed pattern, and it might change due to the trip purpose and the existence of time constraints. Athira et al. [44] show that the VOT increases when the income and the length of the trip (i.e., travel time) rise. Litman [47] shows that the VOT is not only connected to the reduction of travel time but to the occurred improvement on the service onboard, too. Banerjee and Kanafani [19] state that conducting onboard activities impacts the VOT significantly, especially when the activities are related to working. The scholars integrate Internet access in the utility model because it forms the main attribute for transit commuters. Varghese and Jana [12] show that the VOT is reduced by 26% when travelers multitask. Lyons and Urry [2] show that using ICT and doing onboard activities impact the VOT positively (i.e., less VOT). Ettema and Verschuren [20] and Malokin et al. [24] conduct empirical studies to find the impact of multitasking on the VOT. The researchers find that multitasking contributes to reducing the VOT. Malokin et al. [15] find difference between the impact of multitasking on young adults (i.e., people born in the last two decades of the twentieth century) and older adults. The researchers present that young people have more enhanced perceived travel time (i.e., smaller VOT) than older adults. Besides, it is found that young adults are more willing to pay to use laptop onboard than old adults.

In the upcoming few years, autonomous vehicles (i.e., driverless vehicles) might appear on the market, and this technology will affect the travel behavior onboard [48, 49]. Pudāne et al. [50] study the benefits that can be earned by using autonomous vehicles which provide a better environment for conducting activities than conventional cars, where the saved time is used for conducting other activities. Malokin et al. [24] show that autonomous vehicles might attract people who want to multitask during traveling. Autonomous vehicles can give travelers pleasant time because these remove the stress of driving and enable passengers to be involved in multitasking during the travel more than other modes [31, 51, 52]. Simoni et al. [53] state that the VOT is decreased when travelers use autonomous vehicles.

Previous studies are diverse in methodology, multitasking introduction, ICT tools, and other related sociodemographic and travel characteristics, as shown in Keseru and Macharis [28] and Pawlak [6]. The results of the previously discussed studies focus on those factors that affect travel behavior based on certain properties, such as trip purpose, transport mode, travel time, and qualitative measures. Moreover, the majority of previous studies focuses on specific transport modes and on ICT rather than all transport modes and all the carried tools (digital and nondigital ones) that travelers bring onboard. This study presents a new way to introduce multitasking and examines the tools (including ICT) carried by travelers onboard to see their effects on the perceived trip time. In this research, the behavior of travelers as well as the influence of onboard activities and the tools carried by travelers on trip time are discussed.

3. Methodology

Travel behavior includes the attitudes of people when they travel to the destination of their activities in urban areas. Travel behavior is influenced by sociodemographic, economic, and trip characteristics. In this research, the travel behavior of people onboard with regard to the study of the onboard activities (i.e., multitasking) and the carried tools that travelers take is presented. The onboard multitasking options can affect the travel behavior of people negatively or positively based on their perception. Moreover, the tools carried by the travelers affect the possibility of engaging in an activity onboard.

In this paper, the in-vehicle behavior of travelers regarding onboard activities and the tools carried by travelers with trip time are analyzed. A questionnaire is designed to collect information about the travel behavior of travelers onboard concerning multitasking and the usefulness of the tools carried by travelers onboard. This study answers eight research questions:

(i) Question 1: how are onboard activities and the tools carried by travelers associated with sociodemographic and trip characteristics variables?

(ii) Question 2: how are onboard activities associated with the tools carried by travelers onboard to impact trip time?

(iii) Question 3: which transport mode is used mostly to conduct onboard activity based on its positive impact on the trip time?

(iv) Question 4: what are the effects of onboard activities and the tools carried by travelers on the perceived trip time?

(v) Question 5: are there any differences between certain groups of travelers regarding the impacts of onboard activities on the perception of trip time?

(vi) Question 6: are there any differences between certain groups of travelers concerning the impacts of the tools that travelers carry onboard on the perception of trip time?

(vii) Question 7: what are the rankings of onboard activities across certain groups?

(viii) Question 8: what factors (onboard activities/the tools carried by travelers' subset) can be used to estimate the impact of other onboard activities/the tools carried by travelers (set) on trip time (uncover the underlying structure in each set)?

The questionnaire includes the following information:

(i) Sociodemographic variables such as age, gender, and education

(ii) Economic variables such as the traveler's income, car ownership, and job

(iii) Trip characteristics (i.e., main trip) such as the trip purpose, the transport mode, and the trip time

(iv) What tools the traveler uses onboard?

(v) What impact the use of the tools carried by travelers makes on the perceived trip time (i.e., whether the selected tools impact the trip time positively)?

(vi) What impact the onboard activities make on the perceived trip time? (i.e., whether the selected onboard activities impact the trip time positively)?

Figure 1 illustrates the methodology, which is followed to achieve the aims of this research. A questionnaire is used to collect the preferences of travelers regarding onboard activities and the tools that travelers carry and use during traveling to their main trip purposes. Besides, other individuals and travel variables are collected. The collected data are analyzed according to the research questions and the objectives of the research.

Questions 1 and 2 are used to achieve objective 1. Question 3 aims to answer objective 2, while objective 3 is obtained by answering Questions 4, 5, and 6. Finally, objective 4 is accomplished by Question 8. The dependence and the strength of the association tests (i.e., symmetric measures) of two variables are used to answer Questions 1 and 2. The Likert scale analysis method (e.g., central tendency and interquartile range (IQR)) is applied to answer Questions 3 and 4. In Questions 5 and 6, multivariate analysis of variance is used to determine if there are any differences among certain groups of people regarding their onboard activities and their carried tools. In Question 7, the difference between two groups of travelers regarding a particular variable is examined by using a nonparametric test (i.e., rankings). Finally, in Question 8, exploratory factor analysis (EFA) is applied to decrease the number of variables (i.e., onboard activities/carried tools) and to be used in measuring the impact of all variables on the trip time.

The questionnaire was distributed for two months starting in March 2020 by using LimeSurvey tool in Budapest, Hungary [54]. It is worth mentioning that the questionnaire was distributed under the COVID-19 pandemic; however, the participants were asked to fill the questionnaire considering their normal life before the outbreak of the pandemic.

3.1. The Presentation of Onboard Activities and the Tools Carried by Travelers. In the survey design, the potential onboard activities are derived and based on the literature review, they are grouped into the following ten activity groups [28]: reading, writing, talking via ICT tools or with other passengers, using social media, relaxing including sleeping/window watching, listening to music/radio, thinking including trip tracking/contemplating/planning, eating/drinking, gaming, and doing nothing. The doing nothing activity means that travelers do not do any activities or do other activities than the previously mentioned, such as a traveler feels unwell/bored. Furthermore, the tools carried by travelers are gathered based on the literature, and the results show 14 tools that people commonly use. The carried tools that a traveler might carry during the travel are classical cellphones, smartphones, tablets, laptops, headsets, newspapers/books, work documents, Internet bundles, battery chargers, food, drinks, and nothing (i.e., no tools). A 6-point Likert scale is used, where people choose actual activities and tools that make impacts on the perceived trip time either positively or negatively rather than no opinion [55]. The participants are asked for giving their level of agreement to the impact of the examined onboard activities and the tools carried by travelers on trip time [55].

The questionnaire is used to extract responses that detect the priorities and preferences of the travelers as well as the relative importance of the individual features associated with transport mode characteristics [56]. The analysis of the collected data is conducted by using several statistical methods. A Likert scale method is applied to analyze the categorical (ordinal) questions [57]. A chi-square, which is a nonparametric test, is used to examine the dependence between the variables. Whenever the results are significant, Cramer's V is applied to measure the strength of the associations (where more than 0.15 is a strong relationship and more than 0.25 is very strong relationship). Phi represents the correlations between the variables, where a value more than 0.3 indicates a moderately correlated variable, while higher than 0.7 is considered as a strongly correlated variable [58]. A Kruskal–Wallis H test (i.e., one-way ANOVA on rankings), which is a rank-based nonparametric test, is used to determine the differences between two or more groups, such as male and female groups, and provides rankings [59]. The statistical method of exploratory factor analysis (EFA) is used to find the underlying structure of a large set of variables, where EFA is executed based on the correlation matrix between variables (see Williams et al. [60]). The multivariate generalized linear model (GLM) is applied to examine the statistical difference between the multiple dependent variables taken at the same time of the same sample size and more than one independent variable (e.g., gender group) [61]. To examine any differences between the independent variables, the one-way multivariate analysis of variance (one-way MANOVA) is applied. Eta square (η^2) is used to measure the proportion of the total variance in the dependent variables associated with the different groups of independent variables [62]. While the partial Eta square stands for the generated effects from other independent variables and the interactions between them, where all are partialized out. The η^2 is explained the same way as the coefficient of determination (R^2) in regression analysis [63]. The η^2 estimates the proportion of the variation in the dependent variable associated with the independent variables (i.e., groups) [64], as it is given in

$$\eta^2 = \frac{(\text{sum of the squares for the effects})}{(\text{total sum of squares of all errors, effects, and interactions in ANOVA})}. \quad (1)$$

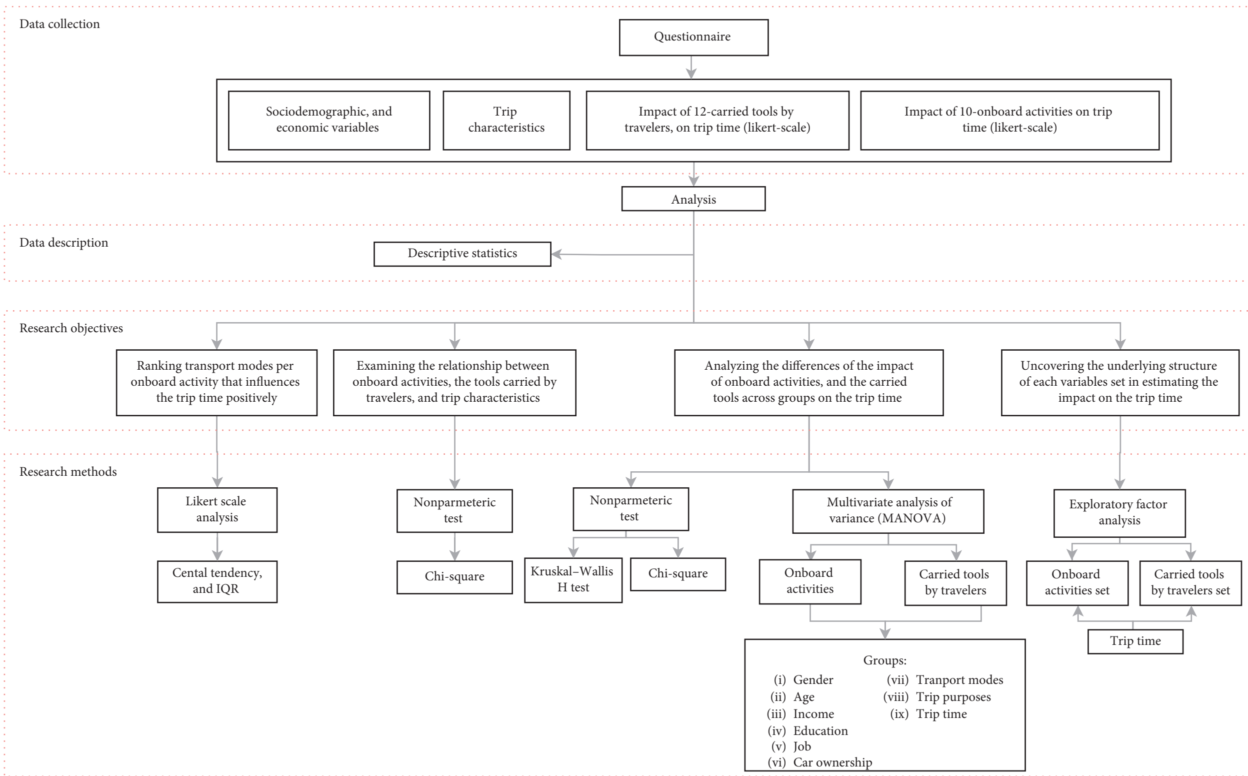


Figure 1: The methodological approach.

It is worth mentioning that Wilks' lambda (Λ), Hotelling's trace, and Pillai's criterion statistics are used to test the hypothesis that the dependent variables are influenced by different independent variables, such as transport mode and trip purpose [63]. In essence, each statistic estimates a hypothesis that the means of the population on the dependent variables are equal among groups. Measures of effect size are reported with partial Eta squared (η^2). In SPSS, the multivariate effect size associated with Λ is given in the following equation [65, 66]:

$$\eta^2 = 1 - \Lambda^{1/s}. \quad (2)$$

Here, s equals the number of the dependent variables minus 1. The η^2 ranges from 0 to 1, where 0 means no relationship between the independent variable and the dependent variable, while 1 means a strong relationship [65, 66].

4. Results

525 participants provided their personal and travel information, such as sociodemographic, economic, and travel data, as shown in Tables 1 and 2. The sample contains 53.9% undergraduate certificate holders, 30.86% master or Ph.D. degree holders, 11.24% high-school degree holders, and 4% have other degrees. The gender is demonstrated in the survey; the percentage of females is 51.43%, while of males is 48.57%. The percentage of those participants who own personal cars is 34.67%. 38.10% of the participants have low-income (i.e., <650 Euro/month), 25.52% have middle-income (i.e., <650 Euro but < 1250 Euro), and 14.67% have high-income (i.e., more than 1250 Euro), and around 21.71% do not declare about their income levels. The age categories are collected, as well. The sample shows that 56.19% of the participants are 25–54 years old, 1.14% are more than 65 years, which is the smallest category, 37.9% are in the 15–24 age category, and 4.76% are in the age category of 55–64 years. Based on the age categories, it can be declared that the sample represents primarily the preferences of young people whose ages are higher than 15 years but lower than 55 years. Eight job categories are reported as the followings: 43.62% of the participants are full-time workers, 7.05% are part-time workers, 37.33% are students, 4% are housewives, 4.38% are unemployed, 1.52% are self-employed, 1.71% are retired, and a very small percentage choose the category: other job types.

The participants provide information about their main travel such as transport mode, trip purpose, and trip time, as presented in Table 2. The percentage of those participants who use personal cars as drivers is 17.9%, car use as a passenger is 23.81%, traveling by taxi is 4.38%, by public transport is 41.71%, cycling is 3.24%, walking is 8%, and other transport modes is 0.95%. Moreover, the sample contains information about the main trip purpose of each traveler. The percentage of participants who report work trips is 50.1%, educational trips is 37.52%, home trips is 6.29%, and shopping trips is 2.86% and 3.24% mark leisure and other trip purposes. The travel distance is reflected in the trip time to the main trip purpose. The sample contains

Table 1: The descriptive statistics of the sociodemographic and economic variables.

Category	%
Educational level	
High school	11.24
Undergraduate studies	53.90
Graduate studies	30.86
Others	4.00
Gender	
Female	51.43
Male	48.57
Car ownership	
Yes	34.67
No	65.33
Income	
Low	38.10
Medium	25.52
High	14.67
No answer	21.71
Age	
15–24	37.90
25–54	56.19
55–64	4.76
+65	1.14
Employment	
Full-time worker	43.62
Part-time worker	7.05
Student	37.33
Unemployed	8.38
Self-employed	1.52
Retired	1.71
Others	0.38

16.63% who travel less than 10 minutes, 25.81% who travel 10–20 minutes, 20.27% travel between 20 and 30 minutes, 13% travel 30–40 minutes, 8.22% travel 40–50 minutes, 6.5% travel 50–60 minutes, and 9.56% travel more than 60 minutes. From the statistics, it can be concluded that primarily, the sample includes participants who travel between 10 and 30 minutes. As mentioned previously, the study focuses on the urban areas, where short trips are dominant.

Based on their main trip purposes, individuals fill out the survey by examining some attitudinal variables, such as the usefulness of trip time, and by updating the travel plan regularly (e.g., route choice and transport mode choice). The results are the followings: the participants are asked about whether they consider trip time as a waste of time, and the statistics show that 31% of the participants give a positive answer, 38% say no, while other participants choose the answer: sometimes. This information aids in making a conclusion that the preferences of travelers determine the usefulness of trip time or not. Around 41.3% of individuals update their daily trip plans every day, while 25.5% use the same travel plan as earlier, and the remaining travelers say that sometimes, they update their travel plans. Around half of the participants are willing to reconsider their trips, which means that a large percentage of people are eager to change their travel behavior based on their preferences at the time of the journey.

A 6-point Likert scale is used to study the travelers' level of agreement to the positive impact of 10 different types of onboard activities and 12 types of tools carried by travelers on trip time. Table 3 shows the tools that travelers carry and onboard activities as well as their influence on the perceived trip time (i.e., experienced trip time). The question that participants answered is "does this onboard activity/the tools carried by travelers that you conduct/use impact your trip time positively?" It is worth mentioning that the participants consider exclusively the tools that they usually use onboard as well as the onboard activities that they usually conduct while they travel to their main trip purposes. The mean, the IRQ/H-spread, the median, and the mode are calculated to investigate the responses of the participants toward the tools carried by travelers and the activities onboard. The H-spread of the responses is four or above for all carried tools, which means the participants agree on that the tools carried by travelers and the onboard activities have a positive impact on trip time. The median, which is the middle value, is calculated; thus, the higher half of the sample is separated from the lower half. The median is 5 on the Likert scale, which means 50% of the participants have "agree" and "totally agree" (i.e., 5 and 6 on the Likert scale) about the positive impact of smartphones on trip time, while 50% have different opinions (i.e., 1, 2, 3, and 4 on the Likert scale). The mode gives information about the most frequent answers, such as participants who choose classical cellphone as the carried tool answer "disagree" (i.e., 2 on the Likert scale) about the positive impact of classical cellphone on trip time. The most frequent answer for the impact of onboard reading, talking, listening, using social media, relaxing, thinking, gaming, and doing nothing on trip time is positive (i.e., 5 on the Likert scale).

Thus, all the tools carried by travelers onboard except for the classical cellphone and all onboard activities except for eating/drinking and writing have a positive impact on trip time, while doing nothing, where participants are bored or stressed, has a slightly negative impact on trip time, which means that even though travelers seem to be used to doing nothing onboard, they would like to change their habit. To make the data of Table 3 more understandable, the responses of participants are presented in Figures 2 and 3.

Figure 2 shows the responses of the participants regarding the impact of the tools carried by travelers on trip time (i.e., whether a carried tool has a positive or a negative impact on trip time). The focus is on the tools that a traveler not only brings but uses onboard of the conventional transport modes (CTMs), too. It is shown that smartphones, Internet bundles, battery chargers, and drinks bear high positive impacts (i.e., 5 and 6 on the Likert scale) on trip time, i.e., 43%, 40%, 35.2%, and 43.6%, respectively. On the other hand, the tools which show the largest percentage of negative impacts on trip time are classical mobiles (33%), laptops (25.7%), work documents (23.2%), and no tools (23.2%) (i.e., 1 and 2 on the Likert scale). It is worth mentioning that choosing the category "slightly disagree" (i.e., 3 on the Likert scale) is unpopular, which means that travelers rarely use a particular tool indicated by "slightly disagree," or they do not see its impact on the trip time.

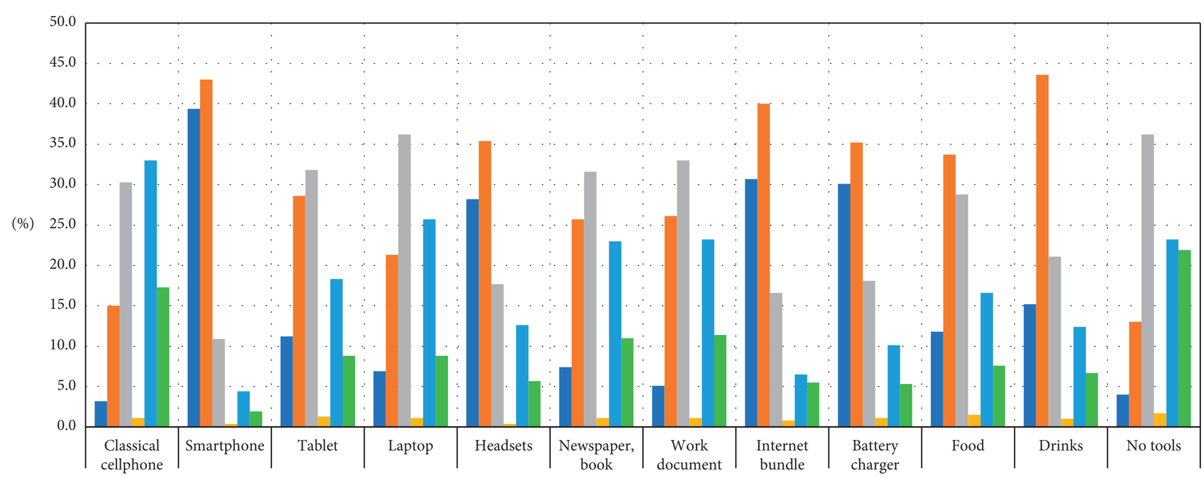
Table 2: The participants' trip purposes, transport modes, and trip time statistics.

Main daily transport mode	%	Main daily trip purpose	%	Trip time (main trip)	%
Car-as-a-driver	17.90	Work	50.10	<10 minutes	16.63
Car-as-a-passenger	23.81	Shopping	2.86	>10 minutes and <20 minutes	25.81
Taxi	4.38	Education	37.52	>20 minutes and <30 minutes	20.27
Public transport	41.71	Home	6.29	>30 minutes and <40 minutes	13.00
Bicycle	3.24	Leisure or others	3.24	>40 minutes and <50 minutes	8.22
Walking	8.00			>50 minutes and <60 minutes	6.50
Others	0.95			>60 minutes	9.56

Table 3: The participants' responses regarding the positive impact of various tools carried by travelers and onboard activities on trip time*.

Carried tools	Mean	IQR	Median	Mode	Activity onboard	Mean	IQR	Median	Mode
Classical cellphone	3.03	4	2	2	Reading	4.10	5	5	5
Smartphone	5.07	6	5	5	Writing	3.09	4	3	2
Tablet	3.56	5	4	4	Talking	4.24	5	5	5
Laptop	4.49	6	5	5	Listening	4.97	6	5	5
Headsets	3.60	5	4	4	Using social media	4.15	5	5	5
Newspaper, book	3.55	5	4	4	Relaxing	4.57	5	5	5
Work document	4.71	6	5	5	Thinking	5.01	6	5	5
Internet bundle	3.87	5	4	4	Gaming	2.95	4	2	5
Battery charger	4.58	6	5	5	Eating/drinking	3.46	5	4	2
Food	3.99	5	4	5	Doing nothing	2.76	2	2	3
Drink	4.28	5	5	5					
I do not use anything (i.e., no tools)	3.07	4	4	4					

*1: totally disagree, 2: disagree, 3: slightly disagree, 4: slightly agree, 5: agree, and 6: totally agree.

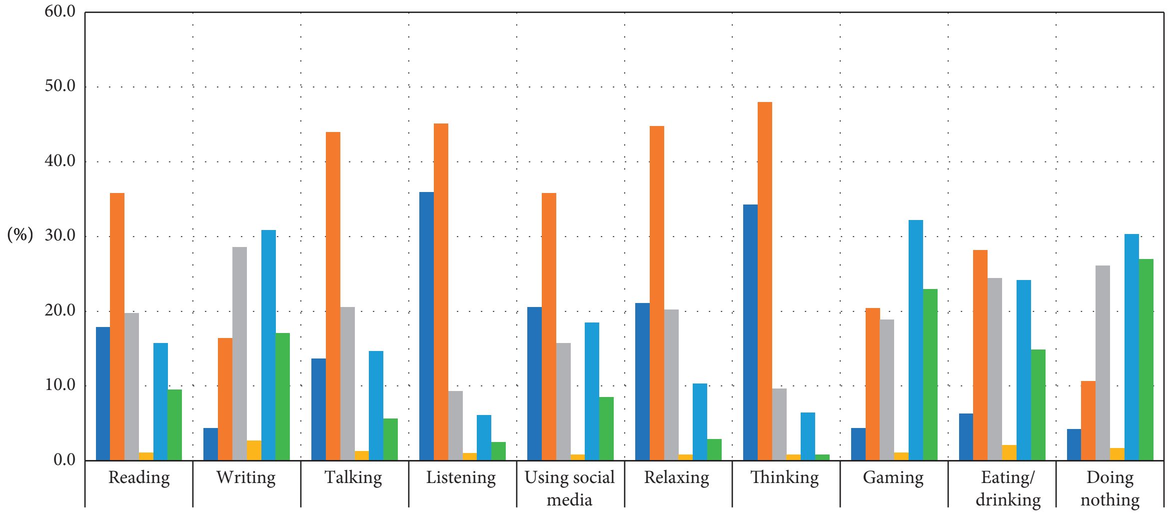


	Classical cellphone	Smartphone	Tablet	Laptop	Headsets	Newspaper, book	Work document	Internet bundle	Battery charger	Food	Drinks	No tools
Totally agree (6)	3.2%	39.4%	11.2%	6.9%	28.2%	7.4%	5.1%	30.7%	30.1%	11.8%	15.2%	4.0%
Agree (5)	15.0%	43.0%	28.6%	21.3%	35.4%	25.7%	26.1%	40.0%	35.2%	33.7%	43.6%	13.0%
Slightly agree (4)	30.3%	10.9%	31.8%	36.2%	17.7%	31.6%	33.0%	16.6%	18.1%	28.8%	21.1%	36.2%
Slightly disagree (3)	1.1%	0.4%	1.3%	1.1%	0.4%	1.1%	1.1%	0.8%	1.1%	1.5%	1.0%	1.7%
Disagree (2)	33.0%	4.4%	18.3%	25.7%	12.6%	23.0%	23.2%	6.5%	10.1%	16.6%	12.4%	23.2%
Totally disagree (1)	17.3%	1.9%	8.8%	8.8%	5.7%	11.0%	11.4%	5.5%	5.3%	7.6%	6.7%	21.9%

The carried tools

Figure 2: The participants' responses concerning the positive impact of each carried tool on trip time.

Figure 3 demonstrates the responses of the participants concerning the impacts of onboard activities on trip time, as shown in Table 3. The level of agreement to each activity is shown in a bar chart, and the percentage per level of agreement (i.e., whether an onboard activity has a positive or a negative impact on trip time) is presented in Figure 3, as well. The percentage of participants who answers "agree" (i.e., 5 on the Likert scale) on the inquiry about the positive impact of reading, talking, listening, using social media, relaxing, thinking, and eating/drinking onboard is 35.8%, 44%, 45.1%, 35.8%, 44.8%, 48%, and 28.2%, respectively. Around 30.9% of the participants answer "disagree" (i.e., 2 on the Likert scale) to the question about the impact of writing on trip time, 32.2% answer "disagree" (i.e., 2 on the Likert scale) in case of gaming, which means that this activity impacts on trip time negatively, and 30.3% of the



	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Totally agree (6)	17.9%	4.4%	13.7%	36.0%	20.6%	21.1%	34.3%	4.4%	6.3%	4.2%
Agree (5)	35.8%	16.4%	44.0%	45.1%	35.8%	44.8%	48.0%	20.4%	28.2%	10.7%
Slightly agree (4)	19.8%	28.6%	20.6%	9.3%	15.8%	20.2%	9.7%	18.9%	24.4%	26.1%
Slightly disagree (3)	1.1%	2.7%	1.3%	1.0%	0.8%	0.8%	0.8%	1.1%	2.1%	1.7%
Disagree (2)	15.8%	30.9%	14.7%	6.1%	18.5%	10.3%	6.5%	32.2%	24.2%	30.3%
Totally disagree (1)	9.5%	17.1%	5.7%	2.5%	8.5%	2.9%	0.8%	23.0%	14.9%	27.0%

Onboard activities

Figure 3: The participants' responses concerning the positive impact of each onboard activity on trip time.

participants consider doing nothing onboard affects the trip time negatively. A similar tendency can be seen as in case of the carried tools, the "slightly disagree" (i.e., 3 on the Likert scale) category has low percentages for all activities. It means that being involved in onboard activities affects the trip time positively with high variations in the level of agreement (i.e., 4, 5, and 6 on the Likert scale), while the negative impact of involving in onboard activities has low variation in the level of agreement (i.e., 1 and 2 on the Likert scale). Moreover, it is shown that listening and thinking have high percentages regarding the positive impacts on the trip time, which indicates the usefulness of these onboard activities in making the travel more pleasant onboard.

Figure 4 shows the onboard activities of the travelers per transport mode. The participants report their current transport modes and the activity that they conduct and influence their trip time positively. The criterion to be used in the decision is the median, where the percentage of the participants is higher than 50%. It is worth mentioning that "others" refers to any transport mode except for car-as-a-driver, car-as-a-passenger, taxi, public transport, bicycle, and walking. Figure 4 shows that reading activity prevails among public transport users (74.6%), in case of car-as-a-passenger modes (53.6%), and others (80.0%). Writing and gaming activities do not show significant usage among travelers in case of all transport modes (i.e., the percentages are less than 50%). Thinking and listening activities prevail in all transport modes. Using social media is significant in case of car-as-a-passenger (55.2%), public transport (76.8), walking (59.5), and others (80.0%). Talking activity prevails in all transport modes except for others. Relaxing activity is conducted in all transport modes except for car-as-a-driver. Eating/drinking activity appears in all transport modes except for others. It has to be noted that others, bicycle, and taxi are not summarized because they represent a low percentage in the sample (see Table 2). Based on what has been discussed, public transport is the preferred transport mode for conducting onboard activities such as reading (74.6%), writing (27.6%), listening (92.4%), using social media (76.8%), relaxing (82.7%), thinking (99.5%), and gaming (34.1%). While car-as-a-passenger is the preferred transport mode for conducting onboard activities such as talking (66.4%) and eating/drinking (49.6%). The sequence of transport modes from the best to the worst based on the consensus of conducting onboard activities that influence the trip time positively is as follows:

(i) Reading: public transport, car-as-a-passenger, walking, and car-as-a-driver.

(ii) Writing: public transport, car-as-a-passenger, walking, and car-as-a-driver.

(iii) Talking: car-as-a-passenger, car-as-a-driver, public transport, and walking.

(iv) Listening: public transport, car-as-a-passenger, car-as-a-driver, and walking.

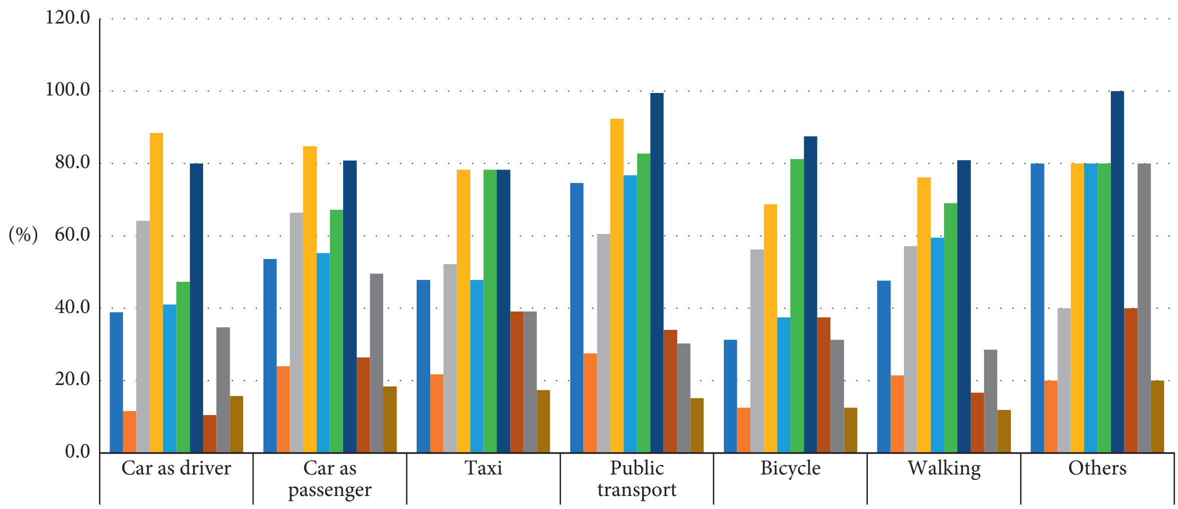
(v) Using social media: public transport, walking, car-as-a-passenger, and car-as-a-driver.

(vi) Relaxing: public transport, walking, car-as-a-passenger, and car-as-a-driver.

(vii) Thinking: public transport, walking, and car-as-a-passenger/driver.

(viii) Gaming: public transport, car-as-a-passenger, walking, and car-as-a-driver.

(ix) Eating/drinking: car-as-a-passenger, car-as-a-driver, public transport, and walking.



	Car as driver	Car as passenger	Taxi	Public transport	Bicycle	Walking	Others
Reading	38.9%	53.6%	47.8%	74.6%	31.3%	47.6%	80.0%
Writing	11.6%	24.0%	21.7%	27.6%	12.5%	21.4%	20.0%
Talking	64.2%	66.4%	52.2%	60.5%	56.3%	57.1%	40.0%
Listening	88.4%	84.8%	78.3%	92.4%	68.8%	76.2%	80.0%
Using social media	41.1%	55.2%	47.8%	76.8%	37.5%	59.5%	80.0%
Relaxing	47.4%	67.2%	78.3%	82.7%	81.3%	69.0%	80.0%
Thinking	80.0%	80.8%	78.3%	99.5%	87.5%	81.0%	100.0%
Gaming	10.5%	26.4%	39.1%	34.1%	37.5%	16.7%	40.0%
Eating/drinking	34.7%	49.6%	39.1%	30.3%	31.3%	28.6%	80.0%
Doing nothing	15.8%	18.4%	17.4%	15.1%	12.5%	11.9%	20.0%

Figure 4: The percentage of each onboard activity that a transport mode user conducts.

The participants' answers about the onboard activities and the tools carried by travelers on the Likert scale are examined across the sociodemographic and travel variables by applying contingency tables, χ^2 tests, the Spearman rho assessment, and the Mann–Whitney U statistical tests [58]. The dependence and the association between the trip purpose and the various types of onboard activities are examined in Table 4, where solely the significant variables are presented. The chi-square test and Cramer's V tests are used to examine the dependence and the strength of the association between the onboard activities and the travel factors, such as the trip purpose, the transport mode, and the trip time. While Phi represents the correlation between two variables. A p value that is more than 0.05 means independence, while a p value smaller than 0.05 indicates a dependent relationship [58].

In Table 4, dependence is found between the trip purpose and the use of social media, relaxing, and gaming at a confidence interval of 95%, while at a confidence interval of 90%, eating/drinking shows dependence. Other onboard activities, such as reading, writing, talking, listening, and doing nothing are insignificant (i.e., p value > 0.1), which means that there is no dependence between these activities and the trip purposes; therefore, they are excluded from the table. The transport mode affects the activities of reading, using social media, gaming, and eating/drinking, where the chi-square test shows dependence between these activities and the transport modes at a confidence interval of 95%, while onboard writing shows dependence at a lower confidence interval. Finally, the trip time is associated with writing at a confidence level of 95%. From Table 4, it can be seen that being involved in writing activities is affected by the transport mode and the trip time, while relaxing is affected by the trip purpose. Moreover, the use of social media, gaming, and eating/drinking are influenced by the trip purpose and the transport mode. Additionally, the activity of relaxing is most related to the trip purpose, while reading is most related to the transport mode. It is worth mentioning that no significant symmetric measures are found between the tools carried by travelers with transport modes, the trip purpose and trip time.

The combination between onboard activities and the tools carried by travelers is examined by using the cross-tabulation method. The aim is to find the connection between using the tools carried by travelers and the involvement in onboard activities during traveling to the main trip purpose, as shown in Table 5. It is worth mentioning that the connection is built based on the impact of onboard activities and the tools carried by travelers on the perceived trip time. In Table 5, dependence is found between the tools carried by travelers and the onboard activities, as shown in the rows of Pearson chi-square. Dependence is found between all onboard activities and the tools carried by travelers except for doing nothing and Internet, tablet, battery charger, food, and drink, which shows independence, based on a confidence level of 95% and 90%. Cramer's V shows the association strength between the tools carried by travelers and the onboard activities, where the strength of the association is explained in the methodology section. Strong associations (indicated by aqua hatch) are found between using newspaper-reading, using work document-reading, using work document-writing, having Internet bundle-reading, having headsets-relaxing, having Internet

Table 4: The chi-square test and the symmetric measures of the trip purpose, the transport mode, and the trip time across onboard activities.

Variables	Pearson chi-square	Phi	Cramer's V
Trip purposes			
Using social media	50.022*	0.309	0.154
Relaxing	55.568*	0.325	0.163
Gaming	40.364*	0.277	0.139
Eating/drinking	30.533**	0.241	0.121
—	—	—	—
Trip times			
Writing	19.057*	0.191	0.085
Transport modes			
Reading	87.462*	0.408	0.183
Writing	36.253**	0.263	0.118
Social media	47.732*	0.302	0.135
Gaming	67.763*	0.359	0.161
Eating/drinking	70.733*	0.367	0.164

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%. *N* is 525.

Table 5: The chi-square test and the symmetric measures of the tools carried by travelers and the onboard activities.

Variables	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Classical mobile phone										
Pearson chi-square	60*	29.7*	116.14*	51.47*	51.99*	125.16*	49.03*	77.27*	79.36*	38.09*
Cramer's V	0.151	0.106	0.21	0.14	0.141	0.218	0.137	0.172	0.174	0.12
Phi	0.338	0.238	0.47	0.313	0.315	0.488	0.306	0.384	0.389	0.269
Smartphone										
Pearson chi-square	59.14*	42.32*	116.12*	80.88*	143.78*	61.52*	48.82*	97.73*	79.13*	41.83*
Cramer's V	0.15	0.127	0.21	0.176	0.234	0.153	0.136	0.193	0.174	0.126
Phi	0.336	0.284	0.47	0.392	0.523	0.342	0.305	0.431	0.388	0.282
Laptop										
Pearson chi-square	149.01*	102.01*	98.46*	52.32*	85.36*	82.42*	62.379	109.3*	84.13*	47.23*
Cramer's V	0.238	0.197	0.194	0.141	0.18	0.177	0.154	0.204	0.179	0.134
Phi	0.533	0.441	0.433	0.316	0.403	0.396	0.345	0.456	0.400	0.3
Headsets										
Pearson chi-square	77.82*	53.28*	131.22*	105.5*	122.0*	169.14*	124.05*	84.38*	75.91*	40.89*
Cramer's V	0.172	0.142	0.224	0.2	0.216	0.254	0.217	0.179	0.17	0.125
Phi	0.385	0.319	0.50	0.448	0.482	0.568	0.486	0.401	0.38	0.279
Newspaper										
Pearson chi-square	169.24*	137.67*	61.65*	45.67*	60.31*	130.73*	54.47*	102.54*	100.0*	34.08**
Cramer's V	0.254	0.229	0.153	0.132	0.152	0.223	0.144	0.198	0.195	0.114
Phi	0.568	0.512	0.343	0.295	0.339	0.499	0.322	0.442	0.436	0.255
Work document										
Pearson chi-square	192.46*	234.61*	55.07*	41.96*	5736*	156.22*	50.14*	74.2*	59.9*	36.53**
Cramer's V	0.271	0.299	0.145	0.126	0.148	0.244	0.138	0.168	0.151	0.118
Phi	0.605	0.668	0.324	0.283	0.331	0.545	0.309	0.376	0.338	0.264
Internet bundle										
Pearson chi-square	165.58*	78.82*	74.64*	58.64*	199.58*	139.82*	81.35*	98.53*	98.13*	28.44
Cramer's V	0.251	0.173	0.169	0.149	0.276	0.231	0.176	0.194	0.193	0.104
Phi	0.562	0.387	0.377	0.334	0.617	0.516	0.394	0.433	0.432	0.233

Table 5: Continued.

Variables	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/ drinking	Doing nothing
Tablet										
Pearson chi-square	87.73*	103.271	49.11*	49.05*	137.32*	143.02*	49.96*	88.7*	91.39*	30.40
Cramer's V	0.183	0.198	0.137	0.137	0.229	0.233	0.138	0.184	0.187	0.108
Phi	0.409	0.444	0.306	0.306	0.511	0.522	0.309	0.411	0.417	0.241
Battery/charger										
Pearson chi-square	75.78*	54.4*	54.46*	62.44*	79.78*	153.47*	62.71*	80.05*	125.02*	30.38
Cramer's V	0.17	0.144	0.144	0.154	0.174	0.242	0.155	0.175	0.218	0.108
Phi	0.38	0.321	0.322	0.345	0.390	0.541	0.364	0.39	0.488	0.241
Food										
Pearson chi-square	80.09*	58.34*	97.6*	60.11*	67.93*	95.92*	65.02*	101.67*	510*	31.63
Cramer's V	0.175	0.149	0.193	0.151	0.161	0.191	0.157	0.197	0.441	0.11
Phi	0.391	0.333	0.431	0.338	0.36	0.427	0.352	0.440	0.986	0.245
Drink										
Pearson chi-square	103.08*	44.58*	100.64*	51.94*	67.57*	70.29*	51.07*	89.51*	412.47*	46.85*
Cramer's V	0.198	0.13	0.196	0.141	0.16	0.164	0.139	0.185	0.396	0.134
Phi	0.443	0.291	0.438	0.315	0.359	0.366	0.312	0.413	0.886	0.299
No tools										
Pearson chi-square	75.03*	46.05*	30.31*	48.18*	43.0*	42.90*	87.07*	32.73	41.82*	158.21*
Phi	0.169	0.132	0.107	0.135	0.128	0.128	0.182	0.112	0.126	0.245
Cramer's V	0.378	0.296	0.24	0.303	0.286	0.286	0.407	0.25	0.282	0.549

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%. N is 525.

bundle-using social media, having a drink-eating/drinking, and having food-eating/drinking. Moderate associations (indicated by tan color) are presented, and solely associations more than 0.2 are discussed due to the purpose of this research. Moderate associations are found between classical mobile phone-talking, classical mobile phone-relaxing, smartphone-talking, smartphone-using social media, laptop-reading, laptop-gaming, headsets-listening, headsets-using social media, headsets-thinking, newspaper-writing, newspaper-relaxing, work document-relaxing, work document-eating/drinking, Internet bundle-relaxing, tablet-using social media, tablet-relaxing, battery/charger-relaxing, battery/charger-eating/drinking, and no tools-doing nothing. It is noted that conducting onboard activities is connected to the tools carried by travelers onboard to a certain extent. For example, having food onboard means that a traveler might conduct onboard eating/drinking activity, having smartphones motivates travelers to use social media, having newspaper onboard suggests a traveler might read or write, smartphones or classical cellphones are connected to talking activity, having headsets means listening to music, using social media, talking, or relaxing, having battery/charger suggests travelers use it while they are eating or relaxing, and having no tools onboard means that travelers do not conduct any onboard activities connected to the given tools. Thus, the perception of trip time is affected by the travelers' behavior onboard, for instance, doing onboard activities by using their carried tools adds a positive impact on the trip time (i.e., better utility).

The change in the effects of the used tools that travelers carry onboard and the onboard activities on the perceived trip time across groups when travelers travel to their main trip purposes is examined by using multivariate analysis. Multivariate analysis is used to examine the statistical difference between onboard activities and groups of transport modes, trip purpose, trip time, gender, age, income, education, job, and car ownership, where the same individuals answer the same questions in the questionnaire. However, the one-way MANOVA is conducted, where the onboard activities and the tools carried by travelers are treated as the dependent variables, while the sociodemographic, economic, and trip characteristics are the independent variables. Before conducting the analysis, the correlation analysis, Box's test, and the equality of error variances test are run. Box's test of equality of covariance matrices shows that the null hypothesis that the observed covariance matrices of the dependent variables (i.e., onboard activities) are equal among all groups (e.g., transport modes) is invalid ($p < 0.001$). Table 6 shows that Levene's test of equality of error variance is insignificant for any of the dependent variables, which leads to the conclusion that the multivariate test results can be interoperated. A bivariate analysis of onboard activities (i.e., the dependent variables) is conducted. The correlations are significant in all pairs except for listening-reading, listening-writing, thinking-writing, thinking-talking, eating/drinking-reading, doing nothing-all activates except for listening. All the correlations are weak, except for writing-reading, which shows moderate correlation. The results support the conducting of

Table 6: KMO and Bartlett's test.

		Onboard activities set	The tools carried by travelers set
Kaiser–Meyer–Olkin		0.672	0.835
	Approx. chi-square	717.922	2055.705
Bartlett's test of sphericity	df	45	66
	Sig.	0.000	0.000

one-way MANOVA, which assumes no multicollinearity to conduct a multivariate statistical analysis (no strong correlations > 0.8) [63].

Eta square is used to measure the proportion of the total variance in those onboard activities that are associated with the different groups of transport modes, trip purpose, trip time, gender, age, income, education, job, and car ownership. It is worth mentioning that in this paper, one-way interaction is presented alone. In Table 7, each F tests the multivariate effect of the independent variables (i.e., groups). These tests are based on the linearly independent pairwise comparisons of the estimated marginal means. The four multivariate tests are Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root tests, which are used in examining any statistical differences between the independent variables based on the tools carried by travelers. Box's test of equality of covariance matrices shows that the null hypothesis that the observed covariance matrices of the dependent variables (i.e., onboard activities) are equal among all groups (e.g., transport modes) is invalid; thus, using Wilks' lambda multivariate test in the interpretation is valid. The four tests are significant in transport mode ($p < 0.01$), gender ($p < 0.1$), income ($p < 0.1$), and car ownership ($p < 0.025$) groups, and due to the unviolated result of the Box M test of the covariance equality's homogeneity, Wilks' lambda result is presented.

Table 7 presents Wilks' lambda multivariate test. The transport mode, gender, income, and car ownership are significantly dependent on which onboard activities travelers conduct. Thus, there is a statistically significant difference in conducting onboard activities based on transport modes, $F\,(54, 2462.322) = 1.567$, $p < 0.05$; Wilk's $\Lambda = 0.842$, and partial $\eta^2 = 0.031$. The gender shows statistically significant difference in conducting onboard activities, $F\,(9, 482.000) = 1.677$, $p < 0.1$; Wilk's $\Lambda = 0.970$, and partial $\eta^2 = 0.042$. The income shows statistically significant difference in conducting onboard activities, $F\,(27, 1408.331) = 1.383$, $p < 0.1$; Wilk's $\Lambda = 0.926$, and partial $\eta^2 = 0.027$. Besides, car ownership shows statistically significant difference in conducting onboard activities, $F\,(9, 482.000) = 2.258$, $p < 0.05$; Wilk's $\Lambda = 0.960$, and partial $\eta^2 = 0.046$, while other independent variables are not statistically significant. The formulation of the generalized model that combines the dependent variables and the independent variables is shown at the bottom of Table 7. Moreover, η^2 value is the variance explained by a given variable of the variance remained after excluding the variance explained by other predictors. The power of η^2 is considered small to medium (i.e., small = 0.01, medium = 0.06, and large = 0.14) [67].

Multivariate analysis is applied to examine the statistical difference between the tools carried by travelers and the transport modes, trip purpose, trip time, gender, age, income, education, job, and car ownership. However, the one-way MANOVA is conducted. Box's test of equality of covariance matrices shows that the null hypothesis that the observed covariance matrices of the dependent variables (i.e., onboard activities) are equal among all groups (e.g., transport modes) is invalid ($p < 0.001$). Table 8 shows that Levene's test of equality of error variance is insignificant for any of the dependent variables, which leads to the conclusion that the multivariate test results can be interoperated ($p > 0.05$). A bivariate analysis of the tools carried by travelers (i.e., the dependent variables) is examined to check the correlations. The correlations are significant in all pairs except for no tools-newspaper and no tools-work document. All the correlations range from weak to moderately strong correlations, where the highest correlation locates between drink-food (0.783). The results support the conduction of one-way MANOVA that assumes no multicollinearity to conduct a multivariate statistical analysis (no strong correlations > 0.8).

In Table 9, each F tests the multivariate effect of the independent variables (i.e., groups). The four multivariate tests that are used in examining any statistical differences between the independent variables based on the tools carried by travelers are Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root tests. Box's test of equality of covariance matrices shows that the null hypothesis that the observed covariance matrices of the tools carried by travelers are equal among all independent variables (e.g., transport modes) is invalid; thus, using Wilks' lambda multivariate test is valid. The four tests are significant ($p < 0.01$) in transport mode, trip purpose, trip time, gender, age, education, and job groups. Because of the unviolated Box M test of the covariance equality's homogeneity, Wilks' lambda is used to interpret the results. Table 9 presents solely Wilks' lambda multivariate test. The transport modes are significantly dependent on which tools carried by travelers are used by the travelers ($p < 0.01$). Thus, there is a statistically significant difference in using the tools carried by travelers based on transport modes, $F\,(72, 2611.846) = 1.537$, $p < 0.01$; Wilk's $\Lambda = 0.798$, and partial $\eta^2 = 0.037$. The trip purpose shows statistically significant difference in using the tools carried by travelers, $F\,(48, 1847.197) = 1.316$, $p < 0.1$; Wilk's $\Lambda = 0.879$, and partial $\eta^2 = 0.032$. The trip time shows statistically significant difference in using the tools carried by travelers, $F\,(72, 2611.846) = 1.281$, $p < 0.1$; Wilk's $\Lambda = 0.828$, and partial $\eta^2 = 0.031$. The gender shows statistically significant difference in using the tools carried by travelers, $F\,(12, 479.000) = 1.923$, $p < 0.05$; Wilk's $\Lambda = 0.953$, and partial $\eta^2 = 0.047$. The age shows statistically significant difference

Table 7: Onboard activities across variables (i.e., groups): the results of the multivariate analysis test[a].

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta squared (η^2)
Intercept	Wilks' lambda	0.323	112.350[b]	9	482.000	0.000*	0.705
Transport mode	Wilks' lambda	0.842	1.567	54	2462.322	0.005*	0.031
Trip purpose	Wilks' lambda	0.929	0.992	36	1808.014	0.484	0.021
Trip time	Wilks' lambda	0.921	0.741	54	2462.322	0.920	0.016
Gender	Wilks' lambda	0.970	1.677[b]	9	482.000	0.092**	0.042
Age	Wilks' lambda	0.949	0.950	27	1408.331	0.538	0.019
Income	Wilks' lambda	0.926	1.383	27	1408.331	0.092**	0.027
Education	Wilks' lambda	0.956	0.809	27	1408.331	0.744	0.016
Job	Wilks' lambda	0.872	1.059	63	2720.757	0.352	0.021
Car ownership	Wilks' lambda	0.960	2.258[b]	9	482.000	0.018*	0.046

[a]Design: intercept + transport mode + trip purpose + trip time + gender + age + income + education + job + car ownership. [b]Exact statistic. *Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 8: Levene's test of equality of error variances of onboard activities[a].

Dependent variables	F	df1	df2	Sig.
Reading	1.179	436	88	0.173
Writing	1.300	436	88	0.066
Talking	0.674	436	88	0.994
Listening	1.070	436	88	0.357
Using social media	0.894	436	88	0.764
Relaxing	0.981	436	88	0.561
Thinking	0.914	436	88	0.722
Gaming	1.144	436	88	0.222
Eating/drinking	1.198	436	88	0.151
Doing nothing	1.174	436	88	0.181

[a] Tests the null hypothesis that the error variance of the dependent variable is equal among the groups.

Table 9: The tools carried by travelers across variables (i.e., groups): the results of the multivariate analysis test[a].

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared (η^2)
Intercept	Wilks' lambda	0.374	66.802[b]	12	479.000	0.000*	0.626
Transport mode	Wilks' lambda	0.798	1.537	72	2611.846	0.003*	0.037
Trip purpose	Wilks' lambda	0.879	1.316	48	1847.197	0.073**	0.032
Trip time	Wilks' lambda	0.828	1.281	72	2611.846	0.058**	0.031
Gender	Wilks' lambda	0.953	1.982[b]	12	479.000	0.024*	0.047
Age	Wilks' lambda	0.872	1.872	36	1415.987	0.001*	0.045
Income	Wilks' lambda	0.910	1.271	36	1415.987	0.132	0.031
Education	Wilks' lambda	0.893	1.529	36	1415.987	0.024*	0.037
Job	Wilks' lambda	0.790	1.375	84	2941.677	0.014*	0.033
Car ownership	Wilks' lambda	0.967	1.362[b]	12	479.000	0.180	0.033

[a]Design: intercept + transport mode + trip purpose + trip time + gender + age + income + education + job + car ownership. [b]Exact statistic. *Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

in using the tools carried by travelers, F (36, 1415.987) = 1.872, $p < 0.005$; Wilk's $\Lambda = 0.872$, and partial $\eta^2 = 0.045$. The education shows statistically significant difference in using the tools carried by travelers, F (36, 1415.987) = 1.529, $p < 0.05$; Wilk's $\Lambda = 1.529$, and partial $\eta^2 = 0.037$. The job shows statistically significant difference in using the tools carried by travelers, F (84, 2941.677) = 1.375, $p < 0.05$; Wilk's $\Lambda = 0.790$, and partial $\eta^2 = 0.033$, while other independent variables (i.e., car ownership and income) are not statistically significant. The formulation of the generalized model that combines the dependent variables and the independent variables is shown at the bottom of Table 9. Moreover, η^2 value is the variance explained by a given variable of the variance remaining after excluding variance explained by other predictors. The power of η^2 is considered small to medium (i.e., small = 0.01, medium = 0.06, and large = 0.14) [67].

It is worth mentioning that Table 10 shows that Levene's test of equality of error variance is insignificant for any of the dependent variables, which leads to the conclusion that the multivariate test results can be interoperated ($p > 0.05$).

The results of multivariate analysis demonstrate that the perception of trip time is not the same across some groups. Thus, travelers have different perceived trip time across the groups while conducting onboard activities and using the carried tools onboard, as presented in Tables 7 and 9.

Statistically significant differences between the sociodemographic variables considering onboard activities and

Table 10: Levene's test of equality of error variances of the tools carried by travelers[a].

Dependent variables	F	$df1$	$df2$	Sig.
Classical mobile phone	1.094	436	88	0.309
Smartphone	1.221	436	88	0.127
Laptop	1.141	436	88	0.226
Headsets	0.934	436	88	0.675
Newspaper	1.134	436	88	0.237
Work document	1.187	436	88	0.163
Internet bundle	0.863	436	88	0.826
Tablet	0.806	436	88	0.915
Battery/Charger	0.834	436	88	0.875
Food	1.279	436	88	0.079
Drink	0.878	436	88	0.798
No tools	1.083	436	88	0.330

[a]Testing the null hypothesis that the error variance of the dependent variable is equal among the groups.

the tools that travelers carry are tested by using the Kruskal–Wallis H test to find the ranks for each onboard activity per group. The Kruskal–Wallis H test is applied for travelers' groups, such as gender, age, income, education, job, car ownership, transport mode, and trip purpose. Only gender group is presented in detail, while the results of others are presented in Appendix. The result of the test on the gender group shows that there is a statistically significant difference between the responses of males and females in case of reading, writing, talking, relaxing, and no activity, as well as the rankings, shown in Tables 11 and 12 (see χ^2, p, and the mean rank). Table 11 shows the significance of the results, while Table 12 shows the rankings. Reading, writing, talking, and relaxing are significant at a confidence level of 95%, while "no activity" is significant at a confidence level of 90%. On the other hand, listening, using social media, thinking, gaming, and eating/drinking activities do not show significant differences across the gender. Based on the produced rankings, women are more likely to read, write, or relax onboard than men because it has a higher mean ranking than for males, while males are more likely to talk or to do nothing onboard than females because these activities have a higher mean ranking than in case of females. The results of the analysis of the remaining groups are presented in Appendix (see Table 13 to 19). Based on the produced rankings and a confidence level of at least 90%, the main findings show that people from the age class of 15–24 years are more likely to be engaged in onboard activities than other age classes. Similarly, low-income people are more involved in onboard activities than high-income and middle-income classes, and high-school degree holders are more involved in onboard activities than other educational degree holders. Furthermore, the self-employed group followed by students, in sequence, is more likely to be involved in onboard activities than other job types as well as people who do not own personal cars are more involved in onboard activities than car ownerships. Finally, people who travel to home and to school are more involved in onboard activities than other trip purposes, and people who use public transport, taxi, and car-as-a-passenger are more involved in onboard activities than other transport mode users.

Participants evaluate the trip time in the presence of onboard activities and each carried tool. The evaluation is based on a 6-point Likert scale. EFA is used to find the factors that own the most impact on the perceived trip time, where each onboard activity or carried tool is considered as a factor. The aim of this analysis is to decrease the number of activities/tools involved in the evaluation of the perceived trip time. Pearson and Mundform [68] state that as the sample size increases, the output quality increases, too. The Kaiser–Meyer–Olkin (KMO) test is used to measure the adequacy of the sample size, and Bartlett's test is applied to measure sphericity [60]. Table 6 shows that KMO is 0.672 for the onboard activities and 0.835 for the tools carried by travelers, which means the sample size is large enough for conducting the analysis (KMO > 0.05) [60]. The eigenvalues, which are the variances of the factors, and the statistical technique varimax rotation method are used in EFA (at one level of factor analysis as an attempt to interpret the relationship among the factors) [69, 70].

The EFA result is presented in Table 20, while Figure 5 and Table 21 show the scree plots and their values of the eigenvalues against the factor numbers, where the factors of the eigenvalue larger than 1 are selected. The correlations with less than the absolute value of 0.3 are removed. The factors that are good to evaluate the trip time are the first four factors in case of onboard activities and the first three factors in case of the carried tools, where the eigenvalue is larger than 1. In the onboard activities set, the results show that reading, writing, talking, and listening factors explain 25.56%, 13.66%, 10.74%, and 10.5% of the variance, respectively, while in the tools carried by travelers set, the following factors: classical mobile phones, smartphones, and laptops explain 35.88%, 12.506%, and 9.88% of the variance, respectively.

From the results of EFA, it is important to understand the underlying structure between factors, where a reduction in the number of factors in the set of factors (i.e., onboard activities/carried tools) is possible. The rotation component matrix, which shows the Pearson correlation between the components and items (i.e., the correlations are called factor loadings), is presented in Table 21. In the onboard activities set, eating, gaming, using social media, talking, and listening can be measured by component one (i.e., reading), reading and writing can be measured by component two (i.e., writing), thinking and relaxing can be measured by component three (i.e., talking), and doing nothing can be measured by component four (i.e., listening). In the tools carried by travelers set, Internet bundle, smartphone, headsets, tablet, and no tools can measure component one (i.e., classical mobile phone), newspaper, work document, classical mobile phone, and laptop can measure component two (i.e., smartphone), and drink, food, and battery/charger can measure component three (i.e., laptop).

5. Discussion

The results of this study demonstrate the influence of different activities conducted onboard of CTMs on the perceived trip time, where during traveling to their main

Table 11: Kruskal–Wallis test statistics of the gender groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	8.579	7.598	4.379	0.253	0.105	6.858	0.272	0.073	0.004	3.461
df	1	1	1	1	1	1	1	1	1	1
Asymptotic sig.	0.003*	0.006*	0.036*	0.615	0.746	0.009*	0.602	0.787	0.951	0.063*

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 12: One-way ANOVA/ranks of the gender groups.

Gender	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Mean rank (female)	282.30	281.18	249.47	266.18	260.86	279.85	259.73	264.79	263.41	250.75
Mean rank (male)	244.77	245.83	275.77	260.00	265.02	247.09	266.09	261.31	262.62	274.56

Table 13: Kruskal–Wallis test statistics and the rankings of transport mode groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	33.429	5.459	32.746	7.286	27.443	17.912	2.427	31.778	20.245	3.292
df	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
Asymptotic sig.	0.000*	0.486	0.000*	0.295	0.000*	0.006*	0.877	0.000*	0.003*	0.771
					Mean ranking					
Transport mode										
Car-as-a-driver	195.44	234.72	277.31	281.05	204.76	209.39	263.88	197.08	276.47	262.59
Car-as-a-passenger passenger	259.75	258.45	291.19	279.46	257.54	264.60	251.39	257.71	296.89	270.30
Taxi	255.20	274.87	250.30	255.07	236.33	293.89	246.24	325.43	285.57	245.00
Public transport	295.99	275.66	246.55	255.99	295.00	275.24	266.11	283.75	233.54	255.02
Bicycle	214.00	266.50	244.84	228.25	229.38	297.47	276.94	287.13	296.88	270.38
Walking	275.00	265.62	251.94	230.98	267.95	281.54	278.07	261.50	248.08	282.20
Others	275.10	271.90	216.40	232.00	293.00	297.50	305.90	387.20	363.20	335.50

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 14: Kruskal–Wallis test statistics and the rankings of trip purpose groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	7.662	8.584	2.864	4.744	45.006	14.386	3.314	26.669	4.862	3.513
df	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Asymptotic sig.	0.085**	0.072**	0.581	0.315	0.000*	0.006*	0.507	0.000*	0.302	0.476
					Mean ranking					
Trip purpose										
Work	275.36	251.48	254.93	251.99	229.79	243.72	266.15	233.50	259.66	260.26
Shopping	250.08	309.53	239.00	263.67	155.50	232.83	219.20	215.27	247.37	262.53
Education	282.97	274.18	270.29	275.59	313.23	279.45	260.73	300.04	258.41	269.62
Home	292.85	296.15	282.58	255.09	276.76	295.21	251.12	298.79	315.02	275.29
Leisure or others	243.75	203.41	288.47	305.31	264.81	340.41	304.53	264.63	281.94	201.84

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 15: Kruskal–Wallis test statistics and the rankings of car ownership groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	12.682	7.935	0.536	0.023	22.316	12.984	0.785	35.479	6.468	0.700
df	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Asymptotic sig.	0.000*	0.005*	0.464	0.879	0.000*	0.000*	0.376	0.000*	0.011*	0.403
					Mean ranking					
Car ownership										
No	279.61	276.16	259.65	262.32	285.02	279.41	266.93	290.84	251.07	266.90
Yes	231.69	238.21	269.32	264.29	221.49	232.08	255.59	210.54	285.48	255.65

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 16: Kruskal–Wallis test statistics and the rankings of job groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	16.403	12.979	4.899	13.091	45.174	14.920	7.275	32.746	9.483	3.753
df	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
Asymptotic sig.	0.012*	0.089**	0.557	0.042*	0.000*	0.021*	0.296	0.000*	0.148	0.710
					Mean ranking					
Job										
Full-time worker	244.16	248.09	259.94	257.26	228.76	243.63	269.38	235.60	262.30	255.71
Part-time worker	265.47	250.11	265.74	207.11	263.11	231.36	239.58	222.73	221.08	287.31
Student	276.13	274.28	274.24	282.55	310.73	287.64	264.92	302.42	273.54	269.95
Unemployed	323.83	306.79	255.17	224.69	222.07	289.48	261.29	280.67	298.90	281.57
Self-employed	317.80	315.28	209.46	289.09	304.98	284.98	263.46	311.17	266.26	239.96
Retired	156.38	201.75	233.44	221.31	122.44	297.63	281.56	199.50	237.38	216.88
Others	259.82	267.50	265.68	271.09	217.50	211.86	163.55	178.27	174.14	255.45

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 17: Kruskal–Wallis test statistics and the rankings of educational groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	3.458	7.946	1.855	1.232	2.544	2.084	2.665	10.010	13.646	2.552
df	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
Asymptotic sig.	*0.326*	*0.047**	*0.603*	*0.745*	*0.467*	*0.555*	*0.446*	*0.018**	*0.003**	*0.466*
					Mean ranking					
Education										
High school	289.21	299.60	279.06	265.24	265.28	285.03	247.93	305.24	318.44	266.64
Undergraduate studies	265.43	267.97	261.18	268.19	270.45	258.46	263.59	267.73	260.27	267.77
Graduate studies	248.91	240.15	256.75	255.57	253.56	260.50	261.92	237.90	241.85	259.39
Others	265.29	269.45	290.57	244.05	229.02	281.60	305.71	274.24	307.17	216.45

Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 18: Kruskal–Wallis test statistics and the rankings of income groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	10.837	21.368	2.222	0.070	13.526	16.742	1.763	24.681	10.762	2.778
df	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
Asymptotic sig.	0.013*	0.000*	0.528	0.995	0.004*	0.001*	0.623	0.000*	0.013*	0.427

Table 18: Continued.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
					Mean ranking					
Income										
Low	279.61	275.66	269.59	262.84	279.67	269.85	265.14	287.16	262.76	275.31
Medium	252.16	242.99	266.32	260.83	258.01	280.63	258.74	247.20	254.97	257.06
High	220.28	212.78	260.58	265.12	210.44	202.27	278.34	197.84	231.61	251.01
No answer	276.37	307.87	243.09	265.05	275.44	270.84	250.91	285.18	304.41	252.13

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 19: Kruskal–Wallis test statistics and the rankings of age groups.

	Reading	Writing	Talking	Listening	Using social media	Relaxing	Thinking	Gaming	Eating/drinking	Doing nothing
Chi-square	1.310	5.254	0.580	8.325	31.333	10.981	1.176	31.845	14.695	3.490
df	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
Asymptotic sig.	0.727	0.154	0.901	0.040*	0.000*	0.012*	0.759	0.000*	0.002*	0.322
					Mean ranking					
Age										
15–24	270.85	279.87	268.00	283.37	302.71	283.09	260.52	302.55	281.71	275.89
25–54	259.77	255.29	260.81	252.86	245.97	256.26	266.86	246.01	256.84	257.75
55–64	240.66	231.30	255.34	239.66	162.60	194.86	247.68	185.52	232.16	231.88
+65	254.83	214.50	236.67	183.17	201.83	212.17	219.33	109.33	73.67	223.08

*Statistically significant at a confidence level of 95%. **Statistically significant at a confidence level of 90%.

Table 20: Total variance explained by selected factors (onboard activities/tools carried by travelers)*.

Component (factor)		Initial eigenvalues			Extraction sums of squared loadings		
		Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
	Onboard activities: factors that affect the travelers' perceived trip time positively						
1	Reading	2.556	25.559	25.559	2.556	25.559	25.559
2	Writing	1.366	13.657	39.216	1.366	13.657	39.216
3	Talking	1.087	10.874	50.091	1.087	10.874	50.091
4	Listening	1.035	10.352	60.443	1.035	10.352	60.443
5	Using social media	0.855	8.553	68.995			
6	Relaxing	0.799	7.988	76.983			
7	Thinking	0.745	7.448	84.431			
8	Gaming	0.704	7.037	91.468			
9	Eating/drinking	0.485	4.846	96.314			
10	Doing nothing	0.369	3.686	100.000			
	The tools carried by travelers: factors that affect the travelers' perceived trip time positively						
1	Classical mobile phone	4.306	35.880	35.880	4.306	35.880	35.880
2	Smartphone	1.501	12.506	48.386	1.501	12.506	48.386
3	Laptop	1.185	9.877	58.264	1.185	9.877	58.264
4	Headsets	0.966	8.052	66.315			
5	Newspaper	0.772	6.436	72.751			
6	Work document	0.652	5.433	78.184			
7	Internet bundle	0.575	4.792	82.976			
8	Tablet	0.558	4.652	87.628			
9	Battery/Charger	0.475	3.961	91.589			
10	Food	0.420	3.501	95.091			
11	Drink	0.378	3.149	98.239			
12	No tools	0.211	1.761	100.000			

Extraction method: principal component analysis.

trip purposes in urban areas, the majority of the travelers experience positive perception when they conduct multitasking and use their carried tools. The perception and the experience of the travelers onboard of a transport mode during the travel might be positive or negative based on the type of the onboard activities and the tools that

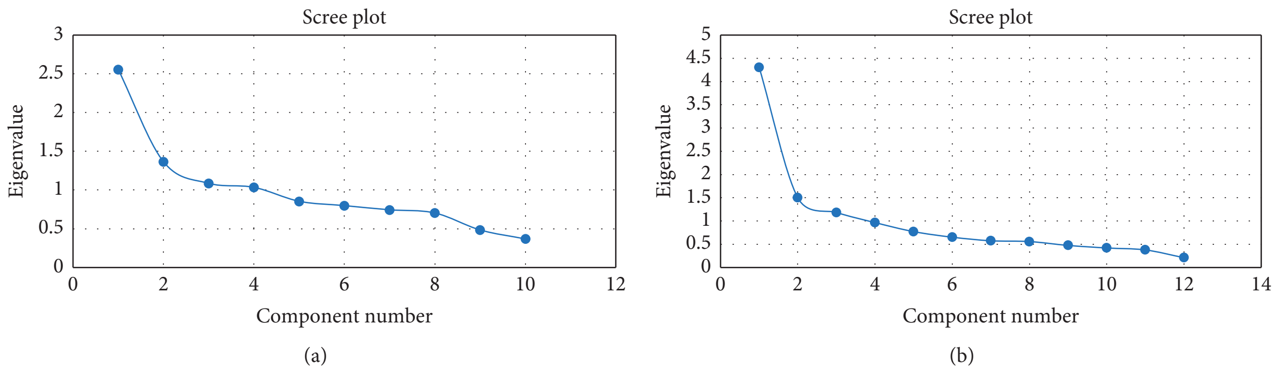


Figure 5: The scree plots of the onboard activities (a) and the tools carried by travelers (b).

Table 21: Rotated component matrix[a].

Item	Component[b] 1	2	3	4
Onboard activities				
Eating	0.681			
Gaming	0.618			
Using social media	0.610			
Talking	0.572			
Listening	0.562			
Reading		0.880		
Writing		0.845		
Thinking			0.878	
Relaxing			0.589	
Doing nothing				0.896
The tools carried by travelers				
Internet bundle	0.768			
Smartphone	0.742			
Headsets	0.675			
Tablet	0.544			
No tools	0.414			
Newspaper		0.798		
Work document		0.779		
Classical mobile phone		0.501		
Laptop		0.487		
Drink			0.894	
Food			0.882	
Battery/Charger			0.544	

[a]Extraction method: principal component analysis. Rotation Method: varimax with Kaiser normalization, rotation converged in 5 iterations. [b]Components are factors in Table 20, for example, 1 stands for reading in case of the onboard activities and classical mobile phone in case of the carried tools.

travelers bring onboard. Moreover, the characteristics of the individuals and journey impact the perceived trip time. In this section, the results with the pertained research questions are presented and discussed in line with the objectives of this study.

5.1. The Results of the Symmetric Measures of Association Analysis. Travelers conduct onboard activities based on their preferences and the tools that they carry onboard. Examining the relationship between onboard activities, the tools carried by travelers, and trip characteristics (i.e., transport mode, trip purpose, and trip time) are conducted. Two research questions are answered, as follows:

(1) How are onboard activities and the tools carried by travelers associated with sociodemographic and trip characteristics variables?

The study presents the dependence and the strength of the association between the onboard activities and the traveler characteristics (i.e., trip purpose, transport mode, and trip time). The trip purpose shows a significant correlation with using social media, relaxing, gaming, and eating/drinking, where a traveler, based on the trip purpose, determines the onboard activities. The transport mode shows significant results in reading, writing, using social media, gaming, and eating/drinking activities. The transport mode determines the type of onboard activities, while a traveler is involved in writing activities based on the trip time rather than the transport mode or the trip purpose. Thus, some activities are connected to the trip time not to the transport mode, especially those activities that require suitable circumstances, such as writing. Thus, it is preferable to provide a suitable environment for onboard writing in case of long trips. However, no connection is found between the tools carried by travelers and the sociodemographic as well as trip characteristics variables. Thus, some onboard activities and tools carried by travelers are associated with the characteristics of the individuals and the journeys, while some of them are not associated due to their nature and requirements, such as listening activity can be conducted by driver and by passenger, while writing is not possible for a driver.

(2) How are onboard activities associated with the tools carried by travelers onboard to impact trip time?

The connections between using the tools carried by travelers and the onboard activities are examined, and the results demonstrate moderate to strong associations. The associations' table (see Table 5) shows that conducting onboard activities are connected to the availability of tools onboard (i.e., tools carried by travelers) of CTMs. Thus, the availability of the tools carried by travelers onboard affects the type of onboard activity, for example strong association is presented between Internet bundle and using social media. Thus, the perceived trip time is affected by the availability of tools onboard, whether the tools are carried by travelers or provided by transport mode operators.

5.2. The Results of the Likert Scale, Multivariate Analyses, and Ranking Analyses. The individuals provide information about their existing conditions when they travel to their main trip purposes. The responses are analyzed, and the transport mode on which travelers conduct specific activities are presented. The transport modes are sequenced per onboard activity (which influences the trip time positively) based on the satisfaction of the respondents (see point 3). The onboard activities and the tools carried by travelers with the trip time are analyzed based on the responses of the individuals about the impact of conducting onboard activities and using their carried tools onboard on the trip time (see point 4). Besides, the differences between the groups across the onboard activities and the tools carried by travelers are analyzed to see if the perceived trip time is enhanced across groups or not (see points 5, and 6). The values of the difference across groups per onboard activity are estimated, where the superior subgroup (i.e., class) in each group is presented (see point 7).

(3) Which transport mode is used mostly to conduct an onboard activity based on its positive impact on the trip time?

The Likert scale analysis shows that the preferred transport mode for conducting specific onboard activities is addressed. The public transport is the most preferred transport mode over others when reading, writing, listening, using social media, relaxing, and gaming, while car-as-a-passenger is the preferred transport mode in case of eating/drinking and talking. Moreover, it is demonstrated that the car is the preferred mode for talking because the car provides privacy. Thus, the type of transport mode generally determines the activities onboard.

(4) What are the effects of onboard activities and the tools carried by travelers on the perceived trip time?

Onboard multitasking adds a positive experience to the travelers' perceived trip time, while some activities show a negative impact on it. For example, gaming is relatively low ranked; a potential reason for that is gaming takes time, and the trip time is reported to be short. Another reason might be that the study focuses on the main trip purpose, which means that the travelers are not so much interested in gaming during this kind of trip. Additionally, writing affects the perceived trip time negatively (i.e., 30.9% and 17.1% of 2 and 1 on the Likert scale, respectively) because onboard writing activity requires special environment, such as no crowding, enough space, available tools, and comfort. Finally, doing nothing activity shows a negative impact on the perceived trip time, where travelers feel bored and unpleasant during traveling to their main trip purposes. Thus, providing an appropriate environment onboard is required to avoid unpleasant journeys, where traveler can increase their utility by involving themselves in multitasking.

On the other hand, the impact of the different tools carried by travelers on the perceived trip time that travelers usually use onboard of CTMs is examined, and the results are the followings: travelers using classical mobile onboard show that the impact of this tool on the perceived trip time is not significant (i.e., a slight impact), while other tools have a much more positive influence on the perceived trip time. It is worth mentioning that the percentage of those people who say that laptops, newspapers/books, and work documents affect the perceived trip time negatively is close to those who state the opposite. Thus, the relevance of traveler experience on determining the impact of various tools on the perceived trip time is demonstrated. The ease of use of the tools that travelers carry as well as their availability impacts the perceived trip time, for example, a classical cellphone is not like a smartphone, in which the last can be used to conduct various activities.

(5) Are there any differences between certain groups of travelers regarding the impacts of onboard activities on the perception of trip time? and

(6) Are there differences between certain groups of travelers concerning the impacts of the tools carried that travelers carry onboard on the perception of trip time?

The study conducts one-way MANOVA to display the difference in the groups of travelers based on their characteristics (i.e., transport mode, trip time, and trip purpose), sociodemographic and economic characteristics (i.e., age, gender, job, education, income, and car ownership) across onboard activities and the tools carried by travelers onboard. The analysis shows various results in the groups toward onboard activities and the carried tools. The results of the MANOVA analysis demonstrate a statistical difference in the use of the tools carried by travelers and onboard activities based on several independent groups, such as transport modes, trip purposes, trip time, age, gender, education, car ownership, and job. The use of the tools that travelers bring onboard is statistically different based on transport modes, trip purposes, trip time, age, gender, job, and education. Besides, the involvement in onboard activities is statistically different based on transport modes, gender, income, and car ownership. This paper demonstrates the impact of onboard activities and the tools carried by travelers onboard on trip time in urban areas, where the travel distance is reasonably short, and the main trips that a traveler usually conducts are in focus. Furthermore, it demonstrates differences between some groups of travelers when they use the tools that they carry onboard and conduct activities during the travel. Thus, statistical difference means that the perceived trip time is not fixed across groups. Travelers conduct onboard activities and use their carried tools based on their characteristics and travel properties, where the degree of enhancement on the perceived trip time depends on more than one variable, such as trip purpose, and the availability of tools onboard.

(7) What are the rankings of onboard activities across certain groups?

Based on the result of the Kruskal–Wallis test, it is found that participation in onboard activity is different across gender, age, income, education, job, car ownership, trip purpose, and transport mode groups. The values of difference are presented in Tables 13–19 as rankings (i.e., one-way ANOVA rankings). The result of the analysis demonstrates that the subgroups of women, the people aged 15–24 years, low-income people, high-school degree holders, non-car owners, travelers with home and educational trip purposes, taxi/public transport/car-as-a-passenger users, self-employed workers, and students are the most likely to engage in onboard activities during their traveling to the main trip purposes. It is worth mentioning that a confidence level of 90% is used as a reference, and the summation of the rankings of all significant results is used in finding the dominant subgroup. Some onboard activities do not show significant results at a confidence level of at least 90%; they do not change across groups, such as doing nothing and relaxing, because they depend on the preferences of travelers at the time of their travel rather than on other variables (see Table 13–19). Thus, an activity is changed across groups, and no dominant activity for each subgroup is noted. Moreover, each subgroup is changed across activities, as shown in Table 13–19.

5.3. Uncover the Underlying Relationship between the Onboard Activities and the Tools Carried by Travelers. The underlying relationship in onboard activities set and in the tools carried by travelers set is examined to uncover the underlying structure of each set in estimating the impact on the trip time.

(8) What factors (i.e., onboard activities/the tools carried by travelers' subset) can be used to estimate the impact of other onboard activities/the tools carried by travelers (i.e., set) on trip time (i.e., uncover the underlying structure in each set)?

Identifying the structure of relationship between the tools carried by travelers and the trip time is analyzed by using EFA. EFA is applied on the tools that travelers carry onboard and the onboard activities. The results are four components/factors (i.e., activities) out of the ten onboard activities which can be used to estimate the influence of the ten activities on the perceived trip time, and three components/factors (i.e., carried tools) out of the 12 tools carried by travelers which can be used to estimate the influence of the 12 tools carried by travelers on the perceived trip time. The connection between EFA and the Likert scale analysis is that EFA simplifies the analysis, and it requires less effort as studying four activities needs less time than studying ten activities. The same applies for the carried tools. Thus, the underlying relationship between onboard activities and the tools carried by travelers is determined (see Table 20).

Therefore, the new way of introducing onboard activities with the tools carried by travelers is examined across the groups as well as across each other. The results reveal the influences of the tools carried by travelers and onboard activities on the perceived trip time in urban areas and across groups. The perceived trip time is enhanced when travelers use the carried tools during their traveling to the main trip purposes in urban areas. The tools that travelers carry determine the onboard activities. Travelers prefer a specific transport mode over others to conduct a specific activity. A consensus is revealed about the importance of onboard activities and carried tools on the perception of trip time. Thus, travelers seek to increase their utilities by involving themselves in productive activities onboard.

5.4. Limitations and Future Work. The limitations of this research include the study of short trips and the main trips as well as that it does not consider solely the locals of Budapest but international people (e.g., students), too. Besides, the results are based on the ability of respondents to evaluate their trip time onboard considering the used tools and the activities. Moreover, the power of the results of MANOVA is moderate, and further studies with higher power based on η^2 are recommended. The study does not take into account the causal relationship of tools onboard and conducting activities. For example, talking activity can be conducted via a phone call or talking with other travelers (i.e., passenger/driver). Moreover, the research demonstrates only the impact of the used tools onboard, but people can bring tools onboard without using them.

It is recommended to expand the study by including long-distance travelers. The sample size might be enlarged with a focus on the compositions of the various classes that show some insignificant results (see low percentage in Table 1). A stated choice experiment study considering a new way of introducing the tools carried by travelers and onboard activities are recommended. The onboard activities and the availability of tools onboard can be used as attributes per transport modes to see the impact of each of them on the value of trip time in case of different transport modes. Finally, autonomous vehicle is a trending topic to be examined across multitasking and the onboard tools provided by traveler or operator.

6. Conclusion

A sample of 525 participants is collected and analyzed to study the influence of onboard activities and the tools carried by travelers on the perceived trip time. The questionnaire includes information about the travel behavior and focuses on the main trip purposes of the travelers in urban areas. 10 onboard activities and 12 tools carried by travelers are introduced and studied in this work. Statistical methods, such as chi-square, EFA, MANOVA, and rank-based nonparametric test methods are applied. Not all onboard activities show significant associations with the trip purpose, the transport mode, or the trip time. The dependence and the strength of the association between the onboard activities, the carried tools, and the trip characteristics are presented. The results demonstrate a statistically significant difference across groups regarding the perceived trip time onboard of CTMs, such groups are gender, age, income, education, job, transport mode, trip purpose, and car ownership. All onboard activities except for doing nothing indicate a positive experience on the perceived trip time, and all tools carried by travelers onboard add a positive experience on the perceived trip time. The study shows that travelers prefer conducting onboard activities on a particular transport mode more than on others, for example, reading, writing, listening, using social media, relaxing, thinking, and gaming are preferred modestly onboard of public transport. EFA uncovers the underlying relationship among onboard activities and the tools carried by travelers, which influences the travelers' perception; thus, subsets of the onboard activities (i.e., reading, writing, talking, and listening) and tools that travelers carry onboard (i.e., classical cellphone, smartphone, and laptop) are presented. Moreover, the impacts of groups on the onboard activities and the tools carried by travelers are analyzed. MANOVA analysis demonstrates statistically difference within groups. The results show differences in the responses within the groups, for instance, in transport modes group, the perceived trip time as a result of conducting onboard activities is varied.

In conclusion, an investigation of different possible onboard activities and the tools carried by travelers is accomplished, in which using the tools carried by travelers and conducting onboard activities impact the perceived trip time. The output of this study might aid decision-makers and mobility planners in understanding the behavior of travelers in more detail, such as the impact of the availability of tools and multitasking options on the satisfaction of travelers in urban areas might be perceived.

Data Availability

The data that support the findings of this study are available on request from the corresponding author.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors' Contributions

J. H. was responsible for conceptualization, methodology, formal analysis, writing—original draft preparation, and software. J. H. and D. E. are responsible for investigation, writing—review and editing, and visualization. D. E. supervised the study.

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