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The Influence of Trustworthiness and Technology Acceptance Factors on the Usage of e-Government Services during COVID-19: A Case Study of Post COVID-19 Greece

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Abstract: The COVID-19 pandemic imposed challenges and offered opportunities, which were recognized and assessed in developed countries. In many cases though, the lack of systematic preparation for the required digital transformation resulted in confusion and discomfort in citizens' lives, where the imposition of nonphysical contact excluded a large part of the population from basic needs and rights. This article investigates the influence of trustworthiness and technology acceptance factors on the usage of e-government services during the pandemic, and proposes a model that integrates factors adapted from the TAM model (social influence, performance expectancy and effort expectancy) with trust in e-government, a factor influenced by trust in government, trust in the internet, security and privacy, to predict e-government usage. To test the model, a survey was conducted using a 38-question questionnaire we designed, with a total sample size of 301 Greek citizens. The model was confirmed using the structural equation modeling (SEM) approach with maximum-likelihood estimates. Results indicate that all aspects in this study related to trustworthiness and user acceptance can be predictive factors of citizens' usage of e-government services during periods of uncertainty and high risk, such as the COVID-19 pandemic.

Keywords: Greece; COVID-19; e-government services; trustworthiness; user acceptance; citizen engagement; technology acceptance model (TAM)

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1. Introduction

In recent years, there has been great interest in the field and practice of e-government, as its usefulness and ease-of-use satisfies citizens' needs, making it a part of our daily lives (Chatfield and Alhujran 2009; Grimsley and Meehan 2007; Wang 2014). E-government is the use of information technology and telecommunications in public administration in combination with improvements and changes in technology aimed at serving the public and strengthening democracy. Understanding e-government and its perceived value requires first and foremost an understanding of public sector management (Beldad et al. 2011; Panagiotopoulos and Al-Debei 2010; Panagiotopoulos et al. 2012). The provision of public services through e-government is a strategic goal of governments around the world, who are always aiming to upgrade the services provided both in terms of improving citizen communication with the government and insuring service quality without jeopardizing security and putting sensitive personal data at risk. Thus, governments strive to create the right conditions in the public sector by applying already tested and effective practises while also experimenting with innovative and unique ideas (Singh and Sahu 2018). Their goals are to inform their citizens, to serve citizen needs, and to increase transparency but also to integrate into administrative practices the latest IT developments and increase the degree of digitization (Baker et al. 2010; Gilbert et al. 2004; Hiller and Bélanger 2001).

With the COVID-19 pandemic (Karamalis and Vasilopoulos 2020; Rossidis and Belias 2021), there have been radical changes in the way state mechanisms operate, as many

governments have found themselves facing unpreceded challenges while being largely unprepared to ensure both the smooth and safe operation of the health sector but with a lack of physical presence, a situation that highlighted the need for quality goods and services offered by governments all over the world. This sudden change in everyday life has been a challenge for every government in its effort to bring about the necessary changes in the way its services and information systems operate and for the provision of necessary services to citizens in a new, digital way.

Our research is an attempt to study the influence of trustworthiness and technology acceptance factors on citizen engagement with e-government services during COVID-19. We study the citizen within the context of behavior adoption models and acceptance of new technologies, as well as the influence of trust in government, internet, security and privacy and how these factors affect citizen trust in online services. We also examine social influence (i.e., how influences from the social environment affect the citizen in the use of e-government services) and how the system providing these services impacts citizens' intentions to use them. Realizing the drastic changes brought by the global pandemic, we consider the changes it has imposed and how it has affected the use of e-government services during this demanding period of social distancing.

The article is structured as follows: Section 2 provides the relevant literature review on the origins and applications of adoption and acceptance of technology models in their general context and in e-government. In addition, we place particular emphasis on the factors of trust and technology acceptance with regard to citizen engagement and use of e-government during the COVID-19 pandemic. Moreover, we study similar research carried out with the Greek population. In Section 3, we provide a detailed description of the model we constructed and tested in our research, followed by analysis and presentation of our findings in Section 4. Section 5 discusses and interprets the results of our study and identifies related limitations. Finally, we conclude and provide suggestions for future research.

2. Literature Review and Hypothesis Development

2.1. Study and Comparison of Theoretical Models

Over time, much research has been conducted to study the factors that influence behavior and lead to the final adoption and use of new technologies.

The Theory of Reasoned Action (TRA) (Ajzen and Fishbein 1980; Ajzen 1985) was developed in the early 1960s to explain, analyze and understand the complexity of human behavior in accordance with the principles of social and developmental psychology. It also emphasizes how an individual is led to the final adoption of a particular behavior by considering the consequences of his/her decisions. Thus, the model intends to predict human behavior from where it originates and how it leads to a future attitude. It is based on the notion that predictions come from a logical process and voluntary behaviors. The original model included constructs to measure attitudes, subjective norms and behavioral intentions, making the connection that a person's attitude and beliefs greatly influence the adoption of a behavior (positive or negative, respectively) and that the opinions of important individuals have a significant impact on the beliefs and critical thinking of a person.

One of the most widespread and established approaches is the Technology Acceptance Model, which was originally used to study the motivations and behaviors that lead to the adoption of new technologies by employees (Davis 1989; Davis et al. 1989; Davis 1993). This model was based on TRA, which explains how an individual's beliefs affect intention and therefore the way people act. The difference between TRA and TAM lies in the two constructs of Perceived Ease of Use (PEOU), defined as the degree to which an individual believes the system will enhance work performance, and Perceived Usefulness (PU), defined as the degree to which the use of the system does not require special effort. PEOU and PU are the two most important guidelines for the adoption of new technologies, and they were defined to reflect users' mental state and the way they perceive a system in

terms of accessibility and understandability, and the overall positive or negative attitude they adapt towards it. The results showed that PEOU has a positive effect on PU, although separation of users into experienced or inexperienced showed that inexperienced users are significantly affected by PEOU, while experienced users are less affected by PU. (Malhotra and Galletta 1999), to address the limitations and factors not accounted for by the TAM model, suggested an extension of the model by implementing psychological attachments and, specifically, social influences based on Kelman's three processes of social influence (i.e., compliance, identification and internalization) (Kelman 1958, 2017). To ensure the model's validity in the context of the original TAM, an organizational environment is established with the addition of the psychological constructs. The evidence from this study suggests that users' acceptance and attitudes are positively impacted by social influences, while behavioral intentions were not affected. All Kelman's influence processes had a direct effect on attitude.

The original TAM model has as dependent variable, the Actual Use (i.e., the frequency of use of an application), which results from the Behavioral Intention to Use (BI) and the Attitude towards Using, which in later models was removed, as after studying and optimizing the model it could not be supported empirically. Then, the TAM2 proposed by Venkatesh and Davis (2000) and the Unified Theory of Acceptance and Use (UTAUT) introduced by Venkatesh et al. (2003) placed particular emphasis on the social factors that influence an individual's attitude towards adopting a system and, as mentioned above, established a direct path from Perceived Usefulness and Perceived Ease of Use to BI and consequently to Usage Behavior in TAM2. Based on the TRA, TAM2 introduces the concept of subjective norm: the influence that a person's social environment has on the beliefs that lead to the demonstration of specific behaviors, which is associated with image and social influence. The model was enriched with other constructs such as voluntariness and experience as moderators to subjective norms, job relevance, output quality and result demonstrability.

The Innovation Diffusion Theory (IDT) proposed by Rogers Everett (1995) studies the mechanisms that lead a user to adopt a new innovative product and, from a general point of view, the degree of success of an innovation. According to Rogers Everett (1995), diffusion is the process by which an innovation reaches the members of a social group through various communication channels. The main features of the theory are innovation, communication channels, time (for the acceptance of innovation) and the social group. Thus, during the conceptualization phase of the model, new constructs were introduced for the interpretation of the beforementioned concepts, such as the rate at which diffusion is affected by relative advantage, the degree to which an individual believes innovative technology is better than pre-existing, Complexity (i.e., the degree to which an innovation can be adopted and is easy and understandable to use—similar to Perceived Ease of Use of TAM). Moreover, the model incorporated Compatibility (meaning the degree to which innovative technologies are compatible with existing market needs and user experiences), Trialability (i.e., the ability for the user to experiment and test innovation with minimal knowledge), and finally, Observability (i.e., the degree to which the results are visible to third parties). Although the model was influenced by pre-existing theories, it is primarily a descriptive tool rather than a crucial predictive tool for adopting new innovations (Goss 1979; Lyytinen and Damsgaard 2001; Wani and Ali 2015).

To create and establish a dominant and comprehensive behavioral model, Venkatesh et al. (2003), after comparing existing models, formed a new one called the Unified Theory of Acceptance and Use (UTAUT). The primary purpose in this case is to depict the behavioral intention of technology usage in organizational environments. Passing elements from other theories, the creators constructed three variables with direct effects on behavioral intention: Performance Expectancy, Effort Expectancy and Social Influence, while the variable of Facilitating Conditions (current or pre-existing conditions to support the introduction of new technologies) has a direct relation with Usage Behavior. As in TAM2, similar constructs are implemented as moderators to measure the impact on BI and

Usage Intention. UTAUT constructs have similar properties to those of TAM2, such as Performance Expectancy, which is defined as the degree to which an individual believes the adoption of new technologies will result in higher productivity (Perceived Usefulness of TAM/TAM2). In this research, the focus is placed on the impact of gender as a moderator: men tend to be more goal-oriented, thus signifying the relationship between Performance Expectancy and gender. Similarly, Effort Expectancy describes the ability to easily adopt and accept the use of new technology (TAM/TAM2's Perceived Ease of Use); in this case, gender plays a significant role, as women are more willing to adapt to changes, while age is associated with the ability to process complex knowledge in information systems. Social Influence (as the name indicates) describes the extent to which the opinion of third parties can determine the final decision to use a technology. It has similar properties to those of the Subjective Norm of TAM2. Based on the intermediate factors, the results have shown that social influence is important when the user is still in the early stages of becoming familiar with a technology, and gradually declines with experience and use. When considering gender, women seem to be influenced to a greater extent by the social environment.

One critical issue that arises with the implementation of these models is that they cannot fully explain with precision and detail the exact reasons behind the final adoption and use of a technology. Especially if we consider that the initial use of the TAM model was conducted in a business environment, notions such as Perceived Usefulness and Perceived Ease of Use are easily interchangeable concepts, as one technological tool or system can be replaced with another based on the needs of each business or organization. Factors such as customs, culture, values of a society, etc., constitute a challenge as to how they will be attributed and consequently quantified in an empirical investigation. The personality of each user in conjunction with personal and life experiences cannot be attributed in a concrete way; thus the terms of relatives and friends used to study the concept of social influence can be subjective and easily misunderstood for certain individuals. Further factors such as age and educational level, while not considered in the initial research design and implementation, can have a significant effect on future usage. Largely, the study of behavior is a multifactorial issue and, on several occasions, problematic in its approach and measurement, as hidden motivations and possible exaggerations lurk behind though and decision-making process of each potential user (Ajibade 2018). Still, the limitations of theoretical models do not decrease their value in explaining in a systematic way the drives and internal mechanisms determining human behavior, and researchers of numerous domains (including e-government) use them extensively.

Nam (2014) attempted to determine the factors that lead to e-government usage based on the main purposes, a secondary set of factors and the influence of the sociodemographic background. The dependent variables are the main determinants of e-government use (service use, information and policy research), while the independent variables include a variety of factors that study a specific concept (psychological factors, civic mindedness, information channels, trust in government and technology adoption). Based on a sample of 1375 participants from two public datasets, the analysis showed that sociodemographic background influences the type of e-government usage. Specifically, males make more frequent use of e-government services and education levels are associated with information-seeking through e-government, while policy research is not affected by personal background. On the other hand, trust in government indicated weak correlations with the types of e-government usage and the psychological factors. Civic mindedness and policy research were strongly correlated.

Al-Hujran et al. (2015) attempted to investigate the reasoning behind citizens' adoption of e-government services. Their research model took inspiration from TAM, with the integration of various socio-political factors. The constructed survey included the measurements of PEOU, behavioral intention and scale items for perceived public view, culture, and trust. Analysis of 413 respondents revealed that PEOU is a significant influential factor, with strong positive relationships with perceived public value and citizens' intention to use e-government services. The results indicated that attitude to use services has a mediating

effect on citizens' beliefs and behavioral intention to use e-government services. As for the external factors, there is a positive relationship between trust and perceived public view and ease of use, while uncertainty avoidance of the cultural factor positively influences the beforementioned constructs. The authors emphasize the importance of added value given by citizens when it comes to using e-government services, as the provided information should meet the needs of citizens, be easy to use and inspire confidence for future use.

Shafi and Weerakkody (2009) studied the factors that influence citizens' intention and the role of innovation when it comes to e-government services usage. Their research model was an adaptation of UTAUT, as it implemented the constructs of performance expectancy, effort expectancy and social influence as the independent variables, behavioral intention to use as the dependent variable, and included all items adapted to fit in the e-government context. The results from 216 respondents indicated that all independent variables have a direct and positive effect on citizens' behavioral intention to use e-government services, while age, gender and internet experience as moderators did not influence the aforementioned relationship in this research study. A visual overview of TAM's evolution and the constructs included in each version can be found in (Mohammad Ebrahimzadeh Sepasgozar et al. 2020).

2.1.1. Similarities and Comparisons to e-Commerce

TAM has been the dominant tool for studying the factors that influence and motivate users in the adoption and acceptance of new technologies. Its widespread use has been the subject of user behavior studies for various information systems, such as e-government, e-commerce, mobile devices, etc., (Al-Debei and Al-Lozi 2014; Gefen et al. 2003; Kim et al. 2007; McKnight et al. 2002; Pavlou and Fygenson 2006).

However, the initial design of TAM concerned the study of employees and their intention to adopt new technologies within an organizational environment (i.e., technologies that are used compulsorily by employees daily to increase productivity). If we consider the citizen as a rational consumer who seeks to maximize the value offered by a service, there are many similarities between e-government and e-commerce services, as in both cases we refer to information systems outside the organizational environment. Thus, the main emphasis is not placed strictly on our effort to introduce and adopt new technological services, a fact that has led many researchers to the adaptation and application of their models in the context of e-commerce. It should be noted here that e-commerce does not address the general population at the same scale as e-government services, as they provide information and services of political nature as well as devote resources to the provision of the public good (Gefen and Straub 2000; Hung et al. 2013; Moon and Kim 2001; Tung and Rieck 2005; Van Slyke et al. 2004).

E-government services are used primarily by citizens for whom the value offered is reflected in the output produced: providing services and information in real-time and in a way that it is easily accessible, useful and satisfies the needs of citizens by improving their productivity. Regardless of the similarities or differences presented in the research and practical field in which the models are applied, their adaptation does not affect the expected results, as our research investigates factors that influence citizens' engagement with e-government services.

2.1.2. e-Government Adoption and Design Challenges in Greece

Over time, significant efforts have been made to upgrade the Greek public administration through the introduction of innovative technologies and information systems with the aim of high efficiency and effectiveness in the context of public reconstruction and the provision of public goods and services to citizens (Bousdekis and Kardaras 2020; Goulas and Kontogeorga 2013; Paloniemi et al. 2015; Rossidis and Belias 2021). In an attempt to lead Greece in the digital transformation, the introduction of digital services has been a matter of high priority in the reorganization of the Greek government's digital infrastructure for decades (Bousdekis and Kardaras 2020; Karagiannaki et al. 2017; Rossidis and Belias 2021).

Particular emphasis has been placed on the establishment of communication channels and internal systems between government and business (Syzefxis), on upgrading skills and continuous training of civil servants (Kleisthenis), on design and development of networks that provide communication between the government and local agencies, on significant efforts to enhance citizen participation in social events, on the provision of services through the internet, and on the provision of public documents (Politeia, Ariandi) (Rossidis and Belias 2021). Despite the great efforts made regarding the implementation of such systems both nationwide and locally, the challenges that public institutions are called upon to face are various, causing their belated development. Constant political changes, the difficulty of adapting to changes and technological developments, adherence to anachronistic and bureaucratic methods, the lack of oversight in the production process and strategic planning, and insufficient human resources make the digital transformation and its adoption a severally problematic task (Gilbert et al. 2004; Karamalis and Vasilopoulos 2020; Panagiotopoulos and Al-Debei 2010).

The COVID-19 pandemic is a key point in the development and improvement of the beforementioned systems and the starting point for the introduction of new government operations and the performance improvement of existing e-government systems (Karamalis and Vasilopoulos 2020; Papadopoulou et al. 2010). The need to ensure public health, the prolonged duration of the lockdowns and mainly the restrictions on physical presence in the competent public bodies led to the establishment of digital systems for the authorization and legal fulfillment of public functions, producing the gov.gr platform. With the conception of a single and unique platform, Greek citizens have direct access to issuance of personal public documents certified with electronic signatures, to the generation of authorization forms for personal use and for third parties, and to the submission of electronic applications to all public services. This new reality not only helped avoid overcrowding of public services, but also allowed more efficient operation of all digital spectra that the government has sought to integrate all these years (Rossidis and Belias 2021). During the pandemic, it provided useful information about social events with useful information and instructions for protection against COVID-19, informing citizens about the developments on a daily basis. Worth mentioning are the contributions to the fields of asynchronous and distance education, distance working, and the general cultivation of appropriate conditions for the acceptance of digital environments (Rossidis and Belias 2021).

Gounopoulos et al. (2020) attempted to investigate how the adoption of e-government services is influenced by the digital divide. Data from the Greek Statistical Authority were analyzed with a study sample of 3321 participants, and the results indicated that social exclusion did not have a significant impact on e-participation, with the exception of e-government usage. Out of all the socioeconomic indicators that influenced the use of e-government services, age, education and citizenship were highlighted. There was also a correlation between educational level and the tendency to join e-participation activities. This research is one of the few efforts that emphasizes the importance of social exclusion and how different social backgrounds affect the future use of services and citizen participation, distinguishing the similarities with social inequality and emphasizing the importance of the educational process in future acceptance of technological systems.

Kalamatianou and Malamateniou (2017) investigated the factors that influence the realization of e-government projects. The evaluation process is based on adoption theories and the inclusion of user privacy, satisfaction, profession and continuous usage (i.e., disposition for future usage) along with their impact on the behavioral intention to use e-government services. The 97 respondents were tasked with submitting a complaint to the Independent Authority of the Greek Ombudsman website and answer the constructed instrument with the item scales. The results indicated that the provision of information in a coherent and efficient manner establishes positive impressions about the system along with its acceptance, future use, and encouragement for recommendation to third parties. Moreover, there is a positive relationship between user satisfaction and perceived usefulness, and the study highlights the role of data protection as a beneficial factor of the system.

Bournaris (2020) implemented the Multicriteria Satisfaction Analysis (MUSA) to evaluate an agricultural e-government web portal and its services and measure user satisfaction. The study sample included 101 users with prior experience with the portal who evaluated it based on five general criteria (navigation, design, accessibility, interaction and content) and 31 sub-criteria in total. The action diagram for the five general criteria indicated the significance of accessibility and interaction, as they scored the highest results by the users, while design, which scored the lowest, should not be ignored but had no need for immediate action. To avoid future implications, interaction and accessibility should be prioritized due to their high effectiveness on user satisfaction. For the design sub-criteria, the front page showed low satisfaction and needed to be reimaged along with languages from the accessibility criteria. Feedback, as the users signify, has a significant effect, despite the users not demanding it.

Similarly, Delopoulos (2015) approached the issue of e-government services adoption from a usability perspective to identify issues and provide suggestions regarding the design of Greece's e-deliberation service. Four experts were tasked to assess the system, discover limitations, and study and measure the service's functionality and robustness. The study was conducted with a combined methods-of-usability evaluation (task scenario, heuristics, web evaluation, etc.) whilst the results were categorized based on Nielsen's Heuristics. The findings suggested that the service's "easy to use" design provides the basis for average users to successfully navigate through the service, in contrast to newcomers and unexperienced users, for whom the lack of guidance and feedback were found to be the most critical issues. This research signifies the importance of usability testing and evaluation of e-government platforms and the issue of following established methods and guidelines (i.e., ISO) in design to increase citizens' adoption.

Papadomichelaki and Mentzas (2012) in their study highlighted the criticality of citizens' perceptions regarding the quality and supply of services, and in particular, e-government services. They created a model derived from SERVQUAL that consisted of 21 items (e-GovQual) and examined the dimensions of Efficiency, Trust, Reliability and Citizen Support in the context of e-government service quality of governmental websites. After the appropriate testing and validation of the model, the authors suggested some basic principles and guidelines to follow based on the results obtained from each of the model categories. The importance of accurate and detailed website design is emphasized once again, as well as a navigation system to increase the efficiency of citizens when seeking information. Further, in terms of trust, citizens need to be aware of how their personal information and data are protected, a policy that the competent institution itself must first establish in the development of its security systems to gain citizens' confidence and trust.

Particular interest is placed in the field of education, where our best efforts are made to develop the spirit and concept of active citizenship through participation. Governments have methodically utilized social networking platforms for the benefit of increased e-participation, development of political campaigns and the generalized attempt to establish communication channels, e-dialogues and active democratic consciousness. Sideri et al. (2019) studied how social media can engage in decision making within the educational system and to promote e-participation and active citizenship based on varying educational leadership perspectives. The distributed questionnaire consisted of items that studied factors of social media familiarity and incorporation, stakeholders' engagement in decision-making processes, and benefits and risks of social media. An exploratory quantitative analysis with 66 respondents from primary, secondary and university institutions indicated that, regarding usefulness, there are hesitations, but there was an overall positive attitude, as it provided a basis for e-participation and e-democracy, while potential risks appear significantly in data privacy and security. Incorporation of social media is revealed to be mostly used as a communication channel for promotion, announcements and educational purposes.

Zafiropoulos et al. (2012) focused on Greek primary and secondary school teachers to investigate, based on adoption theories, their behavioral intention to use e-government

services. Their conceptual model consisted of scale items from TAM, IDT and extended TAM. The findings suggest that there is a positive relationship between perceived ease of use and perceived usefulness, which has a direct impact to the behavioral intention to use. Trust of e-government has a significant influence on perceived risks and intention to use. Once again, the importance of citizens' trust in the government and the services offered is emphasized. Citizens need to understand that these services work for the public interest, the safe exchange of information and the provision of transparency. In their subsequent research, Zafiropoulos et al. (2014) studied various factors that relate to and determine trust in e-government websites with the same sample of primary and secondary school teachers. A statistically significant correlation was observed between trust in the internet and e-government websites, which could positively affect their future use.

In our effort to understand the factors that influence the use and adoption of new technologies, we studied the abovementioned models to obtain a comprehensive overview of the research approach that should be carried out. Based on the past and current literature, we adapted our model to be consistent with the needs and context of our study and, specifically, with the use of e-government services. Our research model utilizes elements from the UTAUT model, deriving from relevant research, to provide a comprehensive explanation of the factors affecting citizens' engagement with e-government services in Greece.

2.2. Trustworthiness

Trust is a factor of crucial significance that has been extensively studied in terms of the acceptance of information systems by the public. A user's trust in any system, whether e-commerce, banking, etc. (McKnight et al. 2002; Miyazaki and Fernandez 2001), is a complex cognitive problem, as there are several factors that lead an individual to use the system, especially when personal sensitive information is required. Aspects such as security and privacy, trust in the internet and trust in the provider of the service offered by the system are typical factors researchers examine as determinants that influence trust. Moreover, efforts have been made to introduce trust as an external factor in the already established models, as its influence on the use of information systems has been of great research interest in the past (Belanger et al. 2002; Chadwick 2001; Dixit and Saroj 1970). The fact is that trust in a system affects the way users perceive it in terms of ease of use and comprehension, and it affects users' belief that it will bring them the desired results. The aim is to reduce the degree of skepticism and create positive expectations from the system and the value it offers.

Further, e-government systems have properties similar to those of e-commerce and banking systems in the way they approach the design and implementation of information systems. In Mughal et al. (2012), the authors attempt to investigate the factors that affect acceptance of banking services and the challenge posed from a design standpoint for an individual to provide sensitive information. Based on current issues in internet banking and acceptance factors, the authors constructed a survey instrument to examine the factors of security and privacy, trust in online banking, innovativeness, familiarity and awareness on a sample of 200 participants. The results indicated that all factors have a statistically significant influence on users' acceptance of e-banking services. Security and privacy, as expected, are the most important factors influencing the trust of users, since, as consumers, users realize the risk that arises from a possible leak of their personal data. However, we must emphasize that a careful approach is required, both in research and in practice, as the perceived risk may deter potential users or consumers from future use since trust and confidence in technology is a prerequisite. Similarly, the findings of Mohammad Ebrahimzadeh Sepasgozar et al. (2020) confirm the direct effect of perceived usefulness and ease of use on customers' behavioral intention to use e-banking services, while subjective norms did not have an influential impact on behavioral intention.

Pavlou (2003) examined the key factors that lead to online transactions and ultimately their influence on consumers' acceptance of e-commerce. To examine user acceptance behavior, the author applied and combined factors from TRA and TAM and developed a

model that includes the factors of trust, perceived risk, perceived usefulness, perceived ease of use, and the intention to transact as the dependent variable. Web retailer reputation, satisfaction with previous online transactions and shopping frequency were used as control variables to measure the mediating effect on the proposed model. To test the model, the first study included 103 students who performed information-seeking scenarios and transactions based on three different scenarios. Taking into consideration the limitations of the sample, the results showed weak effects of perceived ease of use, while behavioral intentions were affected by perceived usefulness and perceived risk. The second study used a consumer population of 155 respondents, and the results indicated a strong relationship between perceived ease of use, perceived usefulness, and intention to transact, while trust positively influences the aforementioned factors and perceived risk. Even though there was no direct effect of the major predictive factors on actual transactions, an indirect effect from these factors was indicated through transaction intentions.

Recognizing the importance of trust, accessibility, information delivery and overall service quality, Carter and Bélanger (2005) focused on those factors that influence citizens to use e-government services. Based on the TAM model, Innovation Diffusion Theory (IDT) by Rogers Everett (1995) and the concept of trust and, specifically, on "Trust of Internet" and "Trust of Government", they tried to explain the final intention of citizens to use government services. All measurements were adapted from previous literature to be appropriately suited to the context of e-government services. The sample included 105 citizens from two different government agencies where two versions of the survey were distributed with non-significant results regarding agency bias. The analysis showed that perceived ease of use has a positive direct effect on citizens' behavioral intention, indicating the importance of design of governmental websites when it comes to performing tasks by the citizens. One significant finding is the influence of perceived compatibility regarding citizens' intent to use e-government services, as they expect their activities and interactions with the government to be similar to their previous experiences. In addition, trust has a positive effect on the final decision on the use of e-government services, as they must provide citizens with the necessary conditions for security, privacy and reliability in the exchange of information and electronic transactions with the government.

Bélanger and Carter (2008) in following research focused exclusively on trust and its influence on citizens' intention to use e-government services. The proposed study model included the constructs of disposition to trust (i.e., "one's general propensity to trust others"), trust of the internet, trust of the government, perceived risk, and as the dependent variable, intention to use. All the items were adapted and modified accordingly to fit the context of the research based on the current literature. The sample included 214 respondents from two different agencies, while the analysis showed no statistically significant differences in the two groups. The most interesting of the findings is that regardless of the levels of perceived risk, citizens' intention to use the e-government services are not affected, while similar results were indicated for the trust of the internet factor. Positive influences were found for the rest of the variables, showcasing the crucial role of trust when it comes to citizens' adoption and usage of e-government services. Regression analysis and analysis of variance indicated that trust in technology and perceived usefulness have a positive direct effect on trust in e-government, while trust in government has a direct effect on intention to use e-government services.

AlAwadhi (2019) studied the influence of trust in e-government services and civic engagement. Taking into consideration the lack of trust factors being represented in theoretical models of user acceptance, the author proposed, through an exploratory study, a research model focused heavily on trust factors that influence citizens' behavioral intention to adopt e-government services. The survey instrument included constructs of trust in government, trust in technology, trust in e-government, perceived usefulness and civic engagement, and, as the dependent variable, intention to use. The questionnaire was distributed to 137 participants and results showed strong positive correlation between trust in government and technology with trust in e-government and intention to use.

Interestingly, trust in e-government had a weak but positive influence on civic engagement and intention to use.

Colesca (2009), through an exploratory study, attempted to determine the factors that influence citizens' trust and to what extent each trust factor affects their relationship with e-government. The questionnaire design included a total of 12 sociodemographic and structured item determinants, including trust in technology, privacy concerns, trust in e-government, etc., to examine their influence on trust. From the analysis of 793 valid respondents, the results of the sociodemographic determinants showed that gender, income, and education background did not influence their relationship with trust in e-government, while age was found to have a significant impact. Although privacy concerns were the most impactful factor on trust to e-government, interestingly, the relationship with perceived risk was not found to be statistically significant, suggesting that citizens' perception of trust and risk in government services is not experienced in the same way as for e-commerce, and the author signifies the need for further investigation.

In the study by Alharbi et al. (2016), the authors attempted to draw specific attention to the factors that impact citizens' engagement in e-participation activities and their behavioral intentions. The dependent variable of the constructed instrument measured the intention to engage in e-participation, with trust and subjective norms being the independent variables. Trust in government, trust in the internet and social trust were the determinants of trust in e-participation, while family, friends, and media influence were the subjective norms. With a study sample of 770 citizens, the results indicated that both trust in e-participation and subjective norms have a significant influence on citizens' engagement in e-participation. From the determinants, trust in government and media influence had the most significant impact in relation to trust and subjective norms, separately, and on the intention to engage in e-participation.

Malik et al. (2016) investigated the key elements that affect citizens' satisfaction when using a government website. The constructed questionnaire included the factors of trust, computer anxiety, user expectations, security and privacy, accessibility, quality and awareness of e-services. The sample included 200 Pakistani respondents, and the findings of this study suggest that accessibility and quality to e-services have a positive impact on citizens' e-satisfaction. Compared to past research, the results showed no significant influence of trust, security and privacy, indicating the importance of cultural differences and how perceived information affects citizens' attitudes, as the authors indicate.

2.3. e-Government Usage and COVID-19

A challenging issue that government services are called upon to address is the active participation and usage of e-government services by citizens. The aim is to provide a platform in which citizens are allowed to express their views on social issues, have an active part in formulating public policies and strengthen democracy in decision-making at both local and national levels (AlAwadhi 2019; Panagiotopoulos et al. 2012). The behavioral attitude of citizens is directly related to the perceived value that the citizens receive in their attempt to gain the maximum value from fulfilling personal and social obligations. It is important that structured government services are usable so as not to cause frustration and deter users but satisfy their needs in an effective and productive way. Attention should be paid to design process guidelines of e-government services, as their violation or defective application may have a severe negative impact on future usage and citizen engagement (Dickson et al. 2009; Gofen 2015). Moreover, citizens should be given the opportunity to evaluate and provide constructive criticism about the e-government services they use and thus actively participate in their formation and development (Sharma et al. 2021; Wenzel 2002).

The COVID-19 pandemic not only caused changes in the healthcare industry, but it presented a challenge to all digital aspects of organizations and businesses alike. It was period where concepts such as digital transformation and digitization became second-nature to how we approach the eminent challenges of a global pandemic to offer better

functionality and productivity to citizens. In this endeavor, organizations and businesses sought to take the next transformational step to survive and expand their competitive advantage (Karamalis and Vasilopoulos 2020). The same applies to e-government services, where the need for renewal and establishment of new technologies for the immediate service of citizens was considered urgent for all public services at local and state level as physical presence was prohibited. However, such a restructuring requires strategic planning and a comprehensive plan for the integration of new technologies in the public sector and the daily life of citizens to ensure the optimum outcome in terms of citizen engagement and use of e-government services. Sharma et al. (2021) focused their research on factors influencing a country's response to COVID-19; the results presented a positive relationship between healthcare infrastructure and a country's ability to quickly respond to the eminent crisis with both a reactive and proactive response. Experience from past pandemics indicates that reactive strategies and centralized governance play a significant role in the response to situations such as COVID-19.

Mensah et al. (2021) studied the impact e-government services that provided COVID-19 information had on citizens' behavioral intention to adopt e-government information and recommend it to others. They adapted the Information Adoption Model (IAM) to explore how the usefulness and its determinates of the presented information affect information adoption behavior. With a sample of 716 respondents, the findings of this study suggest that perceived usefulness of information can have a significant effect on intention to adopt e-government information and future recommendations. Information quality and credibility had a positive relationship with perceived usefulness of COVID-19 information. This research highlights the importance of reliable and valid information provided by government agencies, especially in the age of the pandemic, when the need for information changes perspective when it comes to protecting citizens as individuals and the overall population. It is necessary to ensure usefulness and easy access to such information to form positive expectations and future use of e-government services by citizens.

In a similar approach, Mansoor (2021) examined the moderating of quality information on social media from governmental news agencies and the relationships between good governance practices, public trust and perceived government response to COVID-19. The evidence from the study suggests the mediating effect of perceived government response on the relationship between quality information on social media and trust in government. The approach used in this investigation is similar to that used by other researchers. In Alamsyah and Zhu (2022), perceived quick-response ability, information quality and life satisfaction have a strong positive relationship, while anxiety is negatively influenced by lack of quick response. Gender and education had a positive influence on anxiety and life satisfaction, while age had no statistically significant impact on anxiety, nor did internet usage experience impact life satisfaction.

Shihab et al. (2021) focused on the effect of citizenship and civic norms on engagement and e-participation. Their structured instrument included items to describe the determinants of citizenship norms, duty-based and engaged-citizenship norms, perceived public value and perceived public satisfaction. The analysis of the 173 respondents indicated that perceived public value and satisfaction have a significant influence on engagement in e-participation, showcasing the importance positive experiences have on citizens' tendency to actively participate in public affairs. Despite this, there was no statistical evidence to support a relationship between engaged citizenship norms and perceived public value and satisfaction, with only duty-based norms that showed a weak effect. Out of all normative beliefs, civic norms influenced perceived satisfaction.

Amosun et al. (2021) investigated the influence of the COVID-19 crisis on the relationship between citizen engagement and e-government usage. Their study method included a structured questionnaire adapted to fit in the context of e-government, with constructs that measured e-government usage, trust in government, government transparency and reputation, and citizen engagement as the dependent variable. With a sample of 866 citizens from three major cities of China, the results indicated that there is a positive correlation between

trust and e-government usage and government transparency, while there were statistically significant results to support a positive relation with citizen engagement. Undoubtedly, citizen engagement is a complex and multifactorial concept, making it difficult to measure the levels of engagement. Trust as a mediator between usage and engagement proved to be the most significant factor. Moreover, government transparency and reputation also influenced the levels of citizen engagement during the COVID-19 crisis.

The study of factors that influence the adoption and usage of e-government services has been an active topic of research the last years. Our research aims to provide a comprehensive approach to this issue and to fill in the research gaps and questions from past studies on related topics. Particularly in the Greek academic community, emphasis has been placed on the cruciality of the design part of specific e-government services and portals and how design affects citizens perceptions, satisfaction, service quality and usability. The contribution of this study is that it investigates the impact of trustworthiness and technology acceptance factors on the usage of e-government services during a period of extreme conditions such as that posed by the COVID-19 pandemic. We combined trustworthiness with a set of technology acceptance factors that have been studied individually in past research but not in an integrated and systemic approach. Moreover, we used a sample of the general Greek population, which is a sample that has not been studied for similar purposes.

3. Research Model and Hypotheses

3.1. Methodology and Measurements

Considering the abovementioned theoretical models and resorting to the relevant literature, the current study proposes a comprehensive research model that represents the multifactorial and complex perception of citizens towards e-government services. The model includes factors such as trust, social influence, perceptions towards the system (performance expectancy and effort expectancy), e-government usage (adapted to COVID-19 conditions) and, finally, the behavioral intention to use e-government services in the future as the dependent variable. It is a comprehensive attempt to approach the subject, studying and bearing in mind that many of the constructs have similar properties in wording the items they measure and the different fields of implementation of related surveys, such as information systems, public administration and e-business. Human behavior and the final adoption and use of a technology or a service is a multifaceted problem, which in the framework of this study is approached by identifying the factors that play a vital role, how they are connected, and the sequence of relationships affecting the result. We have adapted our constructs in the context of e-government services, expecting that the validity of the models will not be affected by the initial context of their use (either being e-commerce, general-purpose information systems or coming from the e-government domain). Figure 1 depicts the proposed research model.

To test the model and obtain an overall and representative picture of the sample, our research was conducted using questionnaire distribution tools both within the university campus and the general population. The questionnaire consisted of 38 items (Appendix A) and was also published on social media platforms to ensure the participation of citizens with different backgrounds and to achieve greater diversity within our sample. Participants were informed that the term "e-government services" in the questionnaire refers basically to all online services offered to citizens at http://www.gov.gr (accessed on 31 August 2022), the central gateway to all services of the public administration for citizens and businesses. At the time of the survey, the portal integrated more than 1400 services offered by ministries, agencies, organizations, independent public authorities and prefectures. To maximize participation, we utilized several distribution and sample-gathering techniques, such as snowball sampling (Goodman 1961), encouraging participants after the completion of the questionnaire to suggest and provide the instrument to people in their close environment (friends, relatives, etc.). Further, to motivate and increase participation, when completing the questionnaire, we included the option to enter a EUR 100 gift voucher draw.

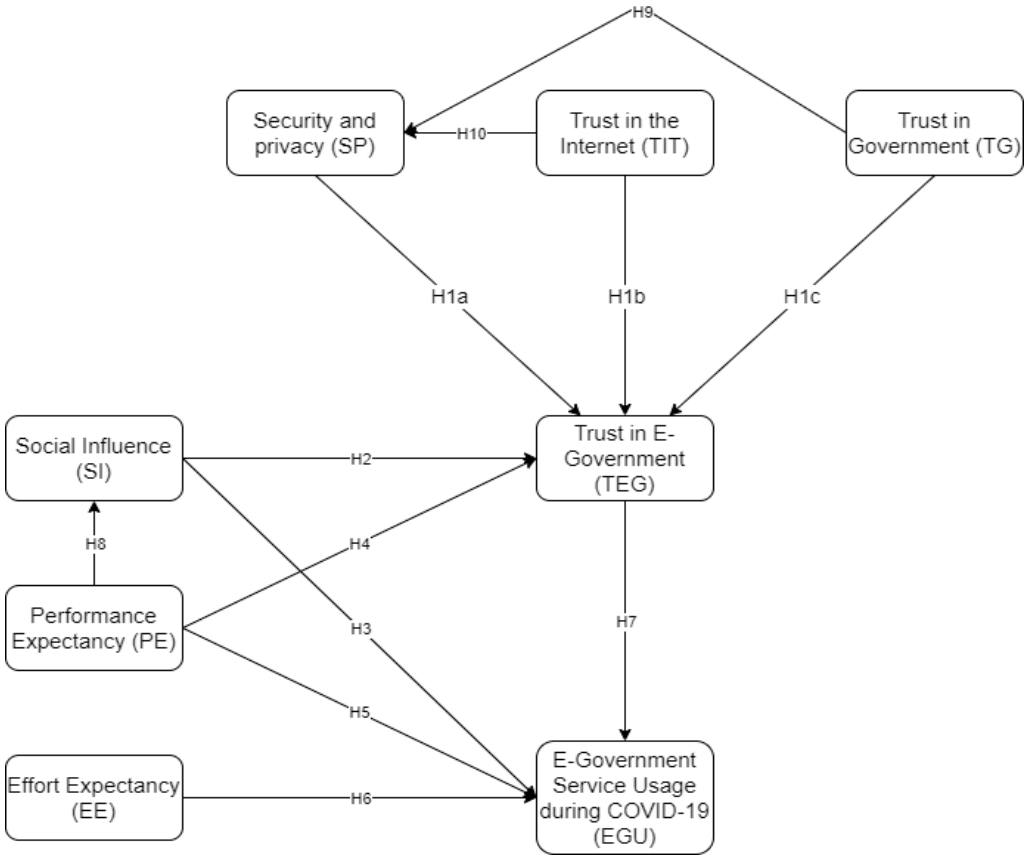

Figure 1. Research model.

Each construct measurement examines an individual factor of behavioral adoption, user acceptance and trustworthiness, with most items being adapted from previous research and certain items proposed by this study. The constructed instrument consisted of two main categories: demographics and the scale measurements. In the demographics section, we acquire general information about our sample characteristics (age, gender and education), system usage (computer experience, e-commerce usage and internet experience), e-government usage (experience in using e-government website and services) and COVID-19-related questions. Social Influence (four-item scale), Performance Expectancy (six-item scale) and Effort Expectance (four-item scale) were adapted from the UTAUT theoretical model (Shafi and Weerakkody 2009; Venkatesh et al. 2003). Trust in Government was measured with a six-item scale and was adapted from AlAwadhi (2019) and Colesca (2009), while the items proposed by this study comprise Trust in Internet as a five-item scale adapted from Alharbi et al. (2016), Carter and Bélanger (2005), Bélanger and Carter (2008) and Colesca (2009), and Security and Privacy as a five-item scale adapted from Al-Hujran et al. (2015), Bélanger and Carter (2008) and Malik et al. (2016). The scale includes statements that study citizens' perceptions of security and privacy issues in e-government services and how they affect future use. Trust in e-Government consists of a three-item scale adapted from AlAwadhi (2019), Colesca (2009), Al-Hujran et al. (2015) and Carter and Bélanger (2005). The e-Government Usage construct includes a five-item scale adapted from Nam (2014) and Amosun et al. (2021). It includes statements that study the intention of citizens to seek useful information through e-government services and questions of general content regarding their daily service usage by citizens. These questions have been adapted to study the effect of COVID-19 conditions and identify any changes caused by the pandemic in citizens' behavioral intention and usage. Based on the existing literature and having extensively studied the factors that influence the adoption and future use of e-

government services, we formed hypotheses to understand the relationships between these factors. Table 1 lists the hypotheses tested and analyzed in our structural equation model.

Table 1. Hypotheses.

	Hypotheses
H1a	Higher Security and Privacy (SP) will positively influence citizens' Trust in E-Government services (TEG).
H1b	There is a significant positive relationship between Trust in the Internet (TIT) and citizens' Trust in E-Government services (TEG).
H1c	There is a significant positive relationship between Trust in Government (TG) and Trust in E-Government services (TEG).
H2	There is a direct and positive relationship between Social Influence (SI) and citizens' Trust in E-Government services (TEG).
H3	There is a direct and positive relationship between Social Influence (SI) and E-Government service Usage during COVID-19 (EGU).
H4	There is a direct and positive relationship between Performance Expectancy (PE) and Trust in E-Government services (TEG).
H5	There is a direct and positive relationship between Performance Expectancy (PE) and E-Government service Usage during COVID-19 (EGU).
H6	There is a direct and positive relationship between Effort Expectancy (EE) and E-Government service Usage during COVID-19 (EGU).
H7	There is a direct and positive relationship between Trust in E-Government services (TEG) and E-Government service Usage during COVID-19 (EGU).
H8	There is a direct and positive relationship between Performance Expectancy (PE) and Social Influence (SI).
H9	There is a direct and positive relationship between Trust in Government (TG) and Security and Privacy (SP).
H10	There is significant positive relationship between Trust in the Internet (TIT) and Security and Privacy (SP).

All items were measured on a five-point Likert scale and adapted and translated accordingly to ensure that the meaning of the questions remained intact for statistical validity in our analysis. As the instrument was distributed to Greek citizens, a bilingual academic expert was tasked with appropriately translating the questions. A preliminary analysis was performed to test for unclear context due to the wording of questions, and they were revised accordingly.

3.2. Sample Profile

A total of 301 responses were acquired during the data collection process. The descriptive statistics of the sample showed that the sample was well-balanced in terms of gender, with 51.5% of the respondents being female and 48.5% male. Regarding the age distribution, the highest percentage is gathered at the age group "18–25" with a percentage of 31.9%, followed by the age group "26–30" with a 22.6% percentage. The educational background of the respondents is accumulated between graduates (33.2%) and undergraduate students with 22.3%, with the majority of the subjects associated with Humanities and Social Sciences (34.9%). As expected, considering the age grouping and educational background, 88.0% of the respondents had more than 5 years of computer experience, while 37.9% of the respondents used e-commerce services on a monthly basis. In addition, the highest percentage (32.2%) used the internet daily for 5–7 h on average, followed by 2–4 h on average (29.9%). More interestingly, the largest group formed when asked about experience in using e-government websites, 42.5% of the respondents stated more than 3 years of experience, followed by less than 6 months of experience (19.3%). Considering

that the digital transformation in Greece is still a process in progress and most citizens have not had the chance to familiarize themselves with e-government services, it is expected that the largest percentage of answers accumulated in "few times monthly" and "once a month", with 35.5% each. Finally, the effects of the dominant age group are once again depicted in the responses regarding the way subjects chose their main source of information about COVID-19, with the leading response being social media (39.5%) and news agencies (32.9%). Demographic statistics of the sample are summarized in Table 2.

Table 2. Sample profile.

		Frequency	Percentage
Gender	Male	146	48.5%
	Female	155	51.5%
Age	18–25	96	31.9%
	26–30	68	22.6%
	31–40	58	19.3%
	41–50	50	16.6%
	51–60	22	7.35
	60+	7	2.3%
Education	High school graduate	45	15.0%
	Undergraduate Student	67	22.3%
	Graduate	100	33.2%
	Postgraduate Student	64	21.3%
	PhD Student	11	3.7%
	PhD Holder	6	2.0%
	Other	8	2.7%
Field of Study	Formal Sciences	71	23.6%
	Humanities and Social Sciences	105	34.9%
	Natural Sciences	18	6.0%
	Professions and Applied Sciences	37	12.3%
	Other	70	23.3%
Computer Experience	3–5 years	20	6.6%
	Less than 3 years	16	5.3%
	More than 5 years	265	88.0%
E-commerce usage	A few times daily	7	2.3%
	A few times monthly	114	37.9%
	A few times weekly	30	10.0%
	Never used	23	7.6%
	Once a month	84	27.9%
	Several times weekly	43	14.3%
Daily Internet Usage	$\leq$2 h	47	15.6%
	2–4 h	90	29.9%
	5–7 h	97	32.2%
	$\geq$8 h	67	22.3%
Experience in Using E-government Website	Less than 6 months	58	19.3%
	7–12 months	43	14.3%
	1–3 years	72	23.9%
	More than 3 years	128	42.5%
E-government services usage	Never used	15	5.0%
	Once a month	107	35.5%
	A few times monthly	107	35.5%
	Several times weekly	48	15.9%
	Once a day	9	3.0%
	Several times daily	15	5.0%
Main source of information about COVID-19	Government website	28	9.3%
	Government social media	24	8.0%
	News agencies	99	32.9%
	Social media	119	39.5%
	Other	31	10.3%

4. Data Analysis and Results

This study utilizes the Structural Equation Modeling (SEM) approach with Maximum Likelihood estimates as an analysis method. Data analysis was performed using SPSS Amos 26. The first step was to test the content, convergent, and discriminant validity of constructs using the measurement model. Then, we tested the hypotheses with the structural model and the goodness-of-fit indices.

4.1. Measurement Model

The content validity of our survey instrument was established in two ways. First, the constructs along with their measures used in this study had already been validated in previous studies, as they were adopted from the existing literature (see Appendix A). Second, the results of the pre-test we undertook with subject-matter experts assured content validity of the survey instrument. For the reliability of the scale, we used Cronbach's alpha, which is typically deployed to measure the reliability and internal consistency of scales Cronbach (1970). Ursachi et al. (2015) suggested that the reliability of the scale is generally accepted if the value of Cronbach's alpha for each construct is equal to or greater than 0.70. The constructs included within the study's model exhibit a high degree of internal consistency, as the values of Cronbach's alpha ranged from 0.728 (SI) to 0.929 (SP), as shown in Table 3. Composite Reliability (CR) and Average Variance Extracted (AVE) tests were computed to measure convergent validity. The acceptable value of CR for each construct must exceed 0.70, while the value of the AVE must exceed 0.50 for convergent validity to be assured Kline (2011). In this study, AVE is less than 0.5, but since the composite reliability is higher than 0.6, the convergent validity of the construct is still adequate (Fornell and Larcker 1981; Hair et al. 1998; Lam 2012; Pervan et al. 2017; Psailla and Wagner 2007). The CR and AVE values for the constructs included in the study model are all above acceptable levels. Moreover, the standardized factor loadings for all indicators were above 0.5, and thus they are all significant (Gupta and Falk 2017; Pervan et al. 2017) except EGU4, which had a value of 0.26, and EE4, with a value of 0.397. Given that the factor loadings for EGU4 and EE4 were the weakest, they were deleted first, and the model was assessed again. As such, content validity, reliability and convergent validity of the measurement instrument are all satisfactorily met in this research. In addition, collected data were checked for common method bias, i.e., whether a single factor is accountable for variance in the data (Chang et al. 2010), using Harman's single factor test. A single factor extracted 37% of total variance and, since it is far less than 50%, there is no threat for the research model.

Table 3. Results of reliability and convergent validity tests.

Constructs	Items	Factor Loadings	AVE	CR	Cronbach	Mean	SD	N
PE			0.41928	0.810991	0.848	4.0415	0.67716	301
	PE1	0.703						
	PE2	0.629						
	PE3	0.524						
	PE4	0.787						
	PE5	0.759						
	PE6	0.733						
EE			0.47797	0.775017	0.839	3.9286	0.74406	301
	EE1	0.922						
	EE2	0.878						
	EE3	0.749						
	EE4	0.397	*(Deleted)*					

Table 3. *Cont.*

Constructs	Items	Factor Loadings	AVE	CR	Cronbach	Mean	SD	N
SI			0.41392	0.722135	0.728	3.4643	0.81788	301
	SI1	0.693						
	SI2	0.501						
	SI3	0.674						
	SI4	0.686						
TG			0.521026	0.866138	0.910	3.1739	0.88278	301
	TG1	0.896						
	TG2	0.880						
	TG3	0.915						
	TG4	0.605						
	TG5	0.722						
	TG6	0.721						
TIT			0.427934	0.786965	0.915	3.3887	0.85104	301
	TIT1	0.770						
	TIT2	0.831						
	TIT3	0.820						
	TIT4	0.860						
	TIT5	0.848						
SP			0.581365	0.873554	0.929	3.5362	0.87494	301
	SP1	0.797						
	SP2	0.815						
	SP3	0.890						
	SP4	0.864						
	SP5	0.895						
TEG			0.534468	0.774816	0.895	3.8992	0.83077	301
	TEG1	0.760						
	TEG2	0.926						
	TEG3	0.925						
EGU			0.450295	0.795463	0.750	3.6452	0.77654	301
	EGU1	0.761						
	EGU2	0.673						
	EGU3	0.807						
	EGU4	0.262	*(Deleted)*					
	EGU5	0.780						

4.2. Structural Model

The results of SEM analysis are presented in Table 4 (Hypotheses testing results) where the estimates (beta) and evaluation of the formulated hypotheses are depicted and in Table 5, which shows the goodness of model fit indices. The results indicated that EGU is a direct function of SI, PE, EE and TEG ($\beta = 0.287$, $p < 0.001$; $\beta = 0.331$, $p < 0.001$; $\beta = 0.131$, $p < 0.001$; and $\beta = 0.351$, $p < 0.001$, respectively). Finally, it was found that TEG fully mediates the relationship between SP ($\beta = 0.437$, $p < 0.001$), TIT ($\beta = 0.377$, $p < 0.001$), TG ($\beta = 0.351$, $p < 0.001$), SI ($\beta = 0.330$, $p < 0.001$) and PE ($\beta = 0.330$, $p < 0.001$). Therefore, the indices of the goodness-of-fit are all acceptable (Champniss et al. 2017; Lee et al. 2019; Zhang et al. 2017).

Table 4. Hypotheses testing results.

Hypotheses			Beta (β)	Result (*p*-Value)
H1(a): SP	<-->	TEG	0.437	Supported ($p < 0.001$)
H1(b): TIT	<-->	TEG	0.377	Supported ($p < 0.001$)
H1(c): TG	<-->	TEG	0.351	Supported ($p < 0.001$)
H2: SI	<-->	TEG	0.329	Supported ($p < 0.001$)
H3: SI	<-->	EGU	0.287	Supported ($p < 0.001$)
H4: PE	<-->	TEG	0.330	Supported ($p < 0.001$)
H5: PE	<-->	EGU	0.331	Supported ($p < 0.001$)
H6: EE	<-->	EGU	0.131	Supported ($p < 0.001$)
H7: EGU	<-->	TEG	0.255	Supported ($p < 0.001$)
H8: PE	<-->	SI	0.441	Supported ($p < 0.001$)
H9: TG	<-->	SP	0.409	Supported ($p < 0.001$)
H10: TIT	<-->	SP	0.415	Supported ($p < 0.001$)

Table 5. Goodness of model fit indices.

Goodness-of-Fit Indices	Value (Null < 0.05)	Acceptable Values
X^2/df	1.913	<2
RMSEA	0.064	<0.08
SRMR	0.072	<0.08
CFI	0.905	>0.90
NFI	0.939	>0.90

5. Discussion

Understanding human behavior is a complex process in both approach and explanation regardless of the specific field or research interest. Realizing the difficulties and challenges that have arisen in recent years due to the global pandemic and digitization of government services, we tried to explain and study the factors that influence citizens with regard to the perception, use and adoption of e-government services during COVID-19.

One of the most important factors we introduced and examined in our proposed model that is not included the TAM models is the concept of trustworthiness. Although a factor such as trust can be complex in its comprehension and representation, we tried to approach it conceptually by including various constructs that represent specific aspects of trust. Hypothesis testing for H1a, H2b and H1c examine whether there is a positive and significant statistical correlation between Security and Privacy (SP), Trust in the Internet (TIT), Trust in Government (TG) and Trust in E-Government services (TEG), where in our sample they are all supported. As we have mentioned above (Mughal et al. 2012; Pavlou 2003), privacy and security in cases where a citizen is queried to provide sensitive personal data pose a challenge for every service or business regardless of the sector it serves. Especially in applications and platforms of government services it is crucial to ensure citizens that the usage of e-government services will provide secure, safe transactions that are beneficial to citizens. It is therefore considered necessary to form the appropriate conditions so that the perception of trust and the perceived risk are at a level that does not affect the future decisions of citizens towards the use of government services and e-participation, as indicated for Greek citizens in Zafiropoulos et al. (2012, 2014). Typical reasons for this are the lack of know-how towards the internet and the belief that the sharing of private information can lead to malicious use, as indicated by previous studies (AlAwadhi 2019; Bélanger and Carter 2008; Carter and Bélanger 2005; Colesca 2009). These findings are also supported by this research, since hypotheses H9 and H10 concerning the effects of Trust in Government and Trust in the Internet have been confirmed. It was indicated that Social Influence and Performance Expectancy play an important role towards Trust in e-Government. Possibly, the fact that over 50% of our sample belongs to ages between 18–40 significantly influences these factors. We refer to citizens with know-how and great experience and familiarity with the use of computers and the internet. This fact

can affect the outcome of the results, since younger age groups could potentially possess the necessary knowledge for the use of e-government services and are aware of the risks that may arise. Administrative authorities, in turn, should seek to reassure and inform citizens about such issues through the provision of documentation or even training, as radical and sudden changes to an already existing and established system can cause confusion and dissatisfaction to the public, considering also the age gap and its effects (Alharbi et al. 2016; Malik et al. 2016). The primary purpose of each governmental organization is to satisfy the needs of citizens, providing the necessary services in an environment of trust, and, in the era of digital transformation, to offer user-friendly and convenient access to online e-government services.

As we have mentioned above, the COVID-19 pandemic triggered unexpected and unpredictable effects in all aspects of everyday life. Including health infrastructures, developing countries were faced with a new reality and circumstances that required immediate and urgent response from their respective governments. In our research, we focused our interest and placed particular emphasis on the use of e-government services by citizens during COVID-19 to provide information and services, and on how citizens' usage is affected by various social and behavioral factors. In this effort, we formed hypotheses to examine the abovementioned issues. Hypothesis testing for H3 and H5–H7 examined the influence of Social Influence (SI), Performance Expectancy (PE), Effort Expectancy (EE) and Trust in E-Government and E-Government services usage during COVID-19 (EGU). The results revealed a direct positive effect for all factors on EGU; thus, in our sample each hypothesis was confirmed. The implications of the results highlight once again the importance of the role of citizens' trust in government organizations. Providing citizens with valid and comprehensible information, especially in times of crisis, is a crucial point in how citizens perceive the government's stance on security and maintaining the public's best interest (Mensah et al. 2021; Sharma et al. 2021). One rudimentary goal for every government is to maintain its transparency and validity in decisions and actions to ensure the consent of citizens to the reforms caused by such unprecedent circumstances. The fact that such radical restructuring was implemented in a brief period of time leaves room for error in the implementation, handling and smooth introduction of citizens to new technologies and services introduced to improve the public sector's technological infrastructure (Alamsyah and Zhu 2022; Shihab et al. 2021).

Another interesting finding of this research concerns the positive correlation between Performance Expectancy (PE) and Social Influence (SI). The main purpose of user acceptance models is to examine the factors that influence the behavior of users towards a system. In this particular case, the behaviors demonstrated through socio–political conditions and from the social environment of each individual affect the perceived value and importance citizens ascribe to certain behavioral conditions (Malhotra and Galletta 1999; Venkatesh et al. 2003). As we mentioned above, the sample consists primarily of a younger audience who are familiar with and accustomed to new technologies, regardless of their pre-existing experience and usage of e-services or systems (Shafi and Weerakkody 2009; Venkatesh et al. 2003). In a period during which citizens are trying to cope with and adapt to social changes, the government is obliged to provide valid and clear instructions for citizens through communication channels such as social networking platforms for the common good and socio–economic progress to shape the behaviors and attitudes of citizens in a period of crisis.

6. Conclusions

This study investigated the effects of trustworthiness, behavioral adoption and user acceptance concepts that influenced citizen use of e-government services during COVID-19. In our effort to understand in depth the factors that influenced citizens' attitudes towards e-government services, we adopted models that study user acceptance and technology adoption models, and, more specifically, the TAM model. In addition, we considered the significance of the trust and reliability citizens anticipate from e-government services

and their effects on citizens satisfaction. The results revealed that trustworthiness plays a crucial role in the adoption and future use of e-services, particularly during emergency conditions such as the recent pandemic. Moreover, the study indicated the socio–political influences on citizens and the values they impart and require from these systems as important factors that may have a positive effect on the use e-government services. To our knowledge, our research is the only attempt to study this issue using a sample of the general Greek population.

An issue that this study leaves open is the fact is that in such an endeavor, the sample plays an important role in shaping the results. Future research could investigate the effect of moderating-factors such as age, gender, experience, etc. Past research has highlighted their importance on the interpretation of the results, as mentioned before, such as the effect of educational levels on e-participation activities and life satisfaction, whilst age and anxiety influence government response speed as perceived by citizens (Alamsyah and Zhu 2022; Gounopoulos et al. 2020). Younger age groups tend to be more open to new experiences, be technologically savvy, and adapt more easily to the needs of the modern digital society. In contrast, older adults are confronted with the new reality and must develop technological skills that they do not possess but are required by social conditions, such as the COVID-19 pandemic. As the Greek government moves towards the digital transformation of its services, the need for training socially vulnerable groups is considered imperative to ensure a smooth transition from past norms to modern and effective solutions. Finally, inclusion of other variables from user acceptance and adoption models (TAM, UTAU, etc.) might change the model and provide a different aspect of the phenomenon. The focus of this study is on citizen trust and the factors that influence user acceptance of an e-government platform or service.

Based on the analysis conducted and the findings from this study, we encourage future researchers to study the effects of trustworthiness on the behavioral intention and actual usage of e-government services by citizens. Further, it would be interesting to include additional factors in their research models, as such studies can provide useful guidelines for governments to understand citizen needs and allow for effective communication between government and citizens, which is necessary in periods of crisis management.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee (REC) of the University of Patras (application no. 12852, date of approval 23 March 2022) for studies involving humans. The Committee reviewed the research protocol and concluded that it does not contravene the applicable legislation and complies with the standard acceptable rules of ethics in research and of research integrity as to the content and mode of conduct of the research.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The raw data collected by the survey are available upon request to the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Measurement Items Used for Data Collection

	Performance Expectancy (PE)	
PE1.	Using e-government services will enable me to accomplish tasks more quickly.	(Al-Hujran et al. 2015; Shafi and Weerakkody 2009; Venkatesh et al. 2003)
PE2.	E-government services will help me avoid existing bureaucracy.	
PE3.	I will be able to use e-government services during non-working hours (24/7).	
PE4.	E-government integrates various government agencies' systems and provides better citizens' satisfaction.	
PE5.	I find it easy to use e-government services to find what I want.	
PE6.	Using e-government services will increase my productivity.	
	Effort Expectancy (EE)	
EE1.	Using e-government services would be easy.	(Shafi and Weerakkody 2009; Venkatesh et al. 2003)
EE2.	Interaction with the e-government services would be clear and understandable.	
EE3.	It would be easy for me to become skillful at using e-government services.	
EE4.	I have the resources necessary to use the e-government services.	
	Social Influence (SI)	
SI1.	Important people to me think I should use the e-government services.	(Shafi and Weerakkody 2009; Venkatesh et al. 2003)
SI2.	I would use e-government services if I needed to.	
SI3.	I would use e-government services if my friends and colleagues used them.	
SI4.	People around me who use the e-government services have more prestige.	
	Trust in the Government (TG)	
TG1.	I trust government agencies.	(AlAwadhi 2019; Colesca 2009)
TG2.	Government agencies keep my best interests in mind.	
TG3.	In my opinion, government agencies are trustworthy.	
TG4.	The trust in a governmental agency increases with its reputation.	
TG5.	The government agencies have the skills and expertise to provide services to citizens in an effective manner.	
TG6.	The government agencies have the ability to meet the citizens' needs.	

	Trust in the Internet (TIT)	
TIT1.	The internet has enough safeguards to make me feel comfortable to engage in e-government websites.	(Alharbi et al. 2016) (Bélanger and Carter 2008; Carter and Bélanger 2005; Colesca 2009)
TIT2.	I feel assured that legal and technological structures adequately protect me from problems on the Internet	
TIT3.	I feel confident that encryption and other technological advances on the Internet make it safe for me to communicate with government agencies	
TIT4.	In general, the Internet is a robust and safe environment to interact with government and other citizens	
TIT5.	Overall, I have confidence in the technology used by government agencies to operate the e-government services.	(Colesca 2009)
	Security and Privacy (SP)	
SP1.	I feel assured that legal and technological structures adequately protect me from any problems on using e-government services.	(Al-Hujran et al. 2015; Carter and Bélanger 2005)
SP2.	e-Government services make me feel comfortable (safe) when conducting governmental transactions.	(Malik et al. 2016)
SP3.	e-Government services ensure the confidentiality of my personal information.	
SP4.	e-Government services adhere to personal data protection laws.	
SP5.	Overall e-Government services satisfy citizens' needs for privacy and security.	
	Trust in e-Government (TEG)	
TEG1.	I believe that e-government services will not act in a way that will harm my personal interests or violate my rights.	(AlAwadhi 2019; Colesca 2009)
TEG2.	In my opinion, e-government portal and/or Ministry's website(s) are trustworthy.	(Al-Hujran et al. 2015; Carter and Bélanger 2005)
TEG3.	In general, I think I can trust e-government portal and/or Ministry's website(s).	
	E-government usage during COVID-19 (EGU)	
EGU1.	I have used e-government services to seek information during the COVID-19 pandemic.	(Amosun et al. 2021; Nam 2014)
EGU2.	During the COVID-19 pandemic I used e-government services that I didn't use before.	
EGU3.	I have used e-government services to seek trustworthy information about the COVID-19 pandemic.	
EGU4.	I have used e-government services to complain about government services during the COVID-pandemic.	
EGU5.	Overall, I have a positive experience using e-government services during COVID-19 pandemic.	

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