

Article

Mobility Need-Adaptive Housing Platforms: The Benefit of a Commute Time Search Feature

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Abstract: The growing influx of people to urban areas has resulted in a tense housing market in many places, making the search for a suitable residence an increased challenge. Dedicated online platforms facilitate this process and offer two distinct approaches to find suitable accommodations concerning its location. Traditionally, users can search for a general area like a city to narrow down the results displayed. Additionally, some platforms offer searches based on the maximum commute time between apartments and points of interest. This paper investigates the benefit such approaches yield concerning technology acceptance and the fit of the task and information representation. Thus, a prototypically implemented online platform with and without a commute time search feature was evaluated in an online experiment. The treatment specification achieved significantly better results in terms of information quality and technology acceptance, implicating that such a design should be preferred for websites that facilitate the search for apartments. These insights can contribute to an enhanced understanding of visual system design to reduce the negative sustainability impacts of traffic induced by a divergence of residential and workplaces.

Keywords: housing platform; commute time; mobility IS; technology acceptance modeling; cognitive fit



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1. Introduction

With an increase in urbanization and an imbalance of supply and demand for accommodations in many areas, finding affordable housing is challenging [1,2]. Often, the associated housing scarcity is caused by geographical or regulatory constraints [3,4], forcing tenants to accept high rent prices or long commute times [5,6]. However, long commutes can lead to several impairments, including increasing traffic volume and greenhouse emissions. Moreover, commuting is a key driver of both individual transport and highway congestion [7,8]. Nonetheless, the decision-making process when looking for an apartment is not only dependent on the commute. Instead, for individual apartments, a combination of various aspects like size, accessibility, and amenities impact the residential location choice ultimately [9].

The process of finding accommodations can occur via a multitude of channels, such as friends and relatives, newspapers, or real estate agents [10,11]. However, in the course of ubiquitous digitalization, it is often facilitated by dedicated online platforms providing a comprehensive overview of apartments available for rent or sale [11,12]. These websites aim to identify and provide well-matching accommodations by allowing the user to narrow down the list of suggested apartments through a search field and a set of filters for characteristics like rent and size. For example, websites such as immowelt.de [13] and rentals.com [14] contain a search field for a geographical area like a city or city district.

However, some housing websites have also started to incorporate information and search capabilities about the expected future commute time of a user under the assumption that customers would appreciate this feature [15–18].

Our research assumes that by providing commuting-relevant information already in the apartment selection process's search stage, mismatches between an apartment and a future tenant may be prevented, and hence satisfaction with the accommodation may increase. Furthermore, apartments previously considered unattractive due to a large geographical distance from the desired location may become attractive if the respective commute time is relatively low, which is also sometimes mentioned as a reason for the feature's implementation [18]. Remarkably, commuter traffic can counteract all three conventional sustainability dimensions, causing negative externalities in the ecological, economic, and social spheres.

The existing literature examines, among other things, the role that the search engine of housing platforms might play or the consequences an overload of information could have. In this context, it is helpful to investigate whether a tailored search function in online platforms is beneficial or not. As mentioned before, several online platforms have implemented commute-related information in their search engine, but research has not focused yet on whether this could be beneficial regarding information quality and technology acceptance. Rashidi et al. introduced a method for housing search in which the decision-making process is based on, among other things, the average working distance of the household. This approach mirrors our idea of point of interest, but neglects commute time. This and other existing approaches that focus on housing search also use other frameworks than ours, like the hazard model and discrete choice modeling [19,20]. Valente's work is one of the few that focuses on students in the context of housing platforms. However, it focuses on switching behavior between different platforms rather than the search process [21]. All in all, there is a lack of evidence in the literature on how beneficial a tailored housing platform can be for the students' search process. Therefore, our research aims to explore the benefit of the commute time visualization feature explicitly. As our research context, we chose student housing as an instantiation to shed initial light on the effect of commuting-relevant information on housing platforms. We consider students' particular needs (e.g., limited financial power and often no or only limited working contracts) a particularly interesting sphere for our research. The following research question summarizes this:

RQ: Does tailoring a student housing platform towards students' commuting needs benefit information quality and technology acceptance?

As a theoretical lens, our research considers the theory of cognitive fit [21], as well as the technology acceptance model (TAM) [22,23]. To test our research hypotheses, we built an online experiment with a between-subject design based on a prototypical apartment search platform. We conducted this experiment with 98 participants.

Thereby, this paper aims to provide insights into the design of housing platforms with respect to incorporating students' commuting needs in the apartment search process. More precisely, the goal is to determine whether a search interface and selection process based on the commute time between apartment and point of interest yields a benefit concerning technology acceptance and the fit of the task and problem representation compared to a search based on the desired geographical area alone.

The remainder of this paper is structured as follows: First, the general research background is established to focus on the design of existing housing platforms, the theory of cognitive fit, and the TAM. Based on this, four hypotheses are derived. An online experiment with a treatment and control group is set up to test these hypotheses, and its results are reported. Finally, as the main contribution of our study, the implications for theory and practice are discussed. Furthermore, we present the limitations and avenues for future research.

2. Research Background

In order to better understand the potential impact and benefit of a commute time search feature, it is first necessary to establish the relevant research background. Therefore, this section discusses prior research regarding commute time and housing platforms. Furthermore, the design of existing housing platforms is examined under consideration of this paper's research goal.

2.1. Research of Digital Housing Platforms

Apartment location and, implicitly, commute time have been a relevant criterion for apartment selection in various studies like [24,25]. This is interlinked with research performed in the context of commute time itself, e.g., for its effect on a person's satisfaction, well-being, or even academic success [26–29]. For example, Ye et al. [26] studied mismatches between actual and ideal commute time and found that dissonance significantly affects commute satisfaction. In a different study, Lorenz [29] found that high commute times are associated with reduced satisfaction, especially in family life and leisure time due to higher time scarcity. One of the underlying issues of commuting is the balance of housing and points of interest, where a well-researched category is the job-housing-balance [30,31]. In essence, housing platforms serve as an electronic marketplace to match landlords' apartments with potential tenants suggesting that housing platforms are often intermediaries where information technology results in more efficient matching and lower transaction costs. Based on this assumption and existing websites, e.g., [13,32], a schematic overview of housing platforms' design is given in Figure 1.

While there are many commercial websites and platforms available that facilitate a mobility accessibility search for accommodations showing that significant effort has been spent on their design and development, to the best of our knowledge, no extensive academic research has been performed on the design of housing platforms focusing on users' mobility demands, yet. However, Yuan et al. [33] aimed to design a user-oriented real estate website where the search capabilities are based on an ontological information management approach. As part of this, they analyzed existing real estate websites and conducted a study on user search behavior. They also incorporated the distance to a point of interest in terms of means of transportation and commute time. Yuan et al. [33] also evaluated their design, which proved to be well-liked; however, compared to our approach, no controlled between-subjects experiment was conducted focusing only on the commuting-search feature. In the context of digital marketplaces, Fradkin [34] analyzed the transaction costs and associated search engine design based on airbnb.com [35]. This study used models for searcher choice and host rejections to show that search engine capabilities like filtering and availability tracking are of great importance for the use case of airbnb.com [35].

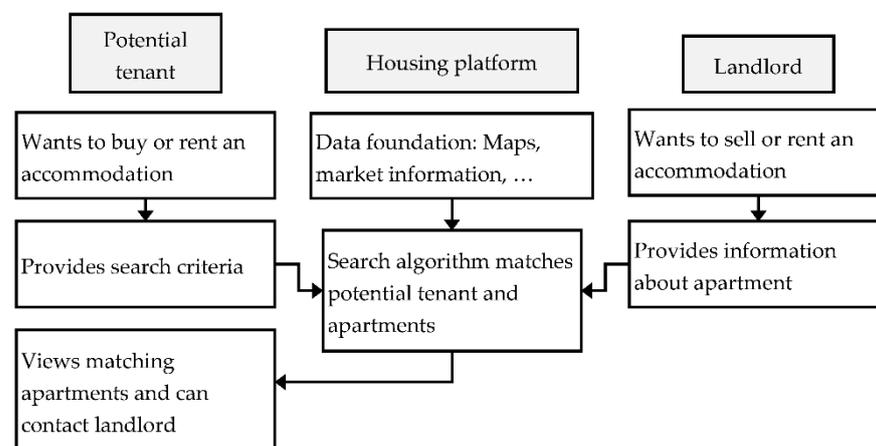


Figure 1. The framework of digital housing platforms, inspired by [36].

2.2. Design of Existing Housing Platforms

To evaluate the standard design themes and mobility- and commute-relevant capabilities, we examined existing housing platforms. Notable examples of existing platforms include rentals.com [14], apartments.com [37], and apartmentlist.com [38]. For Germany, popular websites are immowelt.de [13], immobilienscout24.de [32], and wg-gesucht.de [39].

We identified that housing platforms vary in terms of the type of accommodations (e.g., single rooms, apartments, and houses) either for rent or sale. In the remainder of this paper, we will only consider apartments, but we expect the results to apply to other accommodation types. The housing platforms run advertisements or include optional, paid premium features and listing fees to offer a sustainable business model. In an extensive analysis of e-business models in real estate, Cherif and Grant [40] found similar revenue sources.

Nearly all existing platforms follow the same general procedure to match accommodations and potential tenants. First, the user enters the apartment's desired location (e.g., via city, district name, or zip code) as the primary search criterion in addition to filters regarding the type of accommodation and range filters regarding rent and dimension. Then, all matching apartments are displayed in a list view or a map and often a combination of both. Typically, the user can further refine the search by applying additional filter criteria and sorting it. On some platforms (e.g., [32,37], or [41]), a search area can also be manually drawn onto the map. Clicking on an individual apartment displays a more detailed description and new information like pictures and finer-grained apartment characteristics. If users consider the accommodation suitable, they can contact the owner to agree on a viewing appointment. This process has also been similarly described by Yuan et al. [33].

Many housing websites also incorporate mobility-specific information in some form. For example, the person or company who listed the apartment on the platform may already be encouraged to include relevant information about (public) transport connection in a free-text description, which can, for example, be found on [39]. However, as initially explained, some websites consider commute time the main search criterion by default and allow for a search based on the maximum commute time a tenant is willing to spend.

Commute or travel time as an ingredient of a search function has been analyzed in several studies. For example, De Vos and Witlox found that travel time plays an essential role in a housing decision. Accordingly, people who do not love to travel self-select in urban neighborhoods where travel time is likely to be short. On the other hand, people who like to travel long distances want to live in suburban areas, so they have a longer travel time to their working area or other points of interest [42]. Similar studies analyze the difference in travel preference of individuals for urban and suburban regions and find that travel time is an important element in both travel and housing decisions [43,44]. Other studies support the statements in which commute time is found to be important in the context of housing [45,46]. A schematic illustration of the search approach, including commute time compared to the traditional approach, is given in Figure 2.

Location

Max. distance to location in km (optional)

Point of interest

Means of transport

Car Bike Train Walk

Max. commute time

Figure 2. Schematic illustration of different search interfaces with and without the commute time.

When writing this paper, examples for websites that follow some form of this approach include apartments.com [37], walkscore.com [47], apartmentlist.com [38], primelocation.com [48], and homesnap.com [41].

In some cases, e.g., [37] or [41], the user can also provide multiple relevant points of interest at once, which is especially helpful if more than one tenant will live in the apartment. Furthermore, the user also needs to specify the means of transport, e.g., bus, train, or car, on most of these websites so that the expected commute time can be accurately calculated. For example, in the case of apartments.com [37], it is also possible to incorporate the expected traffic situation for the commute. Similar to most housing platforms without a search based on commute time, matching apartments are usually listed on a map where a search area is displayed based on the commute time. Sometimes, commuting relevant data can be further visualized by providing a heatmap and highlighting bus and train connections like on, e.g., walkscore.com [47].

3. Theoretical Lens and Hypotheses Derivation

Based on our initial research question and research background, we use the TAM and the theory of cognitive fit as our theoretical lens, which is motivated and discussed in this section. Furthermore, we derive four hypotheses that are later examined in the paper's experiment.

3.1. Cognitive Fit of Task and Problem Representation

Cognitive fit is a theory first introduced in the cognitive perception of a graphical and tabular representation of data [21,49]. In essence, cognitive fit refers to the match between the task and problem representation, where a better fit leads to increased performance in solving the respective problem [21]. The reason for that is that the user has to spend less effort deriving an appropriate mental representation based on problem representation and task and thus solves the task more efficiently and effectively [21]. The cognitive fit theory falls into the more general area of task-technology fit, which deals with technology characteristics beyond data representation [50].

The paradigm of cognitive fit has been used in plenty of other research. For example, Xu et al. investigated the format of videos for product reviews in the context of e-commerce [51], and Dennis and Carte [52] applied cognitive fit theory to map-based versus tabular data representations. Similarly, Speier and Morris [53] used cognitive fit theory to analyze query interfaces for housing platforms to compare text-based and visual (map-based) querying.

In the context of our research, the task of the user is to find appropriate apartments, which is a task that includes many information dimensions such as price, location, and size. In our case, a focus is put on the apartment's location with two distinct problem representations. First, the location is represented as is, simply as a single data point, only fulfilling the condition that the apartment is located within a specific area. Second, for the commuting-based search, the apartment's location information is represented in the form of commute time to a specific point of interest. According to the cognitive fit theory [21,49], we hypothesize that offering a search based on commute time provides a reliable representation of the problem with a higher fit for the task. Therefore, we presume that the user can derive a more consistent mental representation and regard this approach to have a higher quality of information:

Hypothesis 1 (H1): *A housing platform with a search based on commute time offers a higher information quality than a platform with a search based on the city alone.*

3.2. Technology Acceptance

To examine technology acceptance, we followed the TAM [22,23,54]. We selected the TAM as a well-established theory [55] to avoid any potential problems related to the validity of a different and less common set of theories. In the TAM, the perceived ease of

use and usefulness are considered relevant determinants for the behavioral intention to use and, thereby, the actual future use of a system [22,23]. More specifically, ease of use refers to the amount of effort spent using a system, whereas high usefulness means a high improvement in performance for a particular job or task [23]. The original TAM has been extensively discussed, applied, and extended, and is an often-used model, although not without limitations [54,56,57]. Due to its versatile nature and wide recognition, we argue it is highly suitable for judging an online platform's benefits that facilitate an apartment search based on commute time.

The TAM has already been applied by Lee et al. [58] in the context of apartment agency platforms, but without a specific focus on mobility or commute-relevant aspects. In our case, we assume that the information regarding commute time supports users with searching for and selecting apartments. As filters already exist for other criteria like price and size, we consider a finer-grained method to narrow down the result set in terms of location lets users perceive the platform as more useful. Therefore, we follow the TAM and hypothesize accordingly:

Hypothesis 2 (H2): *A housing platform with a search based on commute time results in higher perceived usefulness than a platform with a search based on the city alone.*

Similarly, we presume that the possibility of a search based on commute time also makes the discovery of a suitable apartment easier. We assume that our search feature facilitates a faster selection of apartments. Although users can filter their search with more criteria, we hypothesize that, overall, users need to exert less effort to reach at suitable results. Following the TAM, we hypothesize that our commute time search feature shall increase the perceived ease-of-use of the housing platform:

Hypothesis 3 (H3): *A housing platform with a search based on commute time results in a higher perceived ease-of-use than a platform with a search based on the city alone.*

If users perceive an IS as more useful and easier-to-use, they might develop a higher intention to use such IS [23]. This in line with the TAM and, accordingly, we expect to find H2 and H3 resulting in a higher intention to use [22,23] of a platform offering a commute time search feature:

Hypothesis 4 (H4): *A housing platform with a search based on commute time results in a higher intention to use than a platform with a search based on the city alone.*

4. Research Design

In this section, we introduce our research design, data collection procedure, and measures. We chose to follow a quantitative research set up with an online experiment accompanied by a user questionnaire. Recent studies have shown a valuable contribution of questionnaires, including the area of public opinion on mobility usage [59], the case of mobility-impaired individuals [60], or potential conflicts in shared spaces among different mobility means [61].

4.1. Control and Treatment Configuration

For a controlled comparison, a web-based prototype of a housing platform was implemented, including a search interface, a map showing all apartments found, and a detail page for each accommodation. The instance for the control and treatment groups differed only regarding mobility-relevant search criteria and displayed information. A comparison of the search interface for the control and treatment groups is shown in Figure 3. Here, the mobility-relevant addition in the treatment instance is a search field for the point of interest, a field for the maximum desired commute time, and checkboxes indicating relevant means of transport. To give the prototype a more realistic feeling, we further included widely used filter criteria beyond the minimum required to find an apartment

(like price and size) in our platform setup. However, those are equal for both instances and, therefore, not depicted in Figure 3. Furthermore, the treatment instance differs slightly in how the apartments are listed to the user. The map also shows the point of interest, and each apartment detail page lists the commute time to the point of interest.

A – Partial screenshot of control configuration

Search for housing

Filter

In which city do you want to live?

City

B – Partial screenshots of treatment configuration

Search for housing

Filter Additional functionality available!

What is your university?

Select

Which is your preferred way to get to university?

Select

Max. commute time

30 min

Do you have a...

Bike Student ticket (Bus) Student ticket (Train) Car

Figure 3. Excerpt of search interface with and without mobility-relevant filters (translated from German).

4.2. Data Collection Procedure

The experiment was conducted as a between-subject test to avoid carry-over and demand effects [62] with an initial overall sample size of 102 participants (see Figure 4 for an outline of our data collection procedure). The data has been collected using the online survey tool Qualtrics [63]. Each participant was randomly assigned to either the control or treatment group and received an instruction sheet in which the experiment's setting was explained. The participants were supposed to pretend to be students looking for a shared apartment for the time of their studies. For this purpose, the participants were given a set of filter criteria, including the city and university's location, the type of accommodation, the rent, the number of rooms, and the room or apartment size. Moreover, mobility-relevant information was provided for the treatment group consisting of the preferred way to get to the university, possible means of transport, and maximum commute time to the university. To conclude the task, the participants should decide on a single apartment.

The survey itself was conducted in two iterations with 50 participants in the first and 52 participants in the second iteration. Of those, the results of 4 participants were discarded as they were incomplete, resulting in an overall sample size of 98. In terms of gender, 49 males and 44 females participated (5 participants did not provide their gender). With 75 participants, the vast majority of participants were aged between 20 and 29. In 42 cases, the net income was between 500 € and 1000 €, in 20 cases below 500 €, and the remaining cases more than 1000€. Three participants did not specify their net income.

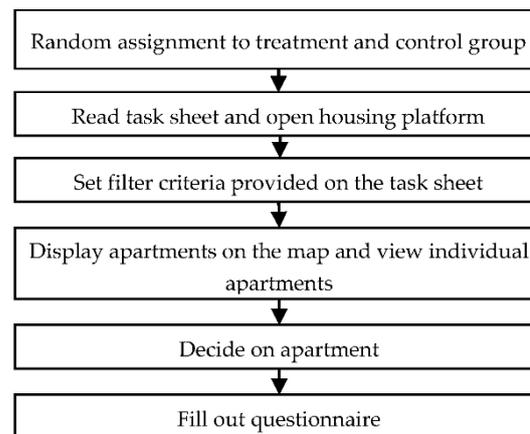


Figure 4. Schematic overview of the data collection procedure.

4.3. Measures

As independent measures, we considered items indicating information quality [64] to assume that a better fit of representation and task ultimately leads to a higher perceived quality of information. On a semantic level, DeLone and McLean [65] argue that information quality is distinct from system quality. As such, scholars also discussed the link of information quality with cognitive fit [66]. To measure information quality, we use slightly modified and translated items suggested by McKinney et al. [64] in the categories of information relevancy and adequacy. Items for intention to use, perceived usefulness, and perceived ease of use were mostly adapted from Venkatesh et al. [67] based on [54] to consider technology acceptance. We chose to measure all items in a 7-point Likert scale since this configuration is widely recognized as a reasonable balance between differentiation and comprehensibility [68]. An overview of constructs and items is depicted in Table 1. To analyze the constructs, we conducted a confirmatory factor analysis with the software package lavaan in R [69]. All constructs show sufficient [70] composite reliability and average variance extracted, and the individual factor loadings of the items are well above the threshold of 0.6 suggested by Gefen and Straub [71].

Table 1. Constructs and corresponding items (translated from German).

Constructs and Items Items Adapted from the Sources Indicated in Brackets	Factor Loadings
Intention to use [54,67] ($\alpha = 0.865$, CR = 0.866, AVE = 0.686)	
I would use the platform to search for an apartment.	0.877
I intend to use the platform the next time I come across it.	0.804
I would use the platform even if I find similar other platforms.	0.794
Perceived usefulness [54,67] ($\alpha = 0.901$, CR = 0.904, AVE = 0.702)	
I found using the platform to search for an apartment useful.	0.810
The use of the platform provided me with a benefit compared to similar other platforms.	0.788
The experience of using the platform to search for an apartment was useful to me.	0.875
I believe that the experience of using the platform to search for an apartment added value to the search for an apartment.	0.881
Perceived ease of use [54,67] ($\alpha = 0.913$, CR = 0.915, AVE = 0.730)	
My interaction with the platform was clear and understandable.	0.785
It was easy for me to become skillful at using the platform.	0.890
I found the platform easy to use.	0.895
Learning to operate the platform was easy for me.	0.864
Information quality [64] ($\alpha = 0.913$, CR = 0.915, AVE = 0.783)	
On the platform, I can find all information that is relevant to my decision.	0.795
Information on the platform is sufficient for my decision.	0.896
Information on the platform is complete concerning my decision.	0.955

α : Cronbach's alpha, CR: Composite Reliability, AVE: Average Variance Extracted.

5. Results

The results of the evaluation were analyzed using descriptive statistics and t-tests. The statistical data analysis was carried out using the statistical computing software R. A t-test was then performed, which is considered appropriate for Likert-scaled data and even non-normal distribution if the sample size is sufficient [72]. The Levene test showed homogeneity of variance for all constructs, and we performed the t-test in its one-tailed variant, as we are only interested in a significant difference of means in one direction.

According to the t-test, the response's mean was significantly higher for the treatment group in all instances, as depicted in Table 2, thereby supporting all respective hypotheses. Significance for a higher intention to use and perceived ease of use for the treatment group was present on a 5% significance level, whereas this was the case for perceived usefulness and information quality on a 1% significance level.

Table 2. Results.

Constructs	Control (n = 50)		Treatment (n = 48)		t-Value (df = 96)	p-Value	Hypotheses
	Mean	SD	Mean	SD			
Information quality	3.87	1.65	4.87	1.58	3.07	0.0014 ***	H1 Supported
Perceived usefulness	3.5	1.43	4.71	1.53	4.09	<0.001 ***	H2 Supported
Perceived ease of use	5.41	1.57	5.91	1.3	1.71	0.0446 **	H3 Supported
Intention to use	4.2	1.52	4.85	1.56	2.08	0.0201 **	H4 Supported

. $p < 0.05$, *. $p < 0.01$, SD: Standard deviation.

In addition to considering the mere statistical significance, the mean effect size may also be examined. As such, the quality of information and the perceived usefulness were found to be strongly increased within the treatment group compared to the control group. This effect is weaker when looking at the perceived ease of use and intention to use. However, the standard deviation is somewhat comparable for all constructs in both groups.

6. Discussion

This paper investigated the benefit of websites providing a search for apartments based on the expected commute time to a point of interest. We found a benefit in information quality, perceived ease of use, perceived usability, and intention to use.

6.1. Theoretical Implications

Compared to the city-based search, an interface allowing for a search based on commute time is expected to yield a higher degree of information quality, perceived ease of use and usefulness, and intention to use. According to our hypotheses, this means that we consider a commuting-based search a superior information representation to find an apartment. Following the paradigm of cognitive fit, the derivation of a mental representation is expected to be easier, suggesting that task solving efficiency and effectiveness may also be better. Likewise, the acceptance of an information system for apartment search and rental with a commuting-based search is higher than one without such functionality. The findings suggest that a reduction of the result set under the consideration of commute time is preferred compared to the full result set. An explaining factor can be choice overload in the city-based search caused by large assortment size with complex choice sets, an aspect also mentioned by Fradkin [34] regarding search engine design, and an individual's goal to reduce the cognitive effort to decide [73]. Regarding these and other findings in existing literature, our study contributes to this research area. We were able to expand the current literature on housing platforms and the utility of a commute time search function. While the research to date has focused primarily on commute time in other topics, such as the differences between urban or suburban areas, it is also important to examine the benefits of implementing a commute time search feature in particular [42–44].

Additionally, we extend the literature on the point of interest in housing search by adding the context of commute time in this regard [20].

6.2. Practical Implications

Based on our study, this paper emphasizes the benefits of tailoring apartment search platforms towards mobility needs. Not only does the user benefit from this approach, but most importantly, the intention of use is also significantly higher compared to a traditional search approach resulting in an expected increase in actual use. This is probably the most critical aspect for an operator of a housing platform, where the user base's size ultimately impacts the revenue. Therefore, the paper implicates that housing platform designers should consider users' mobility needs concerning commute time. Moreover, it should be noted that the treatment group contained additional filters compared to the control group, suggesting that at least in the context of commuting, a more complex user interface is still perceived as easier to use.

6.3. Limitations and Future Research

This present research is not free of limitations and hence provides possibilities for future research. The main limitations to the generalizability of the results arise through the relatively small sample size and that the study design only asks the participants for one task concerning students with only a single point of interest, a university. Apart from students and universities, a search based on expected commute time is possible for many other scenarios and stakeholders. Another interesting group might be employees with their workplace or elderly people with particular (mobility) needs. It is also probable that not only one single point of interest is of importance, but rather multiple different ones, as with the case of families. Similarly, our research could be replicated in both rural areas and in a cross-country comparison to shed further light on the effect of providing commuting-relevant information. For instance, various urban forms like metropolises or small villages could impact individuals' desires, preferences, and behaviors in their flat search. Aspects like increasing rents and housing prices may be less prevalent in rural areas.

Furthermore, a search based on expected commute time can be provided in varying forms, as discussed in Section 2.2. The evaluation ultimately decided on one specific implementation, meaning that the experiment did not evaluate the approach for all of its nuances. Moreover, the experiment does not provide evidence whether a search tailored towards commuting needs eventually improves the fit of apartment and tenant and reduces housing shortage. This aspect could be considered in future research, for example, in the form of a case study.

It should also be noted that the choice for a location is likely not only made with respect to future commute times, but also based on the neighborhood's attractiveness [74]. Location factors beyond commute time are not directly considered in either search interface, meaning that future research could investigate the effect of offering some search capability regarding the neighborhood's desired socioeconomic profile similar to Grant and Cherif [75].

Moreover, we have deliberately chosen a quantitative and experimental study design. However, different approaches are conceivable, and this study could serve as a starting point for future research endeavors: First, a design-oriented approach could touch on the specifics of a housing platform itself, but would set utility over truth (i.e., would focus less on explaining why a behavior happens). Second, a qualitative approach could shed additional light on user choices, but would result in fewer data points, rendering generalizable conclusions less probable. Third, we deliberately chose the cognitive fit theory and TAM as our guiding theories and frameworks. We made this choice as a tradeoff between research model complexity and explanatory breadth. Future research might shed additional light on further aspects, e.g., social or organizational impacts, by incorporating successors of the TAM like the Unified Theory of Acceptance and Use of Technology (UTAUT) [54]. With a growing discussion about the role of significance tests, future studies could also benefit from questioning how a dwarfing of valuable research to simple statistical tests can

be avoided. In this respect, too, an accompaniment with strong qualitative methodology elements might enrich the level of insight gained.

An important aspect that has not been considered in our paper is the rising rate of telecommuting [76], which impacts residential choices for commuting distance, as some studies have shown [77,78]. This is even more relevant in light of the current COVID-19 pandemic, which forces many people to work from home and thereby may significantly impact telecommuting and similar work and learning arrangements in the future [79–81]. Likewise, there may be other user groups that do not regularly commute, so that a commute-based search is of little interest. These aspects may dampen the benefit of a commute time search feature and motivate future research that could conduct the paper's experiment by deliberately selecting participants who usually work or study from home.

7. Conclusions

In this paper, we investigated whether an apartment search based on commute time yields a benefit compared to a search based on the general area alone. We conducted an online experiment with 98 participants and found that the former approach is advantageous to information quality and technology acceptance. This highlights the practical need to tailor housing platforms towards the user's requirements under consideration of mobility-relevant aspects to achieve a better fit between task and problem representation and perceived usefulness, ease-of-use, and intention to use.

We were able to show that mobility-related aspects should be included in individual decision-making. For this purpose, it would be helpful for users of a housing platform to be aware of these mobility-related features and that these features are present during the housing search. If tenants move closer to their regular points of interest, this can avoid traffic and emissions, rendering communities more sustainable.

Furthermore, this paper's findings can serve as a foundation for future research that addresses the paper's limitations, for example, by further analyzing the impact of a commute time search feature with other research approaches such as a case study.

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References

1. Inchauste, G.; Karver, J.; Kim, Y.S.; Jelil, M.A. *Living and Leaving: Housing, Mobility and Welfare in the European Union*; World Bank: Washington, DC, USA, 2018.
2. Van Doorn, L.; Arnold, A.; Rapoport, E. In the Age of Cities: The Impact of Urbanisation on House Prices and Affordability. In *Hot Property*; Nijssens, R., Lohuis, M., Hilbers, P., Heeringa, W., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 3–13; ISBN 978-3-030-11673-6.

3. Saiz, A. The Geographic Determinants of Housing Supply. *Q. J. Econ.* **2010**, *125*, 1253–1296. [CrossRef]
4. Glaeser, E.; Gyourko, J. The Economic Implications of Housing Supply. *J. Econ. Perspect.* **2018**, *32*, 3–30. [CrossRef]
5. Ahrens, A.; Lyons, S. Do rising rents lead to longer commutes? A gravity model of commuting flows in Ireland. *Urban Stud.* **2021**, *58*, 264–279. [CrossRef]
6. Stutzer, A.; Frey, B.S. Stress that Doesn't Pay: The Commuting Paradox. *Scand. J. Econ.* **2008**, *110*, 339–366. [CrossRef]
7. Creutzig, F.; Jochem, P.; Edelenbosch, O.Y.; Mattauch, L.; van Vuuren, D.P.; McCollum, D.; Minx, J. Transport: A roadblock to climate change mitigation? *Science* **2015**, *350*, 911–912. [CrossRef] [PubMed]
8. Wang, H.; Zeng, W. Revealing urban carbon dioxide (CO₂) Emission characteristics and influencing mechanisms from the perspective of commuting. *Sustainability* **2019**, *11*, 385. [CrossRef]
9. Balbontin, C.; Ortúzar, J.D.D.; Swait, J.D. A joint best-worst scaling and stated choice model considering observed and unobserved heterogeneity: An application to residential location choice. *J. Choice Model.* **2015**, *16*, 1–14. [CrossRef]
10. Krysan, M. Does race matter in the search for housing? An exploratory study of search strategies, experiences, and locations. *Soc. Sci. Res.* **2008**, *37*, 581–603. [CrossRef] [PubMed]
11. Dunning, R.J.; Grayson, A. Homebuyers and the representation of spatial markets by information providers. *Int. J. Hous. Mark. Anal.* **2014**, *7*, 292–306. [CrossRef]
12. Kroft, K.; Pope, D.G. Does Online Search Crowd Out Traditional Search and Improve Matching Efficiency? Evidence from Craigslist. *J. Labor Econ.* **2014**, *32*, 259–303. [CrossRef]
13. Immowelt, A.G. Available online: <https://www.immowelt.de/> (accessed on 20 February 2021).
14. RentPath, LLC. Available online: <https://www.rentals.com/> (accessed on 20 February 2021).
15. CoStar Group, Inc. How to Find an Apartment with a Great Commute. Available online: <https://www.apartments.com/blog/how-to-find-an-apartment-with-a-great-commute> (accessed on 20 February 2021).
16. Homesnap, Inc. Introducing: Search by Commute Time. Available online: <https://blog.homesnap.com/introducing-search-commute-home-search/> (accessed on 23 February 2021).
17. RentPath, L. Factoring a New Commute into Your Apartment Search. Available online: <https://www.rent.com/blog/new-commute-apartment-search/> (accessed on 20 February 2021).
18. Borchert, B. Die neue Immobilienscout24-Fahrzeitsuche: Einfach & Innovativ—Eine Kurze Erklärung. Available online: <http://web.archive.org/web/20200927074103/https://blog.immobilienscout24.de/die-fahrzeitsuche-bei-immobilienscout-24-kurz-erklaert/> (accessed on 20 February 2021).
19. Rashidi, T.H. Dynamic housing search model incorporating income changes, housing prices, and life-cycle events. *J. Urban Plan. Dev.* **2015**, *141*, 4014041. [CrossRef]
20. Rashidi, T.H.; Auld, J.; Mohammadian, A.K. A behavioral housing search model: Two-stage hazard-based and multinomial logit approach to choice-set formation and location selection. *Transp. Res. Part A: Policy Pract.* **2012**, *46*, 1097–1107. [CrossRef]
21. Vessey, I. Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature. *Decis. Sci.* **1991**, *22*, 219–240. [CrossRef]
22. Davis, F.D.; Bagozzi, R.P.; Warshaw, P.R. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Manag. Sci.* **1989**, *35*, 982–1003. [CrossRef]
23. Davis, F.D. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Q.* **1989**, *13*, 319–340. [CrossRef]
24. Bina, M.; Warburg, V.; Kockelman, K.M. Location Choice vis-à-vis Transportation. *Transp. Res. Rec.* **2006**, *1977*, 93–102. [CrossRef]
25. Plaut, P.O. The intra-household choices regarding commuting and housing. *Transp. Res. Part A: Policy Pract.* **2006**, *40*, 561–571. [CrossRef]
26. Ye, R.; de Vos, J.; Ma, L. Analysing the association of dissonance between actual and ideal commute time and commute satisfaction. *Transp. Res. Part A: Policy Pract.* **2020**, *132*, 47–60. [CrossRef]
27. Kobus, M.B.; van Ommeren, J.N.; Rietveld, P. Student commute time, university presence and academic achievement. *Reg. Sci. Urban Econ.* **2015**, *52*, 129–140. [CrossRef]
28. Kroesen, M. Assessing Mediators in the Relationship between Commute Time and Subjective Well-Being. *Transp. Res. Rec.* **2014**, *2452*, 114–123. [CrossRef]
29. Lorenz, O. Does commuting matter to subjective well-being? *J. Transp. Geogr.* **2018**, *66*, 180–199. [CrossRef]
30. Ta, N.; Chai, Y.; Zhang, Y.; Sun, D. Understanding job-housing relationship and commuting pattern in Chinese cities: Past, present and future. *Transp. Res. Part D: Transp. Environ.* **2017**, *52*, 562–573. [CrossRef]
31. Rahman, M.H.; Ashik, F.R. Is neighborhood level Jobs-Housing Balance associated with travel behavior of commuters? A case study on Dhaka City, Bangladesh. *GeoScape* **2020**, *14*, 122–133. [CrossRef]
32. Immobilien Scout GmbH. Available online: <https://www.immobilienscout24.de/> (accessed on 20 February 2021).
33. Yuan, X.; Lee, J.-H.; Kim, S.-J.; Kim, Y.-H. Toward a user-oriented recommendation system for real estate websites. *Inf. Syst.* **2013**, *38*, 231–243. [CrossRef]
34. Fradkin, A. Search, Matching, and the Role of Digital Marketplace Design in Enabling Trade: Evidence from Airbnb. *SSRN J.* **2017**. [CrossRef]
35. Airbnb, Inc. Available online: <https://www.airbnb.com/> (accessed on 20 February 2021).
36. Ullah, F.; Sepasgozar, S.; Wang, C. A Systematic Review of Smart Real Estate Technology: Drivers of, and Barriers to, the Use of Digital Disruptive Technologies and Online Platforms. *Sustainability* **2018**, *10*, 3142. [CrossRef]

37. CoStar Group, Inc. Available online: <https://www.apartments.com/> (accessed on 20 February 2021).
38. Apartment List, Inc. Available online: <https://www.apartmentlist.com/> (accessed on 20 February 2021).
39. WG-Gesucht.de, ein Service der SMP GmbH & Co. KG. Available online: <https://www.wg-gesucht.de/> (accessed on 20 February 2021).
40. Cherif, E.; Grant, D. Analysis of e-business models in real estate. *Electron. Commer. Res.* **2014**, *14*, 25–50. [[CrossRef](#)]
41. Homesnap, Inc. Available online: <https://www.homesnap.com/> (accessed on 20 February 2021).
42. De Vos, J.; Witlox, F. Do people live in urban neighbourhoods because they do not like to travel? Analysing an alternative residential self-selection hypothesis. *Travel Behav. Soc.* **2016**, *4*, 29–39. [[CrossRef](#)]
43. Mokhtarian, P.L.; Chen, C. TTB or not TTB, that is the question: A review and analysis of the empirical literature on travel time (and money) budgets. *Transp. Res. Part A: Policy Pract.* **2004**, *38*, 643–675. [[CrossRef](#)]
44. Frank, L.; Bradley, M.; Kavage, S.; Chapman, J.; Lawton, T.K. Urban form, travel time, and cost relationships with tour complexity and mode choice. *Transportation* **2008**, *35*, 37–54. [[CrossRef](#)]
45. Zhao, P.; Lü, B.; de Roo, G. Impact of the jobs-housing balance on urban commuting in Beijing in the transformation era. *J. Transp. Geogr.* **2011**, *19*, 59–69. [[CrossRef](#)]
46. Vandersmissen, M.-H.; Villeneuve, P.; Thériault, M. Analyzing changes in urban form and commuting time. *Prof. Geogr.* **2003**, *55*, 446–463. [[CrossRef](#)]
47. Redfin Corporation. Available online: <https://www.walkscore.com/> (accessed on 20 February 2021).
48. Zoopla Limited. Available online: <https://www.primelocation.com/> (accessed on 20 February 2021).
49. Vessey, I.; Galletta, D. Cognitive Fit: An Empirical Study of Information Acquisition. *Inf. Syst. Res.* **1991**, *2*, 63–84. [[CrossRef](#)]
50. Goodhue, D.L.; Thompson, R.L. Task-Technology Fit and Individual Performance. *MIS Q.* **1995**, *19*, 213–236. [[CrossRef](#)]
51. Xu, P.; Chen, L.; Santhanam, R. Will video be the next generation of e-commerce product reviews? Presentation format and the role of product type. *Decis. Support Syst.* **2015**, *73*, 85–96. [[CrossRef](#)]
52. Dennis, A.R.; Carte, T.A. Using Geographical Information Systems for Decision Making: Extending Cognitive Fit Theory to Map-Based Presentations. *Inf. Syst. Res.* **1998**, *9*, 194–203. [[CrossRef](#)]
53. Speier, C.; Morris, M.G. The Influence of Query Interface Design on Decision-Making Performance. *MIS Q.* **2003**, *27*, 397–423. [[CrossRef](#)]
54. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User Acceptance of Information Technology: Toward a Unified View. *MIS Q.* **2003**, *27*, 425–478. [[CrossRef](#)]
55. King, W.R.; He, J. A meta-analysis of the technology acceptance model. *Inf. Manag.* **2006**, *43*, 740–755. [[CrossRef](#)]
56. Venkatesh, V.; Davis, F.D. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Manag. Sci.* **2000**, *46*, 186–204. [[CrossRef](#)]
57. Marangunić, N.; Granić, A. Technology acceptance model: A literature review from 1986 to 2013. *Univ. Access Inf. Soc.* **2015**, *14*, 81–95. [[CrossRef](#)]
58. Lee, C.-C. Assessment of websites user behavior: A case study of housing agency firms. *J. Inf. Optim. Sci.* **2012**, *33*, 553–574. [[CrossRef](#)]
59. Campisi, T.; Akgün, N.; Ticali, D.; Tesoriere, G. Exploring public opinion on personal mobility vehicle use: A case study in Palermo, Italy. *Sustainability* **2020**, *12*, 5460. [[CrossRef](#)]
60. Mrak, I.; Campisi, T.; Tesoriere, G.; Canale, A.; Cindrić, M. The role of urban and social factors in the accessibility of urban areas for people with motor and visual disabilities. *AIP Conf. Proc.* **2019**, *2186*. [[CrossRef](#)]
61. Nikiforiadis, A.; Basbas, S.; Campisi, T.; Tesoriere, G.; Garyfalou, M.I.; Meintanis, I.; Papas, T.; Trouva, M. Quantifying the Negative Impact of Interactions Between Users of Pedestrians-Cyclists Shared Use Space. In *International Conference on Computational Science and Its Applications*; Springer: Cham, Switzerland, 2020; Volume 12250, pp. 809–818. [[CrossRef](#)]
62. Charness, G.; Gneezy, U.; Kuhn, M.A. Experimental methods: Between-subject and within-subject design. *J. Econ. Behav. Organ.* **2012**, *81*, 1–8. [[CrossRef](#)]
63. Qualtrics. Online Survey Software. Available online: <https://www.qualtrics.com/core-xm/survey-software/> (accessed on 23 February 2021).
64. McKinney, V.; Yoon, K.; Zahedi, F. The Measurement of Web-Customer Satisfaction: An Expectation and Disconfirmation Approach. *Inf. Syst. Res.* **2002**, *13*, 296–315. [[CrossRef](#)]
65. DeLone, W.H.; McLean, E.R. Information Systems Success: The Quest for the Dependent Variable. *Inf. Syst. Res.* **1992**, *3*, 60–95. [[CrossRef](#)]
66. Urbaczewski, A.; Koivisto, M. The Importance of Cognitive Fit in Mobile Information Systems. *Commun. Assoc. Inf. Syst.* **2008**, *22*, 185–196. [[CrossRef](#)]
67. Venkatesh, V.; Aloysius, J.A.; Burton, S. Design and Evaluation of Auto-ID Enabled Shopping Assistance Artifacts in Customers' Mobile Phones: Two Retail Store Laboratory Experiments. *MIS Q.* **2017**, *41*, 83–113. [[CrossRef](#)]
68. Lietz, P. Research into questionnaire design: A summary of the literature. *Int. J. Mark. Res.* **2010**, *52*, 249–272. [[CrossRef](#)]
69. Rosseel, Y. lavaan: An R Package for Structural Equation Modeling and More Version 0.5-12 (BETA). Available online: <https://users.ugent.be/~jyrosseel/lavaan/lavaanIntroduction.pdf> (accessed on 1 March 2021).
70. Urbach, N.; Ahlemann, F. Structural equation modeling in information systems research using partial least squares. *J. Inf. Technol. Theory Appl.* **2010**, *11*, 5–40.

71. Gefen, D.; Straub, D. A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example. *Commun. Assoc. Inf. Syst.* **2005**, *16*, 91–109. [[CrossRef](#)]
72. Norman, G. Likert scales, levels of measurement and the “laws” of statistics. *Adv. Health Sci. Educ. Theory Pract.* **2010**, *15*, 625–632. [[CrossRef](#)] [[PubMed](#)]
73. Chernev, A.; Böckenholt, U.; Goodman, J. Choice overload: A conceptual review and meta-analysis. *J. Consum. Psychol.* **2015**, *25*, 333–358. [[CrossRef](#)]
74. Ioannides, Y.M.; Zabel, J.E. Interactions, neighborhood selection and housing demand. *J. Urban Econ.* **2008**, *63*, 229–252. [[CrossRef](#)]
75. Grant, D.; Cherif, E. Using design science to improve web search innovation in real estate. *J. Organ. Comput. Electron. Commer.* **2016**, *26*, 267–284. [[CrossRef](#)]
76. Picu, C.G.; Dinu, A. Research on the current telecommuting trends in United States and European union markets. *Manag. Econ. Rev.* **2016**, *1*, 194–202.
77. Mokhtarian, P.L.; Collantes, G.O.; Gertz, C. Telecommuting, Residential Location, and Commute-Distance Traveled: Evidence from State of California Employees. *Environ. Plan. A* **2004**, *36*, 1877–1897. [[CrossRef](#)]
78. Ettema, D. The impact of telecommuting on residential relocation and residential preferences: A latent class modelling approach. *J. Transp. Land Use* **2010**, *3*, 7–24. [[CrossRef](#)]
79. Kramer, A.; Kramer, K.Z. The potential impact of the COVID-19 pandemic on occupational status, work from home, and occupational mobility. *J. Vocat. Behav.* **2020**, *119*, 103442. [[CrossRef](#)] [[PubMed](#)]
80. Howe, D.C.; Chauhan, R.S.; Soderberg, A.T.; Buckley, M.R. Paradigm shifts caused by the COVID-19 pandemic. *Organ. Dyn.* **2020**, 100804. [[CrossRef](#)] [[PubMed](#)]
81. Adedoyin, O.B.; Soykan, E. COVID-19 pandemic and online learning: The challenges and opportunities. *Interact. Learn. Environ.* **2020**, 1–13. [[CrossRef](#)]