The impact of IT mindfulness on complex task performance

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Abstract

Travel bookings are time-consuming as many HICSS participants know. Finding suitable flights from Europe with minimal flying times, layovers long enough to catch the next flight but not too long takes time and can be considered a complex task. However, the travel search engines are quite easy to use without many advanced features and using them creatively does not seem probable. We set out to study whether information technology (IT) mindfulness or mindlessness have any impact on complex task performance. IT mindfulness has been found to affect the use of advanced features and finding new ways to use software. Doing something on automatic pilot has been considered to be mindless. We gave students a complex booking task and the survey results on their performance reveal the impact of IT mindfulness.

1. Introduction

Driving home from work without remembering the journey afterwards. Eating a bowl of popcorn while watching a movie without paying attention at all. Walking to the coffee machine at work only to notice that the cup is still at the desk. Browsing through and liking Instagram posts without remembering what the message actually was. Easy routine tasks are often done on "auto-pilot" without thinking about the task, mindlessly [26]. Prior research has noticed that it is not effective to focus constantly on every detail, but allowing our attention to concentrate on the more complex and difficult tasks allows for more creativity and innovation. [10]. But does the usage of digital services require constant focus, or can we turn the autopilot on?

We spend an increasing amount of time online nowadays, often using some kind of digital services. The task complexity varies greatly: some require calculations and coordination between many different digital services, such as making complex travel bookings to HICSS. Other tasks are simple and straightforward such as checking timetables, using a search engine or filling ordering details to forms. Prior literature has recognized ease-of-use as an important characteristic of any information system and users' preference to lowest level of effort [24]. Therefore, the level of attention and focus required for task fulfilment using digital services is interesting.

In this paper, we focus on individual mindfulness that has been defined as a "state of alertness and dynamic awareness" [21], which may be useful in performing complex tasks. It has been studied in IS and other disciplines for some time [4]. IT mindfulness has been noticed to alleviate technostress [13], and is required in order to be in conscious control in a digital environment [7]. Thatcher et al. studied information technology (IT) mindfulness and noticed that it was connected to usage of more advanced features and novel usage of the system [25]. Overall, mindfulness seems to lead to positive outcomes, whereas mindlessness has been connected to more negative outcomes [10].

However, Levinthal and Rerup [10] question this idea of mindful and less-mindful behavior leading to positive or negative performance respectively. They point out, based on prior research, that mindfulness may actually be innovative use and combination of previously tested routines [26]. They also notice that individuals may use routines until those fail and then the routines have to be modified mindfully to learn from the novel situation. Both mindful and less-mindful or mindless behavior seem to have a place in organizations and task performance.

We wanted to study this notion of mindful and mindless behavior and their effect on task performance. Prior research on IT mindfulness has focused on tasks with specific instructions [25], although individual mindfulness might be most useful when performing difficult tasks. The task in our study is a high-complexity task to "book" a trip to HICSS-54 with strict limitations, thus the outcome was defined carefully, but no instructions for performing the task were given. The

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task required coordination between several digital services and therefore we considered this task to be complex. We expected that some students would perform this task mindfully to perform well (i.e. find cheap travel arrangements) and others would mindlessly just do the task quickly, and not focus on their performance.

Therefore, in this paper we aimed to study how mindfulness or mindlessness affect student performance in a complex task? We gave the complex booking task for bachelor level students and 76 students completed the survey.

Next, we describe the contextual and conceptual background of the study, then we describe our experiment in detail. After this we present the findings of the study and discuss the implications and contributions at the end of the paper.

2. Theoretical background

2.1 Online travel booking

Online travel booking can be seen as an ambiguous or a straightforward task based on the degree of complexity of the travel product [6]. Whereas the straightforward task is easy to understand due to few separate parts and simple cause and effect relationships, the ambiguous task has many separate parts and their relationships are obviously more difficult to grasp [11]. In the present study we are dealing with an ambiguous task, i.e. a high-complexity online travel booking. The characteristics associated with an ambiguous task are among others international travel, multi-destinations, multi-leg flights (connecting flights), non-routine journeys, inflexible travel dates and times, significant product depth involving coordination of services, lightly travelled routes and/or poor destination accessibility and independent travel in contrast to packaged tours [1].

The global market for online travel booking has grown huge. Around 148.3 million travel bookings are completed online every year. For example, 82% of all travel bookings in 2018 were made online via a mobile app or website. The revenue generated for worldwide online travel bookings in 2018 was 698 billion U.S. dollars and is expected to grow to 755 billion dollars in 2019. The corresponding figures projected by 2020 i.e. 817 billion dollars will however be significantly different - likewise for the whole travel industry - due to the Corona pandemic, which hit the travel industry really hard and has forced for example many countries to close their borders for international travelers for months [3].

A traveler empowered by the Internet and technologies has according to Smaliukiene et al. [19] become knowledgeable and is seeking exceptional value for money and time. Predictions have it that mobile booking will become the norm, the online travel agencies will strengthen their position on the market, predictive pricing will allow consumers to find out the best prices to travel, chat features will be available by the service providers, and online booking service providers will focus on operating without intermediaries [3]. For example Rheem [16] found that more than 50% of travelers are using search engines for their destination selection and enjoying discussing travelling experiences with others indicating new sub-cultures of travelers.

The undergraduate students in the present study could choose many different ways for performing the booking task as no instructions were given, only the booking outcome was carefully defined. Although the students were familiar with the technology and were as a rule experienced internet users the search combinations of possible booking outcomes added to the complexity of the task.

2.2 Individual mindfulness and mindlessness

Mindfulness has been studied in information systems science for a long time from organizational, group and individual perspectives or their combinations, as an implication, accelerator or prerequisite [4]. In this paper, we focus on the individual level, which can be defined “as the process of drawing novel distinctions”; the novelty being something new to that particular person whose mindfulness is in question [9]. Others have defined individual mindfulness for example as a “state of alertness and lively awareness” [21] or “continuous scrutiny and refinement of expectations based on new experiences, appreciation of the subtleties of context, and identification of novel aspects of context that can improve foresight and functioning”[17]. The focus of these definitions is on individuals’ attention and ability to find novel ideas.

Thatcher et al [25] have applied individual mindfulness in the context of IT and they define “IT mindfulness as a dynamic IT-specific trait, evident when working with IT, whereby the user focuses on the present, pays attention to detail, exhibits a willingness to consider other uses, and expresses genuine interest in investigating IT features and failures.” Although traits have been considered rather stable characteristics of a personality [20], training can change one’s IT mindfulness [25].

Drawing from prior research on individual mindfulness [8, 9], Thatcher et al. [25] identified four dimensions of IT mindfulness 1) alertness to distinction, 2) awareness of multiple perspectives, 3) openness to novelty and 4) orientation in the present.

Alertness to distinction refers to the ability to use IT applications creatively also in new contexts [25] for example an online word processor can be used for writing essays, but also for sharing a joint grocery list within family. Awareness of multiple perspectives means that a user can appreciate different uses of a system such [25] as some users can use music streaming service for focused music listening and others use it primarily to create background noise in an open office space.

Openness to novelty can be considered as the "user's willingness to explore new features or potentials of a system" [25]. An example might be a user finding constantly new ways to use the features of a learning management system rather than merely using it to share files to students. Orientation in the present refers to users' capability to concentrate in the present and understand the requirements of the context [25], for instance media choice when person uses email with formal language in professional contexts and uses instant messaging with family and friends.

Levinthal and Rerup [10] have noticed that mindfulness often is considered to lead to positive outcomes and task performance. For instance, mindfulness has been found to predict safety compliance and safety participation behavior in nuclear power plant operators [28], identifying relevant information effectively and efficiently [27], and choosing suitable technology to fit their task [22]. Sutcliffe et al [23] report also an impact on worker well-being and overall performance.

Thatcher et al. [25] noticed that IT mindfulness affected positively using advanced features and finding new ways to use Excel in their daily work, and those respondents, who got conditional instructions to use PowerPoint or Prezi to develop a visual resume used more IT mindfulness than those who received absolute instructions (about color, number of slides etc.). Therefore it seems that IT mindfulness is especially relevant when the task is complex. Thus we hypothesize:

H1: IT mindfulness has a positive effect on complex task performance.

On the other hand, mindlessness (or less-mindful as [10] put it) is referred to as being on automatic pilot, relying on existing routines [26], not being mindful [20]. Using a search engine is an example of a routine that does not require constant focus. Langer and Moldoveanu [9] describe mindlessness as mechanical execution of tasks, which may have disastrous consequences if for instance an airline pilot routinely performs her/his daily work without noticing a dangerous situation. They also see fact-based teaching leading to mindless acceptance of facts, when in schools it would be important to teach innovative thinking and questioning of taught perspectives, and this mindless acceptance can lead also to prejudice and stereotype-based thinking in other contexts. In summary, their perception of mindlessness is quite critical.

However, it has been noticed that people cannot be mindful constantly: there is limited amount of attention and therefore routines, standard operating procedures, and less-mindful behavior allows people to focus on important tasks [14]. Mindless routines seem to be also essential building blocks of mindfulness, which can be rapidly recombined in novel ways to solve new problems i.e. improvise [10]. Routines have to be constantly adapted to new contexts [5], especially when they fail [10].

Salovaara et al [18] studied digital high-reliability organisation, which had automated malware detection into an algorithm. When the algorithm could not handle a novel threat, human experts took over since they were capable of mindful actions. Routines in the shape of standard operating procedures or algorithms can restrain noticing novel problems, but on the other hand they may allow mindfulness in complex problem areas [18]. Although the task had multiple restrictions, the students had to know how to use a search engine. Firstly, they had to find suitable service providers for travel services and then use their search engines to find flights, hotels and other services. Mindlessly behaving students might just pick the least expensive alternatives from search results without doing comparisons between alternatives. Therefore we hypothesize:

H2: IT mindlessness has a negative effect on complex task performance.

Figure 1 depicts our proposed conceptual model and the hypotheses. The level of individual IT mindfulness was measured with thirteen variables adapted from Thatcher et al. [25] and IT mindlessness with five variables adapted from van Dam et al [2]. Please see appendix 1 for a full list of variables. The items were translated into Finnish and the wording was tested with three researchers and modified based on their recommendations. The variables were measured on a 7-point scale ranging from 1 (Totally agree) to 7 (Totally disagree) to apply the scales from original studies. The outcome in our model, "Performance", was measured through the total price of their booking proposal; a lower value indicated a better performance.

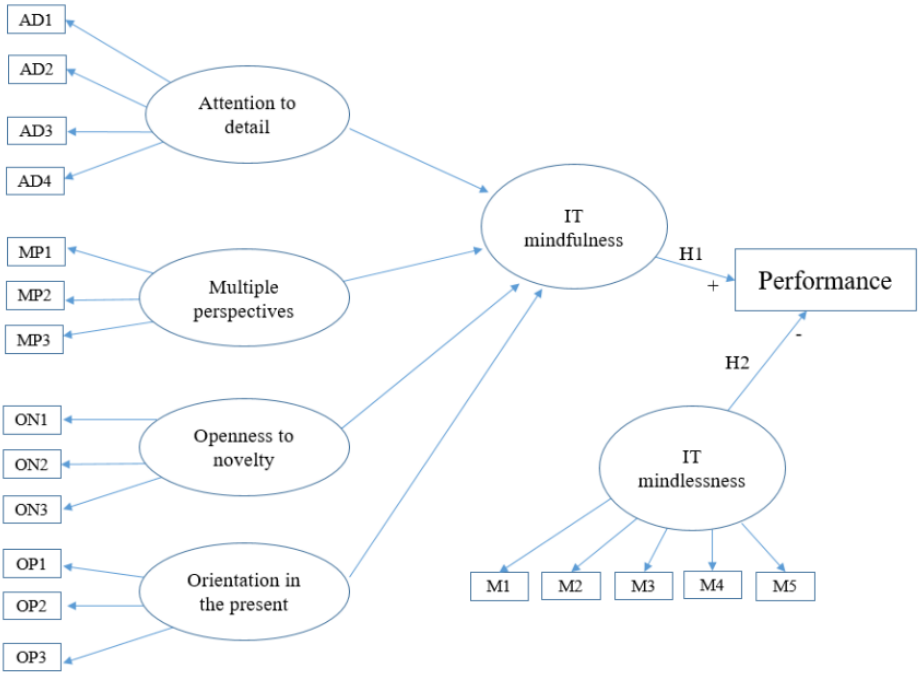

Figure 1. Conceptual model and hypotheses.

3. Methodology and sample

The students recruited to the study were participating on a bachelor level capstone course focusing on value chain management on March-April 2020. After the students had performed the complex task, they had to reflect on the value chains or networks of tourism business in a learning journal and they were asked to fill in the survey. The person finding the lowest price fulfilling all the requirements was given a 50€ gift card to a local restaurant. Of 96 students on the course 76 filled the survey (response rate 79%).

The task given to the students was to book a roundtrip from Turku, Finland to Kauai, Hawaii for two researchers participating in the HICSS-54 conference at the hotel Grand Hyatt Kauai. The goal was to find the lowest price for the roundtrip following some strict requirements. Many of the online travel service providers use dynamic pricing, which adds to the task complexity. We advised the students to use their creativity when planning the round trip, but also encouraged the use of common sense. The task requirements were the following: (i) no student or loyal customer discounts were allowed, (ii) specified dates and time for departure and arrival in Turku, (iii) no more than 8 intermediate landings during the round trip acceptable, (iv) none of the intermediate landings was to last longer than five hours with one exception: the researchers wanted to rest at a hotel for one night on both routes, (vi) all accommodation facilities were to be high class equaling the conference hotel, (vi) an offer of a one-day trip to the neighboring Island of Maui was to be included following a given date and a time specification and (vii) a rental car for the stay at Kauai was among the booking requirements. The students were advised that all bookings were to be made over the Internet, but no advice or recommendations were provided regarding the different players and the different travel booking sites available online.

Some characteristics of the respondents can be seen in Table 1 and Table 2, which outlines respondent answers to some of the attitude statements in the survey. Most (86%) of the respondents fall into the 20-24 years age bracket. A majority of the respondents (76%) described themselves as being experienced in international travel, and about half (54%) agreed that they are experienced in doing international travel bookings. Most of the sample do some online shopping, 71% (54) with a weekly or monthly frequency.

Table 1. Participant descriptives (n=76)

		Frequency	%
Gender	Female	42	55 %
	Male	34	45 %
Age	20-24	65	86 %
	25-30	8	11 %
	31-45	3	4 %
Experienced in international travel	Totally agree	27	36 %
	Somewhat agree	32	42 %
	Do not agree or disagree	4	5 %
	Somewhat disagree	12	16 %
	Totally disagree	1	1 %
Experienced in international travel bookings	Totally agree	17	22 %
	Somewhat agree	24	32 %
	Do not agree or disagree	11	14 %
	Somewhat disagree	15	20 %
	Totally disagree	9	12 %
Online shopping frequency	Weekly	10	13 %
	Monthly	44	58 %
	Every few months	19	25 %
	More rarely	3	4 %
Total price for two researchers €4195--€11517			

Table 2. Response on travel-related attitude statements (n=76, scale 1 = Totally agree to 5 = Totally disagree).

Doing the booking task was time consuming because of...	*Mean*	*SD*	*Min*	*Max*
Unclear instructions	2,8	1,071	1	5
Technical problems	4,04	0,958	1	5
Poor usability of service provider websites	3,49	1,125	1	5
To find a flight schedule within the given constraints	1,57	0,718	1	4
Complexity of travel booking sites	3,54	1,076	1	5
My limited knowledge of travel booking strategies	3,63	1,198	1	5
Complexity of international flights	2,38	1,07	1	5

4. Results

Reliability and validity analyses showed that all subscales for IT mindfulness and the scale for IT mindlessness had Cronbach alpha's above the conventional threshold of 0.7, except the Orientation in the present (OP) subscale which was dropped from subsequent analyses. Average variance explained (AVE) and composite reliability scores (CR) were calculated and found to surpass the cutoff limits of 0.50 for AVE and 0.7 for CR, except in the case of the dropped OP subscale [29]. For full results on discriminant and convergent validity see Appendices 2 and 3. In accordance with Thatcher et al [25] we dropped an item from the Multiple perspectives subscale to improve the consistency. Confirmatory factor analysis (CFA) revealed factor loadings above 0.75 on all remaining items in the IT mindfulness subscales and above 0.6 in the IT mindlessness scale [29]. To test our hypotheses, we employed Structural Equation Modelling with IBM SPSS Amos 25. Testing our original research model revealed that IT mindlessness did not influence the performance (i.e. Total price) and the explanatory value of the model was poor (R2= .08, see Table 4 for model fit). Hypothesis 2 was thus rejected. This led us to revise our model omitting the

non-significant path from IT mindlessness. A higher level of IT mindfulness is positively related to a better performance in the booking task (standardized coefficient = 0.32, p=0.01), confirming hypothesis 1. Moreover, we found that a perception of unclear instructions given for the task (standardized coefficient = 0.31, p = 0.009) and technical difficulties experienced while performing the task (standardized coefficient = -0.26, p = 0.002) negatively affected performance in the task. These were included in the revised model. The revised structural model can be seen in Figure 2 (Table 3 provides a correlation table of dimensions used in the revised structural model, for fit indices see Table 4). The fit statistics for our revised model show CFI above .95, chi square/df below 2, RMSEA below .08 and SRMR narrowly above .08, indicating fair fit.

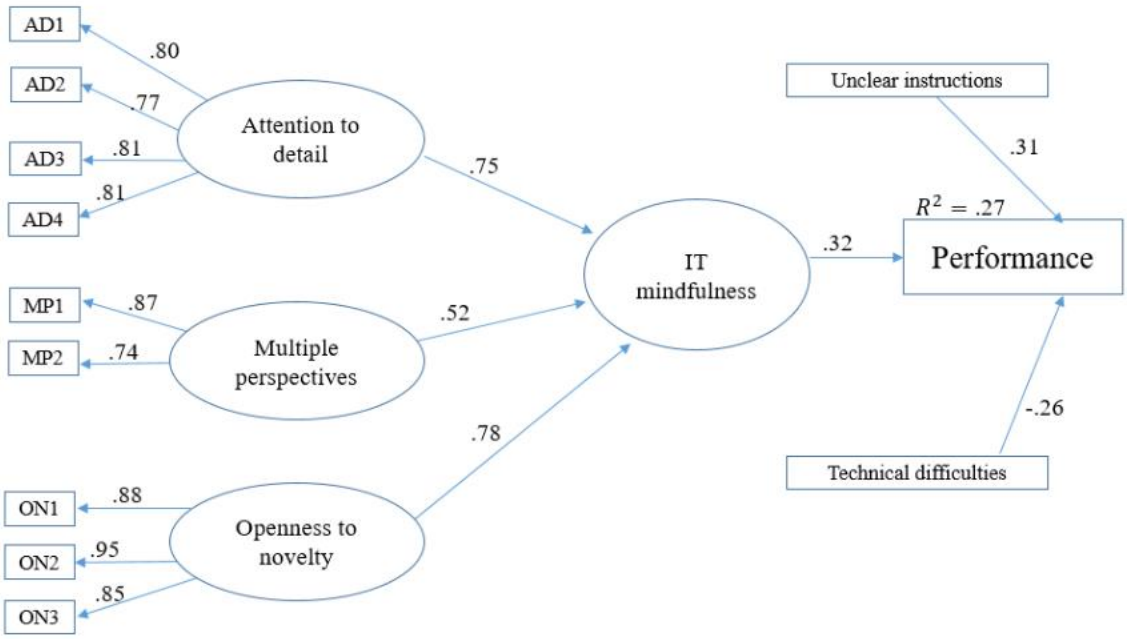

Figure 2. Revised structural model.

Table 3. Construct correlations.

	1	*2*	*3*	*4*	*5*	*6*
1. Unclear instructions	1					
2. Technical difficulties	0,229	1				
3. Openness to novelty	-0,076	0,05	1			
4. Performance (price)	0,223	-0,211	0,232	1		
5. Multiple perspectives	-0,129	-0,181	0,378	0,256	1	
6. Attention to detail	-0,15	-0,084	0,592	0,17	0,4	1

Table 4. Goodness of fit statistics.

Model	*Chi-square**	*Chi-square/df*	*CFI*	*RMSEA*	*SRMR*
Measurement model	60,703	1,029	0,997	0,02	0,0623
Original structural model	22,7	1,258	0,977	0,059	0,062
Revised structural model	11,724	1,303	0,956	0,064	0,0886

**Non-significant for all models (p>.05)*

5. Discussion

We set out to study how mindfulness or mindlessness affect student performance in a complex task? The task was to search for a travel booking option for two researchers travelling from Finland to HICSS-54 in Kauai, Hawaii. We gave participants several requirements that had to be met and the goal of finding the most inexpensive price, but no instructions for example on which tools or sites they should use. The booking task was therefore deemed as being a high-complexity task compared to for example to the PowerPoint/Prezi task described in [25].

Our initial hypotheses suggested that IT mindfulness would affect positively the performance in this task, namely the total price, and IT mindlessness would affect negatively. Our analysis of the data supported hypothesis 1. As supposed, mindfulness seems to affect task performance when the task is complex, which is rather natural. The students were experienced in travelling abroad and shopping online, but their experience in international travel bookings was varied. In this kind of a complex task, the participant had to find new ways to approach the problem and decide international flight routes, which were not usual for them. As Levinthal and Rerup [10] argued, they could use their existing routines from international travel and online shopping to new task, and therefore use mindfulness.

The other hypothesis focusing on the effect of mindlessness was not supported. We supposed that some students would perceive this task as irrelevant and would merely quickly find some kind of price to complete the task, but that was not the case. Only very few students confessed that they did not focus on the task but were in a hurry or were on "automatic pilot". Therefore it was not possible with the small sample size to split the data into mindful and mindless students and test the hypotheses separately for each group. We suspect that university students aim for good grades and good performance in their assignments and therefore they did not consider themselves behaving mindlessly even in an anonymous survey. This leaves room for further research to explore, what is IT mindlessness and how it can be captured. For instance, Kreps et al. [7] call for mindfulness of people to gain control of their digital behavior rather than mindlessly browsing through apps. Mind wandering might be connected to mindlessness somehow, and it has been considered an important activity allowing creativity [15].

We noticed that studies on IT mindfulness and mindlessness from an individual perspective are rather scarce. This seems odd, since many of us spend a majority of our working days with IT and sometimes it seems that IT is taking control of our lives, as Kreps et al. [7] point out. When are we mindful in digital environments and when mindless? According to our study, we are mindful when doing complex tasks. But many white-collar workers are constantly performing complex tasks as experts of their field, researchers etc. It is unlikely that we can be mindful constantly. When are we then mindless and when are we allowed to be mindless?

This study also has interesting implications to digital service usage. If a person can achieve better performance in a complex task with mindfulness, could the task complexity be somehow reduced? We believe that the focus when designing digital services should be on reducing task complexity rather than finding ways to support IT mindfulness; i.e. a service that does not require the user to be especially mindful is a user-friendly service, in line with [24]. In this case, most students used several service providers to finish the task, which probably increased the complexity. Then one-stop shopping or booking service provider could decrease the complexity. The design of digital services could also allow more customization of the search, which would facilitate finding alternatives, which fill all the restrictions.

Further, this kind of task with clear restrictions is perfect for smart personal assistants using artificial intelligence, at least in the future. We asked students not to use travel agents or any other external assistance, which was interpreted by students forbidding the use of Siri or other voice-controlled assistants. Experienced travel agents can do this task quickly, and although smart personal assistants nowadays help many with simple tasks, it is not unlikely that they will soon assist in complex tasks. Smart personal assistants might therefore decrease the need for mindfulness in some tasks and allow for creativity in other tasks.

In addition to hypothesis testing, we noticed some other variables affecting the performance. Many students felt that the lack of clarity in the assignment was time consuming, which is probably closely related to the goal-oriented nature of the task. This approach left much of the responsibility to students, they had to find suitable websites for their searches and according to the survey they used 1—20 different sites such as momondo.com; skyscanner.com, booking.com, Google Flights. The assignment instructions also encouraged the use of common sense, but some students used the course FAQ forum to ask very detailed questions such as if the travelers have to stay at a hotel on both trips, is it possible that they stay a day rather than a night. They also used 1.5—33 hours in total (most of them 5—15 hours) for this assignment, which indicates that they really struggled

with the task. We noticed that there was no significant correlation between total price and the time spent for the task.

Another time-consuming issue in the task was technical problems. Unfortunately, we did not get more information on this from the survey, but some students explained in their learning journals that for example some travel sites reset the given constraints after a certain time period, and then the constraints had to be re-entered. Another possible explanation might be that the assignment was performed just when the Covid-19 isolation started in Finland (in early April, 2020) and there might have been network problems when students worked from home.

The learning journals with students after their submissions revealed interesting issues. The most inexpensive student booking proposal was €4195 for two researchers, with 8 intermediate landings, resting in Maui and Gdansk and in shared rooms and filling all the requirements. The winner described her goal to find the cheapest booking, but "by no means the most comfortable". Some students had interesting strategies to find suitable flights, for example one started searching by checking from which city the flights to Kauai would be cheapest and proceeded from there. Others commented in the survey that if they would have booked this flight for themselves, they would have been even more thorough and some thought that they would have found even more inexpensive alternatives, since they would have settled for lower quality hotels.

6. Conclusions

Our theoretical contributions were twofold. First, this was to our knowledge the first IT mindfulness study with a complex task. There are some studies which use the IT mindfulness scale relating to for example technostress [13] and cyberloafing [12], but not to task performance. Our own study noticed that the orientation in present subscale items did not load on their own factor, when we performed confirmatory factor analysis and therefore we had to exclude it from the IT mindfulness variable in the revised structural model. One explanation for this might be, that our adaptation of the scale with using "travel booking sites" instead of "Excel" in [25] study, may have caused the problems. Another possibility is that students were not able to discuss how others used travel booking sites due to remote working environment during Covid-19 crisis or were not able to catch the big picture of the task or get involved since they were not doing the booking task for themselves. This requires further research of IT mindfulness in task performance.

The second contribution is the first attempt to create an IT mindlessness scale, by adapting van Dam et al.'s [2] scale to IT context. There were several other items in van Dam et al.'s study, but after careful consideration, only adapting the used items seemed suitable. However, with another kind of task or context, IT mindlessness items could be more varied. The hypothesis was not supported in our study, and we did not develop the scale as rigorously as Thatcher et al. [25], and therefore more research is required.

There were several limitations in our study. The survey was administered to students, in one country and the sample size was not really large. However, the task complexity dimension reveals interesting possibilities for further research with other audiences.

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Appendix 1

IT mindfulness items, adapted from [25]:

AD1: I find it easy to create new ways of using travel booking sites

AD2: I find it easy to create effective ways of using travel booking sites

AD3: I am very creative when using travel booking sites

AD4: I come up with many new ways of addressing the booking task when using travel booking sites

MP1: I am open to learning new ways of using travel booking sites

MP2: I have an open mind about new ways of using travel booking sites

MP3 (dropped): I use travel booking sites in many different ways to support doing this task

OP1: I like to investigate different ways of using travel booking sites

OP2: I am very curious about different ways of using travel booking sites

OP3: I like to figure out different ways of using travel booking sites

ON1: I like to investigate different ways of using travel booking sites

ON2: I am very curious about different ways of using travel booking sites

ON3: I like to figure out different ways of using travel booking sites

IT mindlessness items, adapted from [2]:

1: While using travel booking sites, I find it difficult to stay focused on what's happening in the present.

2: While using travel booking sites, it seems I am "running on automatic", without much awareness of what I'm doing.

3) While using travel booking sites, I rush through activities without being really attentive to them.

4) While using travel booking sites, I do tasks automatically, without being aware of what I'm doing.

5) While using travel booking sites, I find myself doing things without paying attention.

Appendix 2

Convergent validity:

Scale	Cronbach's alpha	AVE	CR
AD	.87	.610	.862
MP	.77	.745	.814
ON	.93	.723	.850
OP	.56	.525	.635
Mindless	.83	.604	.822

Appendix 3

Fornell-Larcker Criterion for discriminant validity:

	AD	MP	ON	OP	Mindl.
AD	**0,7810**				
MP	0,400	**0,8631**			
ON	0,592	0,378	**0,8503**		
OP	0,15	0,214	0,232	**0,7245**	
Mindl.	0,022	-0,60	-0,44	-0,208	**0,7771**

The square root of AVE values are shown diagonally in bold. The other items are latent variable correlations (LVC). According to the Fornell-Larcker Criterion, discriminant validity is met if the square root of AVE value is greater than the LVC value; this criterion is met.