Human evaluative conditioning: Is there a diminishing frequency in impulses to remove a distraction during a reading task when an obstacle is presented?

Kevine I. J. Minka

Id. 6515266

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Faculty of Humanities

University of Utrecht

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Abstract

In this study, it is the goal to evaluate the effects of human evaluative conditioning through a reading comprehension experiment. Using impulsive behaviours as 'inspiration', which are behaviours that tend to work with various triggers depending on the individual, a simplified experiment containing three reading comprehension trials was devised. Due to the Covid-19 pandemic resulting in the lack of participants suffering from impulsive disorders, 15 random acquaintances were chosen to participate. During trial one, participants had to read a text and then answer 10 questions about it. Trial two introduced clickable brown 'stains' as a nuisance to the reading screen, which appeared at a randomized time, in a randomized location and had a randomized size. Trial three did the same as trial two with the addition of popups following the removal of a 'stain'. The experiment examined whether adding an obstacle or extra step (popups) to an action (removing stains) would change the behaviour of people. The results were more related to attention than human evaluative conditioning, and inconclusive since multiple issues prevented the experiment from being performed in the proper conditions. 2/3 of the participants were not bothered by the 'stains', which is counterintuitive to what was expected, and thus produced no data on stain removal. However, results showed that the addition of stains led to more attentional shifts and less accurate answers to questions. Overall, their performance during the third trial was better, which could be due to the familiarity effect, i.e., they got used to stains. The other 1/3 of participants showed a stark difference in behaviour. They suffered from disorders like dyslexia, ADHD, impulsiveness, and autism. They were bothered by stains and actually clicked them away, which reinforces the correlation between concentration issues and people suffering disorders like ADHD, impulsiveness, dyslexia, and perhaps even autism. Reading with distractions is more difficult for people with attention related disorders. Further study in better conditions is needed to investigate whether impulses to remove a distraction can be reduced.

Introduction

Compulsive disorders have achieved a great level of familiarity among the masses over the past decades with an ever-rising amount of people becoming aware of behavioural issues that would have been dismissed as non-problematic or even normal in a different time. One example could be compulsive eating disorders, which is characterized by a constant craving for food and has been suggested to be a part of the common spectrum as OCD (Altman, 2009). Another example which many associate with obsessive compulsive disorder (OCD) is obsessive cleaning; a disorder that has been heavily popularised through TV shows. A lesser-known type of OCD is dermatillomania, also known as excoriation disorder. Simply put, it is an obsessive-compulsive mental disorder which causes those affected by it to impulsively pick at their own skin to the point of physical and even psychological damage during periods of anxiety and stress (Sachan, 2014).

So, how do you coerce patients into giving up their obsessive behaviour for the betterment of their health when they struggle with constant impulses? An experiment conducted by Ivan Pavlov on conditioning, published in 1903, gave a very relevant perspective in understanding how conditioning works and how one could proceed to manipulate behaviour in humans as well as other animals like dogs for example. Pavlov focussed on the latter species in his experiment, specifically dogs. To briefly recapitulate his work, Pavlov offered food to dogs which caused them to salivate. He then rang a bell which obtained no reaction. He then proceeded to ring the bell at the same time as the food was being offered. Over time, the dogs began to associate the bell with food causing them to salivate when the bell was rung, even though no food was being offered. Using his experiment, many arrived at a conclusion that humans, just like dogs, could very well be conditioned into adopting (or abandoning) a type of behaviour. Pavlov's experiment put a strong accent on the importance of evaluative conditioning methods and inspired research in the field to a certain degree.

OCD is a topic that interesses many onlookers. With people becoming more knowledgeable about the subject, more efforts are being put into research based on it as well as anxiety and its effects. After all, there is a bigger demand for psychological treatment now than ever given that there is a strong correlation between OCD and quality of life among patients (Eisen, 2006). The demand in psychological treatment resulted in many developments currently in place to help patients deal with their anxious behaviour and any disorder that falls under the OCD spectrum. This paper also uses OCD as inspiration to research and experiment using evaluative conditioning on a specific instance where OCD, or anything related to it, may play a role. Note that the purpose is not to research OCD given that there is little room for something of such a big scale at the moment. A strong emphasis is put on the word 'inspiration'.

Reading is an action which requires concentration and attention. Keeping that concentration strong and unchanged is a difficult thing to achieve when surrounded by distractions (Carlson, 1995). There are major distractions that can take the attention away immediately and effectively. Think of sounds like car horns, lawnmowers, children playing loudly; or even physical hindrances like a sudden pain in the body or a football hitting you in the face. There are also minor distractions like a wrongly folded page or a coffee stain. These minor distractions count as something that could distract a reader but do not have the same level of effect as major distractions. Minor distractions can be easily ignored. An individual might passively take notice but will continue on with the main task without actually being bothered by the distractor (Chisholm, 2014).

In a way, certain disorders on the OCD spectrum like dermatillomania work the same way. An individual finds itself in deep thought, sometimes stressful and anxious thoughts. The consciousness stays busy completing the task but to relieve some of the stress and/or anxiety (Malayala, 2021), they start skin picking impulsively and might not even be fully aware that they are picking their skin. Even after the individual becomes aware of the picking, they find it difficult to stop immediately because they wish to feel the relief skin picking brings, thus explaining why it is an impulse disorder (Fricke, 2015). Skin picking is incredibly harmful and may lead to fatal infections. The

question is whether there is a way to manipulate human behaviour so that individuals associate their harmful behaviour with negative connotations.

A lot of research has been done on the subject. For example, a paper written by Haynes, Kemps & Moffitt (2015) researched the moderating role of inhibition in the effect of evaluative conditioning on temptation and unhealthy snacking. In short, the study wished to use evaluative conditioning to modify the temptation to consume unhealthy snacks in participants. They hypothesised that by using a training task that would cause participants to associate unhealthy snacks with negativity, they could effectively reduce the need to consume such foods. Their research showed that evaluative conditioning indeed does work when it comes to reducing temptation and is especially useful in reducing temptation and consumption when participants had a low inhibition capacity. Whether it also applies to impulses is a different matter because temptation and impulse are not the same thing. Another study by Hofmann et al (2010) showed that evaluative conditioning works on humans and is more efficient when there is a high contingency awareness. Evaluative conditioning has a lot to do with attention because it is governed by specific attentional constraints in the working memory (Brunstrom 2002).

To study if evaluative conditioning truly work promotes the reduction of impulses, it is crucial to simulate impulses. The experiment conducted in this study is a simplification resulting in a reading comprehension task. Participants will have to do three reading trials. They will be given three texts digitally, all three being news articles with various topics. Attention was paid to the length, difficulty, and overall readability of the text. During the first trial, participants had to simply read the text. After the fact, they were handed a sheet of paper with 10 questions to answer about the text. These are basically reading comprehension tasks constructed to ensure that participants take things seriously, concentrate and really pay attention to what they are doing.

The second task will introduce a new variable to the reading task called ‘stains’. Stains are simply clickable brown square buttons that will appear at random on the screen while the individual is reading the text. These stains will variate in size and location to keep the dynamic and prevent familiarity since participants will not know where the next stain will appear. They also will not know when a stain will appear since that is a factor that was also left to randomization. These stains can become invisible when the cursor is moved on top of it to allow people to read the text behind it but the stains go back to being visible once the cursor is moved away. They will remain on the screen unless they are clicked away. The purpose of the stain is to create a (minor) distraction during the reading task and the expectation is that individual will eventually be annoyed by it till the point where they deem it necessary to remove them, although it is not framed as obligatory. Creating annoyance using bothersome stains as distractions is an attempt at simulating OCD-like impulses. The second task also acts as a sort of priming task so participants get used to clicking on stains.

The third reading task is for the most part the same as the second task. The only difference is that the third task introduces a new variable in the form of popups. The popups will put evaluative conditioning to the test. A popup appears every single time a participant clicks a ‘stain’ away. The purpose of the popups is to add an extra step to the whole ordeal. The goal is to waste time and figure out whether participants realise that they lost track of their main task, which is to read and comprehend the text. What is important to measure is whether participants stop clicking on stains or if at the very least, there is a diminishing return in the number of stains being clicked away in the third task. If so, it could show that associating the removal of stains with the waste of time lead people to stop trying to remove them, thus highlighting that evaluative conditioning can also work on impulses. If not, it could prove that the stains have no effect on the readability, concentration and attention given to the text since they turn invisible anyway, meaning that they are not even viewed as a hindrance. It is the hypothesis that the former will be the case. The hypothesis is that there will indeed be a diminishing return in the frequency of impulses to remove stains when popups are added with the purpose of wasting time.

Method

Participants

To generate a sufficient amount of data, 15 participants have been involved in the experiment. They varied gender-wise, occupation-wise and age-wise with a range of 17-65 years old. Not much attention was paid on the psychological status of participants; meaning that there was no discrimination between participants that may have had an attention deficit disorders, behavioural issues or others. From the 15 participants, 5 turned out to suffer from some kind of issue that may have affected their attention like dyslexia for example. Unfortunately, those 5 have been excluded from the general results due to the deviation they showed but produced results definitely warranting a discussion.

Materials

The trials were to be made both physically on paper as digitally on a desktop or laptop. The program Microsoft Visual Studio was used to develop the application necessary for displaying news articles in picture format (see *stimuli*). Another piece of material that seemed crucial was an USB-connected mouse because handling a touchpad may prove to be slower, thus less efficient.

Stimuli

The Windows Form within Visual Studio was programmed using the programming language C# to work as bellow step by step:

1. A 'homepage' welcomed participants and explained the general rules and guidelines regarding the experiment. A button, which remains constant throughout the trials at the bottom of the screen, allows participants to move to the next page/step.
2. Next, upon clicking the constant button, the trial 1 instruction screen explained the rules and guidelines regarding the first trial in details (see *Procedure*).
3. Third of all, the first trial truly begins. A news article in picture format is shown on the screen. A stopwatch runs within the program to record the time length and only stops when participant click on the lone button in the screen, thus allowing them to move to the next step.
4. Then, it moves on to the 'questions' page, where participants had to answer 10 questions about the news article on a distributed sheet of paper. Again, a stopwatch runs in the background on the program to record how long it takes them to complete the task meanwhile the stopwatch belonging to the reading-segment is stopped and the final time stamp is registered. The stopwatch belonging to the questions-segment stops and gets registered when participants finish answering questions by clicking the constant button.
5. Once finished, step 2 to 4 is repeated for trial 2 and 3. However, the difference in trial 2 is that stains, which were just brown clickable squares, appeared at random. They were programmed to appear at a random time interval between 0-10 seconds and at a random location on the screen, paying attention not to make it appear at the bottom of the screen to prevent the constant button from being inaccessible. The size of these stains was also randomized and its range will be between 25 to 100 pixels. These stains become invisible once the cursor is move over it but reappear when the cursor is moved away. They can be clicked away and the program will keep track of how many stains and which stains were clicked away, given that each appearing stain has an id-number starting from 0 going up. Note that a time stamp is made every single time a stain appears and is removed with the help of the stopwatch running within the program. Note also that stains only appear during the reading-segment of the trial, not the question-segment. The difference between trial 2 and 3, is that after clicking any stain away, a popup message appears informing the participant that the stain will be removed. The popup does not disappear on its own. The participant must click it away, which adds an extra step is added to the action of stain removal. Again, a time stamp is made each time a popup appears and is removed.

6. At the very end, a screen is displayed announcing the end of the experiment and thanking people for their participation.

There was a total of 3 news articles chosen randomly, while paying attention not to pick an article that was too long or difficult. All the time stamps and information regarding the number of stains and popups that appeared and were removed, will be registered and displayed in a Console application at the end of the experiment. The time stamps and their events are the data that would be crucial for examination. Pictures that illustrated what the program looked like can be found in the appendix.

Design

This is a within-subject experiment, meaning that a control group would not be necessary. The goal was to detect the change in performance in the same individual.

Environment

The experiment took place in April 2021 during the Coronavirus pandemic. Therefore, it was unsafe to practice within the confinement of a lab or any controlled environment. It was necessary for participants to be approached in the comfort of their homes, meaning that no strangers had been approached to volunteer. A minimum distance of 1.5 meter was implemented, the materials provided by the experiment's supervisor were disinfected before and after the experiment, masks were worn and participants as well as the supervisor had to wash their hands or apply disinfecting hand gel before touching anything.

Procedure

Participants were seated at a table in front of a laptop in a quite environment. They were given an USB-connected mouse, a sheet of paper containing questions and a pen.

They first had o read the rules and guidelines of the experiment and trials that were being displayed on the screen. The supervisor stayed close to answer any questions and explain anything that may have been too vaguely put. The rules and guidelines were as such:

a. Participants had to read a news article and answer 10 questions about the content afterwards.
b. To start the trial, they must click the 'Start' button at the bottom of the screen. A news article will be displayed.
c. Once they finish reading, they must click the 'Questions' button. When the questions page appears, they must pick up the sheet of paper and answer questions with a pen or pencil.
d. Once done with the questions, they must click the 'Next' button at the bottom of the screen, which will great them with the explanation page for the next trial.
e. The explanation page displays rules and guidelines regarding the next trial. They are allowed to ask questions or further explanation. They are also allowed to take a short break if necessary. All of that must be done before the start of the trial.
f. At the end of the experiment, they alerted the supervisor to help them close the program to prevent the console application displaying the data from accidentally being closed and lost.

Note that participants will be vaguely told about the stains. They will know that stains will appear at random during trial 2 and 3, that they can be made invisible by moving the cursor on top of it to be able to read the text behind it and that they can remove these stains by clicking on the spot the stain is, even when it seems invisible. They will also be informed of the popups during trial 3 and what to do with it. The goal of the stains and popups will not be discussed to prevent participants from becoming aware and tampering with results. They must think the experiment is simply a task of comprehensive reading.

Multiple measures will be kept track of: ratio of clicked stains relative to the total number of stains that appeared, ratio of good answers relative to 10, time difference between stain appearance and disappearance in seconds, time difference between popup appearance and disappearance in seconds, time difference between trials in seconds.

The independent variable in the experiment is time because its variation did not depend on other variables whilst the first dependent variable is the number of clicked stains and the second being the number of good answers.

Results

The purpose of the experiment was to investigate if when giving an individual a task to perform three times, there would be a diminishing return in the number of stains removed over time. The first task was performed in normal circumstances, the second was performed with the introduction of a removable hindrance and the third was performed with the hindrance while adding an extra loop to jump through. There was a total of 15 people that participated and only 10 were used to form results because the other 5 suffered from disorders that may have caused deviations, those deviations being that they seemed to be bothered by stains while none of the 10 participants without disorders showed the urge or impulse to remove stains. Such an observation was not expected or even acknowledged when developing the experiment. Some measures will no longer be reported and those are the dependent variable 'amount of clicked stains', the ratio of clicked stains and the time difference between stain/popup appearance and disappearance.

So, the experiment may have failed to yield the expected results as written in the hypothesis. However, it does not mean that there were no useful results to report. The information obtained is interesting in itself. The experiment had three trials in total and each trial contained two parts being the reading part and the question part.

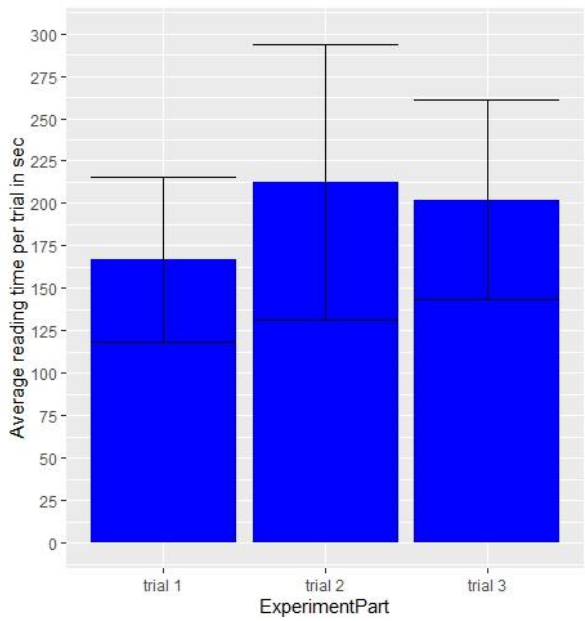

Figure 1: Average reading time per trial in seconds with its standard deviation. Trial 1 (M = 166.972, SD = 48.624, CI 95% = [136.835, 197.110]), trial 2 (M = 212.284, SD = 81.198, CI 95% = [161.958, 262.611]), trial 3 (M = 202.095, SD = 58.796, CI 95% = [165.653, 238.537]).

Figure 1 portrays the average reading time per trial in seconds with the standard deviation incorporated. Table 1 in the appendix, shows a summary of the reading part of the experiment.

A t-test is the most common testing method to compare two populations and determine whether the difference between values of both populations is significantly different. The t-test will thus be applied twice between trials 2-1 and trials 3-1. Trial one is the common denominator because it technically acts as a control condition. The performance trial one is the performance in normal circumstances. The hypothesis is written as such: $H0 = \mu1 = \mu2$; $H1 = \mu1 \neq \mu2$, i.e., the mean of population 1 is equal to that of population 2 or not equal. T-critical for an alpha of 5% with a df of 9, is 2.622 according to the t-table and will be used for all t-tests that follow.

To calculate the t-value:

1. Calculate the mean difference between both populations. For example, participant 1 had 146.76 sec in trial 1 and 188.903 in trial 2. Thus, the difference is 42.143. The same is done for all participants. The differences are summed up and divided by the population size N.
2. Calculate the standard deviation of these differences by subtracting each difference value with the mean difference, square the resulting value, make a sum of all squares, divide by the population number N, and calculate the square root.
3. Calculate the standard error which is just the standard deviation divided by the square root of N.
4. Finally, calculate the t-value by dividing the mean of difference with the standard error.

The t-values concerning the reading time: t(trial 2-1) = 4.2 with mean = 50.7, SD = 38.2, SE = 12.1 and t(trial 3-1) = 4.4 with mean = 35.2, SD = 25.1, SE = 7.9. In both cases, H0 ought to be rejected because $t > 2.622$ meaning that $p < 0.05$. In conclusion, there is a

significant difference in time between trials 2-1 and 3-1. Note that the numeric values written above are all rounded to 1 decimal, and so are those of the t-tests following bellow.

A t-test compares the raw data from 2 populations, but it may also be handy to compare variance between these populations with a F-test. Therefore, an F-test will be performed between the trials 2-1 and the trials 3-1. The critical value, in this case with a numerator and denominator DF (degrees of freedom) set to 9 and an alpha of 5% in a two-tailed distribution, is 4.026. The F-value (trial 2-1) is $81.198^2 / 48.624^2 = 2.789$ and the F-value (trial 3-1) is $58.796^2 / 48.624^2 = 1.462$. So, F-value (trial 2-1) < F-critical and the same applies for F-value (trial 3-1). The conclusion is that in both scenarios, the variances in time are not significantly different.

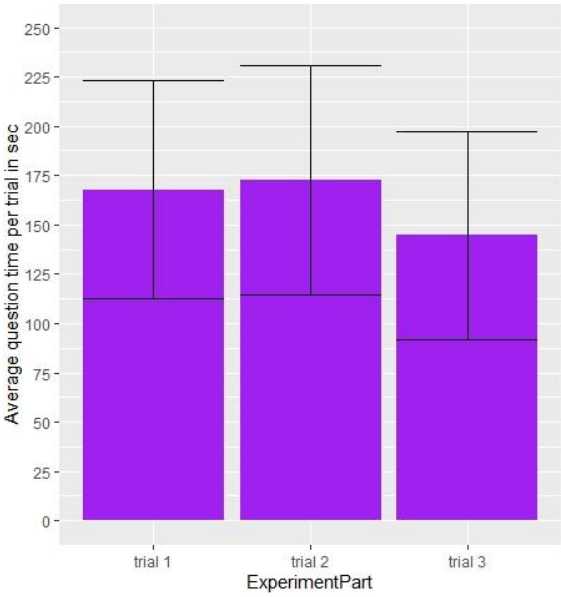

Figure 2: Average question time per trial in seconds with its standard deviation. Trial 1 (M = 167.784, SD = 55.279, CI 95% = [133.521, 202.046]), trial 2 (M = 172.628, SD = 57.985, CI 95% = [136.689, 208.568]), trial 3 (M = 144.552, SD = 52.644, CI 95% = [111.923, 177.181]).

The t-values concerning differences in question times: t(trial 2-1) = 3.9 with mean = 29.7, SD = 24.0, SE = 7.6 and t(trial 3-1) = 3.5 with mean = 28.6, SD = 25.7, SE = 8.1. Again, H0 ought to be rejected because there is a significant difference in both cases and because t > t-critical (2.622) thus $p < 0.05$.

Again, we will apply a F-test to determine the difference in variances. F-critical is still 4.026. The f-value (trial 2-1) = $57.985^2 / 55.279^2 = 1.100$ while f-value (trial 3-1) = $52.644^2 / 55.279^2 = 0.907$. In both cases, f-value remains smaller than f-critical meaning that the variances in time are not significantly different.

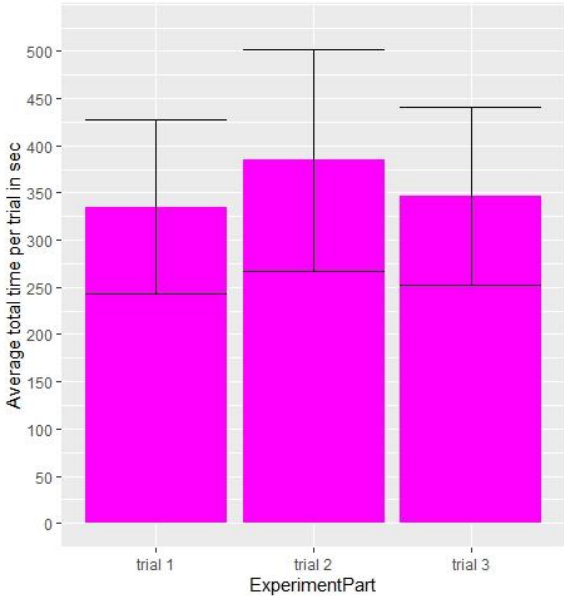

Figure 3: Average total time (reading + question) per trial in seconds with its standard deviation. Trial 1 (M = 334.8, SD = 92.3, CI 95% = [277.6, 392.0]), trial 2 (M = 384.9, SD = 117.5, CI 95% = [312.1, 457.8]), trial 3 (M = 346.7, SD = 94.7, CI 95% = [288.1, 405.4]).

The t-values concerning the differences in total time: t(trial 2-1) = 4.9 with mean = 64.7, SD = 41.7, SE = 13.2 and t(trial 3-1) = 5.6 with mean =35.2, SD = 20.0, SE = 6.3. Once again, H0 ought to be rejected because t > t-critical (2.622) and $p < 0.05$. There is indeed a significant difference between trial 2 and 1, as well as trial 3 and trial 1.

Once more, the f-value (trial 2-1) = $117.519^2 / 92.302^2 = 1.621$ and f-value (trial 3-1) = 1.052. Knowing that f-critical is still 4.026, we conclude that neither f-values are significantly different. So far, all t-tests showed a significant difference between the data of populations meanwhile the f-tests showed no significant difference in variances from populations.

As you may have noticed in figure 1, 2 and 3, participants seem to take on average a little more time to complete the second trial. The

theory is that it could be due to the introduction of the stains. Participants may have been taken aback by it at first, thus successfully getting distracted to a small extent. Note that stains appeared at any given moment, at any point on the screen and were all of different randomly generated sizes. The difference in time is in part also due to the fact that participants had to take the time to drag the cursor over whichever stain may have caused a disturbance while they were reading since stains completely hid the text behind it but became invisible when the cursor was move on top of it.

What is interesting is that the time difference between trial 2 and 3. On average, the time needed in trial 3 is lower than trial 2 which could be due to the learning effect. It is possible that participants got used to the idea of reading the text with stains in their way called the learning effect. The learning effect may have caused a quicker reaction and less distraction. If the situation had been as expected, i.e., participants clicked on stains, it could possibly mean that there would have definitely been a significant change between trial 2 and 3. But such a conclusion remains hypothetical so it is not safe to discuss what kind of changes may have occurred.

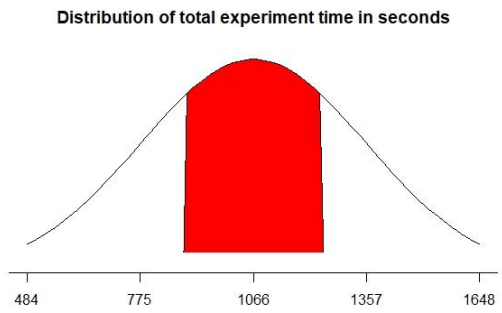

Figure 4: Normal distribution of the total time in seconds for the entire experiment. The minimum recorded time is 611.957 against a maximum of 1507.12. It was recorded that M = 1066.4, SD = 291.0, SE = 92.0 and the confidence interval with alpha 5% is between [886.0, 1246.8]. A normal distribution is used to best represent this. The red area represents the 95 % confidence interval, which is the area in which is mathematically assumed that the total time of the trial will most likely occur.

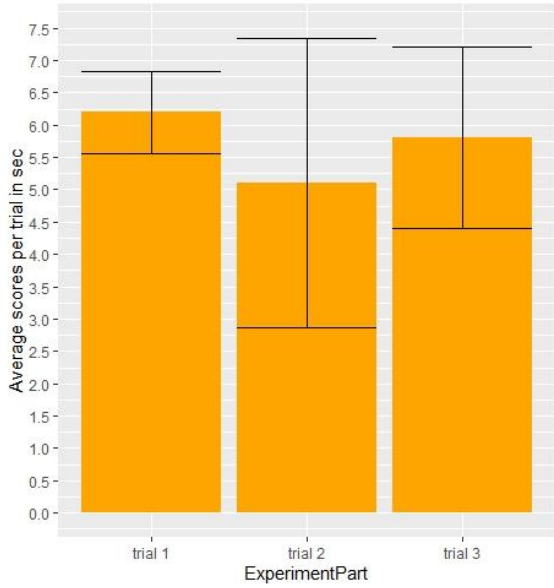

Figure 5: Average score per trial. Trial 1 (M = 6.2, SD = 0.6), trial 2 (M = 5.1, SD = 2.2), trial 3 (M = 5.8, SD = 1.4).

The t-values concerning the scores are: t(trial 2-1) = 3.6 with mean = 2.1, SD = 1.9, SE = 0.6 and t(trial 3-1) = 5.3 with mean = 1.4, SD = 0.8, SE = 0.3. Once again, we must reject H0 because t > t-critical (2.622) and $p < 0.05$, meaning that there is a significant difference in scores between trials 2-1 and trials 3-1.

Participants were given a total of 30 questions, 10 per trial, to answer regarding the text they read. On average, they scored a 6.2 during the first trial, a 5.1 during the second trial and a 6.1 during the third trial. The difference in both values shows once again that the second trial was slightly less easy to achieve than the first and third trial. However, it does not necessarily show a correlation between the amount of time spent on a trial and the score obtained, even though it may seem obvious in this situation, and that is because the difficulty of the text may have also played a role. We already assumed earlier that the participants spent more time during the second trial because they were still trying to get used to the stains appearing at random on screen leading to more attentional shifts, which in turn, led to a disturbance during the absorbance and retention of information, resulting in a lower score.

What concerns the results of the other 5 participants that were excluded from the general results, their results were fairly interesting on their own. These will be

discussed in the general discussion since they are unfortunately not of great importance to this particular study.

General discussion

Problems with the experiment

The main question of the study was whether a diminishing frequency of impulses could be observed? The results are too inconclusive to answer that question since what was expected to be observed did not take place. But we can at least conclude that introducing a hindrance to a task definitely brings some changes in the behaviour or capacities of participants resulting in attentional shifts and thus more time to complete the task. However, the many F-tests conducted showed that the difference in time, although it may have highlighted something important, was not that significant. There are plenty of reasons why the experiment did not provide the data necessary, and it is important to discuss that in greater detail for better understanding.

The very first reason and biggest factor is the Covid-19 pandemic which started in the year 2020 and continued well into the making of the experiment. Due to the pandemic, academic facilities had to abide to multiple restrictions as one should in a pandemic to prevent the spread of the Covid-19 virus, which turned out to be mostly fatal to the elderly. No risks were to be taken. One of the consequences was the lockdown of many facilities, putting a stop to almost all pending research requiring human participants. Students of the humanities faculty, as well as other faculties, who wanted to write their final paper based on experimentation, needed to make strict adjustments to their method so as to not go against restrictions. Supervisors strictly advised students to conduct this in the safest manner they could while abiding to the 6 feet distance rule, washing and sanitizing their hands before touching also sanitized equipment, and wearing a mask at all times. The pandemic is the reason for the low number of participants in this study.

On top of the low number of participants, one third had to be excluded from the study's main results because they showed deviations in data compared to the others. They had attentional deficit disorders or other disorders that may have made it difficult for them to complete the task properly like impulsiveness or impatience, ADHD, dyslexia, slow processing speed deficit and autism. Ironically, this subgroup of people were also the ones that ended up clicking on stains while the participants without deficit did not. They still had to be excluded because since no participants without disorders clicked on stains, there was a possibility that their behaviour was linked to the disorder. The interesting results of this subgroup will be highlighted further down and in table 4 of the appendix.

Further, there were more issues with the participants, one of them being the level of English they were able to speak or read. The participants ability to properly practice English may have caused a deviation in data because those people who knew English better could read faster, retain information about the text better and answer questions about the text more accurately than others. Note that none of the participants had poor English skills. However, some of them were simply drastically better than others thus contributing to a standard deviation for the reading time and question time as high as observed in figure 1 and 2 in the *results* section. The level of English had nothing to do with the lack of stain removal but it did affect the experiment.

Another factor that affected the experiment is the age range. Age is an important factor because younger people may perform differently than older people. There was very little room to find participants thus there was a significant diversity. The age range was between 17 to 65. Only 5 of the 15 qualified as young people. From the remaining 10, the majority was middle aged while only two were qualified as genuinely old. One of the two suffered multiple attention deficit issues that had already developed during their youth while the other was skilled enough to complete the task with one of the fastest time records. Age may not have been a factor in fast or slow reading time, but age as a factor should not be underestimated. It is a common belief that younger people and middle-aged people perform better than older people. So, such a large age range could be deemed unreliable.

There were also plenty of issues with the experiment itself. In this research, not that much attention was paid to what kind of text

was used. The point was to have participants be busy with a task while being bothered by stains. But the type of text or the subject of the text may have played a larger role than expected in the data obtained. Some of the participants reported being more interested in the last article from trial 3 because it was actual and had to do with the development of the pandemic. The subject of the text was the decisions being made to facilitate tourism in the Asian city Phuket in Thailand. So, the third text was considered informative, which may partly explain the relatively higher score compared to trial 2, which had the lowest average score.

People also admitted that the text from trial 2 was more difficult because it contained too many difficult words. The text was about China imposing travel restrictions on certain US and Canadian officials in response to the Biden administration imposing restrictions on China first about the Uighur-Muslim situation. The text contained some Chinese names of people and cities. These words were difficult to remember and may have reduced the general quality of the text. It was already said that participants took longer during the second text because they were trying to adjust to the stains. But it is probable that the difficulty of the text played a role. So, the results concerning trial 2 lead to an ambiguous conclusion. The first text was a fairly simple one and no one reported having any issues with it.

Another problem were the stains themselves. They were a brown opaque colour and not truly living up to their name. When thinking of stains, one tends to think of coffee stains in a book. Coffee stains are somewhat a tinted transparent colour that still allows the reader to read what is written, but on a lightly coloured background. Coffee stains were the inspiration behind the stains in the experiment. If stains in a book were removable without damaging the paper, will people find them bothersome enough and remove it? Unfortunately, the stains looked nothing like those. Making them an opaque brown colour made them unrealistic. Also, allowing these stains to disappear to complete invisibility was not realistic either, which may have allowed participants to not be as bothered as much as they should have been.

A mistake, or rather a misinterpretation, was made in the experiment. It was expected that trial 2, on top of introducing the stains, was also going to act as a primer. It would have been best to add another part to the experiment to prime the participants, possibly before any of the reading comprehension trials. Picture a simple button clicking game: how many buttons can one click away during a short period of time? It could have also been divided in three trials to give participants the idea that they could improve their speed each time. A clicking game could have been a successful way to get participants used to clicking stains away when bothered. It was not done and it was incorrect to assume the second trial would be a successful primer.

Improving the experiment

The many problems with the experiment are all reparable. To ensure consistent and usable results, the number of participants will have to be larger. The more participants, the stronger the study will be. There needs to be a separation based on age. It is already commonly known that older people struggle more with reading possibly due to cognitive decline or the worsening of eyesight, thus making a younger group of participants more favourable. It is doubtful that gender would make a difference, but the level of English definitely does. Participants would not need to have a B1 level at the very least and a good understanding of the English language. The chosen texts must match this level to avoid people with a lower English capacity from struggling. Difficult words as well as foreign words that are hard to pronounce must be avoided.

It was also noted earlier that there needs to be a distinction between people with disorders affecting attention and people without. One of the two groups should be the subject depending on the topic and interest of researchers. Studying both within the same experiment as a mixed group will lead to mixed results, wrong conclusions and assumptions. It is best to either study one group separately or use the group without disorders as a control group. One last point is that participants had to be familiar with technology, assuming that an experiment like this would be conducted digitally. There is no way of replicating it non-digitally anyway.

The experiments were conducted in an environment with very little control. There were external distractions which may have affected results. It is believed that the external distractions did not significantly affect the results since people remained focussed on the task. But for future references, it is best to isolate participants if possible. The way the experiment was created required a supervisor to be physically present for guidance. They also had to be present to launch the program from their own device. It is possible to make the experiment available to everybody online from a remote location although it may warrant a lot more programming work. But the upside is that a supervisor won't be needed and won't be required to bring their own laptop. Using the participant's own materials also means a bigger sense of security and safety due to the prevention of the spread of any disease.

Another vital point of improvement are the stains. Programming them proved to be challenging but something that could be changed to their display is the opacity, shape. Stains are not usually square, leading to an unrealistic lay out. By making them less opaque in colour, one can achieve a tinted local background on the text rather than full coverage. As explained above, removing the invisibility option for when the cursor is on top of the stain may push participants to react a different way than they did in the experiment, meaning that they may actually try to remove stains. However, as it has been observed that they were not bothered even when a part of the text was fully covered, this effect can only be achieved by extensively priming them, which is the next point of improvement.

By priming people, you can change their behaviour. Association strength and feature overlap play a big role. Priming helps to condition people into unconsciously associating stains as a nuisance, which they tend to be in reality. Priming can happen in the form of a game. Picture a simple game where the instructions are to click as many brown tinted squares away in a certain number of seconds on a computer screen. The squares will show back-to-back, meaning that when a square is clicked away, the other will appear immediately after. Also, the location of the squares as well as their size should be generated at random. A time will run in the background and stop the game when time has run out. Assuming that one game trial will not be enough, it is possible to make multiple trials, each with a different level of difficulty. For example, level 1 could be 60 squares per minute while level 2 could be 80 squares and so on. While this type of game falls under the concept of Fitts's law, which is a predictive model used in human-computer interactions, using it for priming is a good idea.

Participants with disorders

It is in this section that we will discuss other findings from the experiment. As it has already been noted above, there were 15 participants from which 5 suffered an attention related deficit of some kind. These deficits were:

- Participant 4: Impulsiveness, impatience
- Participant 7: Dyslexia, ADHD
- Participant 9: Impulsiveness, impatience
- Participant 13: Processing speed deficit
- Participant 15: Autism

For a summary on these participants, please consult table 4 in the appendix. Basically, the average time spent on the trial for the participants with disorders was 1499,24 seconds, which falls outside the 95% confidence interval of [886.0, 1246.8] calculated in the *results* section (see figure 4). Beside the fact that the group seemed to show a stark deviation in behaviour during the experiment, i.e., clicking on stains, they also spent a lot more time relative to the subgroup without disorders. The time difference was another reason for their exclusion from the general results.

Participants 4 and 9 showed signs of impulsiveness which, upon further questioning, was revealed to be related to their tendency of being impatient. In both cases, there was no proof of this disorder being severe and needing treatment. Participant 7 commented on being extremely uncomfortable during the experiment due to difficulties related to their disorders. They reported not being able to read properly and that being made far worse by the stains. They reported that they wanted to quit the experiment mid-session because of how bothersome it turned out to be. They still

managed to complete the tests with a total time that fell within the 95% confidence interval as presented in figure 4 of the section *results*.

Participant 13 was another special case. Processing speed deficit entails that the individual suffering from it has difficulties reading a text and immediately understanding what is being said. They usually need to read the text twice or/and read sentences multiple times for the information to really enter their working memory. It is important to note that the participant did not suffer from this deficit when completing other tasks; for example, when watching a video, they do not need to replay it to process it better. Participant 13's deficit says nothing about this person's intelligence because, as it turns out, they had the highest total score of al 15 participants. However, they also had the highest total time recorded lying in the 2421.2 seconds while the majority stayed between 900 and 1300 seconds rounded as perceived in the normal distribution (figure 4).

Participant 15 suffered from autism. It was observed that they had the most issues with stains compared to others. They constantly clicked stains and popups away. Given that autism and ADHD may be related according to many studies like Mayes et al (2012) and Ronald et al (2014). They found symptoms of ADHD in children with autism but there cannot be spoken of complete comorbidity. Participant 15 was heavily bothered by these stains and kept removing them even when they realised that it will just keep coming back, thus showing no signs of a diminishing return. They also had the second highest total time recorded being well in the 1739.546 seconds. Their total score was not too special with a 6 out of 10 in all three trials.

All these participants have clicked stains away while the other 10 did not. It is possible that there is a strong link between attentional deficits and the desire to remove an obstacle. Stains were added to cause attentional shifts and frustration. A dyslexic individual already struggles enough with letters as it is. An ADHD affected individual may already has trouble focussing on the task. The one that makes the least sense is processing speed deficit. If the problem is the retention of information, then why was this individual (mildly) affected by stains? Research by Shanahan et al (2006) showed that processing speed deficit is a shared cognitive risk factor that may help explain the comorbidity od reading disability and ADHD, meaning that there is somehow a relation between processing speed deficit and attention. However further research is required to fully understand the concept. It is also important to note that participant 13 only clicked on 2 stains and they were near the end of the third text. So, in general, we cannot really say that they were bothered.

Autism, impulsiveness, and impatience also make sense to a certain extent. But again, not much can be said about it without further research. Participant 4 seemed to truly be bothered while participant 9 only clicked on 8 stains in total (*see table 4 in the appendix*). The state of the individual is important and although we may make an assumption, a conclusion cannot be made. The degree with which stains may truly bother a person with autism is also relative to that person. It is not guaranteed that all people with autism will show this same level of disturbance. Given that only one autistic individual was tested, a firm conclusion cannot be made. The subject is fairly interesting and deserves a study of its own.

What concerns the main group of focus of the experiment, i.e., people without disorders, they process information differently. They are capable of filtering out useful information and do not lose too much time on other stimuli. They do not get frustrated easily or at least they did not get frustrated easily by the stains in the experiment. They failed to actually consider it as an obstacle needing to be removed but did see it as a minor distraction, which explains the generally heightened total time during trial 2. However, the stains did not distract them enough to cause frustration. Actually, they adapted fairly quickly to their presence on the screen, no matter the fact that they kept appearing and adding up to the screen, meaning that they started expecting these distractors and managed to lower their effect. The adaptation is also somewhat confirmed by the general total time for trial 3, which ended up being lower than trial 2.

Coming back to the main subject of this study, which was originally compulsive behaviour, how can this study beneficiate this larger topic in any way? It is important to research compulsive behaviour, the many disorders that exist within this spectrum, the many ways it manifest and the methods of condition that can be applied to help patients deal with their issues. In this study, the goal was to show that adding an obstacle in the way of an impulsive action can even minorly reduce the impulse to perform that action by conditioning people into seeing it as bad. This study used a simple approach with an experiment easy to set up and understand within the means that were given to try and shed some light into the topic. Although it failed to provide any result that answered the main question, it did show that people with attentional issues and disorders have a higher chance of impulsively removing distractions if that were to be a possibility.

The experiment has highlighted the difference between people with and without attentional deficits of any kind. People without these disorders have a high capacity of filtering information and thus locking out anything not related to the task they need to accomplish meanwhile people with disorders wish to do the same but are more likely to be get distracted. It has been shown that given the opportunity, people with disorders would rather try to remove those distractions, if possible, instead of just dealing with it.

It shows the importance of controlled environments like soundproof offices, isolated learning cubicles or, probably more accurate given the setting of the experiment, informational websites without commercial sections on the screen like: ads, popups ads, dynamic ads, video ads. Given that people's data keeps getting collected for the purpose of having companies target potential consumers, it will be difficult to get rid of this type of advertisement. People with attentional disorders are more likely to have more attentional shifts, get distracted, show interest in products they were not looking for, and possibly buying them. So, economically speaking, it may be a good thing, but cognitively speaking, it is highly disadvantageous.

The narrative that people with attentional disorders have more trouble processing information when dealing with distractions, can help the development of artificial intelligence. It could lead to the development of better interfaces designed specifically for people with attentional disorders. Such an alternative is already seen in smartphones developed specifically for the elderly who handle technology with difficulty. These smartphones contain programs and interfaces that are less confusing and easier to navigate. The same idea can be applied to people with attentional disorders. One example is the brain-computer interface which seems to be effective in treating children with ADHD by using a gaming approach (Rohani, 2014). There are also other initiatives such as guidelines on how to build a dyslexic-friendly website. It is necessary to keep the wellbeing of individuals with attentional disorders in mind when developing and improving AI.

Conclusion

This study ended up being a lot more about attention than human evaluative conditioning, which is completely normal since it is not that uncommon in the scientific community for a study to change direction or show different results than anticipated. Therefore, it will not be wise to rule it out. What can be learned from the experiment is that people with disorders that tend to affect their attentional functions, process information differently than people without. They are even aware of their shortcomings and would prefer to remove obstacles and distractions to achieve a task more efficiently. Some may do it almost impulsively, as observed on the participant with autism, while others do it out of frustration, as observed on the participants with impatience, impulsiveness, and ADHD.

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Appendix

Table 1: General information regarding the reading time in seconds per trial							
	Min	**Max**	**Mean**	**SD**	**SE**	**Lower bound**	**Upper bound**
Trial 1	114.041	277.432	166.972	48.624	15.376	136.835	197.110
Trial 2	138.359	385.279	212.284	81.198	25.677	161.958	262.611
Trial 3	130.033	306.782	202.095	58.796	18.593	165.653	238.537

Table 2: General information regarding the question time in seconds per trial							
	Min	**Max**	**Mean**	**SD**	**SE**	**Lower bound**	**Upper bound**
Trial 1	60.235	253.649	167.784	55.279	17.481	133.521	202.046
Trial 2	75.844	257.177	172.628	57.985	18.336	136.689	208.568
Trial 3	77.045	263.679	144.552	52.644	16.647	111.923	177.181

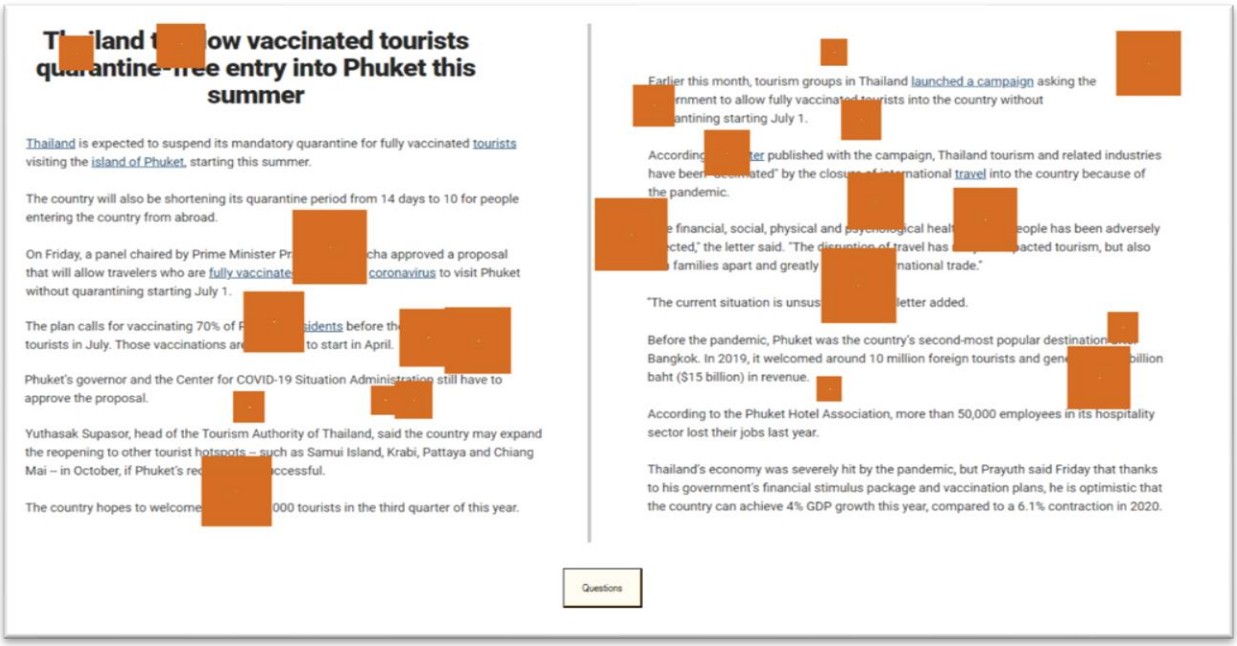
Table 3: General information regarding the total time in seconds per trial							
	Min	**Max**	**Mean**	**SD**	**SE**	**Lower bound**	**Upper bound**
Trial 1	190.675	491.215	334.756	92.302	29.188	277.547	391.966
Trial 2	214.204	563.509	384.913	117.519	37.163	312.074	457.753
Trial 3	207.078	497.896	346.748	94.683	29.941	288.062	405.433

Table 4: General results of the 5 excluded participants suffering from disorders						
Participant	Time	Stain appearance	Stain removal	Popup removal	Total score	Disorder name
4	922.294	92	59	11	14	Impulsiveness/ impatience
7	1297.874	108	42	21	13	Dyslexia/ ADHD
9	1115.283	82	8	0	16	Impulsiveness/ impatience
13	2421.200	139	2	0	22	Processing speed deficit
15	1739.546	181	163	89	16	Autism

News articles links:

- Trial 1: Ewing J. (March 2021), Accused German editor is reinstated but with a co-editor, NYTimes. https://www.nytimes.com/2021/03/25/business/springer-reinstates-bild-editor.html
- Trial 2: El-Bawab N. (March 2021), China sanctions U.S. religious freedom officials, Canadian member of parliament, CNBC. https://www.cnbc.com/2021/03/27/china-sanctions-officials-with-us-religious-freedom-commission-canadian-member-of-parliament.html
- Trial 3: Schmidt A. W. (March 2021), Thailand to allow vaccinated tourists quarantine-free entry into Phuket this summer, Fox News. https://www.foxnews.com/travel/vaccinated-tourists-skip-quarantine-phuket

Figure 1: Illustration of the experiment, in particular, trial 3 at around 110 seconds with all the appeared stains visible.



Thailand to allow vaccinated tourists quarantine-free entry into Phuket this summer

Thailand is expected to suspend its mandatory quarantine for fully vaccinated tourists visiting the island of Phuket, starting this summer.

The country will also be shortening its quarantine period from 14 days to 10 for people entering the country from abroad.

On Friday, a panel chaired by Prime Minister Prayuth Chan-ocha approved a proposal that will allow travelers who are fully vaccinated against the coronavirus to visit Phuket without quarantining starting July 1.

The plan calls for vaccinating 70% of Phuket residents before the tourists in July. Those vaccinations are expected to start in April.

Phuket's governor and the Center for COVID-19 Situation Administration still have to approve the proposal.

Yuthasak Supasor, head of the Tourism Authority of Thailand, said the country may expand the reopening to other tourist hotspots – such as Samui Island, Krabi, Pattaya and Chiang Mai – in October, if Phuket's reopening is successful.

The country hopes to welcome 1,000,000 tourists in the third quarter of this year.

Earlier this month, tourism groups in Thailand launched a campaign asking the government to allow fully vaccinated tourists into the country without quarantining starting July 1.

According to a letter published with the campaign, Thailand tourism and related industries have been "decimated" by the closure of international travel into the country because of the pandemic.

"The financial, social, physical and psychological health of people has been adversely affected," the letter said. "The disruption of travel has impacted tourism, but also tore families apart and greatly hurt international trade."

"The current situation is unsustainable," the letter added.

Before the pandemic, Phuket was the country's second-most popular destination after Bangkok. In 2019, it welcomed around 10 million foreign tourists and generated 500 billion baht ($15 billion) in revenue.

According to the Phuket Hotel Association, more than 50,000 employees in its hospitality sector lost their jobs last year.

Thailand's economy was severely hit by the pandemic, but Prayuth said Friday that thanks to his government's financial stimulus package and vaccination plans, he is optimistic that the country can achieve 4% GDP growth this year, compared to a 6.1% contraction in 2020.

Questions