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Mindfulness and Decision Making – Does mindfulness impact individuals' overconfidence?

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Abstract

This paper investigates the relationship between state and trait mindfulness and the three types of overconfidence – overestimation, overplacement and overprecision. As overconfidence is a common issue for many decision makers, finding an effective antidote to counter this human bias could help policy makers, managers and individuals alike in making better decisions. In an online survey, participants were randomly assigned to the treatment with a 6-minute meditation video or control group where they did a mind-wandering exercise. Results show that there were no differences in confidence between the two treatments, and that this is partially due to the insufficient effect of the treatment as a 6-min meditation may be too short to be effective. Further, there is no correlation between neither state nor trait mindfulness and any of the overconfidence types. Women on average are significantly more overprecise than men. This paper, even though without significant results for the main associations studied, serves as a starting point for further analyses into this relevant topic.

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Introduction

General

Throughout the past decades, societies especially in western cultures have experienced an immensely increasing interest in mindfulness, meditation and the resulting effects of both. According to Baminiwatta and Solangaarachchi (2021) there are a total of 16,581 publications with the term "mindfulness" in the title, abstract or keywords that were published between 1966 and 2021. About two thirds of these publications (11,164) were issued between 2016 and 2021. This trend shows the heightened curiosity of not only private people but also researchers all over the world.

This research focuses on one rather neglected effect of mindfulness, namely its effect on individual's overconfidence. Particularly, the research question is:

Does mindfulness influence people's overconfidence in their abilities?

While the effects of mindfulness and mindfulness-based interventions (MBIs) as well as the topic of overconfidence have both been studied to a great extent, these two research areas have not been combined in an experimental study yet.

Overconfidence

Overconfidence, is defined as the tendency "[…] to express confidence in their judgments that exceeds the accuracy of those judgments." (Klayman et al., 1999). According to Moore and Healy (2008), there are three different types of overconfidence that need to be distinguished from each other. Particularly, overestimation refers to a general excessive judgment of one's skills or achievements. The second variety of overconfidence is referred to as overplacement, meaning that people tend to think that they are better than others at a given task or skill. Lastly, overprecision means to be too confident about the precision of one's answers. Researchers have directly or indirectly looked into all different types of overconfidence in a variety of areas as in perceptual judgments (Baranski & Petrusic, 1995), prediction of sports outcomes (Andersson et al., 2005) or in relation to pathological gambling (Goodie, 2005). Furthermore, Malmendier and Tate (2005) investigated overconfidence in CEOs in the context of corporate investment and Libby and Rennekamp (2012) found managers' overconfidence for earnings forecasts. More studies involve one by McGraw et al. (2004) who show that overconfidence can harm people's perceived enjoyment as they possess too high expectations which then lower their momentary happiness when a below forecasted outcome is revealed. Further, studies

like the one by Barber and Odean (2001) have shown that men tend to be more overconfident than women. Reviewing these studies reveals that overconfidence seems to be a common human bias affecting anyone from excessive gamblers (Goodie, 2005) to undergraduate students (Baranski & Petrusic, 1995) and managers (Malmendier & Tate, 2005; Libby & Rennekamp, 2011).

Russo and Schoemaker (1992) mention the highly relevant concept of metaknowledge as being connected to overconfidence. Metaknowledge means to recognize one's own boundaries of knowledge. Knowing that you do not know everything is described as metaknowledge. Furthermore, they name four causes of overconfidence. The first one, availability, characterizes people's tendency of not being able to imagine more improbable pathways in the future, meaning that they leave these possibilities out of their calculations and are therefore overconfident of the more available possible events. Second, anchoring is a bias playing an important role in measuring overconfidence. If people are asked for their 90% confidence interval of, e.g., the year the first human took a step on the moon, they base their upper and lower boundary of their confidence interval from their initial answer (anchor) without sufficiently adjusting. Next, people's tendency of paying more attention to evidence confirming their own beliefs while neglecting contradictory ones is called confirmation bias. Confirming one's own beliefs can lead to insufficient consideration of other possibilities and thus create overconfidence. Lastly, reviewing events retrospectively might give people the illusion that the world is more predictable than it is. This tendency is called hindsight bias and is the fourth possible mental cause for overconfidence.

Reviewing the above-mentioned studies, overconfidence can negatively affect generally preferred rational decisions and predictions by managers, people's tendency to gamble and may decrease happiness. This broad spectrum of overconfidence studies discloses the social importance of studying this topic and investigating ways to lower such bias. As Russo and Schoemaker (1992) mention, there are a couple of possible remedies for overconfidence, yet the most important one seems to be awareness of one's own tendency. Hence, this study tries to investigate the effects of increasing awareness through mindfulness on being overconfident.

Mindfulness

One of the most promising ways to decrease overconfidence bias seems to be the practice of mindfulness and mindfulness-based interventions, which are known for raising awareness. This research uses one of the most popular definitions of mindfulness which is brought forward by Kabat-Zinn (2003). According to him, mindfulness is "[…] the awareness that emerges through paying

attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment." (Kabat-Zinn, 2003). This awareness can be established and grown through the practice of meditation.

The notion of mindfulness includes two types of different concepts, trait and state mindfulness. Trait mindfulness describes the natural average capacity to be aware of the present moment without judgment measured over time (Brown & Ryan, 2003). On the other hand, state mindfulness is described as the awareness to the present moment at a given moment (Tanay & Bernstein, 2013). This indicates that while trait mindfulness is a given characteristic of everyone that cannot be altered much over time, state mindfulness can be changed and manipulated at a given point in time.

Recent years have shown promising results associated with both trait and state mindfulness. For example, mindfulness was shown to positively affect the quality of sleep (Winbush et al., 2007), emotional regulation (Arch & Craske, 2006) or mental illnesses like depression (Hofmann & Gomez, 2017). Furthermore, in their landmark study Brown & Ryan (2003) found positive associations between mindfulness measures and psychological well-being. Also, Pepping et al. (2013) showed that mindfulness can have positive effects on self-esteem. This study takes mindfulness research further and extends it by investigating its effects on overconfidence which as described earlier is a human bias often associated with negative outcomes.

Mindfulness and overconfidence until now

So far, research on the effects of mindfulness on people's overconfidence is relatively scarce. Lakey et al. (2007) examined the relationship between trait mindfulness (measured by the Mindful Attention Awareness Scale (MAAS)) and overconfidence in the context of gambling. Their results show that more mindful individuals score better on the Georgia Gambling Test (GGT) meaning that they are better able to balance judgments of confidence and performance and are therefore less overconfident. Moreover, Kalafatoğlu and Turgut (2017) find a significant relationship between the acceptance measure of mindfulness and overplacement (overconfidence in being better than others). However, their results must be considered with care as even though their quiz questions that are used to measure overconfidence account for varying difficulties, they might not consider domain specific differences enough as all questions are related to culture. As Klayman et al. (1999) showed, this is constituting a major limitation of the study since overconfidence is dependent on both, domain and difficulty of questions asked. Hence, the measurement of overconfidence in Kalafatoğlu and Turgut (2007) might be biased. Furthermore, a meta-analysis showed that mindfulness is significantly

positively correlated with confidence and efficacy (Mesmer-Magnus et al., 2017). On the other hand, Lim et al. (2015) displayed that a 3-week mindfulness training made participants act more compassionate towards others. More compassion towards other people could imply more confidence in other people's abilities and therefore influence the overplacement measure of overconfidence. This effect could, however, be diminished by increased self-confidence through mindfulness.

The current study

Since there is only a small amount of research conducted on the effect of mindfulness on individuals' overconfidence, the two hypotheses of this paper are two-sided. Namely, hypotheses one and two are:

H1: Individuals undergoing a 6-minute humbleness meditation exhibit different levels of overconfidence (measured by overprecision, overplacement and overestimation) than people with a 6-minute mind-wandering exercise.

H2: Trait mindfulness correlates with overconfidence levels.

The two hypotheses include the two concepts of state (H1) and trait (H2) mindfulness defined earlier. These two hypotheses are being investigated to create a complete study that explores the effects of both concepts of mindfulness on overconfidence bias.

The current study is novel in that it seems to be the first to investigate the direct effect of a mindfulness intervention (6-minute humbleness meditation) on people's overconfidence. Furthermore, not only the effect of the mindfulness intervention will be measured, but also the association between individuals' innate mindfulness level (measured by the MAAS) and overconfidence. Moreover, a new type of mindfulness intervention will be used. The intervention is a guided meditation dealing with the topic of humbleness and is recorded by me. This meditation was chosen as it is thought to have a large effect on overconfidence. With these three novelties, the proposed study hopes to contribute to the current scientific literature and inform about potential benefits of mindfulness in the area of overconfidence.

Data and Methodology

Data collection

In order to investigate the research question and the two hypotheses, a survey was created in Qualtrics. This survey was distributed throughout social media and among friends, family members and colleagues. It was shared with information about the main topic (mindfulness and decision making) and the fact that €1 will be donated to the Against Malaria Foundation for each fully completed survey. The Against Malaria Foundation is one of the most effective charities in the world (GiveWell, 2021) providing people in sub-Saharan Africa with bed nets. This incentive is added to increase participation in the study and at the same time decrease attrition. As Gendall and Healy (2010) showed, the promise to donate a small amount to charity for each completed survey increases response rates significantly. The survey was distributed to as many people as possible without aiming for a specific target group. Yet, most participants were relatively young (14-39 years). 94 people completed the survey. Four observations were dropped as they failed the attention check (asking them to tick letter "c").

Table 1. Descriptive statistics

Variable	(1) N	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max
Female	90	0.544	0.501	0	1
Age	90	23.222	3.622	14	39
Alone	90	0.867	0.342	0	1
Meditation	90	0.533	0.502	0	1
Education					
Elementary school	90	0.011	0.105	0	1
High school	90	0.433	0.500	0	1
Bachelor	90	0.389	0.490	0	1
Master	90	0.167	0.375	0	1
Public	90	0.189	0.394	0	1

Notes. The table shows the descriptive statistics collected from each participant. Column 1 shows the number of participants. Column 2 indicates the means of each variable for the entire population. Column 3 indicates the standard deviation for each collected variable. Columns 4 and 5 present the minimum and maximum amount of each variable respectively.

As Table 1 shows the study includes slightly more women than men (54.4%). With a mean age of 23 years, the studied group mainly consists of students with most having attained a high school (43.3%) or bachelor's degree (38.9%). Moreover, most subjects (86.7%) were alone while filling out the survey. In line with the randomization in place, about half of the participants (53.3%) were assigned to the treatment group being shown the meditation video. Furthermore, the vast majority (81.1%) of respondents took the survey in a private setting.

Survey

Once participants clicked on the survey link, they reached an information page explaining the procedure of the study and clarifying data collection and safety. After having agreed to the terms of the study, participants filled out the 15-item Mindful Attention Awareness Scale (MAAS) to assess their trait mindfulness. As the next step, people were randomly assigned to either the control or the treatment group. The control group received a self-recorded 6-minute mind-wandering exercise, constantly asking them to follow their thoughts wherever they go. This active control intervention is adapted from Arch & Craske (2006). An active control group intervention is used as Josefsson et al. (2014) note that the effects could be due to random variables that are uncorrelated with mindfulness if no active control is used. On the other hand, the treatment group received a self-recorded 6-minute guided humbleness meditation starting with a simple breathing exercise and moving into a visualization of the last time participants were overly sure of themselves. They were then asked to imagine how they would have felt if they would have opened their hearts and let go of attachment, let go of the ego. This is a self-created meditation that I believe to be effective to increase humbleness and thus decrease overconfidence. Timers were in place to only allow participants to move to the next part of the survey once the time of the respective video elapsed. The timers were used to control the study slightly more and thus increase internal validity.

To evaluate whether the intervention worked, participants then filled out the 5-item MAAS-S which assessed their state mindfulness. It is expected that people in the treatment group will score higher on the MAAS-S than individuals in the control group.

Subsequently, participants answered 15 multiple choice (4 choices) questions on five different domains with three different difficulties (easy, middle, hard) for each domain. Some of the questions can be viewed in Figure 1 below, while the entire survey can be found in the appendix. Furthermore, one attention question was added, asking respondents to tick letter "c". This methodology is used in

line with previous research like Moore and Healy (2008). Quiz questions were shown in random order to counter a possible anchoring effect.

Q65 How old is Madonna?

- ○ 63 (1)
- ○ 65 (2)
- ○ 67 (3)
- ○ 69 (4)

Q66 What year did a human first take a step on the moon?

- ○ 1969 (1)
- ○ 1961 (2)
- ○ 1976 (3)
- ○ 1955 (4)

Q67 How many percent of the average male human body is water?

- ○ 60 (1)
- ○ 70 (2)
- ○ 50 (3)
- ○ 40 (4)

Figure 1. Example survey questions asked

After having answered the 16 questions, participants were asked three different questions to assess their overestimation, overplacement and overprecision. Particularly, to measure overestimation, subjects were asked to state how many of the 15 general knowledge questions they thought they answered correctly. Further, to assess overplacement, participants estimated their percentile of performance compared to all other participants of the study. Next, overprecision was measured by having participants state their 90% confidence interval of the number of correct answers they had in

the previous quiz. For example, if a person says that they are 90% sure they answered between 5 and 10 questions correctly and their true score lied between these values, they received a point for this question.

Lastly, participants filled in the control variables age, gender, education, location and setting (whether alone or not) during the study. Particularly, the location and setting variables were collected because they could influence the effectiveness of the intervention as well as people's behaviour during the quiz task measuring overconfidence. It seems possible that individuals taking the survey when surrounded by other people feel more pressure to answer the quiz questions correctly and therefore are more overconfident. This effect was shown by Blanton et al. (2001). They observed that people who believed that it is less important to do well in class were less confident in their answers than people who assigned a larger importance to do well in class. After entering the control variables, respondents were thanked for their participation.

Analysis

The data was analysed by first conducting a balance test with the five control variables and the MAAS to evaluate whether randomization worked properly. Furthermore, a t-test was conducted for the MAAS-S to assess whether the intervention worked as expected. Lastly, measures of overconfidence were constructed. Overestimation was evaluated by subtracting each person's correct score from their self-evaluation. If this difference is positive, the participant overestimated themselves. Normally, further analysis would have simply included a t-test to gauge whether the difference between control and treatment group is significant. Unfortunately, the difference in the MAAS-S means between control and treatment group was only marginally significant. Therefore, correlations between state mindfulness and the overconfidence types were measured instead of causal effects. Moreover, to measure overplacement, the difference between each participant's self-evaluation and their actual percentile was calculated. Again, if this difference is positive, the participant overplaced themselves. Lastly, overprecision was evaluated by assigning participants whose confidence interval included their correct score value 1 and those whose interval did not include their correct score value 0.

In total, 9 different regressions were performed to assess the correlations between meditation, state or trait mindfulness and the three distinct types of overconfidence. In particular, the regressions performed per type of overconfidence can be generalized to:

$$Y = a + b_i T_i + X_i + e_i$$

Y represents the dependent variable. *Y* is overestimation, overplacement and further overprecision. Moreover, a stands for the constant and T_i denotes the independent variable. Namely, T_i either embodies the binary treatment variable (meditation), state (MAAS-S) or trait (MAAS) mindfulness. Additionally, X_i represents all control variables. Particularly, these are *Female* (whether female or not), *Alone* (whether alone or not), *Public* (whether in a public location or not), *Education* (highest degree accomplished) and *Age* (in years). Lastly, e_i is the error term.

Results

Balance test

As explained above, the first step of the data analysis consists of controlling whether randomization worked successfully. This is being done with a balance test which can be seen in Table 2 below. As stated in Table 1, 48 of the 90 participants were randomized into the treatment group and watched the meditation video. The balance test is used to investigate whether there are any significant differences between control and treatment group in the other variables collected. Table 2 clearly shows that there are no significant differences between the two groups in any of the variables. In Table 2, as well as in all other results the variable *MAAS_Trait_Mean* refers to the mean trait mindfulness scale score. *MAAS_State_Mean* stands for the mean state mindfulness scale score.

Table 2. Balance test

	(1)	(2)	(3)	(4)
	Mind-wandering	Meditation	Difference	P-value
Age	23	23.417	0.417	0.589
Female	0.571	0.521	0.051	0.635
Alone	0.833	0.896	-0.063	0.390
Education	2.619	2.792	-0.173	0.281
Public	0.262	0.125	0.137	0.100
MAAS_Trait_Mean	3.782	3.835	-0.052	0.718

Notes. The table shows the results for the balance test. Column 1 shows the mean outcomes for the variables within the mind-wandering (control) group. Column 2 indicates the mean outcomes for the variables within the meditation (treatment) group. In column 3, the difference between the values in column 1 and 2 is shown and whether these are significant. Column 4 displays the p-value for the difference in mean values. The p-values are not significant, so randomization worked properly. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Difference in state mindfulness

The next step of the data analysis is to examine whether the intervention (meditation) had a significant effect on state mindfulness compared to the control group which received the mind-wandering video. The t-test displayed in Table 3 below designates that there is only a marginally significant difference in state mindfulness between control and treatment group. The difference in means between the two groups indicates that the treatment group experienced higher state mindfulness. Yet, as this difference is only marginally significant multiple regressions are used for the rest of the data analysis. Now, the investigation focusses on correlations, rather than causal pathways as the treatment only produced a marginally significant difference in state mindfulness between control and treatment group. The marginal significance of the difference in state mindfulness can be attributed to the short length of the intervention (6 minutes) as well as the relatively small number of participants.

Table 3. T-test difference in state mindfulness

	(1) Mind-wandering	(2) Meditation	(3) Difference	(4) P-value
MAAS_State_Mean	3.624	3.925	-0.301	0.0738

Notes. The table shows the t-test for differences in state mindfulness score means measured by the MAAS_S between both groups. Columns 1 and 2 show the mean value scored on the state mindfulness scale for both mind-wandering (1) and meditation (2) group. Column 3 conveys the difference in values between column 1 and 2 and whether this is significant. Column 4 shows the p-value for the difference in mean values. There is no significant difference, indicated by an insignificant p-value. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Meditation and overconfidence

Meditation and overestimation

As explained above, due to the marginally significant difference in state mindfulness between control and treatment group, correlations between treatment and state mindfulness and the overconfidence measures will be investigated with multiple regressions in the remaining analyses. All regressions are executed with the binary treatment variable *Meditation* (taking on value 0 for the control and 1 for the treatment group). Further, as the treatment only produced a marginally significant difference of state mindfulness between the two groups, the same regressions are implemented with the *MAAS_State_Mean* variable indicating participant's state mindfulness instead of the treatment variable *Meditation* to possibly grasp any differences between the two. First, the association between the binary treatment variable meditation and overestimation is measured. As can be seen in column 1 of Table 4 below, there is no significant correlation between the treatment (*Meditation*) and overestimation. Further, there seem to be two significant results. Namely, the education variables *Elementary school* and *Master's degree*. To only have completed elementary school appears to

significantly increase one's overestimation in oneself compared to the average high school graduate. However, as can be seen in Table 1, only one person stated that their highest level of education completed is elementary school. Therefore, this result cannot be considered a valid association. Moreover, on average, people having attained a master's degree seem to significantly overestimate themselves less compared to high school graduates. Yet, as in the case with the elementary school category, this association must be observed with care as there are only 15 master's graduates who have participated in the study and the association is only significant at the 10% level. Besides, no other of the measured variables appear to have a significant correlation with overestimation.

Table 4. Regression results overconfidence measures and meditation

Variables	(1) Overestimation	(2) Overplacement	(3) Confidence_Hit
Meditation	0.533	-1.579	1.254
	(0.470)	(8.025)	(0.691)
Female	-0.327	-8.973	0.223**
	(0.480)	(8.188)	(0.136)
Alone	-0.048	5.732	(omitted)
	(0.726)	(12.379)	
Public	0.651	12.149	3.428
	(0.615)	(10.499)	(2.950)
Education			
Elementary school	0.046**	10.631	(empty)
	(2.348)	(40.058)	
Bachelor's degree	-0.420	-7.057	1.755
	(0.524)	(8.941)	(1.074)
Master's degree	-1.460*	-1.665	2.014
	(0.819)	(13.977)	(1.906)
Age	-0.003	-0.394	0.930
	(0.084)	(1.443)	(0.091)
Constant	0.073	11.431	18.333
	(1.969)	(33.587)	(42.992)
Observations	90	90	90
R-squared	0.134	0.038	0.095

Notes. The table shows the regression results for the three overconfidence measure scores regressed on the treatment variable *Mindfulness*. Column 1 shows the regression coefficients for overestimation regressed on the treatment and control variables. Column 2 indicates the regression coefficients for the overplacement score regressed on the treatment and control variables. Column 3 shows the regression coefficients for overconfidence hit scores (overprecision) regressed on the treatment and control variables. All regression coefficients include significance marked by stars. The standard error is indicated underneath the coefficients in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Meditation and overplacement

After having analysed the association between meditation and overestimation, the correlation between meditation and overplacement is investigated in this section. First, the correlation between meditation and overplacement is shown in column 2 of Table 4 above. Once again, the treatment (*Meditation*) is not significantly correlated with the second type of overconfidence – overplacement. Yet, though insignificant, the correlation between meditation and overplacement reveals a negative trend. This indicates that the higher a person's state mindfulness, the lower their overplacement. However, again, this result is not significant.

Meditation and overprecision

As the last main analysis for the treatment, the results between meditation and overprecision are analysed with a logistic regression. The logistic regression is used as the dependent variable *Overconfidence_Hit* is a binary variable taking on either value 0 or 1. As can be seen in column 3 of Table 4 above, meditation again is not significantly correlated with the chance to include the correct score in the 90% confidence interval. Remarkable, however, is that being a woman on average significantly decreases the chance of including the correct score with the confidence interval. In particular, being a woman on average decreases the chance by 1 - 0.223 = 0.777, so 77.7%. It must be noted that the variable *Elementary school* was dropped because of collinearity (only one observation).

State mindfulness and overconfidence

State mindfulness and overestimation

Just like in the case of investigating the association between the treatment variable and the overconfidence measures above, we again start by looking at the regression of overestimation on state mindfulness. The results of this regression can be seen in column 1 of Table 5 beneath. The results indicate no significant difference for each variable between the association of state mindfulness and overestimation and the results for the regression of overestimation on the treatment variable directly. Again, only having completed elementary school seems to significantly increase the chance to overestimate oneself compared to high school graduates. Yet again, this result cannot be considered as only one participant belongs to the group of people who finished elementary school. Almost the same applies to the seemingly significant result for master graduates whose group only consists of 15 participants in total. This result also must be considered with care as it is only significant at the 10% level.

Table 5. Regression results overconfidence measures and state mindfulness

Variables	(1) Overestimation	(2) Overplacement	(3) Confidence_Hit
MAAS_State_Mean	-0.082	-5.936	1.147
	(0.244)	(4.074)	(0.313)
Female	-0.346	-8.821	0.217**
	(0.483)	(8.080)	(0.133)
Alone	-0.001	5.212	(omitted)
	(0.729)	(12.201)	
Public	0.561	13.983	3.159
	(0.615)	(10.288)	(2.731)
Education			
Elementary school	5.294**	22.701	(empty)
	(2.405)	(40.230)	
Bachelor's degree	-0.332	-7.740	1.861
	(0.521)	(8.721)	(1.129)
Master's degree	-1.396*	-2.873	2.168
	(0.823)	(13.769)	(2.023)
Age	0.004	0.010	0.918
	(0.087)	(1.451)	(0.092)
Constant	0.439	24.036	16.579
	(2.048)	(34.260)	(39.192)
Observations	90	90	90
R-squared	0.122	0.062	0.096

*Notes. The table shows the regression results for the three overconfidence measure scores regressed on the state mindfulness score. Column 1 shows the regression coefficients for overestimation regressed on the independent and control variables. Column 2 indicates the regression coefficients for the overplacement score regressed on the independent and control variables. Column 3 shows the regression coefficients for overconfidence hit scores (overprecision) regressed on the independent and control variables. All regression coefficients include significance marked by stars. The standard error is indicated underneath the coefficients in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.*

State mindfulness and overplacement

In the case of the association between state mindfulness and overplacement the same applies as described for overestimation in the last paragraph. Once again, there are no significant differences between the regression including state mindfulness and the one incorporating the treatment variable directly. No significant results can be found here as can be seen in column 2 of Table 5 above.

State mindfulness and overprecision

Once more, as indicated in column 3 of Table 5 above, no significant differences can be found between the association of state mindfulness and overprecision and the association between meditation and overprecision. Again, the only significant result is for the gender variable, confirming the result found

in Table 4 which indicates that women on average are significantly less likely to include their correct score in their indicated confidence interval.

Trait mindfulness and overconfidence

Trait mindfulness and overestimation

After having investigated the associations between state mindfulness and meditation and the three overconfidence measures, the following analyses study the relationship between trait mindfulness and overconfidence. Column 1 of Table 6 below shows the regression results for the association between the trait mindfulness scale and overestimation. Here again, trait mindfulness does not have a significant association with overestimation. Interestingly, the elementary school category of education only stays significant at the 10% level, while being a master's graduate on average does not have a significant effect on overestimation anymore. However, once more, these results must be interpreted with caution given the small sample size in both groups as stated above.

Trait mindfulness and overplacement

The results of regressing overplacement on trait mindfulness also do not reveal any significant results as can be seen in column 2 of Table 6 underneath.

Table 6. Regression results overconfidence measures and trait mindfulness

Variables	(1) Overestimation	(2) Overplacement	(3) Confidence_Hit
MAAS_Trait_Mean	0.314	4.055	2.094
	(0.375)	(6.357)	(0.976)
Female	-0.328	-8.664	0.224**
	(0.482)	(8.174)	(0.138)
Alone	0.171	7.731	(omitted)
	(0.753)	(12.780)	
Public	0.626	13.583	3.807
	(0.618)	(10.488)	(3.318)
Education			
Elementary school	4.681*	4.008	(empty)
	(2.393)	(40.582)	
Bachelor's degree	-0.346	-7.592	1.748
	(0.520)	(8.818)	(1.072)
Master's degree	-1.346	-1.429	2.393
	(0.820)	(13.916)	(2.258)
Age	-0.024	-0.684	0.881
	(0.089)	(1.508)	(0.093)
Constant	-0.587	-0.039	4.571
	(2.212)	(37.527)	(11.407)
Observations	90	90	90
R-squared	0.128	0.043	0.123

Notes. The table shows the regression results for the three overconfidence measure scores regressed on the trait mindfulness score. Column 1 shows the regression coefficients for overestimation regressed on the independent and control variables. Column 2 indicates the regression coefficients for the overplacement score regressed on the independent and control variables. Column 3 shows the regression coefficients for overconfidence hit scores (overprecision) regressed on the independent and control variables. All regression coefficients include significance marked by stars. The standard error is indicated underneath the coefficients in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01.*

Trait mindfulness and overprecision

Lastly, the relationship between trait mindfulness and overprecision is investigated with a logistic regression whose results are presented in column 3 of Table 6 above. Just like in Table 4 and Table 5, the association between trait mindfulness and overprecision is insignificant as well. Also, again, women on average have a significantly lower chance of including their correct score in their 90% confidence interval compared to men. In this regression the probability decreases by 1 - 0.224 = 0.776 = 77.6%.

Additional analysis

As Tables 4, 5 and 6 show, women on average did significantly worse in including their correct score in their 90% confidence level. To see whether this decreased probability is due to women over- or underestimating themselves, an additional analysis was carried out. As Barber and Odean (2001) showed, men tend to be more overconfident than women. Hence, the amount of times men and women stated a confidence interval below or above their true score was counted. As it turns out, women did not just underestimate, but also overestimate themselves. Specifically, women stated a confidence level below their true score 9 times, while they entered a confidence interval above their true score 7 times. This means that 16 of 49 female participants failed to include their correct score in their confidence interval. Hence, women were particularly overprecise with an overprecision of 90 – 67.35 = 22.65%. On the other hand, for men this tendency was the other way around. They stated a confidence interval below their true score 2 times and above 4 times. At the same time, men were much less overprecise than women as they included their correct score 85.37% of the time, indicating overprecision of 90 – 85.37 = 4.63%. It must be noted that no interpretation can be derived from this additional analysis, mainly because of the relatively small sample size.

Limitations

Even though this study was carefully planned and designed, it still has some limitations which must be taken into account. First of all, as can be seen in Table 3 above, the meditation intervention did only have a marginally significant effect on state mindfulness. Since, in order to study the causal relationship between meditation and the three types of overconfidence it would have been necessary for this change to be significant, the rest of the analysis does not allow to make any causal inferences about the relationship. The reasons for the intervention not to be effective are distinct. One of the largest factors might be the online nature of the survey. Although a timer was implemented for both, the meditation and mind-wandering video, it is not guaranteed that participants watched the videos and followed their instructions. I received multiple questions from people who stated that they were not able to proceed to the next questions after having watched the video. After controlling for any possible technical issues multiple times, the most plausible explanation is that respondents simply did not watch the entire video. Furthermore, while the timers did not allow respondents to proceed to the next question before the time of the video had elapsed, there was no restriction on website use in place. This proposes that participants also could have visited other websites at the same time. Moreover, other external factors could have led to the distraction of participants. Maybe a chat

popped up on their phone, the doorbell rang, or someone called them. In an online survey like this, it is impossible to control for all these factors no matter if participants take the survey at home or in public.

Additionally, participants were shown relatively short videos of 6 minutes. There might be significant differences in the effectiveness of the intervention when the time is increased to e.g., 15 minutes or if participants would undergo an eight-week MBSR (mindfulness-based stress reduction) course. Another limitation of the study is the relatively small amount of quiz questions asked compared to other studies like the one by Moore and Healy (2008). In their study, the authors let respondents answer 180 questions in total. Of course, it is not possible to depict the same number of nuances in difficulties and categories with 15 questions as is feasible with 180 questions. Next, although the number of participants is already fairly large (90) it might not be enough to reach sufficient statistical power. Also, it does not accommodate for adequate external validity as the group of respondents is rather homogenous. The studied population mainly consists of young people who are relatively educated (high school, bachelor's or master's graduates). Therefore, any results found in this research cannot be applied to the general population.

Discussion

This research was conducted in order to answer the research question:

Does mindfulness influence people's overconfidence in their abilities?

The results indicate that there is no significant relationship between meditation, state or trait mindfulness and either of the three types of overconfidence. Therefore, hypothesis one and two can be rejected. Further, the research question must be answered with a no. Yet, this study produced some important insights into possible limitations as well as a first direction of results regarding the connection between mindfulness and overconfidence. Although, no significant relationship was found, this can still be seen as an important result. Further, an interesting side result was found in Tables 4,5 and 6. Being a woman on average seems to significantly reduce the chances of stating a 90% confidence interval that includes their true score. This finding depicts that there seems to be a significant correlation between gender and overprecision. Yet, as mentioned earlier, this result is not generalizable to the wider population because of the relatively young age and high education status attained by the studied group.

Even though there is existing research investigating the relationship between mindfulness and overconfidence (Lakey et al., 2007 and Kalafatoğlu & Turgut, 2017), this research is the first one examining the direct association between the two. Lakey et al. (2007) investigated the effects of trait mindfulness and overconfidence in the context of gambling. Kalafatoğlu and Turgut (2017) looked into the effect of the acceptance and attention dimensions on two of the three types of overconfidence (overplacement and overestimation). Thus, this study is the most comprehensive in researching the effects of all, meditation, state and trait mindfulness on all three types of overconfidence. Therefore, this study must be viewed as a first step towards investigating this correlation further. Although, no significant results were found in this research, this does not mean that there is no significant correlation between mindfulness and overconfidence in the context of the wider population. Also, the several limitations stated above make it possible to learn from the constraints of and mistakes made in this study. It is possible that the two hypothesized counteracting effects of making one more confident (Mesmer-Magnus et al., 2017) and more compassionate towards others (Lim et al., 2015) balance each other out. Yet, more research is needed to answer the research question of this study in a complete manner.

There are a lot of possibilities in improving the underlying research. First, the biggest limitation appears to be the online environment of the intervention and survey. Thus, it might be of great value to gather responses in an offline environment. Furthermore, the intervention might have to be longer than 6 minutes. Therefore, guiding a 15-minute meditation in person could lead to a larger difference in state mindfulness between control and treatment group and thus more significant results regarding the association between state mindfulness and overconfidence. Moreover, further studies investigating this topic should consider gathering more data points as 90 participants may not lead to enough statistical power. Besides these improvement points, further studies might want to incorporate more quiz questions and the studied group should include people from different backgrounds and ages to accommodate for better external validity.

Additional research is needed to answer the question whether there is a significant relationship between mindfulness and overconfidence. If there is a significant relationship between the two, this could be of great value for the entire society. Politicians, managers or private households could improve their decision making by decreasing their overconfidence in themselves and thus be more open to incorporating ideas and propositions from external parties. If mindfulness would lessen overconfidence, meditations could be implemented into daily life and especially before making a big decision for the country, company, or household.

Conclusion

Overall, this study showed no significant results for the effect of state or trait mindfulness on overconfidence. Yet, as this is one of the first research papers investigating this effect, further research needs to be conducted to find whether mindfulness could be a solution to the societal problem of overconfidence. Next to the main findings of the paper, an interesting result appeared. Women on average tend to be significantly more overprecise compared to men when evaluating their own performance. This result can be taken as starting point for further research directed into this area. Even though there were no significant results for the effect of mindfulness on overconfidence, this paper is important in sparking a new research area and starting the discussion about the possibility that mindfulness interventions might have in decreasing the human tendency to be overly confident.

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Appendix

Survey

Block: Default Question Block (1 Question)
Standard: Block 2 (16 Questions)

BlockRandomizer: 1 - Evenly Present Elements

Standard: Block 3 (2 Questions)
Standard: Block 4 (2 Questions)

Standard: Block 5 (6 Questions)
Standard: Block 6 (1 Question)
Standard: Block 7 (16 Questions)
Standard: Block 8 (3 Questions)
Standard: Block 1 (5 Questions)

Page Break

Start of Block: Default Question Block

Q1

General information

On the next page you will be asked to truthfully answer questions related to mindfulness and a general knowledge quiz. A short video is part of this study. **Please find a comfortable, quiet spot to do this survey.** You will be asked to provide some information about yourself. This study is conducted by Clemens Niekler and serves as a crucial part of a bachelor thesis on the topic "Mindfulness and Decision Making" at Erasmus University Rotterdam. Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized. This study will take maximum 15 minutes to complete.

Data Privacy

I will do my best to keep your information confidential. All data is stored in a password protected electronic format. The results of this study will be used for scholarly purposes only and may be shared with Erasmus University representatives. If you have questions about the study, please contact 538141cn@student.eur.nl.

Furthermore, by taking this survey you contribute to a better world by indirectly donating **€1 to the Against Malaria Foundation** which is providing people in sub-Saharan Africa with bed nets.

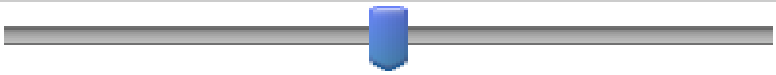
End of Block: Default Question Block

Start of Block: Block 2

Q7 Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

Q8 I could be experiencing some emotion and not be conscious of it until some time later.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

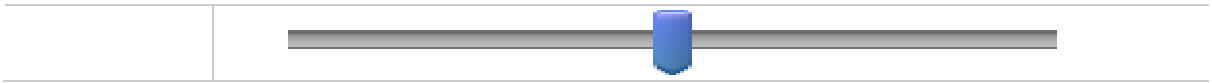


Q9 I break or spill things because of carelessness, not paying attention, or thinking of something else.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q10 I find it difficult to stay focused on what's happening in the present.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6



Q11 I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.

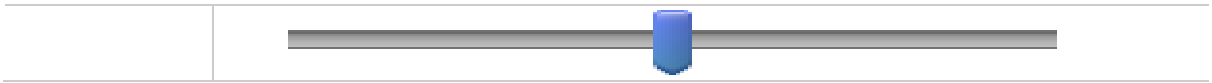
almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q12 I tend not to notice feelings of physical tension or discomfort until they really grab my attention.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q13 I forget a person's name almost as soon as I've been told it for the first time.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6



Q14 It seems I am "running on automatic," without much awareness of what I'm doing.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q15 I rush through activities without being really attentive to them.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q16 I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q17 I do jobs or tasks automatically, without being aware of what I'm doing.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q18 I find myself listening to someone with one ear, doing something else at the same time.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q19 I drive places on ‘automatic pilot’ and then wonder why I went there.

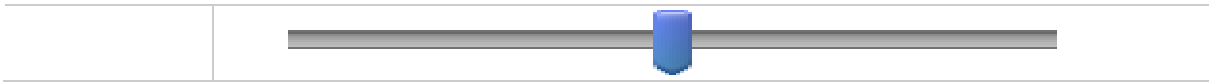
almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

Q20 I find myself preoccupied with the future or the past.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6

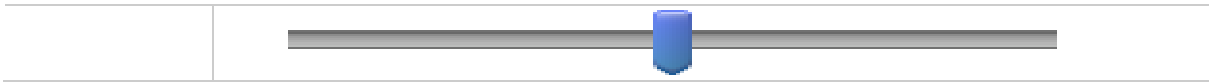
Q21 I find myself doing things without paying attention.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6



Q22 I snack without being aware that I'm eating.

almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
1	2	3	4	5	6



End of Block: Block 2

Start of Block: Block 3

Q48 Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Q23 Please note:

The following video clip involves an active exercise that is crucial to the experiment. Please turn the **sound of your device on or get earphones if you are in public**. You will be able to proceed to the next question after the video has ended.

End of Block: Block 3

Start of Block: Block 4

Q49 Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Q24 Please note:

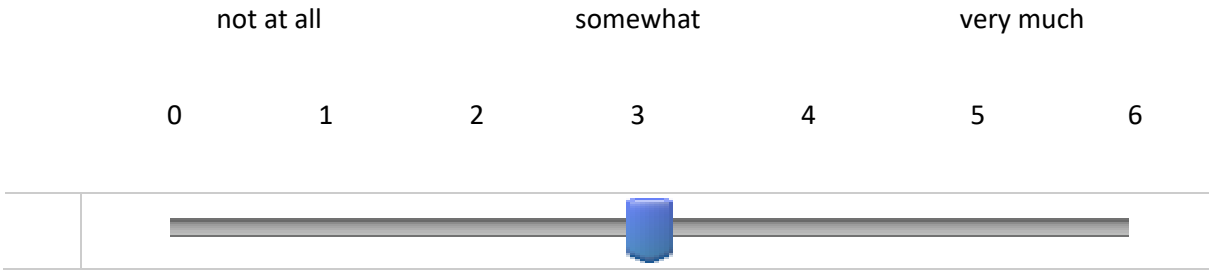
The following video clip involves an active exercise that is crucial to the experiment. Please turn the **sound of your device on or get earphones if you are in public**. You will be able to proceed to the next question after the video has ended.

End of Block: Block 4

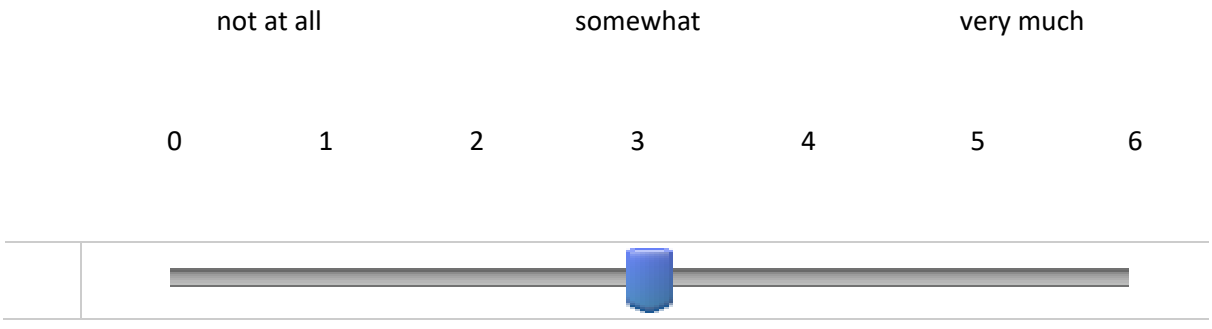
Start of Block: Block 5

Q25 Using the 0-6 scale shown, please indicate to what degree were you having each experience described below during the exercise. Please answer according to what really reflected your experience rather than what you think your experience should have been.

Q26 I was finding it difficult to stay focused on what was happening.

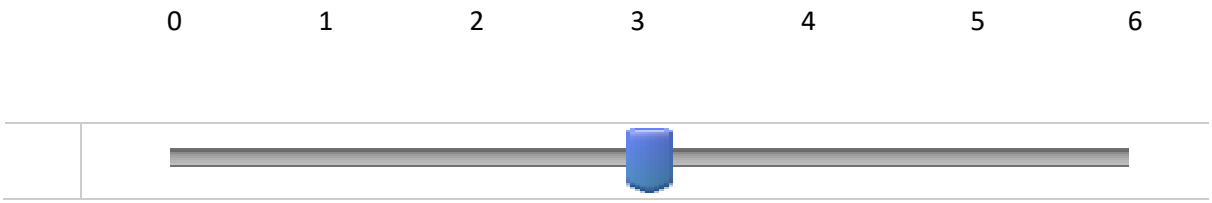


Q27 I was doing something without paying attention

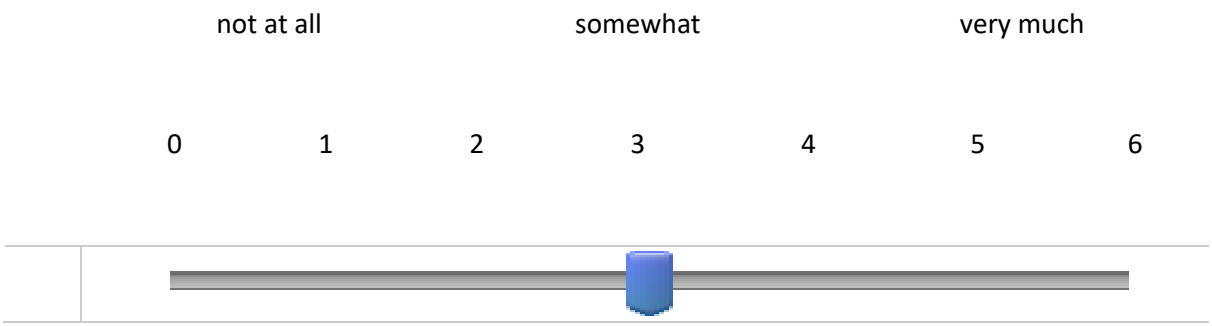


Q28 I was preoccupied with the future or the past.

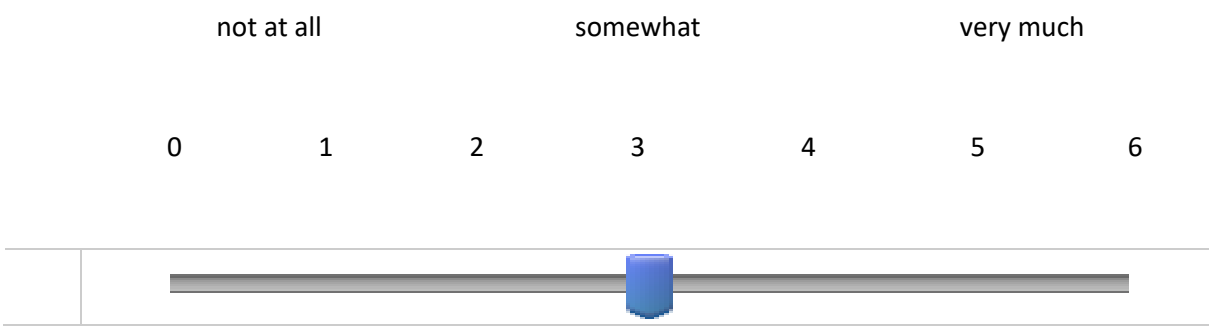
not at all somewhat very much



Q29 I was doing something automatically, without being aware of what I was doing.



Q30 I was rushing through something without being really attentive to it.



End of Block: Block 5

Start of Block: Block 6

Q31 You will be asked to answer 15 multiple choice questions. Please answer them to the best of your knowledge and without the use of any external help.

End of Block: Block 6

Start of Block: Block 7

Q54 In what year was the first flight of a hot air balloon?

- 1783 (1)
- 1864 (3)
- 1738 (4)
- 1929 (5)

Q55 How many years ago did the homo sapiens emerge?

- 300,000 (1)
- 150,000 (2)
- 250,000 (3)
- 200,000 (4)

Q71 To see if you are paying attention: Which choice depicts letter "c"?

- a (1)
- b (2)
- c (3)
- d (4)

Q56 Which year was the first commercial mobile phone sold?

- 1983 (1)
- 1991 (2)
- 1987 (3)
- 1996 (4)

Q57 How long is the river Nile?

- 6,650km / 4,132 miles (1)
- 4,820km / 2,995 miles (2)
- 7,380km / 4,586 miles (3)
- 5,890km / 3,660 miles (4)

Q58 How many countries are there around the world?

- 195 (1)
- 192 (2)
- 198 (3)
- 203 (4)

Q59 How many people live in South America?

- 430 million (1)
- 280 million (2)
- 390 million (3)
- 350 million (4)

Q60 How much sugar is in a 330ml / 11oz can of Coca Cola? (in grams)

- 35g (1)
- 28g (2)
- 32g (3)
- 25g (4)

Q61 How many kernels will you find on an average ear of corn?

- 800 (1)
- 1000 (2)
- 1400 (3)
- 1200 (4)

Q62 How many segments do most oranges have?

- 10 (1)
- 7 (2)
- 15 (3)
- 18 (4)

Q63 How many members did the Beatles have?

- 2 (1)
- 3 (2)
- 4 (3)
- 5 (4)

Q64 How many streams did the most listened artist on Spotify have in 2021?

- 9.1 billion (1)
- 7.4 billion (2)
- 11.2 billion (3)
- 13.5 billion (4)

Q65 How old is Madonna?

- 63 (1)
- 65 (2)
- 67 (3)
- 69 (4)

Q66 What year did a human first take a step on the moon?

- 1969 (1)
- 1961 (2)
- 1976 (3)
- 1955 (4)

Q67 How many percent of the average male human body is water?

- 60 (1)
- 70 (2)
- 50 (3)
- 40 (4)

Q68 About how old is earth? (in years)

- 4.5 billion (1)
- 1.2 billion (2)
- 7.9 billion (3)
- 9.4 billion (4)

End of Block: Block 7

Start of Block: Block 8

Q69
The quiz contained 15 questions (excluding the attention question).
How many questions do you think you answered correctly?

_____

Page Break

Q47
There are about 100 total participants that took the quiz. You were able to reach a maximum of 15 points.
Which percentile of the group do you think you scored?
Please enter a number between 0-100 (e.g., if you believe you scored better than 50 people you would enter "51")

_____

Page Break

Q70
${Q70/ChoiceTextEntryValue/1} **Please indicate a range, such that you are 90% sure that your correct score lies in between the lower and upper bound (including the two numbers).**

Type in your range by typing the lower bound of your confidence interval in the first box and the upper bound in the second indicating that you think there is a 90% chance the right answer is between one number and the other. Please make sure you only enter numerical values.

For example: I am 90% sure that I answered between "value lower bound" and "value upper bound" of the 15 questions correctly.

- Lower bound (1) _____
- Upper bound (2) _____

End of Block: Block 8

Start of Block: Block 1

Q2 What is your current gender identity?

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Q3 How old are you?

_____

Q4 Please indicate the highest level of education that you have completed.

- Elementary school (1)
- High school graduate (2)
- Bachelor's degree (3)
- Master's degree (4)
- Ph.D. (5)
- Other advanced degree (6)

Q51 Where did you take the survey?

- ○ At home (1)
- ○ At university (2)
- ○ Public transport (3)
- ○ Café (4)
- ○ Other private location (5)
- ○ Other public location (6)

Q52
Were you on your own while taking the survey?

- ○ Yes (1)
- ○ No (2)

End of Block: Block 1