Abstract

We do not yet know whether many events, such as the results of dice or games of chance, are controlled purely by chance or whether humans can influence them. Theoretical philosophies, religions as well as physics and psychology have addressed the connection between the spiritual and physical world since ancient times and beyond. The present study is based on the concept of micro-psychokinesis, which suggests an influence of unconscious mental states on probability systems. It is investigated whether in a gambling paradigm the unconscious profit-oriented attitude of subjects can have a significant influence on the image generation of a quantum-based random number generator (tRNG). Subjects viewed sequences of images that indicated either wins or draws. The motivation to win was reinforced at the beginning. In the experiment, the proportion of winning pictures appearing is expected to be higher than the random probability of 50% due to the motivational influence of the subjects. Our results generally argue against a micro-psychokinetic effect, but based on our data the existence of micro-psychokinesis cannot be ruled out. The results are discussed in the paper against the background of previous research, both theoretically and methodologically. Further research is therefore needed to clarify whether and how mental states affect probability systems.

Introduction

Thousands and thousands of events occur every day that we cannot influence - or think that they cannot influence them. Examples that can be used for this are a certain number result when throwing dice or the chance meeting of people in the supermarket. Or the following situation: when playing the one-armed bandit game, the motivation arises to achieve a goal or win a prize. However, it is left to chance whether a win is achieved or not. Can these random events be influenced by certain mental states of people?

General: Is there a connection between the spiritual and physical world? (cf. Eysenck, 1958).

Previous research has focused on micro-psychokinesis. Micro-psychokinesis refers to psychokinesis on microphysical processes, i.e. the mental influence on small things in the environment (Varvoglis, 2016). The most important component of psychokinesis is the use of quantum-based random generators. These generators produce random sequences of numbers, images, etc. The aim of these studies is to verify the existence of micro-psychokinesis.

The assumption about the existence of psychokinesis was often found in areas of religion, mythology and philosophy. The subject area has often been taken up and specified with the help of numerous studies. The focus of many studies is the lottery. Can the probability of winning be increased by certain mental states?

The numerous studies conducted by Radin and Nelson (1989) suggest a strong effect of psychokinesis. Their investigations included the prediction and influencing of

of randomly generated numbers. Radin and Nelson's analyses combine results from a collection of experiments to investigate whether the hit rate of the number 1 is inconsistent by chance (Schub, 2006).

Maier and Dechamps specified that micro-psychokinesis is influenced by unconscious mental processes. In their studies, an optimistic inner state was created in the test subjects. On an unconscious level, this should increase positive results and reduce negative ones. More than 50% of positive stimulus presentations were expected. However, this hypothesis was not confirmed at the time (Maier & Dechamps, 2017).

Many studies on psychokinesis have shown that they cannot be replicated. Random effects cannot be repeated in the same order. In addition, the expression of the mental state of the persons tested differs.

Thus, repetitions of the studies do not yield the same results (Bösch, Steinkamp, & Boller, 2006). Another point of criticism of the studies mentioned is that the mental state of the test subjects cannot be verified. The evaluations of the studies are necessarily based on the self-assessment of the test subjects. However, a person's statement does not constitute sufficient evidence for the actual existence of a certain state. Furthermore, the creation of the mental state can be criticized. In order to create optimism, the VPs in the experiment by Maier and Dechamps (2017) were confronted with a relaxing meditative episode. Each person reacts differently to this confrontation. The differences lie in whether and to what extent a certain mental state arises. This depends on factors such as the ability to concentrate in an unfamiliar environment, specific character traits and

Motivability. The condition of the test subjects has a major influence on the study results (Maier & Dechamps 2017).

The many studies that have been carried out have produced contradictory results. Thus, the question of whether random events can be influenced by certain mental states needs to be investigated more extensively. Does micro-psychokinesis exist?

Despite some studies in favor of micro-psychokinesis, it is still not a generally accepted scientific phenomenon. What is the reason for this? The many studies conducted by Radin & Nelson (2003) used both quantum-based generators and generators based on algorithms. The latter produce lower quality random outputs. Meta-analysis is not a reliable measurement tool due to the influence of heterogeneity. Some studies do not use suitable stimuli to a sufficient extent to generate a correspondingly relevant mental state. Therefore, the study cannot provide representative results.

The following study involves a lottery paradigm. The aim is to investigate whether a certain mental state of the test subjects has an influence on a quantum generator and thus whether micro-psychokinesis exists. To ensure the high quality of our data, we use a high-quality quantum-based random number generator. The influence of mental state motivation on the random appearance of winning and losing images will be observed in more detail. We assume that the proportion of winning pictures appearing increases to over 50% due to the influence of the test subjects. We will therefore measure whether the number of winning pictures appearing is higher than would be expected by chance. The statistical hypotheses are as follows:

H_0: p(profit) <= 0.5 H_1:

p(profit) > 0.5

In order to test the hypothesis, the recording of the winning and losing images that appear and the measurement of the level of motivation are used to check whether the motivation of the test subjects has an influence on the quantum generator.

Methods

This study is based on a preregistered research report. The preregistration was submitted to Moritz Dechamps and uploaded to the Open Science Framework (OSF) science platform on November 19, 2017 (https://osf.io/8wx7k/). A copy of the Pre-registration can be found in the appendix (Appendix A).

Sample

40 test subjects were recruited in the vicinity of the 4 experimenters at the Ludwig Maximilian University of Munich (LMU) and then took part in the study. All of them were included in the statistical analysis.

For illustrative reasons, the test subjects were asked about their age and gender.

The proportion of female and male subjects was almost equal, with 52.5% women (21 women) and 47.5% men (19 men). The mean age of the subjects was 23.98 years (SD = 12.51), the youngest subject was 6 years old and the oldest 59 years old. Before minors took part in the study, their parents were presented with a parental consent form, which they then signed.

Materials

A laptop was provided by Faculty 11 (LMU) for the presentation of the image material. A quantum generator (true quantum number generator, Quantis- USB-4M), which was developed by the company Idquantique in Geneva, was connected to it via USB to generate quantum-based randomness. These quantum states are produced by protons that are sent through a semiconducting mirror, similar to a prism. Based on the famous double-slit experiment in quantum physics, the probability of a photon being sent in one direction or the other is 50%. This information is converted numerically as 0 or 1. In the case of this study, the winning image either appears or does not appear. The visual material was taken from various databases (Shutterstock, Vectorstock) that provide royalty-free images. There were two categories of images: 10 images depicting a winning situation (e.g. "You Win!" Appendix B) and 10 images depicting a losing situation (e.g. "You Lost!" Appendix B). The test subjects were also presented with a questionnaire (Appendix 3), which was important for the exploratory analysis. The questions "Were you reasonably motivated to take part in the test?", "Did you feel the need to win during the test?", "How strong was the desire to count as many winning pictures as possible?" were presented together with an 8-point unipolar response scale "1=very motivated" to "8=not motivated". This scale provided the experimenters with a precise measurement of the extent of gain orientation (Appendix C). Smarties as a prize and the allocation of test subject hours were intended to stimulate the respondents' motivation to win.

The JASP software (version 0.8.5, JASP Team, 2017) was used for the statistical analysis.

Implementation

A within-subjects design was used to investigate the influence of a profit-oriented mental attitude (independent variable) on images generated by a quantum generator (dependent variable).

Four investigators conducted a total of forty individual tests with test subjects aged between 6 and 59 years. In addition to more general information on the use of the data and the duration of the study, it was made clear that test subjects were participating in the study voluntarily and anonymously and could stop at any time.

The experiment follows a lottery paradigm. There are 2 categories of images that are randomly selected and displayed by a quantum generator. The first category consists of pictures showing a winning situation, while the second category shows a losing situation. The participants' desire to see lots of winning pictures is stimulated at the beginning by the announcement of a subsequent prize payout in the form of Smarties. The participants were then instructed to view 20 consecutive pictures in 10 rounds and to count and note the number of winning pictures. Each subject saw a total of 200 pictures (trials). If more than 10 winning pictures appeared in a block, the subjects were given a Smartie for each additional winning picture. The subjects' attention to the pictures was ensured by means of one-minute breaks and monitoring by the experimenters.

At the beginning of each trial, a cross was displayed for 300ms, then the images were presented for 400ms, they appeared in the center of the screen in an image size of 500x400

Pixel. The screen was displayed in black for 600ms between two trials. Figure 1 shows the sequence of the experiment.

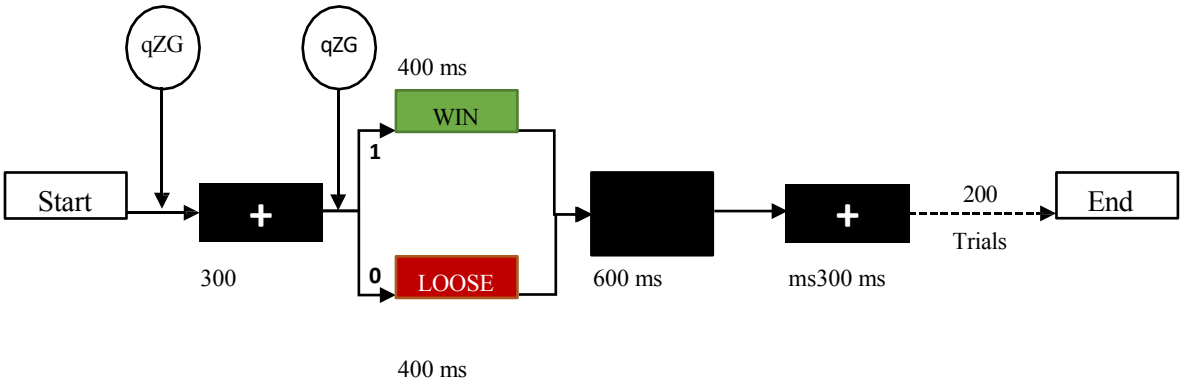

Figure 1: The quantum-based random number generator (qZG) was used twice during each trial: the first time to select one of the images in each of the categories, the second time to decide whether to select the image from the winning category or from the loser category.

The performance of all 200 trials lasted approx. 8 minutes. After the presentation of the 20 trials in 10 blocks, each test subject was given their prize. The test subjects then completed the questionnaire provided, which was intended to quantify the level of motivation to take part in the prize game and the profit orientation. Following the test, all participants were informed about the background to the study.

Data analysis and statistical evaluation

The outputs generated by the quantum generator (absolute proportions of positive and negative images seen per subject and per run) were summarized in a data table (Appendix D) and the number of profitable images seen by each subject was summed to evaluate our hypothesis. To test the

A one-sided Bayesian one-sample t-test was used for the alternative hypothesis. This makes it possible to compare the probabilities of an alternative hypothesis and a null hypothesis. The Bayes factor describes the relative proportion of evidence either for or against an effect, allowing the presence or absence of an effect to be investigated. Based on the effect sizes used in other studies, a parameter of $r = .1$ ($\delta \sim$ Cauchy $(0, .1)$ was defined a priori. In addition to the hypothesis-specific evaluation, a series of exploratory analyses were conducted to obtain more detailed results regarding influences of the extent of motivation, gender, age and the change in the proportion of profitable pictures across different runs. Two-sample t-tests for dependent samples and correlation analyses were carried out for this purpose.

Results

We tested our (directional) hypothesis that the subjects prefer winning images to losing images because they are motivated and experience positive emotions when winning, among other things. The test subjects therefore see more positive stimuli on average than would be expected by chance. The dependent variable measures the percentage of positive stimuli (= winning pictures) that were viewed by each test subject in their 20 runs of 10 pictures each, i.e. 200 trials. The average percentage of positively viewed stimuli was compared with the random value of 50%. On average, no deviation from chance was measured. The Bayesian one-sample T-test (one-sided) with 40 subjects resulted in a BF+0 factor of 0.786 for the null hypothesis and BF-0 of 1.272 for the alternative hypothesis. The mean value of the positive stimuli for 40 participants with an average age of 20 years was $M = 101.1$ with a standard deviation of SD =

6.182. The following graph shows a sequential analysis of the Bayes factor of all participants in the order of the tests (Figure 2).

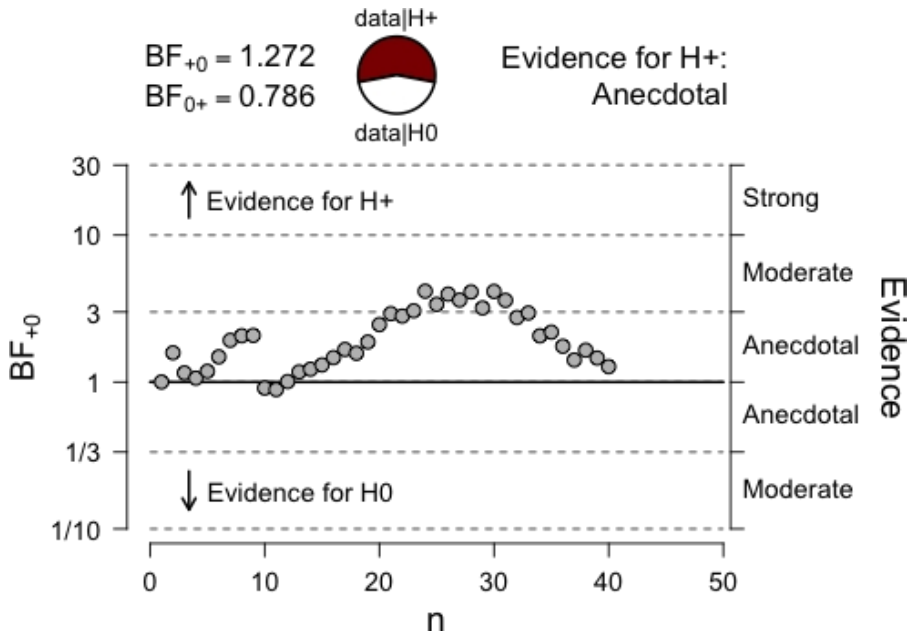

Figure 2: Sequential Bayesian one-sample t-test analysis on the percentage of winning pictures in 40 subjects.

Our hypothesis could not be verified, so we are also concerned with exploratory analysis. In micropsychokinesis research, it is common to observe the effect in more detail over time and to analyze changes (Maier & Dechamps 2017). The comparison of the middle runs with a) the first three runs and with b) the last three runs showed significant results with $p < .001$ in the two-sample T-test, i.e. significantly more images were shown in the middle run than at the beginning and at the end. However, the comparison of the first and last runs again showed

no significant result with p=.706. There could be a pattern here that occurs in the form of an alternation of influence and no influence.

Using the questionnaire, we recorded the motivation of the test subjects to take part in the test (first question) and the motivation to win (second and third questions) using inverse Likert scales from 1="very high" to 8="not at all". The first two questions measured approximately the same motivation component, which is also shown by the significant correlation between the two images (r=.754 and p< .001). On average, the test subjects ticked 2.3 for the first question and 3.2 for the second and third questions. A correlation between motivation and winning images could not be established, as the correlation between the winning images and the response values did not produce any significant results. The correlation of winning pictures with answer values of the first two questions yielded values of r=.104 and p=.739 and winning pictures also hardly correlate with the third question, r=.037 and p=.819.

We tested the relationship between age and motivation and unexpectedly obtained a negative correlation of r= -.071 and p=.661, which means that older subjects on average ticked a higher value in the first question on motivation than younger subjects.

We were also unable to measure any difference in the influence of gender.

Discussion

The famous philosopher and mathematician Réné Descartes established a connection between mind and matter back in the 17th century - he postulated that an otherwise chance-based outcome of a gambling situation could be influenced by a positive attitude on the part of the gambler.

(Davidenko, 1990). These forms of interactions between mind and matter have been subsumed under the term micro-psychokinesis (PK) and have been both theoretically illuminated (Atmanspacher, Römer, & Walach, 2002; Penrose & Hameroff, 2011) and empirically investigated over the last decades (D. Radin, 2006; D. I. Radin & Nelson, 1989; Dean Radin & Nelson, 2003; Rhine, 1944; Varvoglis & Bancel, 2015). Based on the concept of micro-psychokinesis, in our study we investigated the possible influence of an unconscious mental state on the probability system of quantum-based chance. We expected that in a sweepstakes paradigm, an unconscious win-seeking attitude of subjects, previously triggered by the announcement of a prize in the form of candy (Smarties), would influence the generation of images by a quantum-based true random number generator (tRNG). Thus, we hypothesized that subjects would see a significantly higher proportion of images showing a winning situation than the random probability of 50% (H_0: $p(win) \leq 0.5$; H_1: $p(win) \geq 0.5$) compared to images showing a losing situation.

The result of the Bayesian one-sample t-test shows a Bayes factor of $BF_{10} = 1.272$, which means that the alternative hypothesis H_1 is about 1.2 times more likely than H_0. In contrast, the Bayes factor of H0 is $BF_{01} = 0.786$. In general, these results support the validity of the null hypothesis, since the Bayes factor for the alternative hypothesis is considered very low based on the results of other studies that investigated the influence of observer effects on quantum-based random generators (Radin & Nelson, 1989; Radin & Nelson, 2003), and therefore a deviation of the proportion of winning images from the random probability of 50% cannot be assumed, especially since the Bayes factor for the alternative hypothesis is also very low.

difference between the two Bayes factors is also small. At this point, however, it should be noted that due to the expected small effects of micro-psychokinesis, a very high number of subjects was often collected in other research studies in order to ensure a high effect size and test strength (power). In our study, a Cauchy-distributed effect size r of .1 ($\delta \sim Cauchy(0, .1)$ was determined a priori so that a small effect can already be made visible, but we only surveyed 40 subjects, which results in a low test strength and considerably limits the significance of the results.

Therefore, the result of the Bayesian one-sample t-test cannot be used to clearly conclude that the effect does not exist. Even with a small sample size of 40 subjects, our results suggest at least an anecdotal effect of the alternative hypothesis $H1$. The average number of winning pictures seen ($m = 101.1$), our representative sample with an approximately equal number of male and female subjects and participants of different age groups (6-59) and the attention of the subjects ensured by breaks between the runs and controlled by the experimenters indicate that the presence of mind-matter interactions in the sense of micro-psychokinesis cannot be ruled out in our data.

In general, previous research (Dean Radin, Nelson, Dobyns, & Houtkooper, 2006a, 2006b; Schub, 2006) shows that there is a lively controversy and strong skepticism in the paranormal science community about the presence of micro-psychokinetic effects. In particular, the effects of mental states on quantum-based randomness suggested in meta-analyses (Radin & Nelson, 1989; Radin & Nelson, 2003) have been criticized as already

The heterogeneity of the studies is often criticized (Bösch et al., 2006; Schub, 2006) - studies showing different experimental quality and the use of different types of quantum generators could not be compared in a differentiated way. It is also criticized that the micro-psychokinetic effects shown in research studies could be subject to a biased publication perspective (Bösch et al., 2006), as only significant studies are published and a number of non-significant results are disregarded. Finally, failed replication attempts (Maier & Dechamps, 2017a) as well as studies with high test power and a high number of participants, which showed no significant effect and a Bayes factor very strongly in favor of the null hypothesis (Maier & Dechamps, 2017b), are an important reason to assume that mental unconscious states actually have no significant influence on probability systems. Following these aspects and results, an actual effect seems largely implausible despite the fact that in our study the probability of an effect was a minimal factor higher than that of a null effect.

In our study, the offer of a prize in the form of Smarties and the tracking of the proportion of positive images across all 10 rounds (note-taking) during the test created a win-oriented and motivated mental state in the test subjects. We assumed that the desire to count as many winning pictures as possible is stimulated by these two factors to a sufficiently high degree on an unconscious level, although the subjects mostly did not consciously believe that they could influence the output of the pictures. This is in line with the work of Maier and Dechamps (2017b, 2017a), who emphasize the unconsciousness of the mental states influencing a quantum generator. One limitation of our study is that

With regard to the elicitation of the motive to win, the extent of the desire to win in a gambling situation can vary greatly between individuals. For example, certain character traits have been associated with a high motivation to win and a high willingness to participate in betting and lottery games or to engage in competitive situations in various areas (Houston, Harris, Howansky, & Houston, 2015; MacLaren, Ellery, & Knoll, 2015), which were not taken into account in our study. The prevailing mood of the subjects during the test and the lack of variety in the visual stimuli - recurring 10-win-displaying and 10-loser-displaying pictures - could also be classified as confounding variables.

In order to quantify the extent of the subjects' profit-oriented attitude, at least from their subjective point of view, we used a questionnaire at the end of the test. The high average motivation of the test subjects to participate in the study ($m = 2.3$) and to count many winning pictures ($m = 3.1$) shows that it can be assumed that our test subjects are generally motivated and that the extent of the previously described confounding variables may not be significant.

As part of our exploratory analyses, we examined various aspects of our study in order to be able to differentiate the implications of the effect of micro-psychokinesis. No significant Pearson correlations could be found with regard to the influence of age, gender, the degree of motivation to participate in the test (questionnaire: question 1) or the degree of motivation to see many winning pictures during the test (questionnaire: questions 2 & 3) on the output of the quantum generator. The strength of the profit-oriented condition and demographic data therefore do not appear to have any

influence on the winning pictures and thus have a micro-psychokinetic effect. However, the temporal course of the psychokinetic effect could be a decisive factor of micro-psychokinesis, since according to the result of a t-test for dependent samples, the proportion of winning pictures in the middle runs (4-7) was significantly higher on average than in the first runs (1-3) and in the last runs (8-10). This results in a roughly wave-like changing effect over time, which is also visible in the sequential analysis of the Bayesian t-test (Figure 2). An oscillatory changing effect over time (increase and decrease of the effect) was already observed in the data of Maier & Dechamps (2017a, 2017b) and led the researchers to develop the theoretical assumption that such effect patterns result from the concept of entropy, which counteracts the original micro-psychokinetic effect and therefore leads to fluctuating increase-decrease patterns of the effect over time. Although the data from our study are consistent with this assumption, the small number of subjects and the short duration of our study do not allow us to make any assumptions about the stability of the wave-like temporal effect. Nevertheless, we would like to emphasize the relevance of the factor of time as an influencing criterion of micro-psychokinesis, which should possibly be considered in future studies and further investigated both theoretically and empirically.

In summary, no evidence could be found for our hypothesis that a winning-oriented mental state of subjects in a lottery paradigm has a significant influence on a quantum-based random number generator. This argues against the concept of micro-psychokinesis, which postulates an influence of the human mind on probability systems, and is consistent with frequent

This is in line with the skepticism and criticism expressed about empirical studies of micro-psychokinetic effects (Alcock, 2011; Bösch et al., 2006). However, due to the low test strength (power) resulting from our small number of test subjects and possible methodological deficits in our study, it cannot be concluded that micro-psychokinetic effects do not exist. For future research, we suggest a more detailed inspection of quantum-generated outputs, especially with regard to the temporal course of observer effects, as well as a high number of participants in order to investigate basic assumptions of micro-psychokinesis beyond changes in average values. The induction of unconscious mental states could also be monitored in the future by means of visceral measurements (heart rate, respiration) in order to link unconscious mental processes with a biological component and to achieve a higher validity of any effect that may occur. Since our results neither clearly speak for nor against an effect of micro-psychokinesis, the question of whether and to what extent the human mind influences physical matter seems to remain a mystery of paranormal scientific research for the time being.

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Appendixes

Appendix A: Pre-registration of the study

Appendix B: Stimulus material

Appendix C: Questionnaire on the extent of motivation

Appendix D: Data table for the statistical analysis