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A Forced-Choice Precognition Experiment with Selected Cohorts[1]

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Abstract: *Objective***.** We report a pre-registered forced-choice precognition study to test a novel collaborative platform for psi experimentation. The study compared a cohort of experienced meditators and a cohort selected merely for its interest in participating in the study. *Method***.** The Internet-based platform, Psi@Home, was developed to allow participants to contribute at-home experimental sessions using custom software. Each session comprised 20 forced-choice trials. Eighty sessions per cohort were collected for the pre-registered study and the hypotheses for each cohort were the increase relative to MCE of: 1) the variance of session hit rates, and of 2) the total hit rate. A third hypothesis predicted a higher variance of session hit rates for the meditator cohort. Hypothesis 1 was confirmatory and the others were exploratory. *Results***.** Only hypothesis 3 was confirmed (p = .03). However, 90 tryout sessions showed a markedly strong increase of session variance (p = .00003). *Conclusion***.** We successfully tested a novel platform for collaborative psi experiments. Two pre-registered cohort studies found no direct evidence for a psi effect. However, for tryout data whose collection was specified in pre-registration using the same participants and protocol, variance across sessions was highly significant. Differences in participant attitudes during the two periods of data collection may account for the discrepancy.

Keywords: psi, anomalous cognition, precognition, forced-choice, selected participants, meditation, psi-missing

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Highlights

- A novel platform for running psi experiments with selected cohorts was developed.
- The Internet-based Psi@Home platform is available to outside researchers.
- We completed a study of 160 sessions with 47 participants within a month.
- A strong variance anomaly was found in tryout data but not in the formal study, possibly because of uncontrolled psychological variables.
- The variance effect is consistent with a mixture of psi-hitting and psi-missing across sessions.

In recent years, new meta-analytic studies have strengthened the evidence for psi effects from free-response protocols such as remote-viewing and the ganzfeld (Storm & Tressoldi, 2020; Tressoldi & Katz, 2022; Tressoldi & Storm, 2024). The evidence is further supported by simulations of meta-analyses that control for publication bias and other methodological issues such as multiple testing, which are known to compromise meta-analytic results (Bancel, 2018; Bierman et al., 2016). For experiments that use other protocols, such as forced-choice studies, in which participants register a choice among a predefined set of randomized alternatives (for example, guessing the outcome of a coin flip), the cumulative results are quite positive, given the very different procedures and effect sizes that these protocols entail (Bem et al., 2015; Storm & Tressoldi, 2023).

Despite the accumulated evidence, the challenge of replicability in parapsychology remains. The success of one-off experiments is far from guaranteed, even when studies are presumably well-powered. For example, recent attempts at registered, large-scale replications failed to produce an effect (Kekecs et al., 2023; Schlitz et al., 2021). This state of affairs is not new and the coexistence of strong evidence and replication uncertainty has been recognized in the psi literature for a long time, particularly for forced-choice and micro-PK protocols (Bem et al., 2015; Bosch et al., 2006). For many who are inclined to accept the evidence, these replication difficulties highlight the challenge in understanding and creating the necessary conditions for psi to occur. For others, these difficulties lead to an interpretation that psi is real, but somehow resistant to replication (Walach et al., 2022). In contrast, many in mainstream science who are skeptical of the psi hypothesis consider the assurance of ready replication to be a *sine qua non* to accept the reality of an effect. For these researchers, the replication difficulties in psi research derail any consideration that the reported data anomalies represent real phenomena (e.g., Rouder & Morey, 2011).

There has been much effort, over the years, to find better methods to produce psi effects in the laboratory (Palmer, 2015). Among the successes are the aforementioned ganzfeld and remote viewing protocols. These rely on techniques to induce favorable psychological dispositions that are thought to produce psi-conducive mental states. However, notable drawbacks include the high cost in human resources and the considerable tacit knowledge required of experimenters. Even moderately well-powered ganzfeld experiments are quite onerous, so that any progress beyond adding to the evidence tends to be incremental, at best. Consequently, single one-off replications of high power are extremely resource intensive and are rarely attempted (for the report of a recent large, albeit modestly powered, study see Watt, 2024).

Other protocols, such as forced-choice ESP, micro-PK (typically with random sources such as hardware RNGs), and physiological presentiment have higher data rates and are often less time-consuming (Jahn et al., 2007; Radin & Pierce, 2015). They are also able to address a wider range of research questions, but the effects are less stable and success often relies on the efforts of skilled experimenters (Schlitz et al., 2006; Varvoglis & Bancel, 2015). This seems to preclude a recipe for general replication and even confounds the interpretation of data because it begs the question of whether psi is sourced in the participants, those running the experiments, or a combination of the two.

In summary, nearly a century of psi research has yielded a variety of methods that have produced an abundance of evidence, yet the methods are unsatisfactory because they are either resource intensive and thus ill-suited to process-oriented work (research into the conditions needed to stabilize or enhance psi effects), or they yield effects that are difficult to produce and investigate because of uncontrolled factors that increase variability. In consequence, trade-offs between effect size and data rate, reliability and design flexibility, and cost and replicability impede progress.

The experiment reported here is part of a long-term effort at our Institute to address these problems. The program focuses on developing effective induction techniques (meaning the induction of a psi-conducive mental state in participants) on the one hand, and data-collection methods that are faster and easier to implement, on the other, while maintaining overall flexibility in experimental designs. The strategy is to bring together the most fruitful elements of diverse psi protocols to mitigate the negative trade-offs and allow for experiments that are flexible, reliable, and more practical in terms of resources.

Our preferred framework for this program is the forced-choice approach because it allows for higher per session data rates and affords rich data structures for subsequent analyses. Of course, as we know, the potential disadvantage of this approach is the risk for much smaller and less stable effect sizes (Storm & Tressoldi, 2023). If one contrasts the "subject optimization" procedures of remote-viewing or ganzfeld trials with the repetitive task-feedback cycle of forced-choice protocols, it seems plausible that the latter can induce potentially psi-inhibitory conditions: boredom, loss of motivation, stress about trial outcomes, and so forth.

Although plausible, this understanding of the low effect sizes in forced-choice experiments lacks unequivocal empirical support. To assess its validity, we need protocols that can efficiently collect large amounts of data while systematically modulating appropriate psychological variables. A key objective of our research program is to study this question by providing researchers with a flexible yet powerful tool to test hypotheses concerning psi correlates and moderators.

In short, then, the overall aim of our program is to explore how to integrate psi-conducive factors into data-efficient forced-choice protocols. The practical objective here is to develop reliable protocols that will not only speed progress but also render psi research more accessible to outside researchers.

A more theoretical objective is to resolve the tension between views that consider psi's elusiveness to be merely circumstantial versus those that treat it as fundamental. In particular, a current proposal considers psi effects to be inherently elusive and by their nature resistant to replication (Lucadou et al., 2007). In this view, attempts to develop reliable protocols are likely to fail (Walach et al., 2022). Our working assumption is that this view is incorrect, or at least too categorical and our hope is that the protocols we are developing will provide clarification on this issue.

Two factors that we focus on are experientially immersive psi tasks and the selection of volunteers. Although these have been studied previously, we make some innovations and employ a design that attempts to optimize both in a forced-choice protocol. The immersive presentation we use is based on prior development work in our laboratory (Bancel, 2019; Varvoglis et al., 2013). It has been adopted for the current experiment and is described in the Methods section. Selecting participants for their potential to produce psi effects has a long history in parapsychology. Instances of gifted volunteers who have performed well under a variety of circumstances are well-documented (e.g., May & Marwaha, 2018). However, an obstacle to replication with gifted volunteers is that they are rare and often unable (or unwilling) to produce effects on demand. Selecting persons by traits that favor psi performance is another avenue that has been studied. Although there are indications that selection by traits may enhance results (Baptista et al., 2015; Zdrenka & Wilson, 2017), to our knowledge no inventory or survey reliably predicts psi performance.

For the present experiment we selected two volunteer cohorts based on life experiences and attitudes thought to be associated with psi performance. The two criteria are extensive experience in meditation, and interest in psi phenomena. The practice of meditation has long been associated with psychic abilities, dating back at least to the writings of Patanjali (Woods, 1927). Parapsychological studies with meditators have given indications of enhanced performance, but there is as yet no conclusive evidence that meditators outperform the general population (Roney-Dougal, 2015). One difficulty that arises in parapsychological studies with meditators is assessing people's meditation experience. An approach to this problem is presented in the Methods section. The second cohort we study is a group of persons selected for having interest or openness to psi phenomena. Within parapsychology, a generally accepted notion is that people who consider psi effects to be real, or at least a sensible possibility, will perform better on psi tasks than those who are opposed or resistant to the idea. Although meta-analytic support is not firmly conclusive (Lawrence, 1993; Storm & Tressoldi, 2017; Zdrenka & Wilson, 2017), evidence for this distinction is encountered widely in the literature. We are guided by this hypothetical distinction in setting a broad criterion for the second "Open" cohort

Finally, the study takes into consideration that misdirection of psi effects can contribute to the variability of results. In forced-choice experiments, true psi effects may produce data that deviate opposite to the intended target direction. There is considerable evidence for "psi-missing," as it is called (Carpenter, 2004; Rhine, 1969; Storm & Ertel, 2001), and its presence can weaken the statistical power of directional tests. Therefore, our psi hypotheses include tests of variance that have been devised to optimize statistical power under models of psi-missing.

Method

We developed and tested a platform for running home-based studies with selected cohorts that employs a modular approach to experimental design. By modular we mean that the platform allows for the independent design and configuration of three essential experimental elements: a cohort, the research team, and an experimental task. In this section we describe: 1) the structure and technical aspects of the platform, 2) a computer application used by cohort members to run at-home sessions, 3) the process of cohort selection, 4) the experimental hypotheses and pre-registered data analysis, and 5) the procedure for running studies with cohorts.

The Psi@Home Platform

The experimental platform, which we name Psi@Home, consists of a downloadable application, its interface to a web-based server, and a website used for cohort recruitment and management. The application, described below, is bundled into a custom installer package for distribution to cohort members. The package includes custom software to manage login, security features, and data communication with a cloud server at Amazon Web Services (AWS). The AWS account serves as a repository for all experimental and cohort login data. It also allows to deploy and maintain multiple experiments from one integrated platform, and to manage accounts for multiple experimenters.

The website https://imiresearch.fr is the public face of the platform. The website provides general information about the research, sign-up forms for recruitment and information for individual cohorts or current experiments. It also serves as a tool for researchers to collaborate with and manage specific cohorts.

The Selfield Application

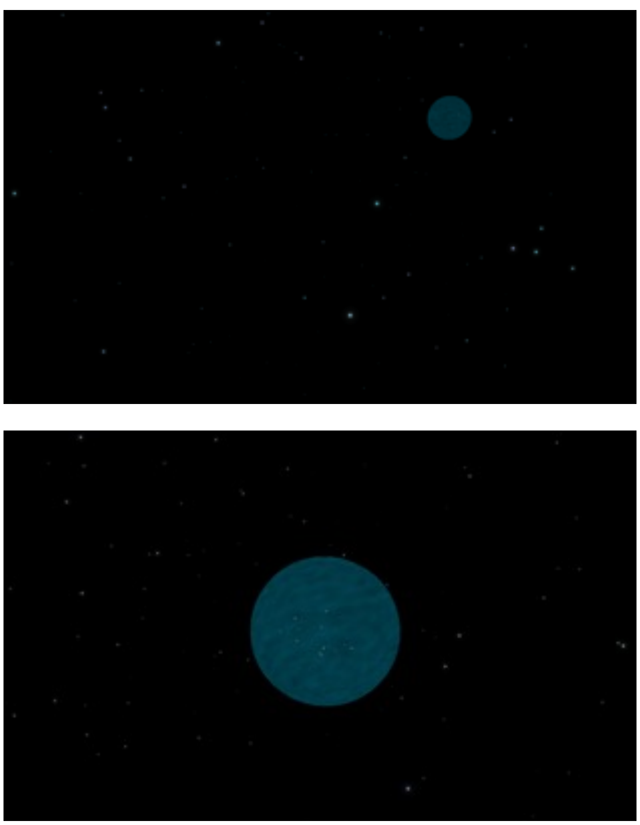
At the heart of Psi@Home is an application used to run at-home experimental sessions. A key feature of the platform is the ability to create and deploy different applications. This permits wide flexibility in designing studies adapted to particular research questions. In this work, the application consists of a binary test of precognition. Named the Selfield for its immersive quality, the application fluidly presents successive forced-choice trials via an engaging graphic interface. The Selfield is designed to maintain participants' attention in the task and lessen boredom. In-person laboratory tests have shown that participants' experience with the Selfield is almost uniformly positive (Varvoglis et al., 2019).

Each formal Selfield session consists of 20 trials in which participants interact with a graphical "target container," which is presented on the computer screen as a luminous, floating blue sphere. Participants are asked to choose the moment to reveal a target hidden inside the container via a keystroke. The container is then revealed to be either empty or contain the striking image of a personage. Finding a personage is considered a "hit" whereas an empty container is considered a "miss." Each instance of hit or miss is determined by a pseudo-random process that is seeded anew for each trial using input from the millisecond timing of two participant keystrokes (the first keystroke readies the choice and the second executes it). After the reveal, the Selfield proceeds to the next trial until all 20 trials are completed. A session lasts about 15 minutes, but participants may take as long as they wish to complete the trials. A soothing background audio of flowing water and wind chimes plays throughout the session, and hits are punctuated with the sound of a gong.

Instructions explain that the experiment tests for psi and that the participants should try to "meet as many personages as possible" (i.e., obtain hits). The null expectation of the pseudo-random generator is a 50% hit rate. The psi effect tested by the Selfield is for an alteration of the null hit rate. The task is considered precognitive because the pseudo-random process to determine a hit or miss occurs *after* the participant's choice (via the keystroke inputs) is made (see Varvoglis et al., 2019 for a detailed description).

Figure 1

The Target Container of a Selfield Trial



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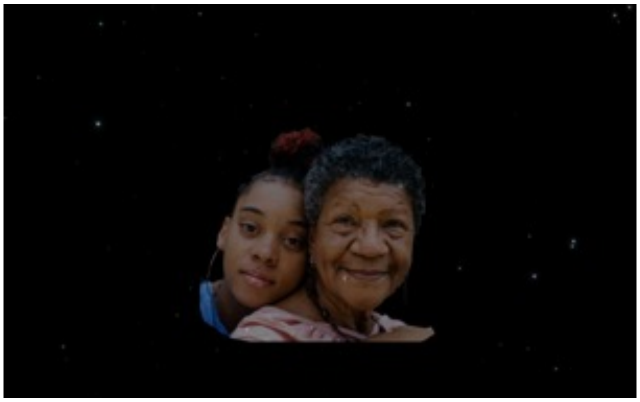
Note. The target container for a Selfield trial is a blue luminous ball that floats through a starry space. The left image is a snapshot of the container on its random trajectory at the start of a trial. The right image shows the position of the container after the first participant keystroke, which brings the container forward for observation. The container moves smoothly to the foreground and hovers in place, awaiting the second keystroke at which point the participant will see either the image of a personage (a hit), or a dissolving of the container (a miss).

Figure 2

Feedback Presentation for Hit and Miss Trials



Note. Feedback follows a participant's decision to reveal the trial result with the second keystroke. The left image is an example of a hit showing the appearance of a personage(s). The bottom image shows the dissolving of the container ball when the result is a miss.

Cohort Recruitment

Cohort recruitment entails two steps: an initial contact and a tryout period. Once cohort criteria are set by the experimental team, potential cohort candidates are contacted by appropriate outreach, such as postings on social media or websites thematically aligned with the likely interests or activities of the cohort group. Interested individuals are directed to the Psi@Home website where they submit a form to enlist as cohort candidates, specify their qualifications for the cohort, and communicate information about their personal macOS device. If the personal information conforms to the cohort criteria, a tryout period is initiated during a video meeting with a team member in which candidates receive a personal introduction to the project, and then install and live-test the Psi@Home application. In the week following the video meeting, candidates must complete a tryout of two full experimental sessions. Those who complete the tryout may join the cohort, meaning that they will receive invitations to participate in future studies.

The recruitment procedure plays a central role in the conception of Psi@Home. It serves to motivate participants and create a connection to the project, and to cull unmotivated candidates before experiments are run. We believe that the quality of these interactions can play a role in experimental outcomes. A long-term goal is to build a database that can help assess how qualitative procedures such as recruitment may impact the results of psi experiments.

The current study established three cohorts: experienced meditators, a general public "Open" cohort, and a third Psychic Arts cohort (which was combined with the Meditator cohort for the formal experiment). The recruitment procedure was first tested with 5 meditators personally known to the PI (Author 1). Their feedback allowed to refine and clarify the process from a user perspective. Also, data from the resulting 10 tryout sessions were used to test analysis procedures in preparation for the formal experiments to come.

Members of the meditator cohort were selected from a community of Buddhist practitioners that maintains a database of individuals' progress. All had 15 to 40 years of meditation experience, maintained daily home practice, practiced the same techniques of mindfulness, visualization and mantra, had completed many group retreats, and most were meditation teachers. The PI has a similar experience and knew personally most of the cohort members. The cohort's depth and similarity of practices, as well as the familiarity shared by the PI, is a rather unique instance in psi studies with meditators.

The Psychic Arts cohort consists of persons involved professionally in mediumship or clairvoyance practices, or persons actively involved in training for these or similar psychic arts. Many were recruited among members of the International Remote Viewing Association (IRVA) via presentations by the PI or emails to IRVA members. The Open cohort for the general public was solicited from email lists of the Institute's sister association (Friends of the Institute) that is active in educational outreach about psi in France, from announcements on the website of the Institute of Noetic Sciences, and from online presentations in English by the PI.

Recruitment for the Meditator cohort was conducted July to early October 2022. Of 81 persons contacted, 20 installed the Selfield application and 19 joined the Meditator cohort. The Meditator cohort generated 38 tryout sessions during recruitment.

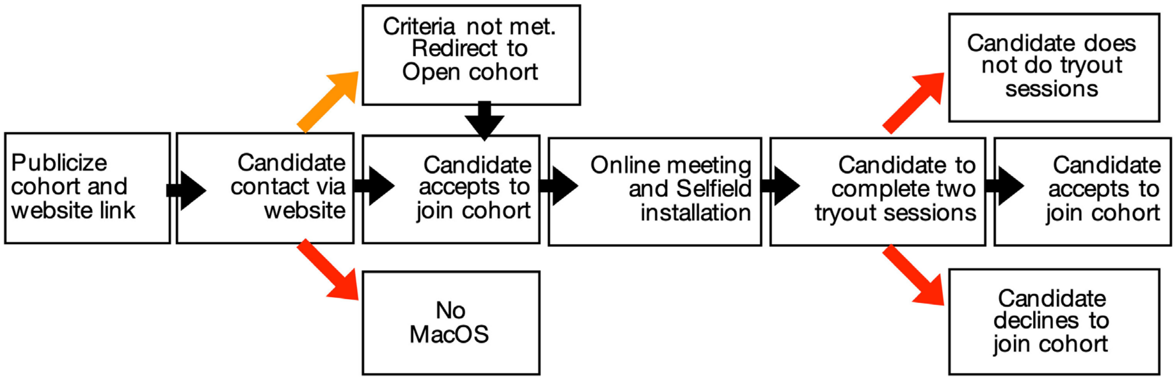
Recruitment for the Psi Arts cohort was conducted from August to October 2022; 14 persons installed the Selfield application and 11 joined the Psi Arts cohort. The Psi Arts cohort generated 20 sessions during recruitment.

Recruitment for the Open cohort was conducted from August to October 2022; 27 persons installed the Selfield application and 23 joined the Open cohort. The Open cohort generated 58 sessions during recruitment.

We estimated that a cohort pool of about 25 members would be needed to complete each study. Because the Meditator and Psi Arts cohorts were below this mark at the end of the 3-month recruitment period, a decision was made to combine the two cohorts for this first experiment (in the following, the combined cohort is referred to as the Meditator cohort, unless otherwise stated). Of the 30 members of the (combined) Meditator cohort, 24 joined the experimental study (22 females and 2 males; mean age 58.2, *SD* = 9.4), and all 23 Open cohort members participated (18 females and 5 males; demographic data were not collected for the Open cohort. However, ages estimated from video interactions range from 20s to 60s). No participant was paid.

Figure 3

Flowchart of the Cohort Recruitment Process



Note. Red arrows indicate paths where a candidate does not join a cohort. The orange arrow indicates cases where candidates do not meet cohort criteria and are re-directed to the Open cohort that accepts all interested candidates.

Hypotheses and Analyses

Before the experiment, data from 50 tryout sessions were analyzed to finalize hypotheses. Three types of 1-tailed hypothesis tests were set:

- The variance of session hits for Meditator and Open cohorts will exceed null expectation (with $p < .05$). Confirmatory, noted in the pre-registration document as H1 and H2.
- The Meditator cohort variance will be greater than the Open variance with $p < .05$. Exploratory, pre-registered as H5.
- Cohort hit rates will exceed >50%, with $p < .05$ on a direct binomial test. Exploratory, pre-registered as H3 and H4.

The session variance is defined as the variance of the values of excess hits across sessions. That is, session hits are subtracted from the null expectation (which is 10 for a session of 20 trials), and the normalized sum of squares is the session variance (see Appendix A for mathematical statements of these terms). Note that our session variance statistic differs from the standard sample variance that is typically calculated relative to the sample mean, and not the theoretical (null) mean as we do here.

The variance hypothesis tests return a *p* value for the session variance. To maintain nearly equal weights of sessions, sessions with less than 17 recorded trials were discarded (about 5% of sessions; trials occasionally failed to record because of intermittent WiFi connections), and the discard procedure was specified in pre-registration. The session variance approximately follows a chi-squared distribution, and herein we refer to this statistic as χ^2. The *p* values can be estimated analytically from the chi-squared distribution and we use these as checks on more precise Monte Carlo (MC) estimates of the *p* values. Full details are available in Appendix A and in the protocol pre-registration document (http://www.koestler-parapsychology.psy.ed.ac.uk/Documents/KPU_Registry_1072.pdf).

Study Procedure

Before launching the experiment, the study protocol was reviewed and accepted by the host institution's (the IMI) ethics committee. The authors were polled to determine their a priori beliefs about the likelihood that the experiment would find evidence

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for a psi effect. On a scale of 1 to 5, with 1 being a strong belief to find no evidence and 5 being a strong belief to find evidence of psi, authors 1, 3 and 4 reported a belief rank of 4 and author 2 reported a belief rank of 3.

Studies began with an email invitation to registered cohort members that described the study, the launch date and duration, the requirements for participation (e.g., the number of sessions to complete), and gave a link to an online consent form. Cohort members joined the study by accepting the invitation, completing the consent form, and self-installing a minor update of the Selfield application that set in software administrative parameters specific to the study. On the launch date, participants were invited to an optional collective online video gathering to clarify any remaining questions and provide a final encouragement to the group. The updated Selfield applications were then activated from the cloud server and participants were free to contribute sessions at the times of their choosing. In general, our design is for studies to last 4 to 6 weeks, with participants individually contributing 4 to 6 sessions. Participants receive an email reminder if they lag in completing sessions, but care is taken not to pressure people for results. Studies assume that some will complete less than the requested number of sessions and allowance for this eventuality is incorporated into the study design. At the study's end, participants are invited to an optional closing video call where they can be thanked and share their experiences with the group. As a final step, participants fill out a brief online feedback survey to assess their experiences.

The experiments we report here were pre-registered with the Koestler Parapsychology Unit Study Registry (http://www.koestler-parapsychology.psy.ed.ac.uk/Documents/KPU_Registry_1072.pdf). The number of sessions for each cohort experiment was set to 80, and participants were asked to complete 4 to 6 sessions of 20-trials each. We allowed for the collection of more than 80 sessions per cohort, but the formal hypothesis tests were performed on the first 80 cohort sessions only, as per the pre-registered procedure.

Results

A major objective of our study was to test the Psi@Home platform and assess its potential for carrying out psi studies quickly and efficiently. The studies ran smoothly, without major difficulties or unexpected problems, and the demands on the experimental team were less than we anticipated. Study invitations were emailed on October 10, 2022, and we were able to launch the formal studies a week later. Data acquisition for the cohorts, comprising 80 formal sessions each, was completed within 30 days. The Psi@Home platform surpassed our expectations for study execution and management.

A second objective was to assess the recruitment procedure for establishing cohorts. Through early October 2022, we received 104 website submissions for cohort candidacy, of which 61 (59%) installed the Selfield application during an online video call. The candidate attrition rate at this step was mostly due to people who lacked access to a computer with macOS. Of those who installed the application, 53 completed the tryout sessions and joined a cohort (87%). Altogether, 47 cohort members participated in our formal study (89% of the cohorts). Roughly speaking, we converted about half of contacts to cohort membership, and nearly 90% of the cohort members were available for the experiment.

Pre-Registered Confirmatory Hypotheses

The confirmatory hypothesis of an increase in session variance was not confirmed for either cohort. The session variance for the Meditator cohort was slightly greater than the null MCE (mean chance expectation) of 80, $\chi^2(80) = 89.43$; $p = .22$; 40k Monte Carlo iterations. The χ^2 for the Open cohort was moderately lower than the MCE, $\chi^2(80) = 58.13$; $p = .97$; 40k MC iterations.

Pre-Registered Exploratory Hypotheses

Hypothesis 2 (larger session variance for the Meditator cohort) was confirmed, $\Delta\chi^2(80) = 31.30$; $p = .032$; 100k MC iterations, where the null MCE value is zero.

Hypothesis 3, a positive bias of the hit rates, was not confirmed for either cohort. The Meditator study generated 780 Hits on 1597 trials, hit rate = 48.8%; exact binomial $p = .83$, one-tailed. The Open cohort study generated 821 Hits on 1593 trials, hit rate = 51.5%; exact binomial $p = .11$, one-tailed.

Non-Registered Exploratory Analyses of Tryout Data

Tryout data are those sessions completed by each candidate during recruitment. This includes 10 sessions of planned pilot data from the first 5 participants of the

Meditator cohort. The goal of that small pilot study was to test cohort management procedures, and the analysis algorithms for hypotheses 1 and 3 (session variance and total hit rate). Unexpectedly, the 10 pilot sessions gave indications of a psi effect, with the zero-mean variance (see Appendix A) well above the MCE of 10, $\chi^2(10) = 18.2$; $p = .016$; 40k Monte Carlo iterations. For these sessions, there were 89 hits on 200 trials (hit rate = 44.5%; exact binomial $p = .95$, one-tailed).

The pilot result prompted a further analysis of tryout data when 50 sessions (contributed by candidates of all cohorts) had been accumulated, with the results for the 50 sessions being highly significant, $\chi^2(50) = 94.83$; $p = .000085$; 2M MC iterations. There were 506 hits on 994 trials, hit rate = 50.9%; exact binomial $p = .295$, one-tailed. This analysis was subsequently used as the basis for the pre-registered protocol, which set the number of sessions for each cohort to 80 and designated the variance test as a confirmatory hypothesis.

After the experiment ended, the analysis of tryout data was updated for all 90 sessions completed by cohort members who participated in the study, χ^2 (90) = 150.72; $p = .000031$; 2M MC iterations. There were 905 hits on 1789 trials, hit rate = 50.6%; exact binomial $p = .318$, one-tailed. Note that 4 tryout sessions which had less than 17 trials were not included in the analysis, per the pre-registered discard rule.

Assessment of the Tryout Data

For the 90 recruitment tryout sessions, hit rate = 50.6%, $p = .318$, trial $N = 1789$; $\chi^2(90) = 150.72$, $p = .000031$). The large variance is 4 standard deviations from the MCE of 90 ($p = .000031$ corresponds to a z-score of about 4, and it is too extreme to ignore. At the same time, the hit rate does not show a significant deviation from the null hypothesis. One explanation consistent with the psi hypothesis is that a mixture of psi-hitting and psi-missing significantly increased the tryout session variance but not the overall hit rate and that psychological factors account for the lack of this effect in the formal study. We explore this interpretation with two models that mix psi-hitting and psi-missing in the Discussion, and then speculate on psychological factors that may have resulted in the different outcomes for the tryout and formal sessions.

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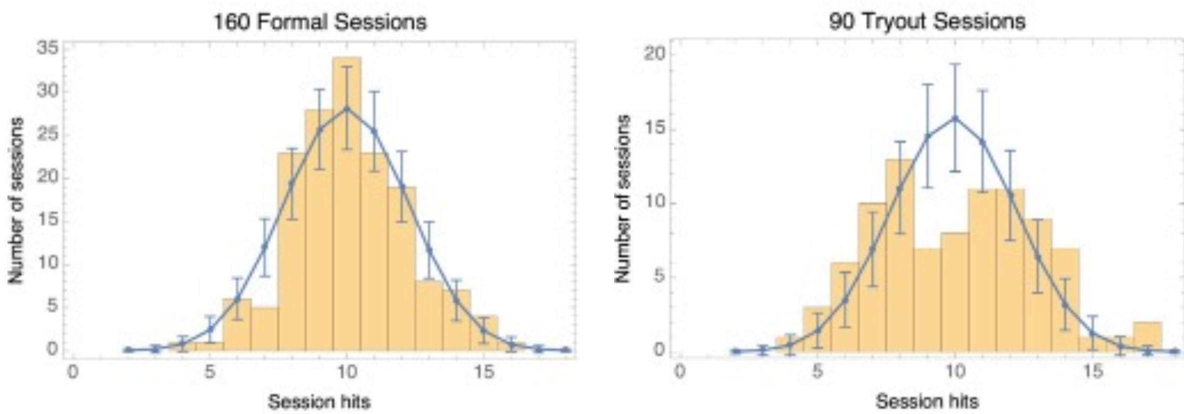
Figure 4

Comparison of Formal and Tryout Data



Note: Bars are frequencies of sessions with a given number of hits. The blue trace shows the expected frequencies under the null hypothesis and error bars are statistical uncertainties of one standard deviation.

Discussion

Our report addresses two research objectives. First, we tested the functionality of a new platform, Psi@Home, whose broad purpose is to facilitate the design and execution of psi experiments. Second, we used the platform to run a study with the goal of eliciting evidence for a psi effect and comparing two cohorts. We discuss the outcomes of each of these objectives in turn.

Assessment of the Psi@Home platform

In terms of functionality, the Psi@Home platform met all our design goals. The at-home Selfield application was successfully interfaced to our cloud-based data management system and the installer package we designed allowed for easy installation by the individual cohort users. The website created for cohort recruitment and management worked well for scheduling and email communication throughout the recruitment process, both within the project team and between team and cohort members. We have processed over a hundred contacts and guided scores of people through the process of joining cohorts. The recruitment process did prove to be somewhat longer and more time-consuming than hoped. Outreach did not generate contacts at the rate we hoped and video calls required more effort than expected.

However, the process was manageable and we believe the value of personal contacts between team members and participants compensated the effort. In particular, we believe the interactions with cohort members successfully clarified and motivated their participation. This was reflected in the results of a feedback survey. A question: “Were the instructions and description clear enough?”, resulted in an average score of 4.8 on a scale of 1 to 5 with 5 being “Very clear”. Our goal of a positive user experience was also met. A survey question “Did you enjoy using the Selfield app?” yielded an average response of 4.4; and “Would you recommend this to others?” yielded 4.5.

The decision to have candidates run two full experimental sessions before committing to a cohort was another valuable feature of the recruitment process. It allowed participants to have a good sense of how to operate the application before participating in a study and served on a few occasions to cull candidates whose motivation was short-lived. It also allowed a thorough verification of the technical integrity of each installation, which was important given the variety of computer configurations encountered. Clearly, recruitment was limited by the restriction to the Apple’s macOS platform, but this can be rectified by porting the application to a PC compatible format in the future. Indeed, of the initial contacts who did not do the installation, most were willing but lacked access to macOS computer.

The clearest measure of the platform’s success was the ease and rapidity of running the two formal studies. Three steps were required of each cohort member: response to an email invitation to join the study; the submission of a consent form and completing the software parameter update; and the accumulation of 4-6 experimental sessions. The steps were accomplished smoothly and quickly. After the invitations were emailed, the studies were ready to launch within a week. Once participants were informed of the launch, they began running sessions whenever they wished. The target of 80 sessions per cohort was reached in less than 30 days. During this time, the team monitored progress and sent a few reminders by email. There was very little further effort required by the experimental team and we attribute this success to the motivation and familiarity with the platform acquired by the cohorts during the recruitment process. This was precisely the outcome the project aimed for: to establish a pool of selected participants, experienced with the platform, who would respond enthusiastically to a subsequent call for study participation.

Ultimately, the Psi@Home project is intended as a “user facility” for psi experimentation that is available to external research teams (user facility is a term borrowed from the hard sciences that refers to institutional facilities, such as satellites and particle accelerators, that are available for use by competent researchers). This intent recalls the modular conception of the project whereby the research team is considered as one of three fundamental elements that compose a study. To this end, we have worked to make the platform user-friendly so that professional scientists can utilize it without too steep a learning curve or the need for special technical knowledge. To test this aspect, we separated the tasks of cohort and study management by cohort, whereby the PI (who designed all aspects of the platform) worked with the Meditator cohort, and two assistant team members (without technical knowledge of the platform), worked separately with the Open cohort. We found that the Open cohort managers were able to use the platform efficiently after a brief introduction and training period. They managed cohort recruitment and the formal study with only occasional assistance from the PI, and the progress tracked that of the Meditator cohort. We conclude that the platform will be transferable to external researchers, either for running experiments with existing cohorts, or for establishing new cohorts that can be used to study hypotheses of interest. The Psi@Home project will continue development work in this regard.

Formal Pre-Registered Hypothesis Tests

Turning to the results of data analysis, our confirmatory pre-registered hypothesis tests did not reject the null hypothesis. For each cohort, the session variance produced non-significant *p* values greater than .05. For the exploratory pre-registered tests, the one-tailed difference of variances for the Meditator and Open cohorts was significant with $p = .03$. However, we are cautious about inferring a psi effect from this exploratory result, given the fact that the corresponding confirmatory tests were non-significant. The difference in variance between cohorts – statistically modest and in the hypothesized direction – may well be a false positive: the probability under the null hypothesis of one or more of the five pre-registered tests returning a *p* value of $p = .03$ or less is about 14.2%.

The exploratory tests of hit rates were also non-significant. A noticeable difference between the Open and Meditator cohort hit rates (51.5% vs. 48.8%, respectively) yields a two-tailed *p* value of $p = .10$ (see Appendix A). We do not consider this post-hoc observation to be suggestive of an effect. Clearly, the registered study failed to find support for the hypothesized effects of psi-hitting, or a mixture of hitting and missing, notwithstanding the support for a variance difference of the cohorts. In summary, the analyses allow for competing interpretations: that the protocol did not evoke a psi effect at all; or that an effect was present but too weak to detect given the study size; or that a psi effect was present in a way not sensitive to our tests. More studies are needed to resolve these possibilities. However, the formal, pre-registered results contrast strongly with the data gathered during recruitment. Those data, collected with the same procedures and software, produced strong variance increases. We next discuss those results.

Models with Psi-Missing

As mentioned in the paper's introduction, psi-missing refers to outcomes that deviate opposite to the intended target direction. Psi-missing has been discussed in the literature since at least the 1960s (Rao, 1965; Rhine, 1969). Recurrent psi-missing can weaken statistical evidence for directional hypotheses such as tests of global hit rates and render directional effects difficult to detect. In contrast, the session variance can increase when either hitting or missing predominates within sessions. The session variance test is designed to detect this case. The test has been proposed previously (Timm, 1983) and used in other psi contexts (Storm & Ertel, 2001). Furthermore, studies in our laboratory (Varvoglis et al., 2013, 2019), have found weak evidence for an elevated variance in forced-choice sessions. Therefore, there are both theoretical and empirical precedents for using the session variance to test for mixtures of psi hitting and missing under this scenario. A feature of the test is its insensitivity to the proportion of hitting and missing: it returns the same result regardless of the relative frequency of hitting and missing sessions. This is a consequence of calculating the variance relative to the theoretical (null) mean, rather than the sample mean of the dataset. We leave a full discussion of the test's properties to a future publication.

We have shown that the variance test of tryout data strongly rejects the null hypothesis. We consider here two simple yet distinct models of mixtures of hitting and missing sessions that can give this result. Both models begin with the observation that largest impact on the variance comes from sessions with large hit rate deviations. The first model assumes that a small subset of sessions deviates substantially from MCE. This outlier model (model O) further assumes that there is no psi effect present in the remaining majority of sessions. A second model (M) attributes statistically a psi effect to all sessions, with a session's hit probability being either *prob* > .5, or (1-*prob*), depending on whether the session exhibits hitting or missing. If *prob* is large enough, model M also produces a significantly high session variance.

Therefore, both models increase the session variance by increasing occupancy in the tails of the distribution of session hit rates. We can demonstrate that the tryout data are consistent with this behavior: the tryout variance p value, p = .00003, increases to p = .03 if only the 6 most extreme of 90 sessions are removed (the p value further increases to p = .12 upon dropping the next 2 extreme sessions; the trimming is balanced, with half of the dropped sessions in each tail). That is, trimming the 6 most extreme tryout sessions yields, $\chi^2(84) = 106.7$, p = .032; hit rate = 50.4%, p = .38, which is a nearly complete attenuation of the variance anomaly. This observation supports the notion that the variance arises from a mixture of a few extreme hitting and missing sessions, in accordance with both models O and M.

If we assume, then, that the tryout sessions do mix hitting and missing psi effects, it is important to ask which model, O or M, better represents the data. The question is important because the goal of the Psi@Home platform is to elicit effects broadly, and this is consistent with model M but in conflict with model O, which assumes that effects occur only for rare outlier sessions.

To assess which is the better model, we first set parameters for models M and O so that the models accord with the experimental session variance. For model M, it suffices to set, with equal probability, a hit rate of either 60% or 40% (corresponding to hitting or missing, respectively) to each session. For the model O, 82 sessions are set to the null hit rate of 50%, and the 8 remaining sessions are set with hit values of ±5, ±6 or ±7 about the MCE of 10 hits. Details of the models are given in the Appendix. The models produce average global hit rates of .50 and mean session variances for M and O, respectively, of 158.5 ± 20 and 144.5 ± 23 (approximate one standard deviation errors). The hit rates and variances of both models accord with the tryout data values, hit rate = 50.6%; $\chi^2(90) = 150.44$.

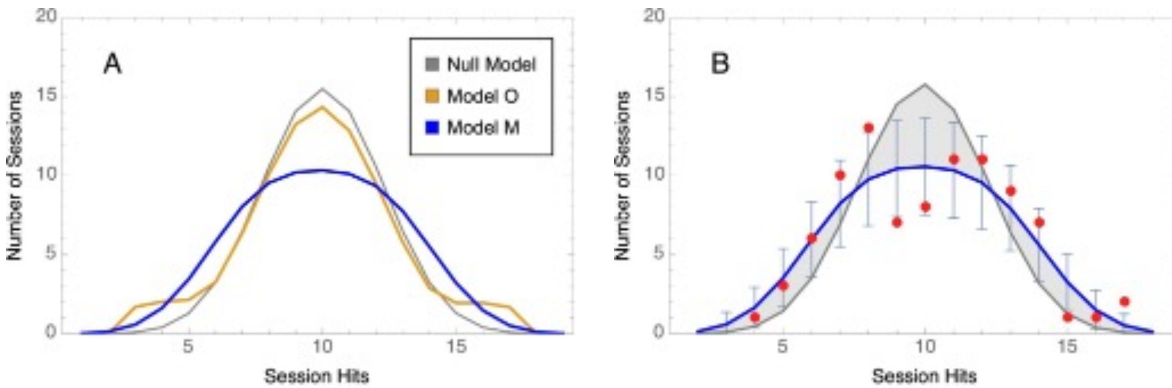
However, models M and O differ strongly at the distribution *centers*, where session hit values are 9, 10, or 11 (see Figures 5 and A.1). A statistic that can distinguish directly between the models is, therefore, the count of sessions with hits in the range 9 to 11. For the tryout data, the count is 26 sessions, and the expectations for models M, O, and the null are 31.4, 41.0 and 44.7 sessions, respectively. The one-tailed p values for a count of 26 or fewer sessions for models M, O, and the null are, respectively, p(M) = .139; p(O) = .00064; p(null) = .000045, so that both the outlier and null models are strongly disfavored (adopting a Fisherian application of the p value). Comparing models M and O directly, we find that the likelihood ratio of exactly 26 sessions favors model M by about 64:1. We therefore conclude that the tryout data are better represented by a model that attributes a psi effect broadly across sessions and participants. A model in which only a few exceptional sessions (or participants) drive the variance anomaly is not favored because it cannot explain the low number of sessions at the center of the hit rate distribution. The psi-missing model M therefore provides a plausible description of the tryout data. Whatever the interpretation, we find that the effect appears for both cohorts (see Tables 1 and 2. Of the 90 tryout sessions, there were 47 Meditator sessions and 43 Open sessions. The variance tests are significant for both groups, Meditator: $\chi^2(47) = 77.6$; $p = .0025$; 400k MC iterations; Open: $\chi^2(43) = 73.2$; $p = .0019$; 400k MC iterations. Last, model M has an effect size (hit/miss rates of 60/40 percent) comparable to other reported psi effects. A 60% binary hit rate is roughly equivalent to a ganzfeld 4-choice hit rate of 33% (see Appendix A). Meta-analyses of the ganzfeld give mean effects of around 32%, and subgroups of selected participants have hit rates as high as 40% (Baptista et al., 2015).

Assuming for the moment that our interpretation holds, it remains to explain why such a strong effect would not be seen in the pre-registered formal study. One possibility mentioned earlier is that psychological factors changed during the two periods of data collection and that these moderated the occurrence and strength of psi effects. An alternate view is that psi declines mysteriously and its elusiveness is beyond our control. The clearest response is that further studies are required to adjudicate the question and it is precisely the purpose of Psi@Home to provide the needed data.

Our inclination is to favor a psychological explanation because we find it more parsimonious, at least as far as theoretical commitments are concerned. In fact, it is quite possible that participants were more motivated during the tryout sessions. The individual video calls with team members were meant to generate enthusiasm for the project, and care was taken to listen to the candidates' personal interests and emphasize the value of their participation in the research. The two tryout sessions were completed within days of the online meeting, when impressions from the video call were likely still fresh. Participants' positive attitudes and motivation for the registered study may have diminished because the emailed study invitation arrived after a delay of 1-2 months and participants had no personal contact with team members before the study launch (a brief group video call at the study's launch had a low attendance of about 20%). The requested task of 4-6 sessions was considerably more than the two tryout sessions and participants were under a deadline to finish. These factors contrast with the tryout period and may have been de-motivating. One can hypothesize that psi performance during the formal experiments was weakened by a combination of stress and a lack of motivated engagement.

Figure 5

Psi-Missing Models



Note: A) The frequency of session hits for the M, O and null models for 90 sessions. Model M puts weight in the distribution tails and suppresses frequencies in the distribution center. Model O forces tail weight by imposing 8 outlier sessions, but the distribution center is close to that of the null model. B) Red points are the tryout data; error bars on model M are one standard deviation. For clarity, error bars for the null model are not shown, but they have approximately the same extent and would be centered on the null curve.

Another possibility is that mixtures of psi hitting and missing occurred within sessions for the registered data. The power of the variance test weakens if psi hitting or missing is not stable throughout a given session. In that case, even if the absolute strength of the psi effect is maintained, the test can fail to detect an effect. Tests sensitive to this eventuality (whereby psi hitting and missing fluctuate within a given session) are based on autocorrelations and are currently under study.

Table 1

Session Variances and Hit Rates by Cohort for the Formal Experiment

			Session Variance		Hit Rate	
Cohort	N_S	N_T	χ^2	p	Hit rate	p
All	160	3190	147,56	.75	50,19 %	.42
Meditator/Psi Arts	80	1597	89,43	.22	48,84 %	.83
Open	80	1593	58,13	.97	51,54 %	.11
Meditators only	54	1078	65,36	.13	48,61 %	.83
Psi Arts only	26	519	24,07	.57	49,33 %	.64

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Table 2

Session Variances and Hit Rates by Cohort for Tryout Data

			Session Variance		Hit Rate	
Cohort	N_S	N_T	χ^2	p	Hit rate	p
All	90	1789	150,72	.000031	50,59 %	.32
Meditator/Psi Arts	47	935	77,55	.0025	48,56 %	.82
Open	43	854	73,17	.0019	52,81 %	.054
Meditators only	32	637	53,13	.0092	50,08 %	.50
Psi Arts only	15	298	24,42	.024	45,3 %	.95

Limitations

A current limitation of Psi@Home is that cohort members need access to a macOS computer to operate the Selfield application, which reduces the pool of cohort candidates and lengthens the recruitment period. Solutions are to port the Selfield software to run on PCs, or to create new applications in programming languages that are broadly supported by common operating systems. The design choice to use applications installed on participants' computers – as opposed to using video streaming or web browser applications – opens several security concerns because applications can be copied to unauthorized users or modified (hacked) to alter data records sent to the Psi@Home server. Security measures include: the use of highly secure AWS servers; the use of individual passwords to connect to the server; hidden verification of each user's unique computer serial ID to detect unauthorized software installations; and a verification of the software checksum (details of which we do not report here) to guard against modification of the application's code. Security measures are never inviolable, and enhanced security is planned for future versions of Psi@Home. An option for future studies is to run applications directly from the cloud server, which overcomes some security issues. The trade-off is that bandwidth limitations and Internet intermittency may degrade the user experience or data integrity, particularly for immersive, interactive presentations like the Selfield that employ sophisticated real-time video generation. It is worth mentioning that the possibility of data manipulation is less plausible when effects are distributed broadly among participants, as we have argued is the case for the tryout data. Data manipulation would then require collusion among members of the global cohort, in addition to overcoming security measures.

Security measures against fraud by the experimenters (such as sequestering duplicate databases, key encoding the data and including skeptical collaborators) can also be implemented later. A complementary long-term approach, integral to Psi@Home, is that a reasonable assurance against fraud from any source is inherent in the ability to reproduce effects reliably and efficiently. Should the program succeed – and we remain optimistic, yet realistic about the challenges – the proliferation of evidence from independent groups would greatly diminish suspicions of hoax or deception.

A limitation of the experiment we report here is the lack of an independent, automated calibration of the random process used to determine trial outcomes. The process consists of seeding a pseudo-random bit generator in the application with input from the millisecond timing of user keystrokes. The process cannot be simulated faithfully because it entails human actions and individual computer configurations across participants. The only way to truly reproduce conditions of the random process is to run actual experimental sessions. An alternate approach is to utilize a true random source installed on the server. An implementation is currently in development.

However, live “control” data does exist de facto as the null results of the registered formal study. Two other data sets of comparable size were also collected during the study period and showed no variance anomaly. One consisted of 74 extra cohort sessions collected after the registered *N* of 80 sessions per cohort was reached. A second was 65 sessions collected by a researcher who tested the Psi@Home platform independently during the recruitment period with participants not from Psi@Home cohorts. Tests of variance for the data sets give insignificant *p* values, respectively, $\chi^2(74) = 80.7$; $p = .27$; $\chi^2(65) = 60.0$; $p = .66$. The null results for nearly 300 sessions (the 160 registered sessions of the formal study; the 74 extra sessions of the formal study; the 65 independent researcher sessions) constitute a de facto control database, generated concurrently and under real-world conditions, that counters an explanation of a persistent software or platform malfunction that might impact the random process. Further, contributions to the tryout variance anomaly are distributed across many sessions and users, so any malfunction would have to occur in multiple installations in the same manner. A few intermittent malfunctions cannot explain the variance. The variance anomaly is not associated with the several sessions that dropped a few trials. Removing those from the 90 recruitment sessions doesn’t impact the test, $\chi^2(85) = 147.8$; $p = .00002$.

Finally, we note that, although the software was updated just before the registered study, the update only changed a text file with a study identifier and did not alter the Selfield application itself. Identical software was used in both periods of data accumulation. These considerations lead us to conclude that the anomalously high variance in the tryout data is not due to technical problems and that the datasets without a variance anomaly can serve as surrogate control data.

A limitation of the variance analysis of the tryout data is that it is a post-hoc exploratory result and not the result of a pre-registered analysis, in contrast to the formal analysis. However, the collection of the tryout data *was* stipulated in pre-registration and the analysis procedures were kept identical for both data sets. There was no exploration of alternate statistics or tests.

A more consequential limitation is multiple analyses of data and the potential impact on interpreting p values of the tryout variance. As mentioned above when discussing control data, several data sets were tested using both the variance and hit rate statistics. In total 7 data sets were tested: recruitment data at 50 and then 90 sessions; formal data for 2 cohorts; the combined data for 2 cohorts; 74 extra cohort sessions; 65 sessions of an independent researcher. A Bonferroni adjustment multiplies the tryout variance p value by a factor 14 (accounting for the tests of hit rate and variance on 7 datasets) that yields an adjusted value $p = .00043$. The adjusted p value is still highly significant. The Bonferroni method is conservative, especially in this case where some data sets are not independent. We conclude that the variance anomaly of the tryout data is not an artifact of multiple testing or improper analytical procedures, despite the limitations we outline here.

Conclusions

We have reported on a new platform for collaborative psi research with selected cohorts. The Psi@Home platform uses a downloadable application that allows people from the across the world to participate in experiments by doing sessions at home. The at-home design permits the establishment of cohorts with substantial numbers of participants, even when applying highly restrictive selection criteria. The platform employs a modular approach to experimental design that treats research teams as a fundamental element of experimental studies. It is envisioned as a user facility that external researchers can use to undertake psi studies with lower costs and faster execution. We hope this will make psi research more accessible to the scientific community. A study to compare two cohorts was easily completed within a month's time, validating our design goal of high data rates and reduced overhead for studies.

The study, which compared a cohort of experienced meditators with a general public cohort, yielded a non-significant result on 4 of 5 pre-registered statistical tests of a psi effect. A fifth test that compared the cohorts was significant at $p < .05$, but confidence in its evidential value is diminished given the other null results. On the other hand, a tryout data set, whose collection was pre-registered as part of the process of recruiting cohort members, yielded a highly significant result for one of the two measures of an effect that we undertook for the formal study. The variance of session hit rates was nearly 4 standard deviations above null expectation, and in the direction expected for a model of psi-missing. We interpret this as evidence of a psi effect and show that a simple model of psi-missing accords well with the data's distribution of session hits. The absence of a similar effect in the formal study may be due to differences in participants' psychological attitudes between the two periods of data collection. Although we feel that this interpretation is a plausible one, it remains a speculative proposal limited by the use of post-hoc analysis and modeling. A confirmation will need input from further studies and data.

Declaration of interests

The Authors declare that there is no conflict of interest.

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Appendix A

Definitions of Terms and the Zero-Mean Variance Test

The null distribution of session hits is a binomial B[*N*, p]. In the text, we borrow a few terms from Gaussian statistics and employ *z*-score for the number of excess hits divided by the theoretical binomial standard deviation:

$$z = 2\frac{(hits - \frac{n}{2})}{\sqrt{n}}.$$

Our use should not be confused with a standard normal variable. We also refer to the sum of squares of *N* *z*-scores as the "zero-mean variance of *N* session *z*-scores":

$$\chi_N^2 = \sum_i^N z_i^2.$$

This is the quantity $\chi^2(N)$ in the text. It is a discrete random variable that closely follows the (continuous) chi-square distribution with *N* degrees of freedom. A normalized value can be had by dividing χ^2 by *N*, as is typically done for (theoretical) variances, but we prefer to cite the raw χ^2 in this paper. "Zero-mean" signifies that χ^2 is calculated about the theoretical mean $z = 0$, instead of the sample mean. This allows a sensitivity to net psi-hitting (or missing) that would be lost if the variance were calculated relative to the sample mean.

Approximate *p* values for χ^2 can be estimated from the corresponding chi-square distribution. We use more accurate Monte Carlo estimates of *p* values when stating results. The MC procedure also allows *p* values estimates when the number of trials per session varies.

Monte Carlo Calculations

P value estimates for χ^2 are done by MC calculations on the *Mathematica* platform. A vector of *z*-scores for a study of K sessions is simulated using the χ^2 RandomInteger[*dist, N*] function, where *dist* is the binomial distribution with *N* trials and probability *p* (p = 1/2 for the null distribution, but see below for other models). Nominally sessions have 20 trials, but occasionally fewer trials are recorded due to participants' intermittent WiFi connections (about 10% of sessions). To maintain nearly equal weights of sessions, the registered protocol stipulated that sessions with less than 17 recorded trials should be discarded (about 5% of sessions). The MC calculations take into account the actual number of trials for each experimental session. A value of χ^2 is calculated from the z-score vector, and the process is iterated to give a simulated distribution for χ^2. Empirical values from the experiment are then compared to the χ^2 distribution to yield p values. Note that the number of iterations can be increased to give a desired accuracy; we typically estimate p values to an accuracy of better than 10%.

Difference Test of Cohort Hit Rates

The registered experiment gave Meditator and Open cohort hit rates of 48.8% and 51.8% respectively, hits of 780 and 825; trial Ns of 1597 and 1593. An effective z-score for the difference of cohort hit rates is given by:

$$z = \frac{HR_{Open} - HR_{Med}}{\sqrt{HR_{av}(1 - HR_{av})(\frac{1}{N_{Open}} + \frac{1}{N_{Med}})}}$$

where = .5031 is the weighted average hit rate, so that z = 1.665 (p = .096, two-sided).

The Psi-Missing Model M

Under the assumption of a psi effect, we ask if contributions to the high variance in the tryout data come from the participant population as a whole, or only a few high performers. The question is important because the Psi@Home platform aims to elicit effects broadly.

Model M mixes hitting and missing sessions of uniform psi strength. The strength parameter, D, is the offset from a 50% hit rate and is defined on [0,1/2]. A parameter F, defined on [0,1], sets the proportion of hitting or missing sessions. The session hit rates are then 1/2±D, and the fractions of sessions with psi-hitting/missing are F and (1-F). Note that hits for the model sessions are binomial variables, so that hitting sessions may produce hit rates less than 50%, and vice versa for missing sessions.

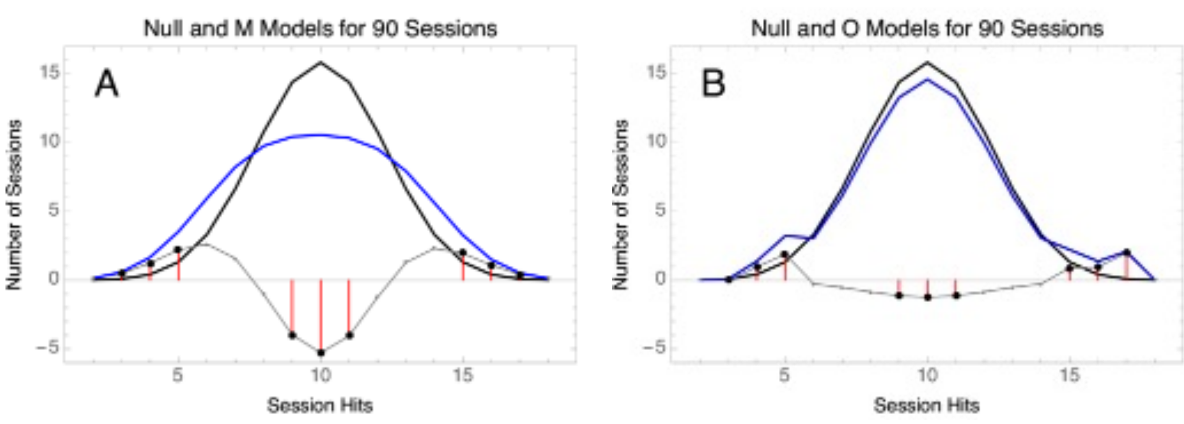
We adjust parameters *D* and *F* to give agreement with the mean and χ^2 of the 90 tryout sessions. It is fine to do this by inspection since we use the model M to draw comparative inferences, rather than determining precise parameter values. The tryout data has a mean hit rate of *HR* = 50.6% and χ^2 = 150.7. Setting *D* = 0.10 and *F* = 1/2 gives MCE of (*HR* = 50%; *CI90*(48.1, 51.9); and χ^2 = 158.5; *CI90*(126.8, 193)), where the 90% confidence intervals are determined from MC. The parameter settings give a good fit to the data's mean and χ^2.

We contrast model M with model O, which assumes no psi effect except for 8 sessions with extreme hit rates. The outlier sessions are set to the empirical values of the 8 most extreme sessions in the tryout data (4 sessions with 5 excess hits; and 2 sessions each with 6 and 7 excess hits). Model O yields: HR = 50.0%; CI90(47.6, 52.4) and χ^2 = 131.5; CI90(118.6, 159.7), which is also consistent with the tryout data.

Comparing M and O with the null finds that the distribution tails are quite similar, but that there is a marked difference for the distribution centers (Figure A.1). Model M moves weight out of the center, which decreases the frequency of sessions with hits in the range from 9 to 11. A test of the session counts in this range therefore can distinguish between the broadly distributed effect of model M, and model O, which restricts an effect to a small number of sessions. The *p* value for obtaining 26 sessions in the center range (as found for the tryout data) is calculated by MC for each model. The likelihood ratio for models M and O is had by estimating the probability of exactly 26 sessions occurring in the center range for each model by 400k MC iterations, and taking the ratio of frequencies.

Figure A.1

Comparison of Models M, O and Null



Note: The plots show how the psi-missing and outlier models, M and O, can be distinguished when there is a significant excess variance. The horizontal axis is the number of hits in a session and the vertical axis is the number of sessions at the respective hit value (for 90 sessions). Black traces: null model; gray traces: differences from the null for models M and O, respectively. Red bars highlight the differences at the distribution tails and centers. The distribution center is much lower than the null for model M, but only slightly so for model O. Models M and O can therefore be distinguished by comparing the session counts in the center range. In contrast, because the tails dominate χ^2 for both models, the χ^2 statistic, while rejecting the null, does not allow a statistical discrimination of the two models, M and O.

Effect Size for Model M

The strength parameter for the hit rate deviation is D ≈ .10 for model M. The effect size for a single trial is

$$ES = \frac{D}{\sigma} = \frac{D}{\sqrt{p(1-p)}}.$$

For D = .1 and p = 1/2 we have ES = .2 which is comparable to recent meta-analytic estimates for ganzfeld and remote viewing databases (Tressoldi & Katz, 2023). The D parameter can be converted to a null offset for 4-choice protocols as the standard ganzfeld (G) if p = 1/4. In this case G = .866*D = .087, which corresponds to a ganzfeld hit rate of 33.7%.

Une Expérience de Précognition à Choix Forcé Avec des Cohortes Sélectionnées

Peter A. Bancel   Jocelyne Bobanl   Anaïs Bensahral   Mario Varvoglis

Résumé : *Objectif* : Nous présentons une étude de précognition à choix forcé préenregistrée afin de tester une nouvelle plateforme collaborative pour l›expérimentation psi. L›étude a comparé une cohorte de méditants expérimentés et une cohorte sélectionnée par le simple intérêt de participer à l'étude. *Méthode* : La plateforme en ligne Psi@Home a été développée afin de permettre aux participants de contribuer à des sessions expérimentales réalisées à domicile à l'aide d'un logiciel spécifique. Chaque session comportait 20 essais à choix forcé. Pour l'étude préenregistrée, 80 sessions ont été collectées pour chaque cohorte. Les hypothèses portaient sur une augmentation, par rapport au hasard (chance moyenne attendue - MCE), de : 1) la variance des taux de réussite par session, et 2) le taux de réussite total. Une troisième hypothèse prévoyait une variance plus élevée des taux de réussite par session dans la cohorte des méditants. L'hypothèse 1 était confirmatoire, tandis que les deux autres étaient exploratoires. *Résultats* : Seule l'hypothèse 3 a été confirmée (p = .03). Toutefois, 90 sessions d'essai (préliminaires) ont montré une augmentation notablement significative de la variance des sessions (p = .00003). *Conclusion* : Nous avons réussi à tester une nouvelle plateforme destinée aux expériences collaboratives en parapsychologie. Les deux études de

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cohortes préenregistrées n'ont pas permis de mettre en évidence un effet psi direct. Toutefois, les données d'essai — dont la collecte était spécifiée dans le protocole de préenregistrement et reposait sur les mêmes participants et procédures — ont révélé une variance intersession significative. Des différences d'attitudes des participants entre les deux périodes de collecte pourraient expliquer cette divergence.

French translation by Antoine Bioy, Ph. D.

Ein Forced-Choice Präkognitions-Experiment mit ausgewählten Kohorten

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Zusammenfassung: *Zielsetzung.*: Wir berichten über eine vorab registrierte Forced-Choice-Präkognitionsstudie zur Erprobung einer neuartigen kollaborativen Plattform für Psi-Experimente. Die Studie verglich eine Kohorte erfahrener Meditierender mit einer Kohorte, die allein aufgrund ihres Interesses, an der Studie teilzunehmen, ausgewählt wurde. *Methode*: Die internetbasierte Plattform Psi@Home wurde entwickelt, um den Teilnehmern die Möglichkeit zu geben, zu Hause mit Hilfe einer benutzerdefinierten Software experimentelle Sitzungen durchzuführen. Jede Sitzung umfasste 20 Forced-Choice-Versuche. Achtzig Sitzungen pro Kohorte wurden für die vorab registrierte Studie gesammelt, und die Hypothesen für jede Kohorte waren die Zunahme der 1) Varianz der Sitzungs-Trefferquoten und der 2) Gesamt-Trefferquote im Vergleich zur Mittlere Treffererwartung (MCE). Eine dritte Hypothese sagte eine höhere Varianz der Sitzungs-Trefferraten für die Meditierenden-Kohorte voraus. Hypothese 1 wurde bestätigt und die anderen waren explorativ. *Ergebnisse*: Nur Hypothese 3 wurde bestätigt (p = .03). Allerdings zeigten 90 Probesitzungen einen deutlich stärkeren Anstieg der Sitzungsvarianz (p = .00003). *Schlussfolgerung*: Wir haben erfolgreich eine neuartige Plattform für kollaborative Psi-Experimente getestet. Zwei vorab registrierte Kohortenstudien ergaben keine keinen direkten Beweis für einen Psi-Effekt. Für Probedaten, deren Erhebung in der Vorabregistrierung unter Verwendung derselben Teilnehmer und desselben Protokolls festgelegt wurde, war die Varianz zwischen den Sitzungen hoch signifikant. Unterschiede in den Einstellungen der Teilnehmer während der beiden Zeiträume der Datenerhebung könnten die Ursache für diese Diskrepanz erklären

German translation by Eberhard Bauer, Ph. D.

Experimento de Precognição com Escolha Forçada em Coortes Selecionadas

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Resumo: *Objetivo***.** Relatamos um estudo pré-registrado de precognição com escolha forçada para testar uma nova plataforma colaborativa para experimentação psi. O estudo comparou uma coorte de meditadores experientes e uma coorte selecionada apenas pelo interesse em participar do estudo. *Método*. A plataforma baseada na Internet, Psi@Home, foi desenvolvida para permitir que os participantes contribuíssem com sessões experimentais em casa usando um software personalizado. Cada sessão foi composta por 20 testes de escolha forçada. Oitenta sessões por coorte foram coletadas para o estudo pré-registrado e as hipóteses para cada coorte foram o aumento em relação ao MCE 1) da variância das taxas de acerto das sessões, e 2) da taxa de acerto total. Uma terceira hipótese previu uma variância maior nas taxas de acerto das sessões para a coorte dos meditadores. A hipótese 1 era confirmatória e as demais exploratórias. *Resultados.* Apenas a hipótese 3 foi confimada (p = .03). No entanto, 90 sessões de teste mostraram um aumento acentuado na variância das sessões (p = .00003). *Conclusão.* Testamos com sucesso uma nova plataforma para experimentos psi colaborativos. Dois estudos de coorte pré-registrados não encontraram evidências diretas de um efeito psi. Entretanto, para os dados de teste cuja coleta foi especificada na pré-inscrição usando os mesmos participantes e protocolos, a variância entre as sessões foi altamente significativa. Diferenças nas atitudes dos participantes durante os dois períodos de coleta de dados poderiam explicar a discrepância.

Portuguese translation by Antônio Lima, Ph. D.

Un Experimento de Precognición de Elección Forzada con Grupos Seleccionados

Peter A. Bancel **Jocelyne Bobanl** **Anaïs Bensahral** **Mario Varvoglis**

Resumen: *Objetivo*. Publicamos un estudio pre-registrado de precognición de elección forzada que evaluó una nueva plataforma colaborativa para experimentos psi. El estudio comparó un grupo de meditadores experimentados con un grupo seleccionado por su mero interés en participar en el estudio. *Método*. Desarrollamos la plataforma en Internet, Psi@Home, para que los participantes contribuyeran sesiones experimentales desde su hogar utilizando un programa personalizado. Cada sesión constó de 20 pruebas de elección forzada. Recopilamos 80 sesiones por grupo para el estudio pre-registrado y las hipótesis para cada grupo fueron de un incremento relativo al MCE (expectativa media de azar) de: 1) la varianza de las tasas de aciertos de la sesión, y 2) la tasa total de aciertos. Una tercera hipótesis fue de una mayor varianza en los índices de aciertos en la sesión para el grupo de meditadores. La hipótesis 1 era confirmatoria y las otras exploratorias. *Resultados*. Sólo se confirmó la hipótesis 3 (p = .03). Sin embargo, en las 90 sesiones de prueba hubo un marcado aumento en la varianza de las sesiones (p = .00003). *Conclusiones*. Evaluamos con éxito una nueva plataforma para experimentos colaborativos psi. Dos análisis pre-registrados de grupos no encontraron evidencia directa de un efecto psi, pero para los datos de prueba cuya recopilación se especificó en el pre-registro utilizando los mismos participantes y protocolo, la varianza entre sesiones fue altamente significativa. Las diferencias en las actitudes de los participantes durante los dos periodos de recopilación de datos tal vez expliquen la discrepancia.

Spanish translation by Etzel Cardeña, Ph. D.