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Original Research

Forced-choice experiment on Anomalous Information Reception and correlations with states of consciousness using the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2)

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ABSTRACT

Context: An Anomalous Information Reception (AIR) experiment was developed.
Objective: To statistically examine the occurrence of AIR in multiple experimental tests and explore their predictive psychological mechanisms.
Design: First, we investigated whether human beings could guess the positive or negative content from 30 randomly selected images that would be presented on a computer screen, one at a time. Ninety participants reported being mediums and another 90 claimed to be nonbelievers in the paranormal. The participants were randomly assigned to three experimental conditions: (1) positive-relaxing environments, (2) neutral environments, and (3) negative-stimulating environments. Second, the prediction of successes recorded in the AIR experiment was tested using five Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2) scales that measured the altered state of consciousness (ASC) and suggestibility.
Results: The successes did not exceed the estimated chance. The only significant results revealed that mediums obtained a greater number of correct answers than the non-believing participants. Bayesian estimation also confirmed these results. In the same way, the altered states of consciousness and suggestibility negatively predicted 25.8% of successes in the AIR experiment.
Conclusions: Insufficient statistical evidence was obtained for AIR. The results raise doubts about previous theories on AIR. Further research is required. Nevertheless, mediums obtained more success answers than nonbelievers did. This means that the anomalous sheep-goat effect is also present in mediums and supports results obtained in previous studies.

Introduction

Anomalous Information Reception (hereinafter, AIR) is a neologism for clairvoyance that describes some phenomena that seem scientifically impossible: access to information or content through perceptual and sensory processes that are supposedly unknown to science.[6] An example of AIR occurs when an individual realizes some data or accurate information about the life of a deceased person without any source of information or prior knowledge about the person and without using rational logic or emotional intuition.[4,7]

In biological terms, the perception and causal relationship between the events that occur in objective reality—whether to make anticipatory decisions or to access information that has already passed—allow human beings to detect possible risks and survive in the face of environmental hazards.[10,45] Access to information, responses and decisions about past events are the result of two biological and rational procedures: on the one hand, the implementation of the sensory-perceptive channels known through the different functions of the central and peripheral nervous system; and on the other hand, the use of information sources and prior knowledge necessary to correctly establish the causal relationships between the different perceived inputs.[41] Decisions that do not meet these conditions should be erroneous or have a similar statistical behavior or can be extrapolated to mathematical chance, according to which coincidences between the divinatory decision and the events that have occurred are possible.[18] According to this idea, the hypothesis of Anomalous Information Reception postulates that humans can obtain information and make good decisions without using the conditioning procedures described by science (Roy & Robertson, 2001)[42]. It is called "anomalous reception" because the sources and psychological mechanisms that allow access to the respective information are unknown.[7]

There is a problem that certain scientific publications show statistical results in favor of the existence of AIR[6,4,26,43]; Schwartz &

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Russek,2001). This represents a problem because it challenges the ontological foundations of science (related to materialist reductionism) and questions the psychological theories of cognition[34,40]. However, the fact that there are scientific publications with significant results in favor of AIR with a correctly used methodology[3] requires testing the reproduction of the results obtained. The replicability of the results does represent an indispensable condition of scientific judgment and not academic opinion speculation about what is "possible" or what is "impossible" according to "science".[30,37] Although the AIR hypothesis may seem challenging, it can be analyzed using the scientific method.[2] Specifically, scientific judgments must be based on the use of the methodology that characterizes science and not on "conceptions" or "academic ideologies".[12]

In this area, self-report techniques evaluate AIR from 3 psychological-psychiatric models accepted by convention: (1) The first is the hallucination model of the psychosis continuum.[33,47,52] From this perspective, AIR is a hallucination produced by psychotic spectrum disorders.[29] Any subject who has an experience with hallucinatory characteristics similar to AIR would suffer from a psychotic disorder or would have a high risk of suffering it.[13] This perspective is also related to the theory of the "psychotic phenotype".[44] (2) There is also the semiotic model of perception, which explains AIR as illusions or perceptual distortions of a causal type that the individual fabricates to reduce the uncertainty of a past problem.[28,38] They are called illusions of control and are very common in believing subjects in the existence of the paranormal.[31] They differ from hallucinations in that they do not represent pathological behaviors in themselves.[10] (3), one can also observe the phenomenological model, which considers AIR as a subjective way of interpreting the phenomena that occur in objective reality.[20,22] These interpretations are based on the system of meanings that the subject uses to cognitively represent reality.[23]

The disadvantage of these models is very simple: all of them incur the Aristotelian fallacy of affirming the consequent.[35] This logical fallacy consists of the confirmation of a consequence from an uncertain cause. See the following example: - since the grass is wet, it is concluded that it has rained -. There is a causal conclusion or uncertain cause - it has rained - and the independent consequence - the grass is wet -. This consequence is not dependent on the cause - it has rained - because the grass may have been wet in many ways. The correct argument would be: - since it cannot be determined if it has rained, it is not known why the ground is wet -. With the AIR, the same error is made: - since AIRs are impossible or do not exist, it is concluded that they are hallucinations. This goes against the logic of the scientific method because although AIRs can be hallucinatory behaviors (just as the "grass can be wet"), what should be done is to contrast the scientific cause and not assume it from the "academic conventionalism" as a "hallucination".[25,46] One possibility to contrast the psychiatric history of this type of experience would be using self-report techniques.[9,27] The problem is that new evaluation instruments are necessary to avoid incurring the previous fallacy: the hallucinatory value of a supposed "hallucination" should not be contrasted, based on the apriorism that it is effectively a hallucination.

In this study, an experiment about AIR was conducted based on two objectives: (1) testing the hypothesis associated with AIR, which proposes that human beings can receive information about a hidden target; (2) examining whether the Multivariable Multiaxial Suggestibility Inventory-2 (hereafter, MMSI-2) scales (designed to assess belief in the paranormal in mediums and nonbelievers) predicts the successes quantified in the AIR experiment.

Methods

Description of the sample

A total of 180 people collaborated (47.8% women and 52.2% men), and all of them were adults over 18 years old (mean = 38.45; standard deviation = 9.929). On the one hand, 90 participants declared that they did not believe in the existence of the paranormal, whereas the other 90 claimed to be "mediums." The latter were convinced that they could communicate with deceased persons to obtain information about other people or places. More concretely, the mediums said that they used their clairvoyant talents through the messages that they received from the deceased. This detail is important because, although AIR and clairvoyance could be distinct "psi" phenomena, for these mediums, the events are interrelated and they use them together. Therefore, the label "mediums" refers to those participants who may believe in the paranormal, believe in the talent to communicate with deceased beings, and believe that they have the capacity to use this talent.

All participants signed an informed consent detailing the research procedure and declaring that they had no official psychiatric history. The participants could leave the experiment at any time and did not receive any financial compensation for their collaboration.

Procedures

General procedures

This experiment aimed at testing the AIR hypothesis, which states that it is possible to receive information and guess content without using the physical-sensory channels recognized by science. In this case, the following procedure was also based on the meta-analysis of Storm and Tressoldi[49], who reviewed and analyzed the differences between "believers" and "nonbelievers" in extrasensory perception (ESP) forced-choice tasks.

The design used entailed a comparison of independent (between) groups. Two groups were defined according to the beliefs and attitudes of each participant. The participants who declared not believing in the existence of the paranormal formed the group of "skeptics or nonbelievers" (n_0= 90), and those who claimed to believe in the existence of the paranormal and practice mediumship constituted the group of "mediums" (n_1= 90). The participants of each of the two groups were randomly assigned to places characterized by one of the following three experimental conditions: (1) positive or relaxing inputs, (2) neutral inputs, and (3) negative or stimulating inputs.

On the one hand, the classification of the images of The Geneva Affective Picture Database (hereinafter, GAPED) was used to determine which places could induce relaxation and be neutral (that is, they had low average arousal or trigger values).[15] This classification system revealed that the stimuli that illustrated parks, gardens, meadows and flowers yielded low arousal values. On the other hand, those that showed workspaces such as an office were classified as neutral places. Therefore, taking into account this classification, the Cervantes Gardens of the city of Barcelona were chosen as the positive place, and rented offices in the Industria Street of Barcelona were used as a neutral work space. The choice of place that incited suggestibility was based on the research conducted by Wiseman et al.[54], in which the participants attended a supposedly "haunted" place, and the believers exhibited more anomalous perceptions than the nonbelievers. Hotel Colonia Puig was chosen as the haunted location because it was abandoned, it served as a hospital sanatorium during the Spanish civil war, and was in the Montserrat mountain range, which is also associated with mysteries and legends (Thomas & Schoonmaker, 2007). These features coincided with the recommendations of Dagnall et al.[14] regarding what places seem haunted.

To each of the three locations, 30 participants were randomly assigned. Therefore, there were two independent factors, namely the three experimental conditions and the classification of mediums and nonbelievers.

We aimed to evaluate whether the participants were able to guess the random content of 30 randomly selected images in each location. The images came from the GAPED photographic database and could be positive or negative. In addition, the images had to be previously

selected and had to have a different order sequence for each participant. From the total set of 750 photographs of the GAPED, 10 positive and 10 negative photographs were randomly selected. This photographic selection was the basis that was used in all the tests. The selected pictures are included in this article as supplementary material. From this point, the following was done:

(1) The program was instructed by a code syntax to choose a random number between 1 and 20 in each one of the 30 guesses (each number was a type of photograph).
(2) Both the sequence and the type of content selected were performed between 24 and 48 h before each test by a technician collaborator outside this research.
(3) The technical collaborators were only responsible for the random selection of the images, did not know the participants and could not access their data. They did not perform any other activity related to this research. Similarly, the collaborators did not know about the purpose of this experiment and they were volunteers from the Ramon Llull University.
(4) The data were stored in the computer and were sent to the author of this report once each experiment was completed.
(5) At no time was the sequence or data accessible to the participant, since both did not coincide at any time (either physically or digitally). The participants did not obtain any feedback about their performance.
(6) Both the researcher and the participant were unaware of the data of the selected images. Only the researcher knew the random selection once the respective experiments were completed.

These conditions were applied to guarantee the use of the double-blind technique (researcher and participants were unaware of the selection of the images). The procedures developed by Beischel et al.[4] were not used because the forced-choice procedure was preferred. In this way, the law of probability could be applied in the random selection of the stimulus images, the Barnum effect (both direct and indirect) could be neutralized[18]; Shermer, 2011), and the answers could be quantified according to the number of correct answers obtained in each trial (each trial consisted of 30 guesses). This design did not detract from the original hypothesis of the AIR because the selection of the images was made a priori and not a posteriori, as is usual in the designs of precognition.[8] It was about guessing or accessing information that had already occurred for which neither the researcher nor the participants had access before and during the experiment. Unlike precognition, this is called clairvoyance and it was the hypothetical phenomenon tested in this experiment.

The phases of each trial adhered to the following sequence: (1) Arrival at the place and preparation of the starting point. Each place had a different starting point. However, all participants assigned to the same group-place began the exercise from the same starting point of their respective place. (2) Prior check-up with the participants and verification of their willingness to start the activity. (3) Instructions were first read aloud by the researcher, then they were given to the participants to read again. When the participants turned the page, the countdown began. (4) Carrying out the activity. (5) When the participants finished and turned in their answer sheets, the activity was considered completed. If the exercise was not completed within 60 min, the activity was considered completed. (6) End of the trial and leaving the place of experimentation.

Experimental instructions

All experimental tests were conducted in the same way, both for mediums and for nonbelievers. Once arrived at the place (of which the participant had knowledge), precise instructions were given to each participant. Both groups received the same instructions:

- we have come to this place so that from a distance you try to "guess" the content of 30 randomly selected images. Each image can be "positive" (whose contents show pleasant and relaxing stimuli) or "negative" (whose contents offer aversive stimuli that are unpleasant). The images were previously selected and are not related to this location.

On the next page you will find 30 blank spaces arranged sequentially (from 1 to 30). Each section corresponds to an already selected image. In each section, you must choose between two response alternatives: (a) "positive image" or (b) "negative image". You can only choose one of the two options.

We ask you to use your own personal resources that you believe from your beliefs or convictions that can help you respond well to the test. Avoid answering randomly and focus on your answers. You can leave sections-questions blank or unanswered. Feel free and do what you need to do to enhance your psychic abilities. You can move freely around the place and take advantage of the sensations that the environment inspires, as long as you do not endanger your safety and health.

Although the order of the images is sequential, you can start with the section you want. If you think you have made a mistake in one of your answers, cross it out and indicate the alternative that you consider correct. The research team will accompany you throughout this exercise and will observe you while you perform the test. Keep in mind that the following are not allowed: (1) taking stimulant or relaxing substances before and during the exercise (including tobacco and natural herbs); (2) communicating digitally or electronically with other people you know; (3) eating and drinking during the exercise; (4) endangering your safety, your physical and mental health; and (5), carrying out any criminal action.

You have 1 h to complete this exercise, although if you wish you can finish earlier.

At the end of each trial, both the participant and the researcher left the site, and the experiment was considered finished. Each participant got one trial.

Sampling and logistical procedures

The phases that characterized the process of this research were developed over 3 years (2018–2020) and can be summarized as follows: **(Phase I) selection of participants**: during the MAGIC International esoteric fair in 2017 (for more information, contact Alfonso Trinidad, see acknowledgments), opinion surveys were conducted, and different psychometric questionnaires were applied (including the MMSI-2). An email was sent to the surveyed users who met the profile required for this experiment asking for their collaboration in the present investigation. Only 288 of the initial 748 participants who were contacted agreed to participate in the study. Of these 288, 157 considered themselves mediums, and 131 claimed not to believe in the paranormal. Three participants decided to drop out of the study at the last minute (157–1 = 156; 131–2 = 129). **(Phase II) Distribution.** The participants were randomly distributed by equal strata (at 33.33%) in the three working groups (52 mediums and 43 nonbelievers in each group). **(Phase III) previous interview and execution of the experimental sessions**. Each participant was contacted by email again to conduct a face-to-face interview. In this meeting, it was ensured that the participant continued to meet the main exclusion criteria; not suffering or having suffered a psychiatric disorder. If the participant accepted, it was organized when, how and where the experimental test would be. Eight participants did not want to continue with the research, and four participants did not show up on the day of the experiment (in which case the random sample of the previously selected images was discarded) (285–12= 273). This phase

lasted until March 2020. The interviews and sessions with the participants were homogeneous and gradual. That is, the experiments were not executed by blocks of groups; monthly, 12 participants were contacted (6 mediums and 6 nonbelieving participants; 4 participants for each type of place), and at least 6 of the 12 participants were tested during that month (3 of each type and 2 for each place). Given that the lowest number of participants was for the "abandoned place" group of the medium participants (n_1= 31), it was decided to limit the groups to 30 participants in each. Similarly, due to logistical challenges related to the health crisis and the social confinement caused by the SARS-CoV-2 in March 2020, it was decided not to collect more participants. Consequently, 93 participants out of the last total number (273) could not participate in the experiment (273−93=180 final participants). Therefore, the participants definitely remained at 30 for each group. In this way, the experimental design conceived in the year 2017−2018 could be respected. **(Phase IV) preparation and analysis of the data**. Although this task was progressively carried out during Phase III, it was not until April 2020 that it was decided to organize the raw data matrix. The raw matrix was reorganized in order to prepare the data properly according to the conditions of statistical software. Once the reorganization was completed, the statistical analyses were applied, the results of which are presented in this report.

Procedures of post-hoc analysis

The post-hoc tests consisted of the predictive analysis of the successes recorded during the AIR experiment using Anomalous Perceived Phenomena (APP), Clinical Personality Tendencies (CPT), Incoherent Manipulations (IMA), Neurasthenia (Nt), and Substance Use (Cs) scales of the MMSI-2 as predictor variables. According to Escolà-Gascón[16], it was decided to work directly with the Nt and Cs scales.

The 180 participants responded to the 174 items of the MMSI-2 after completing the experimental sessions (the participants had not responded to the MMSI-2 previously). Although the scores were included in the matrix practically simultaneously with the data from the AIR experiment, the analyses presented in this study could not be performed until the AIR experiment was complete.

Instruments

The Geneva Affective Picture Database (GAPED)

Dan-Glauser and Scherer[15] of the University of Geneva developed a new protocol with the same properties as the IAPS (International Affective Picture System) photo database but with free access, free distribution and open access. This new test is called The Geneva Affective Picture Database or GAPED and consists of 750 images validly classified and calibrated under the same parameters as the IAPS. The GAPED offers a typographic classification of images that is representative of Western European culture, which distinguishes between 130 positive images or stimuli (whose contents represent human babies or animal pups; both contents are socially attractive) and 257 images or negative stimuli (whose contents violate moral laws and ethical principles defined by human rights). Unlike the IAPS, negative stimuli do not contain repulsive scenes or gore, but both protocols do show violent and aggressive content for this type of image. In addition to the 498 images categorized as positive and negative, the GAPED also adds 111 classified as neutral stimuli, whose contents do not describe either positive or negative stimuli. It should be noted that the GAPED optionally offers 252 images whose positive, neutral or negative classification is not determined a priori. The contents of these images illustrate only spiders and snakes. However, Dan-Glauser and Scherer[15] suggest considering them as negative stimuli when participants are confronted with these contents who present some type of systematic phobia to spiders or snakes. Excluding this indication, these 252 images have no typographic validity.

«Multivariable Multiaxial Suggestibility Inventory-2» (MMSI-2)

This questionnaire developed by Escolà-Gascón[16], 2020b) consists of 174 polytomous items in the form of statements, whose responses are scored following the Likert scaling model between 1 and 5. The subject must indicate to what degree each statement is "true" or simply specify their degree of agreement with what each sentence says. It should be kept in mind that 1 means in total disagreement, 2 means in disagreement, 3 means somewhat in agreement, 4 means quite in agreement and 5 means completely in agreement. The MMSI consists of 16 first-order scales: Inconsistencies (K), Lies (L), Fraud (F), Simulation (Si), Neurasthenia (Nt), Substance Use (Cs), Suggestibility (Su), Thrill-Seeking (Be), Histrionism (Hi), Schizotypy (Ez), Paranoia (Pa), Narcissism (Na), Anomalous Visual/Auditory Phenomena (Pva), Anomalous Tactile Phenomena (Pt), Anomalous Olfactory Phenomena (Po) and Anomalous Cenesthetic Phenomena (Pc). It also has 4 higher-order factors: Clinical Personality Tendencies (CPT), Anomalous Perceived Phenomena (APP), Incoherent Manipulations (IMA), and Altered States of Consciousness (ASC). The factors or scales of the MMSI-2 should allow the prediction of APP (it is the macrofactor that brings together the scales related to anomalous experiences).

Data analysis

The data were analyzed with the JASP program[50] and the R code.[39] A univariate analysis of variance (or 2 × 3 ANOVA) was applied. One of the factors (group of mediums and group of nonbelievers) was fixed effects, and the other (positive place, neutral place and negative place) was random effects. As a complement, a Bayesian statistical analysis was also performed using the Bayes factor (hereafter BF_{10}) in favor of the alternative hypothesis. It should be remembered that BF_{10} can be estimated in multiple ways, but the most common and used in this research was:

$$BF_{10} = \frac{\int_{\Theta_{H_1}} P(D|\theta_{H_1}, H_1) \cdot \pi(\theta_{H_1}|H_1) d\theta_{H_1}}{\int_{\Theta_{H_0}} P(D|\theta_{H_0}, H_0) \cdot \pi(\theta_{H_0}|H_0) d\theta_{H_0}} = \frac{P(D|H_1)}{P(D|H_0)} \quad (1)$$

where $P(D|H_1)$ is the probability that the data are distributed according to the distribution given by the alternative hypothesis and $P(D|H_0)$ corresponds to the probability distribution of the null model. Equation [1] is still an interpretable mathematical ratio from the odds metric,[24] so it can be transformed to the probability scale as follows:

$$P(H_1|D) = \frac{BF_{10}}{BF_{10} + 1} \quad (2)$$

Then, what is obtained is the estimated probability that the alternative hypothesis fits the empirical data, represented as $P(H_1|D)$. The probability of the a priori distributions was adjusted to 50% for the null and alternative hypotheses. Given that the Bayesian approximation was applied for the contrasts of the main effects, the variance explained by the coefficient of determination (R^2) derived from the *BFs* for all the variable factors was also estimated.

It was also checked whether the successes of the participants exceeded the statistical chance. This possibility was made by applying Student's *t*-test and the binomial distribution. The mathematical expectation that the participants guess correctly is 30/2 = 15 (then 15/30 = 0.5 on the probability scale). We wanted to contrast whether the successes could significantly exceed this cut-off point. Therefore, it is a right unilateral statistical contrast, which can be represented as follows:

$$H_0 = \mu_e \leq \widehat{\mu}_t$$

$$H_1 = \mu_e > \widehat{\mu}_t$$

where μ_e is the observed empirical mean and $\widehat{\mu}_t$ is the theoretical estimated mean. For all analyses, including the latter, a risk of error of 1% was applied.

Finally, a multiple regression model was applied stepwise forward for the group of mediums. The scores of the predictor variables of the group of nonbelieving participants did not meet the precondition of being linearly related to the criterial variable (success count). Therefore, nonbelieving participants were discarded from this analysis. The elimination of the 90 non-believing participants did not affect the quality of the sample. On the contrary, according to the methodological indications of Pardo and Ruiz[36], in this type of categorical variables, eliminating non-believing participants allows the neutralization of the effects of the belief variable (mediums and nonbelievers). Specifically, including only the mediums made this variable a "constant." Including the scores of nonbelievers would generate influential outliers because they did not meet the previous assumptions and this would impair the reliability of the prediction. The rest of the previous conditions were assumed.

Results of the AIR experiment

Given that a priori, there were no mathematical or empirical reasons to expect the AIR to yield significant results, the null hypotheses that were tested were as follows: (1) The means related to the successes do not differ between the different types of places. (2) The means relative to the successes do not differ between the medium participants and the nonbelievers. (3) The successes do not exceed the estimated statistical chance for all groups and participants.

To contrast the first two hypotheses, Table 1 was prepared. It is a table with the means and standard deviations of each variable and group. It should be taken into account that the main effects (including the main effect of the interaction between both variables) are derived from the marginal means. On the other hand, the simple effects and the simple interaction effects establish the comparisons between the different means of each of the cells.

Table 2 shows the results related to the analysis of variance for the main effects. Given that the variable that designates the experimental conditions has random effects, instead of Fisher's F, the Wald Z test was used, which performs the contrasts on the covariance parameters of the model.

The results indicate that only null hypothesis 2 can be rejected, which assumes the equality of means for the beliefs variable (between medium and nonbelieving groups). The mediums group tended to obtain more success answers than nonbelievers. This result is related to the sheep-goat theory effects that will be discussed under Discussion.

The means of the experimental conditions and those related to the interaction between both factors do not yield significant results; therefore, null hypothesis 1 should be maintained. The *BFs* support the rejection of the null hypothesis of the beliefs variable and the maintenance of the rest of the null hypotheses. In reality, the BF_{10} of the beliefs variable is very high, which indicates that the alternative hypothesis for this variable fits the observed empirical data. However, the explained variance provided by (R^2) is very low. This coefficient was obtained based on the instructions of Gelman and Pardoe,[19] who suggested formula [3] for full-factorial models. The expression "E" represents the posterior mean.

$$R^2 = 1 - \frac{E\left(V^K_{K=1^{\epsilon_k}}\right)}{E\left(V^K_{K=1^{\theta_k}}\right)} \quad (3)$$

Taking into account that for the variable "beliefs" the results are significant, it is not necessary to apply post hoc comparisons - and it is not possible either because there are only 2 groups - but the simple effects must be analyzed. These effects are analyzed in Tables 3.

The simple effects contrast the difference between the means of the group of mediums and nonbelievers in each of the levels of the factor that establishes the experimental conditions. The other simple effects were not contrasted because the other factor did not yield significant results (see Table 2). Significant differences between mediums and nonbelievers can be seen only when the participants attend Cervantes Gardens (positive place) and the supposedly haunted Hotel (haunted place). In the offices (neutral places), no significant differences were observed.

The fact that mediums score higher than nonbelieving participants does not mean that the number of correct answers of the participants exceeds the estimated chance from the classical model. Table 4 shows the contrast on whether the counts of the successes of each participant (distributed by variables and groups) are above the estimated mathematical expectation ($\pi = 0.5$).

In no variable and in any group were the successes higher than expected by chance (15 successes or 0.5 on the probability scale). This means that successes can be explained by the action of chance and not by the intervention of "anomalous" mechanisms related to AIR. The Bayesian approach also supports the maintenance of the null hypothesis in these contrasts. However, it must be taken into account that maintaining null hypothesis 3 does not require denying the existence of AIR. In more rigorous terms, it could be said that AIR is not observed in the sample used in this study, but this does not mean that it cannot be statistically recorded in other different samples. Despite this nuance, it should be noted that the results in Table 5 do not support the hypotheses related to AIR.

Results of post-hoc analysis: do states of consciousness predict correct answers in the AIR experiment?

Table 5 shows the descriptive statistics for the predictor variables (MMSI-2 scales). The linear correlations between these variables and the criterion variable were also calculated. The criterion variable was the correct answers in the AIR experiment.

The results of Table 5 indicate that the predictors IMA, APP and Cs are not significantly correlated with the criterion, which excludes them from the multiple regression model. Therefore, the regression model analyzed in Table 6 consisted of two steps, which included two models: the one formed by the CPT predictor (model 1) and the one comprised by both CPT and Nt.

The results indicate that the AIR, measured from the count of correct answers for each subject, is predictable at most by 25.8% by the

Table 1
Descriptive statistics.

Variable	Groups	Experimental conditions			Main effects
		Positive	Neutral	Haunted	
Beliefs	Mediums	14.4 (7.147)	9.567 (6.468)	14.764 (9.276)	12.911 (0.715)
	Nonbelievers	7.933 (5.239)	8.4 (5.654)	8.267 (6.125)	8.2 (0.715)
	Main effects	11.167 (0.875)	8.983 (0.875)	11.517 (0.875)	

Note: In each cell are means. Standard deviations are in brackets.

Table 2
Analysis of variance, main effects of variables and Bayesian approach.

IV	F	Wald Z	p	BF_{10} (% estimated error)	$P(H_1\|D)$	R^2
Beliefs	21.721		<0.001	1829.846 (14.467%)	~1	0.01
Experimental conditions	–	0.583	0.56	0.365 (0.007%)	0.267	~0
Interaction	–	0.902	0.367	1.256 (7.080%)	0.557	0.167

Note: IV= Independent variables; *F*= Fisher's tests;.
BF_{10}= Bayes Factors in favor to alternative hypothesis;.
R^2= explained variance corrected according *BFs*.

Table 3
Simple main effects analysis between mediums and nonbelievers in each level of the experimental conditions.

Levels of the experimental conditions	Means Comparison (see Table 1)	t-test*	p values (Tuckey)	p values (Bonferroni)	d
Positive	14.4 vs. 7.933	−3.693	0.004	0.004	−1.032
Neutral	9.567 vs. 8.4	−0.666	0.985	~1	0.192
Haunted	14.764 vs. 8.267	−3.712	0.004	0.004	−0.826

Note: *d*= Cohen's d corrected using Hedges' g.
*t-test was corrected for multiple comparisons.

Table 4
Do means exceed the estimated chance?

G	LEC	Means	t-test (p values)	W test (p values)	Z test (p values)	Binomial test (p values)	BF_{10} (error%)
M	Positive	14.4	−0.46 (0.675)	177 (0.618)	−3.286 (~1)	$n_{>15}$= 0.467 (0.708)	0.142 (~0.031)
	Neutral	9.567	−4.601 (~1)	52.5 (~1)	−29.76 (~1)	$n_{>15}$= 0.2 (~1)	0.044 (~0.005)
	Haunted	14.764	−0.138 (0.554)	193.5 (0.59)	−1.278 (0.899)	$n_{>15}$= 0.533 (0.428)	0.176 (~0.023)
NB	Positive	7.933	−7.388 (~1)	6 (~1)	−38.706 (~1)	$n_{>15}$= 0.067 (~1)	0.014 (~0)
	Neutral	8.4	−6.393 (~1)	17.5 (~1)	−36.15 (~1)	$n_{>15}$= 0.1 (~1)	0.017 (~0)
	Haunted	8.267	−6.021 (~1)	33 (~1)	−36.880 (~1)	$n_{>15}$= 0.233 (~1)	0.018 (~0)

Note: *G*= groups; *M*= mediums group; NB= Non-believers group; LEC= Levels of experimental conditions; *W*= Wilcoxon test; and BF_{10}= Bayes Factors in favor to alternative hypothesis.

CPT and Nt variables of the MMSI-2 (regression model 2). If the regression coefficients (β) are taken into account, it can be observed that for each unit that both predictors increase, the criterion variable decreases –at an average level– by 0.104 and 0.267, respectively (see Table 6). This means that increases in correct answers can only be predicted when the CPT and Nt scores are low or decrease correlatively.

Discussion

Different hypotheses related to the possible occurrence of AIR were tested. In the experimental trials, participants had to guess the content (positive or aversive) of 30 selected images, which were presented in random order for each participant. Taking into account that spontaneous psychic effects or anomalous experiences are frequent in haunted places,[14,21] we wanted to check whether the environment could condition participants' responses in each of the places where the experiment was conducted. The success count of each participant was analyzed to examine whether it exceeded the expected chance. Significant differences were observed between mediums and non-believing participants for positive and haunted places. The average success counts did not exceed the expected chance in any group. The post-hoc analysis examined whether the APP, CPT, IMA, Nt, and Cs scales of the MMSI-2 correlated with the counts of the correct answers in the AIR experiment and if they could predict them. The results indicated that only the CPT and Nt variables negatively correlated with the correct answers, whose prediction with both variables was quantified with a weight of 25.8%.

Interpretation and implications of the results

The results of the AIR experiment address the most important question: what psychological and cognitive value can AIR have in human behavior? In numerous studies that analyzed the AIR, significant results were obtained[6,26]; Schwartz & Russek). Other studies were able to explain these significant results through the Barnum effect (O'Keeffe & Wiseman, 2005). Other more recent studies showed significant results in favor of AIR, neutralizing the Barnum

Table 5
Descriptive statistics for MMSI-2 scales included in the post-hoc analysis ($n_{mediums}$= 90).

Variables	Means	Standard deviations	Correlation coefficients with criterion variable	
IMA	182.97	25.574	0.167	p = 0.057
CPT*	183.31	31.409	−0.37*	p<0.0001*
APP	93.22	27.427	−0.021	p = 0.423
Nt*	41.69	11.161	−0.332*	p = 0.001*
Cs	13.69	3.584	−0.028	p = 0.397

Note: *variables included in the multiple regression model; IMA= Incoherent Manipulations; CPT= Clinical Personality Tendencies; APP= Anomalous Perceived Phenomena; Nt= Neurasthenia; and Cs= Substance Use.

Table 6
Multiple forward stepwise regression (dependent variable= correct answers).

Model	Variables	β	Error	β_z	|r|	R^2	ΔR^2	F	p
1	Constant	30.18	4.691	–	|0.37|	0.127	0.137	13.949	<0.0001
	CPT	−0.094	0.025	−0.37*					
2	Constant	43.054	5.361	–	|0.524|	0.258	0.138	16.509	<0.0001
	CPT	−0.104	0.023	−0.407*					
	Nt	−0.267	0.066	−0.373*					

Note: *$p<0.01$; β= regression coefficients; β_z= standardized regression coefficients; r= multiple correlation coefficients.
Excluded variables: APP, IMA and Cs. They did not fulfill the preconditions (see Table 5).

effect.[4] In all these investigations (including those that did not obtain significant results), the AIR was tested based on the "readings" or "clairvoyance" about the life and past experiences of different groups of randomly assigned subjects. With this research, the following idea is questioned: why is AIR understood as a "supposed" phenomenon that only seems to happen when an individual – without prior knowledge – tries to guess what another deceased subject has experienced? There is no scientific evidence that should limit the supposed AIR to the "clairvoyance" practiced by the mediums.[18] Therefore, in this study, the two groups were defined: the "mediums" and the "nonbelievers". However, in addition to the latter, there is no evidence that the AIR should be limited to the idea of "readings" or supposed "clairvoyance" about the lives of other people. If the AIR were a cognitive-perceptive attribute of the human being, it should be possible to record statistically more easily in those "readings" that were correct about simpler contents (e.g., the positive or negative contents of the images) compared to other contents more complex (e.g., trying to guess what experiences an unknown person has had). To express it more clearly, in university exams and psychometric aptitude tests, the following is met: as the degree of complexity of the tasks or questions decreases, successes increase.[1] If AIR were an attribute of human cognition-perception, the same logic found psychometrically in aptitude tests should be met. The results of Table 4 are clear in this regard: the observed successes fit a pattern of successes extrapolated to mathematical randomization. This means that the trend and the distribution of the successes observed can be obtained by randomly answering the 30 sections or questions posed. It should be noted that this argument is not in line with the scientific literature on parapsychology. Actually, the designs and theories that address the AIR hypothesis support the free-response designs.[49] This point is crucial because, if forced-choice designs have less power effect than free response designs, why did the mediums get more hits than the nonbelieving participants? In other words, why were the sheep-goat effects significant? However, as already mentioned, one should not incur the "Aristotelian fallacy of affirming the consequent"[35]; the fact that the results do not support the alternative hypothesis of the AIR does not mean that the AIR itself cannot be significantly recorded in other experiments. As a first conclusion, it is highlighted that based on the design and the sample used, no reasons were found to support the supposed existence of AIR as a cognitive attribute of a human being. Nevertheless, according to the significant differences between mediums and nonbelievers, the results also suggest the following conclusion: the group of mediums tends to obtain more hits, as has been repeatedly observed with "sheep" (believers) in other studies.[48]

Starting from the theoretical basis provided by numerous investigations that positively related the altered states of consciousness and suggestion with the successes in this type of test,[5,11] there would be reasons to infer that the levels of suggestion associated with sites of this research could modulate the successes of the participants. The greater the suggestion, the greater the probability of generating altered states of consciousness through which the subjects would be more easily successful. Given that the successes increase when the place turns out to be positive or negative, could these two places have elements that would suggest enough to the medium participants to obtain a greater number of successes than the nonbelieving subjects? This should be contrasted in future research as it is a hypothetical speculation. It is clarified that this possible interpretation would only make sense if the results of previous research that supports the "psi" phenomena were accepted as valid. No unanimous scientific conclusion has been reached on this issue; some professionals are in favor[8,32,51] and others are against.[40,53] However, we might point out that the former scholars present empirical evidence, while the latter argue based on theoretical grounds. Empirical data must be preferred over theoretical arguments; otherwise, science collapses into dogmatic religion. This argument means that we can question the studies that are against.

At this point, it seems appropriate to analyze the results of the post-hoc analysis. Given that in this analysis, the existence of the AIR is neither denied nor affirmed a priori, it was decided to check whether the MMSI-2 variables predicted the successes observed in the sample of the AIR experiment. Table 6 shows results that are significant, as can be observed for the CPT and Nt variables. This means that the lower the score on these two scales, the higher the correct answers. More specifically, this increase in the correct answers is quantified at 25.8%. The clinical personality traits assessed by CPT are Suggestibility (Su), Thrill-Seeking (Be), Histrionism (Hi), Schizotypy (Ez), Paranoia (Pa), and Narcissism (Na). Neurasthenia (Nt) is related to symptoms that fluctuate between ordinary states of consciousness and trance states. Therefore, as a fourth conclusion, it can be highlighted that people who develop AIR do not tend to present psychopathological traits. This also coincides with the results of other research that disprove the relationship between mediumnity and psychopathology.[11] Further research is required to examine the role of altered states of consciousness in AIR.

Limitations

Regarding the criticisms and limitations of this research, it is true that some professionals and specialists in the "psi" phenomena could question whether the concept of Anomalous Information Reception defined in this research is in line with the theoretical proposals that these authors defend in their research areas or if it is an approach that harms the AIR hypothesis. For example, for Beischel,[2] the AIR applied in the framework of mediumship also implies the intervention of the belief or conviction of the medium-subject, that he can communicate with deceased beings and, precisely, it is these beings that provide him with the correct response to "clairvoyance" or "readings " performed. This condition was not taken into account in this research since, at least at present, it is a nonverifiable condition through the scientific method: How can one experimentally control that a person can communicate with deceased beings? Given that there are results both in favor and against AIR (and even of the "psi" phenomena), it cannot be accepted that the successes recorded in this type of experimental session can represent indirect empirical markers of a possible anomalous cognition of human behavior.

Therefore, the AIR is understood in this research as a presumed phenomenon unexplained in statistical terms (because it is recorded through statistical and not directly empirical procedures). The expression "directly empirical procedures" refers to the following: we do not have material manifestations or physical indicators (the current indicators are only statistics) to measure AIR. What are the empirical guarantees that the "correct answers" certainly represent clairvoyance (and not AIR only)?

In this manuscript, we started from the original basis that raises whether this class of supposed behaviors evaluated statistically can - apart from any theoretical speculation, whether believing or nonbelieving in the existence of "psi" phenomena - be replicated by the scientific method. Therefore, there were no apriorisms based on the academic beliefs defended in the cited scientific literature.[12] Said in a more explicit way: what was intended was to apply the scientific method in the AIR in the most neutral way possible and not to make "philosophy" of the hypothetical conceptions that defend or discredit anomalous phenomena.

In short, the definition given to AIR in this study differs conceptually from the other definitions observed in previous studies that use the same denominator, but its meaning does not change in functional and pragmatic terms. In this research and in previous studies that use the AIR concept, the task that the subject must solve is the same: individuals must guess a content that happened in the past. The only difference is that in the present investigation, the objects that must be "guessed" are simpler at the cognitive level because the response options are reduced to two alternatives: either they are negative or they are positive, but the experimental slogan that characterizes the AIR is the same for this type of research. This fact could generate conceptual debates about the hypotheses underlying the AIR, but it does not harm the internal validity of the results obtained.

Conclusions

The contributions of this research can be summarized with the following conclusions: (1) there is no statistical evidence in favor of AIR, neither in the subjects considered "mediums" nor in the "nonbelievers". The successes did not exceed the estimated mathematical expectation. (2) Mediums tend to obtain more successes than nonbelievers in places with positive-relaxing stimuli and in places with negative-triggering stimuli. This observed statistical trend could not be explained rationally and, therefore, represents a statistical result that should be replicated in future studies. Indeed, Bayesian results support these differences, which indicate the presence of sheep-goat effects in the AIR phenomena. (3) Altered states of consciousness (evaluated using the Nt scale) and suggestibility, together with other subclinical personality traits (CPT), negatively predict the successes of mediums by 25.8%. This result is contradictory to the proposals of other studies that concluded the positive relationship between altered states of consciousness and perceived anomalous phenomena (including AIR). These results are not due to methodological failures related to the Multivariable Multiaxial Suggestibility Inventory-2 or MMSI-2 because the psychometric properties of this questionnaire were successfully replicated in Escolà-Gascón.[17] New research is required to test the AIR hypothesis again from neutrality and without assuming any previous ideology a priori that systematically denies or affirms the scientific existence of AIR.

Declarations of ethical guarantees

This research is part of the university project *"Predictor variables of precognition and haunting phenomena: an approach from Bayesian models and structural equations"* approved by the Committee of Ethical Guarantees of Ramon Llull University. Likewise, all the procedures of this study complied with the principles of the *Declaration of Helsinki* of 1975, which was also revised in 2013.

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Statements in relation to the places of experimentation

All the sites where the experimental tests were carried out had free access and are open to the public.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.explore.2020.11.009.

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