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ORIGINAL ARTICLE

Superstition predicts favorable weight change in an open-placebo trial: a prospective study

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Abstract Given the difficulty of losing weight via adhering to healthy lifestyle choices, this study sought to understand how a placebo may elicit favorable weight change. Specifically, we examined if superstition may be related to increased responsiveness to an open-placebo. In this pilot study of 25 undergraduate participants, it was hypothesized that individuals with higher levels of superstition may be more responsive to a 3-week open-placebo weight change trial. Participants were given once-daily saltine crackers to use as open-placebos for weight change in their preferred direction (gain or loss). The weight of each participant was measured before and after the 3-week open-placebo period. A Pearson's r correlation showed a significant positive relationship between superstition and placebo responsiveness, determined by weight gain or loss in the preferred direction, $r\ (25) = 0.493$, $p < 0.05$. We hope these preliminary results engender future research on open-placebo uses for weight management.

Keywords Open-placebo · Placebo · Revised Paranormal Belief Scale · Superstition · Weight

The increasing prevalence of obesity and its associated infirmities and failures of dietary restriction resolutions prompt the investigation of alternative strategies for weight loss [1]. A 2005 study revealed that only 3 % of US adults do not smoke, maintain a healthy diet, perform regular physical activity, and consume fruits and vegetables, characteristics that constitute a healthy lifestyle [2]. Given the difficulty of adhering to healthy lifestyle choices, this study sought to understand how placebo use can elicit favorable weight change.

One of the earliest recordings of placebo practice was by Benjamin Franklin in 1784. Franklin prescribed several patients to sit under certain "magnetized" trees that he suggested would heal their ailments. They were healed just as effectively as those who had sought the care of the traditional medic [3]. Today, the gold standard in clinical trials is the double-blind randomized placebo-controlled study. Controlling for the placebo effect is indicative of the power of subjective belief on biological outcomes, from reducing symptoms of Parkinson's Disease [4], motor disorders [5], and major depressive disorder [6] to inducing emotional states [7] and weight loss [8].

Existing studies suggest that many drugs need to work in combination with, and not independent of, expectation pathways in the brain to be effective. In fact, anywhere between 60 % and 90 % of physician-prescribed drugs and therapies rely on the placebo effect to function appropriately [9]. Different methods of administering placebos can activate different brain pathways to produce an effect; for instance, strong or weak expectation cues can produce the same effect through either opioid or non-opioid release [10]. Moreover, we know that some patients who respond to placebo medication also have greater response rates to active drugs [11].

Pavlovian conditioning [12, 13], expectation response [14, 15], and reduced anxiety models [13, 16] are commonly cited theoretical explanations for how the placebo effect works. The Pavlovian model suggests that objects associated with medicine such as pills and lab coats are previously conditioned stimuli that trigger curative effects in patients [13]. Expectation theory proposes that placebo effects are primarily mediated by conscious expectancy

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that redirects somatic focus and guides future actions [15]. Expectations can be incited through verbal suggestions, as incurred in one weight loss study, for example, where one group of hotel room attendants who were told that their time spent cleaning met the surgeon general's suggested amount for weight loss; this group lost significantly more weight than the control group that was not given this information [9]. Last, the reduced anxiety model asserts that the expectation that an ailment will be treated reduces anxiety and enables the body to induce recovery as a result [16].

Recent studies have investigated the neurobiology of the placebo effect [6, 17, 18], but there is limited research on whom the placebo is effective. Identifying placebo responders can have implications in the administration of medicine. For example, if we know that certain weight-loss drugs are more effective on individuals with narcissistic personalities, we might reevaluate the way in which we prescribe medication. However, the notion of identifying responders has been challenged. Kaptchuk et al. [19] posit that if 50 % of 100 participants respond to a placebo, it just may be that 100 % of patients respond to placebo 50 % of the time. They note that some patients may respond to certain placebos and are, therefore, partial responders, whereas others may never respond, and still others may always respond. In general, placebos work on one-third of subjects, and gender, suggestibility, and intelligent quotients do not seem to affect responsiveness [20]. There is some evidence, however, that personality does play a role in determining placebo responsiveness [21] and those who respond well to active drugs also respond well to placebos [11]. In advancing research on favorable weight change, we hypothesized that superstition may be one variable that determines placebo weight loss or gain responsiveness. This postulation derives from evidence on theories of how psychiatric medicines function.

It is thought that antidepressants do not directly enhance mood but require 2–6 weeks because they change how a patient interprets her own behavior and mood, which does not happen instantaneously; antidepressant drugs change information processing neural networks and reconsolidate interpretations of subjective experience over time, thereby thwarting the brain's habitual functioning patterns and allowing favorable modes of information processing [22]. Individuals who are more superstitious may naturally have a greater ability to alter somatic focus without the use of a drug. Being that most types of paranormal beliefs appear to be stronger in young adults than in elderly people [23] and that cognitive malleability lessens with age [24], we hypothesize that superstition may be associated with greater cognitive malleability. This cognitive flexibility may indicate a more global malleability that would allow one to more easily reorient away from habituated brain pathways. In other words, plasticity of cognition may suggest plasticity of physiology.

Moreover, given that superstition is correlated with field dependence and suggestibility [25], we hypothesized that more superstitious individuals would make auspicious placebo responders because belief in the effect of the placebo may trigger expectation pathways. While superstition is often associated with maladaptive behaviors like high trait anxiety [26] and irrational beliefs [27], Wiseman and Watt [28] suggest that some superstitions, such as belief in lucky charms, could be adaptive, for example by increasing self-efficacy and optimism. Positive superstitions for effective placebo response may lead to greater responsiveness in accordance with Expectation Theory.

To test if superstition is correlated with responsiveness, we designed an open-placebo study. Open-placebos have shown to be significantly more effective than no treatment in reducing symptoms of irritable bowel syndrome [29]. Hypnosis is also used therapeutically as a nondeceptive placebo [30], and placebos are as effective in treating obesity as Orlistat, a physician-prescribed weight loss drug; in one study of 47 obese women, those assigned Orlistat showed no significant difference in weight loss compared to those assigned a placebo [31]. Given that placebos rely on conscious expectations to prove operative [9], superstitious individuals, who may be more cognitively flexible and suggestible, may be more responsive to a placebo treatment. In this study, participants ingested inert saltine crackers and were explicitly told that they were to be used for weight loss or gain, whichever the preference of the participant.

Methods

A pretest–posttest quasi-experimental design was used to assess the relationship between superstition and placebo responsiveness. Three-week trials requiring two meetings at the start and end of the experimental period were conducted between February and April 2014. The Barnard College Institutional Review Board approved the study design and informed consent. Written informed consent was obtained from all participants prior to their participation.

Participants

Undergraduate students in the Barnard College psychology subject pool who denied any gluten allergies were recruited for participation. A total of 35 students (8 male and 27 female) with an age range of 18 to 44 elected to participate. The data of six women and four men were discarded because they did not provide demographic information or

an ideal weight, or missed more than 4 days of open-placebo intake as determined by self-report at the end of each trial. Four others were removed to trim the data set to fit the traditional college age population (18–22) and an additional set was removed because the participant's weight change outcome qualified as a significant outlier. Thus, the final data set consisted of 25 participants ($M = 5$, $F = 20$) ages 18–22 (SD = 1.5). The racial-ethnic composition of participants was 32 % Caucasian-Americans, 16 % Asian Americans, 8 % Hispanics, 4 % African-Americans, and 16 % other. All participants were given course credit for their participation.

Materials

Packets of questionnaires included the Superstition Subscale of the Revised Paranormal Belief Scale RPBS; [32], a demographics survey, and a descriptive questionnaire assessing expectations toward responsiveness. Two versions were distributed, with opposite ordering of surveys to limit effects of cognitive fatigue. The demographics survey was placed last in both packets to avoid priming effects. A digital scale was used by the researcher to record pre- and post-trial weight in pounds.

Measures

The Superstition Subscale ($\alpha = 0.89$) is a 3-item, 7-point rating scale derived from the Revised-Paranormal Belief Scale ($\alpha = 0.92$), a 26-item scale that measures the degree of belief among various dimensions of spirituality [32]. This Subscale was used to assess degree of superstition among participants at the start of each trial.

The descriptive questionnaire asked the participant to provide an "Ideal weight." Responses answered as a range, e.g. "between 115 and 120 lb," were marked as the average of the low and high ends. The question, "On a scale of 1–10, how confident are you that you will experience a desired weight change during this study over the next 3 weeks?" was used to determine Expectation values. Two students were excluded from the correlational analysis on expectations because they did not provide a 1–10 value. Individuals who circled more than one option for the category of "Race" on the demographics questionnaire were recorded as "Other." Height and weight were rounded to the nearest whole.

Procedures

Participants were brought into a small conference room and completed the packet of questionnaires. Because mind-set, or conscious positive or negative expectancy, has shown to enhance the effect of the placebo effect [9], each student participated in a 5-min literature review with the researcher outside of the room after completing the packet. This review consisted of the researcher presenting information on scientific studies that have demonstrated the efficacy of the placebo and open-placebo effects. Participants were given a copy of the discussion points to hold and follow through the discussion (See "Appendix A"). The review included statements such as, "An open-placebo is essentially placebo without deception–participants are told that they are receiving an ineffective substance that, in and of itself, is not expected to lead to physiological changes. Surprisingly, this type of placebo has been shown to have real effects on medical conditions such as irritable bowel syndrome. In a study…." Other talking points defined the placebo effect, introduced theories explaining it, and provided background on the use of placebos for weight loss. A copy of the review was e-mailed to each participant later that day. At the end of the review, participants were told, "In this study we're looking at how saltine crackers can function as an open-placebo for weight management. We would like to take your current weight today and see how it compares to your ideal weight at the end of the three-week trial period."

After the review, participants completed a descriptive questionnaire that assessed expectations. It asked, "On a scale of 1–10, how confident are you that you will experience a desired weight change during this study over the next 3 weeks?" in addition to other questions.

Last, participants were asked to remove extraneous clothing layers and shoes and were privately weighed using a digital scale. Weight measurements were disclosed upon request. Afterwards, each participant was given a package of Nabisco's Premium Saltine Crackers with instructions (See "Appendix B") and instructed to eat one cracker per day for 3 weeks. Crackers were chosen because they are available prepackaged and have a neutral taste consistency. Participants were asked to eat the crackers at the same time each day and to respond to automated daily e-mails asking whether they had eaten or not the cracker and to list the time of consumption. These e-mails were sent to reinforce compliance, and the first of these e-mails included the literature review to reinforce an expectant mind-set. Participants were asked to refrain from making any major lifestyle changes (e.g. starting a new diet or changing exercise routing) for the duration of the study.

The second meeting took place 3 weeks after the initial meeting. Participants were asked to complete a survey asking how many days they neglected to eat the saltine cracker and were then weighed and debriefed.

Statistical plan

Because we were interested in whether weight change occurred or not in the desired direction, we constructed a

categorical variable called "success factor" and assigned a value depending on whether the direction of change in weight for each participant was desirable or not. If the direction of change was desired, the success factor equaled 1; if the direction of change was undesired, the success factor equaled −1. We then multiplied the absolute value of weight change by the success factor to create the variable "placebo responsiveness". A regression analysis controlling for age, gender, and initial weight was used to examine the effect of superstition on placebo responsiveness. We controlled for initial weight as it may impact both the desired directionality of weight change as well as the difficulty or ease of achieving the desired change. Pearson's *r* correlational analyses were computed to assess the relationships between superstition and placebo responsiveness, superstition and expectations for placebo responsiveness, and expectations for placebo responsiveness and placebo responsiveness.

Given that students were able to self-select for weight loss or weight gain, we suspected that this selection bias could contaminate regression estimates. We investigated the severity of the selection bias by dichotomizing our independent variable, the level of superstition, into (0–1), where 0 corresponds to weak superstition and 1 corresponds to strong superstition as determined by the median superstition score ($M = 1$). We next estimated the treatment effect by running two separate regressions of our original independent variable, placebo responsiveness, on our new dichotomized variable. In one regression, we made the usual assumption of no selection and in the second, we allowed our treatment variable (0–1) to be endogenous; in other words, we relaxed the no selection assumption to determine if it was significantly different from the former.

Results

A regression analysis examining the effect of superstition on placebo responsiveness when controlling for age, gender, and initial weight predicted a significant positive relationship, $b = 0.468$, $t\ (25) = 2.525$, $p < 0.05$ (Table 1). A Pearson's r correlational analysis showed that superstition and placebo responsiveness were significantly positively correlated, $r\ (25) = 0.493$, $p < 0.05$ (Table 2). No significant relationship was present between expectations and place responsiveness, $r\ (23) = 0.106$, $p = 0.0630$, and there was no significant relationship between superstition and expectations for placebo responsiveness, $r\ (23) = 0.404$, $p = 0.056$. Table 3 displays the coefficients (treatment effects) that correspond to variable *D* (*dichotomized superstition*) which are the key estimates of interest to examine the impact of potential selection bias.

Table 1 Summary of a regression analysis for superstition on placebo responsiveness when controlling for age, sex, and initial weight

	Unstandardized coefficients		Standardized coefficients	*t*	Sig.
	B	Std. error	*β*		
Constant	12.156	9.929		1.224	0.235
Age	−0.332	0.327	−0.226	−1.016	0.322
Sex	−2.665	1.687	−0.502	1.580	0.130
Initial weight	−0.014	0.018	−2.19	−0.778	0.446
RPB superstition	1.057	0.416	0.477	2.543	0.019*

* Correlation is significant at the 0.05 level (2-tailed)

Table 2 Summary of Pearson's *r* correlational computation of successful responsiveness, superstition, and expectations

	Successful responsiveness	RPB superstition	Expectation
Successful responsiveness			
Pearson correlation	1	0.493*	0.106
Sig. (2-tailed)		0.012	0.630
N	25	25	23
RPB superstition			
Pearson correlation	0.493*	1	0.404
Sig. (2-tailed)	0.012		0.056
N	25	25	23
Expectation			
Pearson correlation	0.106	.404	1
Sig. (2-tailed)	0.630	.056	
N	23	23	23

* Correlation is significant at the 0.05 level (2-tailed)

The treatment effect was not significantly dependent on whether we assumed selection bias or not.

Responses on a descriptive questionnaire answered during the first meeting showed differences in perspectives on placebo efficacy between the more and less superstitious participants. The two groups were determined by the median superstition score ($M = 1$). In response to, "Why do you think the open-placebo will or will not lead to a desired weight change?", 73 % of the less superstitious group explicitly stated that they did not believe the open-placebo could be effective in general or during the trial (i.e. "I don't think it will…"; "I think they might help in certain cases, but since I am not presently very concern with weight loss…"), while only 20 % of the more superstitious group explicitly rejected the possibility. While only 33 % of the less superstitious group provided an explanation for why the open-placebo might work, 80 % of the more superstitious group provided an explanation of why it

Table 3 Summary of running a regression on placebo responsiveness, making the assumption of no selection and relaxing no selection

Variables	Placebo responsiveness	Placebo responsiveness
D (dichotomized superstition)	1.123	1.208
	(0.868)	(4.320)
Age	−0.543	−0.551***
	(0.405)	(0.156)
Sex	−3.811**	−3.830***
	(1.358)	(0.794)
Race	0.0962	0.103
	(0.312)	(0.367)
Observations	25	25
Assume	No selection	Allow selection

The treatment effect is not significantly dependent on whether we assume selection or not

would or might work (i.e. "I believe that the open-placebo may lead to desired change in weight because…"), or were not sure why it would work but were willing to "Just give it a try." Finally, while 60 % of the less superstitious group provided at least one reason for why the open-placebo would not or might not work, only 20 % of the more superstitious group provided at least one reason why the open-placebo might not work.

Discussion

As our hypothesis predicted, superstition can have a predictive impact on favorable weight change via placebo use. Individuals who were more superstitious experienced more favorable weight change during a 3-week period compared to those who were less superstitious. However, the degree to which individuals expected the open-placebo to work was unrelated to favorable weight change. While this might initially suggest that individuals who are superstitious are not necessarily more responsive because they harbor greater conscious expectations, responses to a descriptive questionnaire showed that more superstitious individuals provided reasons for why the procedure would or might work more often than the less superstitious, and the less superstitious provided more reasons for why the procedure would not work more often than the more superstitious. This suggests that positive reasoning responses may trigger expectation pathways that lead to successful placebo responsiveness. Those who are less superstitious may be less responsive because they do not have enough positive reasons to support the notion that they might lose or gain weight by means of a saltine cracker. However, there could also be differences in cognitive capacity and effort among the two groups, and future researchers may wish to use the Cognitive Failures Questionnaire (CFQ) to rule out the possibility of this influencing the data. Additionally, it is unlikely that this analysis is biased or contaminated by potential selection issues presented by having participants self-select into weight gain versus weight loss groups given that no significant difference was found in running a regression on placebo responsiveness with the assumption of selection and no selection.

Limitations of this study include a small, homogenous sample size of mostly female undergraduate students and a short trial period. Several trials included 1 week of a Spring Break vacation period which may have influenced the weights of the participants; diet and exercise patterns were not recorded in this study. Additionally, unlike traditional clinical placebo trials, participants in this study were aware of the placebo. Therefore, we cannot say that the same participants would react similarly had they been unaware. Furthermore, this study lacks a control group. With a pretest–posttest design, we cannot be certain that successful weight change was caused by the literature review and/or saltine crackers, as it could be that weight change was influenced by a factor other than the placebo, such as answering the questionnaire packet itself.

This preliminary study opens up the possibilities for open-placebo uses for weight management. Superstitious individuals with weight management difficulties may have alternative options for weight rehabilitation given our findings. Future research should include a control group and a larger, more diverse sample pool. These two factors in combination with varied trial period lengths would help establish a more precise relationship between superstition and open-placebo responsiveness in the general population. Narrowing the participant pool to individuals of similar weight who would like to change their weight in the same direction (loss or gain) would also be an effective way to control for extraneous factors such as the potential differences in the ease or difficulty gaining or losing weight. The differences among this subset of individuals along other psychological measures and scales could hold directional clues for a more nuanced understanding of how superstition interacts with other psychological mechanisms to produce placebo responsiveness.

Conflict of interest None.

Appendix A

Open-Placebos and Weight Loss Literature[1]

[First ask, "Do you know what the placebo effect is?" Once I received their answers, I responded with point (1)].

[1] All bracketed text was not typed into the copy given to participants.

1. The placebo effect occurs when a pharmacologically inert substance, such as sugar, helps aid in the recovery of a medical condition. There is nothing about the pill, or sham treatment, like a fake surgery, that has real medicinal value.

[Next ask, "Why do you think that a placebo has been shown to treat real medical conditions?" Once I received their answer, I responded with point (2)].

2. The reason the placebo works is hotly debated within psychology literature. Some psychologists think that expectations play a key role in inducing the placebo effect: because you believe you are being treated, your body actually starts to recover. Others believe that because a given patient has had interactions with doctors before, they are conditioned to heal from their past experiences, and a healing process is triggered for their present ailment once they see a doctor because of this.

[Then ask, "Do you know what an open-placebo is?" Once I received their answer, I responded with point (3)].

3. An open-placebo is a placebo in which a patient or participant in a study acknowledges that the treatment she is getting is a sham. Surprisingly, this type of placebo has been shown to have real effects on medical conditions such as Irritable Bowl Syndrome. In the study on IBS, "Placebo" was even written on the bottle of pills administered to patients, and symptoms were significantly reduced for the open-placebo group in a matter of a mere 3 weeks.

[Finally ask: "Do you think an open-placebo can lead to changes in weight?" Once I received their answer, I responded with point (4)].

4. Placebos have been shown to be as effective in helping people lose weight as most weight loss supplements. Additionally, they've proven to be as effective as Orlistat, a drug used to treat obesity, for weight loss. Logging, or journaling, may also be considered a placebo; it has proven over and over to lead to weight loss. Mock gastric-bypass surgeries have also lead to many reports of weight loss. In this study, we test if a placebo can lead to weight loss in a non-clinical setting and without deception.

Appendix B

Instructions

Dear participant:

Please eat only 1 cracker daily for a 3-week period beginning with the day that you are weighed. It would be ideal to stick to eating the crackers at the same time each day. You will receive automated e-mails from openplaceboexperiment@gmail.com asking you to confirm that you have eaten the daily cracker. You need only respond with a "Yes" or "No." Please do not miss any days!

At the end of the 3-week period, please meet with the researcher for your second weighing and debriefing.

Thank you!

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