Enhancing treatment effectiveness through social modelling: A pilot study

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Objective: Medical treatments take place in social contexts; however, little research has investigated how social modelling might influence treatment outcomes. This experimental pilot study investigated social modelling of treatment effectiveness and placebo treatment outcomes.

Design: Fifty-nine participants took part in the study, ostensibly examining the use of beta-blockers (actually placebos) for examination anxiety. Participants were randomly assigned to observe a female confederate report positive treatment effects (reduced heart rate, relaxed, calm) or feeling no different.

Main outcome measures: Heart rate, anxiety and blood pressure were assessed, as were symptoms and attributed side effects.

Results: Heart rate decreased significantly more in the social modelling compared to control condition, $p = .027$ (\(d = .63\)), and there were trends towards effects in the same direction for both anxiety, $p = .097$ (\(d = .46\)), and systolic blood pressure, $p = .077$ (\(d = .51\)). Significant pre-post placebo differences in heart rate, anxiety and diastolic blood pressure were found in the social modelling group, $p_s < .007$ (\(ds = .77--1.37\)), but not the control condition, $p_s > .28$ (\(ds = .09--.59\)).

Conclusions: Social observation of medication effectiveness enhanced placebo effectiveness in heart rate, and showed a trend towards enhancing treatment effectiveness in both anxiety and systolic blood pressure. Social modelling may have utility in enhancing the effectiveness of many active medical treatments.

Keywords: placebo; treatment efficacy; social observational learning; social modelling; heart rate; anxiety

Introduction

The placebo effect is a phenomenon whereby a genuine physiological or psychological effect occurs in response to an inert substance (Kaptchuk & Miller, 2015). The two predominant theories of how placebo responses are generated centre on expectancies and classical conditioning (Stewart-Williams & Podd, 2004). However, the importance of learning in placebo responding more broadly, in particular the learning of placebo effects through social modelling, has also been highlighted (Bootzin & Caspi, 2002; Colloca & Miller, 2011). The vicarious experience of another person’s treatment

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outcomes through observation can result in social learning, where learning occurs through observing the response of a model rather than through direct personal experience (Bandura, 1971). Social modelling is thought to induce or enhance personal expectations of benefit from the treatment, which then initiates mind–body mechanisms to produce a placebo effect (Colloca & Miller, 2011; Kirsch, 1985).

A number of studies have demonstrated the importance of social modelling in placebo analgesia (Colloca & Benedetti, 2009; Hunter, Siess, & Colloca, 2014; Vögtle, Kröner-Herwig, & Barke, 2016). In the first study of this kind, the observation of a model reporting reduced pain in response to a salient visual cue (compared to no pain reduction following the presentation of a difference cue) was associated with an enhanced placebo effect in the viewer when they subsequently underwent the same procedure (Colloca & Benedetti, 2009). The magnitude of this effect was similar to that generated by a classical conditioning procedure (direct experience of pain reduction), and was correlated with viewer empathy such that participants with higher levels of empathy experienced greater placebo analgesia. Subsequent research demonstrated that such observational learning can produce a substantial placebo analgesic response regardless of whether the model was viewed face to face or on video (Hunter et al., 2014). Interestingly, higher viewer empathy was associated with greater placebo analgesia in face-to-face, but not video-based, modelling. Recent findings indicate that social modelling can influence placebo analgesia in the viewer even when these cues are presented outside of conscious awareness (Egorova et al., 2015), and participant expectancies appear to fully mediate the relationship between social information and placebo analgesia (Koban & Wager, 2015).

Increases in pain (nocebo effects) can also be induced via social modelling using a similar procedure to that described above (Świder & Bąbel, 2013). Additionally, participants who observed a model display increased pain sensitivity in response to an ointment reported significantly greater levels of pressure pain themselves in the hand the ointment was applied to compared to their control hand (Vögtle, Barke, & Kröner-Herwig, 2013; Vögtle et al., 2016). Outside of pain paradigms, research has also demonstrated that the social observation of symptom reporting can result in increased nocebo effects (Broderick, Kaplan-Liss, & Bass, 2011; Faasse, Grey, Jordan, Garland, & Petrie, 2015; Lorber, Mazzoni, & Kirsch, 2007; Mazzoni, Foan, Hyland, & Kirsch, 2010). Previous research using a similar paradigm to the current study demonstrated that seeing a confederate (presented as another study participant) report treatment side effects also increased symptom reporting in the viewer; however, this effect was limited to female participants in response to the female model (Faasse et al., 2015). Results of the same study indicated that seeing the confederate report unpleasant side effects also reduced the effectiveness of the placebo treatment, resulting in substantially smaller decreases in both systolic and diastolic blood pressure across both male and female participants.

In addition to direct face-to-face observation, seeing and reading about other people’s experiences through news media, social media and other Internet sources may also influence treatment outcomes (Bandura, 2001; Bartholomew, Wessely, & Rubin, 2012; Faasse, Gamble, Cundy, & Petrie, 2012; Tan, Petrie, Faasse, Bolland, & Grey, 2014). The role of observational learning and social modelling are of importance in placebo and nocebo effects, and also have implications for the potential role of social

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communication on treatment outcomes in routine medical practice, clinical trial settings and through the news, social and advertising media (Benedetti, 2013).

While research into the placebo effect has increased dramatically over the past 20 years, there has been relatively little work on the role of social modelling in placebo responding, particularly in domains other than pain. The current pilot study aimed to investigate the impact of the social modelling of medication benefits on placebo treatment effectiveness following the administration of an inert tablet described as a beta-blocker. It was hypothesised that the social modelling of medication effectiveness (reduced heart rate and anxiety) would increase the effectiveness of the medication (placebo) in the observer.

Methods

Design

Participants were recruited to take part in research ostensibly on the use of fast-acting beta-blocker medications for examination anxiety. All tablets were actually placebos. Participants were randomised to one of two social modelling conditions with a female confederate who either reported that the medication had been effective or that they were feeling no different. Allocation concealment was achieved by the use of sequentially numbered opaque envelopes prepared by a researcher not otherwise involved in the study. Envelopes were opened by the confederate only once the participant had begun the session with the experimenter. The experimenter was blind to condition allocation for all baseline assessments and placebo administration. Physiological measures (heart rate and blood pressure) were taken using an automatic ambulatory blood pressure monitor (with results hidden from the participant), and all subjective measures were completed by the participant in pen-and-paper format without input from the experimenter. In addition, the experimenter conducted each study session using a script, to standardise session content and participant experience.

The minimum required sample size was 52 participants (26 in each group) in order to achieve 80% power at an alpha level of .05 to detect a large effect of social observation on the primary outcomes (heart rate and anxiety) in an experimental two group design. Participants were debriefed and informed about the true nature of the study and the tablets once data collection was complete. Ethical approval for the study was received from the university institutional review board (reference number 9094).

Participants

A total of 59 participants were recruited from the university community via posters placed around the campus and distributed through staff and student email lists. The sample comprised 35 females (59%) and 24 males (41%), and most participants identified as being of either European (48%) or Asian (35%) ethnicity. Participants were either studying (30% undergraduate, 32% postgraduate) or employed (38%), with ages ranging from 18 to 52 years ($M = 28$, $SD = 8.5$). Inclusion criteria for participation were being 18 years of age or over, and the ability to read and write in English. Potential
participants were excluded if they had two baseline blood pressure readings less than 100/60 mmHg, or reported a previous diagnosis of asthma.

**Procedure**

Participants came to the university medical school clinical research centre for a one-hour research session. Blood pressure and heart rate were assessed twice at each of three points in the study; at baseline, after the medication-effect waiting period, and at the end of the research session immediately following an exam simulation.

After gathering physiological and questionnaire baseline information, each participant was given standardised verbal information about the beta-blocker tablet. Participants were informed that the tablet contained a 47.5 μg dose of the active ingredient metoprolol, and would take 10–15 min to take effect. Information provided about the intended clinical effects of the medication was that it would lower heart rate and blood pressure, as well as reducing anxiety. Participants were also told about possible medication side effects of headache, tiredness or drowsiness, dizziness or light-headedness, sore throat, dry mouth, skin itching, cold hands or feet, nausea and stomach pain.

After taking the beta blocker tablet, participants were taken to a waiting area for 15 min. Here, they were seated with another participant (actually a study confederate). Only the confederate was aware of which condition the participant had been randomly assigned to until the actual modelling procedure. Approximately, 10 min into this waiting period, the researcher first asked the confederate, and then the participant, how they were feeling after taking the tablet. In the positive modelling condition, the confederate replied ‘I feel calmer and more relaxed, and like my heart rate has gone down’. In the control condition, the confederate said ‘I don’t feel any different’. This single statement made by the confederate was the only difference between the two social modelling conditions.

After the waiting period the participant was taken back to the study room. The participant then completed a brief cognitive task (examination simulation) followed by a post-medication questionnaire, which assessed self-reported state anxiety, symptoms experienced since taking the tablet, and whether these symptoms were attributed as side effects of the medication. Participants received a NZ$20 gift voucher as compensation for their time.

**Measures**

**Blood pressure and heart rate**

Physiological measurements of systolic blood pressure, diastolic blood pressure and heart rate were assessed using a Spacelabs ambulatory blood pressure monitor with a standard cuff size. Two measurements were taken at baseline (approximately 5 and 10 min into the study session). Participants then took the beta blocker placebo tablet. Two more measurements were taken after the waiting period was complete (approximately 15 and 20 min post-tablet), and two final measurements were taken after participants had completed the examination simulation (approximately 30 and 35 min post-tablet). For each of time points (baseline, post-wait and post-test), the mean of these two measurements was calculated.
State anxiety

A modified version of the short-form state scale of the Spielberger State-Trait Anxiety Inventory (STAI) was used to assess state anxiety before and after taking the placebo beta-blocker tablet (Marteau & Bekker, 1992). These authors report that the short-form version of the STAI has acceptable reliability and validity, and is sensitive to changes in state anxiety. The internal consistency (Cronbach’s α) in the current study was good (α = .88). Because the short-form of the STAI produces similar scores to those obtained with the full-form of the STAI (Spielberger, 1983), the short-form was used in the current study to reduce participant burden and total time taken for each experimental session. The scale asks about the degree to which participants are currently experiencing six anxiety-related states: calm, relaxed, content, tense, worried and upset. The original measure is rated on a four-point scale, which was modified to a seven-point scale ranging from 0 (not at all) to 6 (very much) in order to enhance sensitivity to assess change. This modification resulted in a total score ranging from 0 (not at all anxious) to 36 (very anxious) when sum scores of the six items were calculated. Participants were low in self-reported state anxiety at baseline (M = 7.57, SD = 5.48). The modified version of the short-form trait STAI was completed at baseline and again at the end of the session following the brief exam simulation.

Physical symptoms and side effects

Physical symptoms and the side effects were assessed using a modified version of the Subjective Health Complaints scale (SHC), with demonstrated reliability in the assessment of the experience of subjective physical symptoms (Eriksen, Ihlebaek, & Ursin, 1999). The modified version of the SHC used in the current study showed good internal consistency (α = .80). In addition to the original symptoms, possible medication side effects were also included in the scale. At baseline, participants were asked to provide ratings of the degree (not present [0], mild [1], moderate [2] or severe [3]) to which they had experienced each of the 39 symptoms, including tiredness, neck pain and heartburn, during the preceding 30 min. The same symptoms questions were completed again following the exam simulation, with the addition of attribution items; for each symptom that participants reported experiencing, they were also asked whether they believed that the symptom was caused by the medication that they had taken. Responses were in yes/no format. Because the majority of the symptoms reported were rated as being ‘mild’, symptoms were categorised as being ‘present’ or ‘not present’, allowing for the calculation of the total number of symptoms reported by each participant at each time point. The number of symptoms attributed to the medication was also summed.

Statistical analysis

All statistical analyses were carried out using SPSS version 22. Independent-samples t tests and χ² tests were used to assess differences between the control and social modelling groups at baseline. In order to assess the influence of social modelling on anxiety, heart rate and blood pressure outcomes, 2 × 2 × 2 (time by modelling condition by participant gender) mixed analyses of variance (ANOVAs) were used to assess baseline
to post-test (time; within subjects) differences between the control and positive modelling groups (modelling condition; between-subjects) and male and female participants (participant gender; between-subjects). Participant gender was included as a factor in all analyses because the model in the study was female. Because the treatment was described to participants as influencing examination anxiety, primary outcomes were considered those assessed after the simulated examination. Planned comparisons using a Bonferroni correction were conducted to investigate change over time within each of the social modelling groups. The influence of social modelling and gender on post-tablet symptoms and attributed side effects were assessed using a $2 \times 2$ (modelling group by participant gender) factorial analysis of covariance (ANCOVA) controlling for baseline symptom reporting. An alpha level of .05 was used for all tests.

**Results**

The experimental study was designed to assess the influence of observing another participant report beneficial effects of a beta-blocker medication (actually placebo) on changes in heart rate, blood pressure and anxiety. The number of reported physical symptoms and the total number of symptoms attributed as medication side effects was also investigated. There were no significant baseline differences between the two social modelling groups with regard to age, gender, ethnicity, GP visits, state anxiety, heart rate, systolic and diastolic blood pressure or physical symptoms ($p$s > .05). Mean (SE) data for baseline and post-test assessments of heart rate, anxiety and blood pressure are presented in Table 1.

**Anxiety**

There was a significant overall decrease in anxiety from pre- to post-tablet, $F(1, 55) = 4.75, p = .034, d = .59$, as well as a trend with an approximately medium effect size (Cohen, 1992) towards an interaction between time and modelling condition, $F(1, 55) = 2.85, p = .097, d = .46$. Planned comparisons further revealed that the social modelling group experienced a significant decrease in anxiety after taking the placebo tablet, $p = .006, d = .77$, while the neutral control group did not, $p = .74, d = .09$ (see Figure 1). There was also a significant interaction between time and gender, $F(1, 55) = 5.29, p = .025, d = .63$. Only female participants had a significant decrease in anxiety over time ($M_{pre} = 7.93, SE = .95; M_{post} = 5.08, SE = .87$), $p = .001, d = .97$; male participants

| Table 1. Mean (SE) heart rate, blood pressure, and anxiety at baseline at post-tablet across the neutral control and positive modelling conditions. |
|-------------------------------------------------|-----------------|-----------------|
|                           | Neutral control | Positive modelling |
|                           | Baseline        | Post-tablet     | Baseline        | Post-tablet     |
| Heart rate (bpm)          | 74.69 (2.79)    | 73.45 (2.37)    | 71.95 (2.54)    | 67.15 (2.15)    |
| Systolic blood pressure (mmHg) | 120.93 (2.14) | 117.80 (1.99)  | 123.63 (1.94)  | 116.98 (1.81)  |
| Diastolic blood pressure (mmHg) | 76.48 (1.42) | 75.13 (1.59)   | 77.12 (1.29)   | 73.50 (1.45)   |
| Anxiety                   | 6.78 (1.12)     | 6.46 (1.02)     | 8.40 (1.02)     | 5.93 (0.92)     |
showed little change ($M_{pre} = 7.24$, SE = 1.17; $M_{post} = 7.32$, SE = 1.07), $p = .94$, $d < .01$. There was not an overall effect of gender, nor were there any other interaction effects, $ps > .54$.

**Heart rate**
There was a significant overall reduction in heart rate between the baseline and post-tablet assessments, $F(1, 55) = 14.91$, $p < .001$, $d = 1.03$, and a significant interaction between time-point and social modelling condition, $F(1, 55) = 5.17$, $p = .027$, $d = .63$ (medium-to-large effect size; see Figure 1). The positive modelling group experienced a significant reduction in heart rate between baseline and post-tablet, $p < .001$, $d = 1.28$, while the change in the neutral control group was not significant, $p = .29$, $d = .29$. There was not a significant overall influence of participant gender, $p = .99$, nor were there any other significant interaction effects, $ps > .59$.

**Blood pressure**
There was a significant overall change in systolic blood pressure over time, $F(1, 55) = 25.00$, $p < .001$, $d = 1.34$, and a trend towards an interaction between time and modelling, $F(1, 55) = 3.25$, $p = .077$, $d = .51$ (medium effect size; see Figure 2). Planned comparisons further revealed that this interaction indicated a marginally larger decrease in systolic blood pressure from pre- to post-tablet in the social modelling condition, $p < .001$, $d = 1.37$, compared to the control condition, $p = .035$, $d = .59$. There was also a significant effect of gender, $F(1, 55) = 9.20$, $p = .004$, $d = .81$; male participants ($M = 123.79$ mmHg, SE = 2.03) had significantly higher systolic blood pressure than females ($M = 115.88$ mmHg, SE = 1.64). This finding is in line with previous literature demonstrating that premenopausal women have lower blood pressure than men at similar ages (Reckelhoff, 2001). Participant gender did not interact significantly with any other factors, $ps > .16$.

Diastolic blood pressure also showed a significant overall reduction over time, $F(1, 55) = 7.70$, $p = .008$, $d = .74$. There was not a significant interaction between social modelling condition and time, $F(1, 55) = 1.60$, $p = .21$, $d = .35$. However, planned
comparisons revealed a significant decrease in diastolic blood pressure over time in the social modelling group, \(p = .004, d = .81\), but not the neutral control condition, \(p = .31, d = .29\) (see Figure 2). There was not an effect of participant gender on diastolic blood pressure, \(p = .68\), nor were there any other interaction effects, \(ps > .65\).

**Post-wait analyses**

Subsequent analyses were conducted using the same procedure as above but with heart rate and blood pressure outcomes recorded immediately following the 15-min waiting period (note that anxiety was assessed only twice, at baseline and again near the end of the study session following the exam simulation). Results for heart rate and systolic blood pressure showed similar but weaker patterns to those reported, with significant decreases over time in the positive modelling condition, \(p = .001\) and \(.018\), respectively (\(ds = .94\) and \(.67\)), but not in the neutral control group, \(p = .17\) and \(.31\), respectively (\(ds = .35\) and \(.29\)). Diastolic blood pressure did not decrease significantly in either group across the shorter time period, \(ps > .39\). The cover story in this pilot study highlighted the influence of the study tablets on examination anxiety. While not assessed, it is likely that this information influenced participants’ expectations of and attention to treatment outcomes as being most important around the time of the simulated examination.

**Symptoms and side effects**

Social modelling did not influence the number of symptoms reported after participants took the placebo tablet, \(p = .69\). Symptom reporting also did not differ by participant gender, \(p = .14\), nor was there an interaction between gender and modelling condition, \(p = .64\). Similarly, neither social modelling, participant gender, nor the interaction of the two, had any influence on the number of symptoms attributed as being treatment side effects, \(ps > .10\).

**Conclusions**

This is the first study to investigate the influence of social modelling on treatment effectiveness outside of a pain paradigm. The results indicate that seeing another participant...
(actually a confederate) respond positively to the study placebo medication enhanced the effectiveness of the treatment in reducing viewer heart rate, with similar trends in anxiety and systolic blood pressure. Social modelling resulted in approximately medium effect sizes (Cohen, 1992). Examining changes within each group over time revealed significant decreases in heart rate, diastolic blood pressure and anxiety in only the social modelling condition. Taken together, the current findings suggest the possible utility of social modelling of treatment benefits in enhancing treatment effectiveness. Reassuringly, social observation of treatment effectiveness did not influence reported symptoms or side effects. Patients tend to associate the perception of increased treatment effectiveness with a higher likelihood of side effects (McHorney, Schousboe, Cline, & Weiss, 2007). That increased effectiveness did not influence symptomatic outcomes in the current research shows promise in relation to the utility of such modelling interventions in medical care.

The current findings are in line with previous research using pain paradigms (Colloca & Benedetti, 2009; Hunter et al., 2014; Świder & Bąbel, 2016), which have demonstrated that social observation of analgesia in response to a cue (e.g. a green light or a circle) results in analgesia in the viewer following the same cue. Observational learning has been highlighted as having an important influence on pain outcomes (see Goubert, Vlaeyen, Crombez, & Craig, 2011). The importance of extending these findings in a non-pain paradigm is twofold. First, it suggests that the influence of social modelling is not unique to pain outcomes, and that the mechanisms underlying responses to social modelling may extend to cardiovascular effects and self-reported anxiety. Second, these findings point to the potential utility of social modelling to enhance outcomes in medical care in a range of treatments and conditions. The results of the current study may be particularly relevant as medications to treat hypertension and mental health conditions are the most commonly prescribed therapeutic classes in the United States (IMS Institute for Healthcare Informatics, 2016).

An important difference between the previously discussed pain literature and the current study is the use of a placebo medication – an inert pill – rather than a visual cue as the ‘placebo’ stimulus. This allowed for the investigation of the role of social modelling of treatment effectiveness in a more ecologically valid clinical context similar to real-world medication use. In line with information about active treatments, the placebo in the current study was described as having multiple possible effects, both positive (reduced anxiety, heart rate and blood pressure) and negative (treatment side effects). This allowed for the investigation of both modelled (heart rate and anxiety) and non-modelled (systolic and diastolic blood pressure) placebo outcomes, with results indicative of a somewhat generalised effect of modelling on treatment effectiveness in line with the information participants were given about likely effects of treatment. Differences in anxiety and systolic blood pressure in the positive modelling and control groups over time showed only trends towards significance, though both outcomes yielded medium effect sizes. Replication of the current pilot study with a larger sample size is warranted, and future research should be adequately powered to detect medium interaction effects of modelling condition over time. These findings may also be partly explained by a floor effect due to the relatively low baseline anxiety levels, and the use of healthy participants with normal blood pressure.

The current study found no differences between responses of male and female participants, with the exception of self-reported anxiety. Female participants (independent
of modelling group) experienced larger anxiety reductions in response to the placebo treatment than male participants. Previous research using a similar paradigm but with social modelling of treatment side effects (by a female confederate) found large differences in symptom outcomes of female (but not male) participants in response to social modelling (Faasse et al., 2015). However, this study also revealed that this side effect modelling reduced the effectiveness of the placebo tablets in decreasing blood pressure, and similar to the current results this effect was consistent across male and female participants. Subjective treatment outcomes following social modelling may be more influenced by gender effects or perceived similarity to the model than objective physiological outcomes. It remains unclear why male and female participants in the current study had different anxiety trajectories. A recent review highlights the lack of evidence for sex differences in placebo responding (Weimer, Colloca, & Enck, 2015). One explanation is that sitting with a female confederate during the waiting period may have affected male and female participants’ anxiety levels differently. Future research would benefit from a more limited modelling procedure with both male and female confederates.

The current pilot study is limited by a small sample size and the lack of a ‘no treatment’ control group, which would have provided information about any placebo effects generated through the current paradigm, as well as how they were modified by social modelling. Previous research has demonstrated that social modelling intended to generate placebo effects can sometimes result in nocebo effects instead, particularly in response to a male model (Świder & Bąbel, 2013), highlighting the importance of a natural history comparison condition. An additional limitation is that the design of the modelling procedure, with the experimenter eliciting the modelled reports from the confederate in the presence of the participant. This meant that the experimenter was not blind to social modelling condition for the subsequent assessment of outcome measures. To account for this, blood pressure and heart rate were measured using an automatic blood pressure monitoring device, removing the need for experimenter interpretation. All self-report measures were completed by the participant in pen-and-paper format without the input of the experimenter. Finally, the experimenter used an identical script for all study sessions. However, future research should involve outcome assessment by blinded investigators.

The psychosocial context in which medical treatment occurs is important – perhaps just as important as the pharmacological effects of a drug (Frisaldi, Piedimonte, & Benedetti, 2015). Placebo effects derive from this psychosocial context, and form an important component of the outcomes of active treatments (Mora, Nestoriuc, & Rief, 2011), highlighting the importance of utilising psychological strategies to maximise placebo responses in medical care (Rief, Bingel, Schedlowski, & Enck, 2011). The current study has potentially important implications for clinical care; the social modelling of treatment benefits provides a possible pathway for enhancing treatment effectiveness of a wide range of medical interventions. The results also raise interesting questions about the role of pharmaceutical television advertising in the United States, and whether such ads – typically showing patients enjoying treatment benefits – might similarly enhance treatment outcomes in viewers. Future research in this area would also benefit from the examination of the influence of social modelling in active treatments, in order to bridge the gap between theory and real-world applications.
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