Title: 'Always take your doctor's advice': Does trust moderate the effect of information on inappropriate antibiotic prescribing expectations?

Short title: *TRUST AND ANTIBIOTIC EXPECTATIONS*

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The link to the approved Stage 1 protocol, raw data, and materials that support the findings of this research are available on the OSF at: https://osf.io/jdcza/?view_only=40b08601f7d84748a467bc2357734cd9

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Abstract: Objectives. To reduce overprescribing, health campaigns urge physicians to provide people with information regarding appropriate antibiotic use and encourage the public to trust their physicians' prescribing decisions. We test i) whether providing individuals with information about the viral aetiology of an illness and the ineffectiveness of antibiotics will reduce inappropriate antibiotic expectations, ii) whether individuals with greater trust in their physician will have lower expectations, and iii) whether individuals with greater trust in their physician will benefit more from the complete information provision and have lower expectations. **Design.** Experiment 1 features a between-subjects design (information provision: baseline vs. complete information) with a general measure of participants trust in their physician. Experiment 2 features a 2 (physician trustworthiness: low vs. high) × 2 (information provision: baseline vs. complete information) between-subjects design. **Methods.** In Experiment 1, participants (*n* = 366) reported their trust in their physician, read a vignette describing a hypothetical consultation with a physician for a viral cold then expressed their expectations for antibiotics. In Experiment 2, participants (*n* = 380) read a vignette of a consultation with a physician for a viral ear infection then expressed their expectations for antibiotics. **Results.** In both experiments, the provision of complete information significantly reduced inappropriate expectations for antibiotics. Greater trust in physicians was associated with higher antibiotic expectations in Experiment1, but lower expectations in Experiment 2. In both experiments trust in physicians appeared to facilitate the effect of information provision, but this effect was weak and inconsistent. **Conclusion.** Providing information about viral aetiology and the ineffectiveness and side effects of antibiotics reduces inappropriate antibiotic expectations. Further research into the effect of trust in physicians as a moderator of the effect information provision is required, particularly given the recent increase in trust-based antibiotic campaigns.

Keywords: Antibiotic expectations, antibiotic resistance, nonclinical factors, trust, physician-patient relationship

Introduction

Around 33,000 deaths a year in the European Union alone are attributed to antibiotic resistance infections (Cassini et al., 2019). Unabated, antibiotic resistance will continue to engender severe health and economic consequences worldwide (World Health Organization, 2014). Overprescribing of antibiotics promotes the spread and development of antibiotic resistance (Goossens, Ferech, Stichele, & Elseviers, 2005). A well documented source of antibiotic overprescribing is in primary care where, according to recent estimates, 20% of prescriptions (≈ 6.3 million) are given out unnecessarily each year (Pouwels, Dolk, Smith, Robotham, & Smieszek, 2018; Public Health England, 2017). In response, there have been urgent calls to reduce antibiotic resistance by quelling overprescribing in primary care (Davies, 2018). One proposal has been to try and reduce the impact of inappropriate expectations for antibiotics – which refers to expectations for antibiotics in a situation where they are not clinically justified (e.g., for a viral infection) – by developing more effective methods for informing people about appropriate antibiotic use (Donald, 2016). To do so effectively, research must establish which factors might facilitate the effect of information provision at reducing inappropriate expectations for antibiotics.

During a primary care consultation, the patient's behaviour exerts a powerful influence on whether a physician will withhold or prescribe antibiotics (Macfarlane, Holmes, Macfarlane, & Britten, 1997). Patient expectations for antibiotics have been identified as a particularly important factor in the overprescribing of antibiotics in primary care (McNulty, Nichols, French, Joshi, & Butler, 2013; Pan et al., 2016; Sirota, Round, Samaranayaka, & Kostopoulou, 2017). Patients who expect antibiotics from a physician almost always receive them (McNulty et al., 2013). Building on these findings, Sirota et al. (2017) provided causal evidence that patients' expectations to receive antibiotics are sufficient to actuate physicians to prescribe them – even when they are not clinically justified (i.e., inappropriate). Clinical guidelines recommend that when antibiotics are not needed physicians should inform patients about the nature of the illness, the ineffectiveness and side effects of antibiotics, and alternative treatments for managing the illness (Tan, Little, & Stokes, 2008).

Given that providing information to primary care patients has only a limited effect on overprescribing (Macfarlane et al., 2002; Mainous 3rd, Hueston, Love, Evans, & Finger, 2000; Meeker et al., 2016), we can assume that it is not a sufficient condition for completely eradicating patients' inappropriate antibiotic expectations. Several reasons exist as to why the communicated information has only a limited effect, but one obvious reason might be that people do not trust the information enough. Indeed, evidence indicates that more trustworthy sources are more persuasive (Glaeser & Sunstein, 2013; Pornpitakpan, 2004; Tormala, Brinol, & Petty, 2006). Thus, prompting patients to trust their physicians' might lead to greater acceptance of the information provided by physicians (Ancillotti et al., 2018; André, Vernby, Berg, & Lundborg, 2010; Brookes-Howell et al., 2014), which in turn would lead to a greater effect of information provision at reducing inappropriate antibiotic expectations from primary care patients.

Patients' trust in their physician has general importance in health communication and, in particular, in physician communications intended to guide patient treatment decisions (Hall, Camacho, Dugan, & Balkrishnan, 2002; Katz, 2002; Thom, 2000; Thom, Hall, & Pawlson, 2004; Thom, Kravitz, Bell, Krupat, & Azari, 2002). Overall, trusting patients are more likely to report being satisfied with the care provided by their physician and to openly communicate medical problems (Freburger, Callahan, Currey, & Anderson, 2003). Trusting patients are also more likely to report greater adherence to their physicians' instructions (Freburger et al., 2003). For example, Safran et al. (1998) found that patient's trust in the physician was strongly correlated with adherence to physicians' recommendations regarding risky health behaviours (e.g., smoking, alcohol consumption). The role of trust has been recognized in public campaigns as well. For instance, in 2018, a national campaign by Public Health England contained a salient plea for members of the public to "Always take your doctor's advice" on antibiotics.

In addition to the apparent general importance of trust in health communications, the hypothesis that enhancing trust in physicians will bolster the benefits of information provision is supported by population level data and qualitative research. For example, in Sweden, a country with low antibiotic prescribing rates, public trust in physicians' judgments of when to prescribe and withhold antibiotics is high; as is knowledge of antibiotic usage and resistance (André et al., 2010). Faber, Heckenbach, Velasco, and Eckmanns (2010) noted that, in Germany, respondents who did not trust their physicians' prescribing decisions not only admitted that they would not accept the decision, but would attempt to convince the physician to give them antibiotics anyway or go and visit another physician who would. Interviews with patients also report that trust appears to be a key factor in whether they accept their physicians' antibiotic prescribing decisions (Ancillotti et al., 2018; Brookes-Howell et al., 2014).

However, there is currently no causal evidence that patients who trust their physician would be more receptive to information from their physician about whether they need antibiotics and, in turn, less likely to expect them. While both population level data and primary care level interviews provide useful insights into the potential role of trust, these findings are ambiguous with regard to how to interpret the relationship between trust in physicians and the acceptance of information about antibiotics. Increased trust might facilitate the effect of information provision at reducing inappropriate expectations for antibiotics — or might only increase/decrease as a function of information provision. In which case, attempting to reduce inappropriate expectations by targeting trust would likely not be as successful as desired.

The effectiveness of initiatives aiming to tackle antibiotic resistance by reducing inappropriate expectations depends greatly on psychological research to identify key components of behaviour change (Donald, 2016; Tonkin-Crine, Walker, & Butler, 2015). Hence, there would be substantial practical benefits from establishing the nature, and magnitude, of the relationship between trust in physicians and the acceptance of information about antibiotics. Doing so would also provide theoretical insight into the information processing mechanisms underlying the formation, and maintenance, of inappropriate expectations for antibiotics.

Present Research

The overarching goal of the present research is to establish whether trust in physicians moderates the effectiveness of information provision at reducing inappropriate expectations for antibiotics. In Experiment 1, we aim to see whether natural variations of participant's trust in their physician moderates the effect of information provision on patients' expectations for antibiotics. We hypothesize that individuals who are informed about the viral aetiology of the illness and the ineffectiveness of antibiotics will be less likely to have inappropriate expectations for antibiotics than individuals who do not receive this information (Hypothesis 1). Second, we hypothesize that individuals with greater trust in their physician will have lower expectations for antibiotics (Hypothesis 2). Third, we hypothesize that participants' trust in their physician will moderate the effect of information provision, whereby individuals with greater trust in their physician will benefit more from the information provision and, in turn, have lower expectations for antibiotics (Hypothesis 3).

In Experiment 2, we aim to provide causal evidence for the moderation role of trust on information provision reducing inappropriate expectations for antibiotics. To do so, we designed a manipulation, which taps into the two basic dimensions on which people evaluate the trustworthiness of others: warmth and competence (Fiske, Cuddy, & Glick, 2007; Judd, James-Hawkins, Yzerbyt, & Kashima, 2005). In a medical context, these dimensions can be understood as the patient's belief that the physician will act with the patient's best interests in mind and that the physician has the necessary ability to do so (Mechanic & Schlesinger, 1996). We again test three hypotheses. First, we hypothesize that information from a physician will reduce inappropriate expectations for antibiotics (Hypothesis 4). Second, we hypothesize that descriptions of high physician trustworthiness will decrease expectations compared to descriptions of low physician trustworthiness (Hypothesis 5). Third, we also hypothesize that the effect of information provision will be more pronounced when the physician is perceived as being high in trustworthiness compared to being low in trustworthiness (Hypothesis 6).

Both experiments will advance theoretical understanding of the factors underlying inappropriate antibiotic expectations. Experiment 1 will provide insight into how trust in physicians moderates the effect of information provision when trust is naturally distributed within the sample, while Experiment 2 will provide causal evidence for the effect of trust in physicians on the facilitative effect of information provision to patients. All non-pilot data were collected after the date of in-principle acceptance. The link to the approved Stage 1 protocol, raw data, and materials is provided here:
https://osf.io/jdcza/?view_only=40b08601f7d84748a467bc2357734cd9.

Experiment 1

Method

Participants. In the absence of a meaningful effect size estimate in the published literature regarding the effect of information provision and trust in physicians as a moderator of inappropriate antibiotic expectations, we used a small effect size as the lowest meaningful effect size estimate for our power analysis (Cohen, 1988). Assuming $\alpha = .05$ and $1-\beta = .90$ for a conventionally small effect ($f^2 = .03$), we conducted a-priori power analysis for a linear multiple regression analysis (fixed model, single regression coefficient, 3 predictors) to test the effect of information provision on expectations for antibiotics (testing Hypothesis 1), the effect of general trust in physicians on expectations for antibiotics (testing Hypothesis 2), and the interaction effect of trust in physicians and information provision (testing Hypothesis 3) (Faul, Erdfelder, Lang, & Buchner, 2007). This calculation resulted in a total sample size of 353 participants. We contacted participants from the general adult population via an online recruitment panel (Prolific). Participants were paid £0.93 upon completion of the study, which took 5 minutes on average. Only participants who had (i) achieved at least 90% approval rate in previous studies, (ii) resided in the United Kingdom, and (iii) were at least 18 years old were eligible to participate. We expected an exclusion rate of about 10%. To reach the target minimum size of 353 participants, we aimed to gather data from 389 participants. If after applying the a-priori exclusion criteria the valid sample size had been < 353 the contingency plan was to collect more participants (in groups of 10) until the minimum valid sample size was ≥ 353.

A total of 393 participants accessed the experiment; one participant did not consent to participate and did not complete the experiment[1]. Aligned with the pre-specified exclusion criteria, we excluded two participants who did not complete the study fully and a further 24 participants who did not respond to an attention check as instructed (see Attention check in the Supplementary Materials). The final sample consisted of 366 participants (102 were male, 262 female, and 2 other; age ranged from 18 to 70 years old, M = 35.49, SD = 12.17 years). The majority of participants identified as white (89%). Most participants were in full time employment (64%) and the level of education varied between those with less than an undergraduate degree (36%), those with an undergraduate degree (44%), and those with a masters or doctoral degree (20%). Baseline characteristics for participants in each arm of experiments 1 and 2 are presented in Table 1.

Insert please Table 1 around here

Design. All participants reported their general trust in their physician. Participants were then randomly allocated to either the baseline condition (i.e., no explicit information about the viral nature of the respiratory infection or about antibiotics) or the complete information condition (i.e., explicit information about the viral nature of the respiratory infection and the function and potential side effects of antibiotics). We measured participant's trust in their

[1] The reason an extra four participants accessed the experiment than was intended is because the Prolific recruitment system automatically replaces participants who have 'timed-out' or 'returned' their submission with new participants even if these participants do go on to submit their data.

physician prior to the manipulation of information provision to avoid the possibility that the manipulation might influence the participant's reported trust in their physician. The dependent variable was the participant's expectations for antibiotics. Random allocation to conditions (block randomization) was carried out using the built-in randomizer function in Qualtrics' survey flow.

Materials and procedure. After providing informed consent, participants expressed their general trust in their physician on the 11-item Trust in Physician Scale (e.g., "I trust my doctor's judgments about my medical care")(Anderson & Dedrick, 1990). The items in the Trust in Physician scale were generated to reflect three dimensions of trust: dependability of the physician, confidence in the physician, and physician-patient confidentiality and the instrument demonstrated excellent internal consistency as well as construct validity (Anderson & Dedrick, 1990). Participants were instructed, "Throughout this task, we would like you to think about your GP (the GP who you see the most often). If you do not see the same GP regularly, think about the GP who you saw most recently" and then asked to rate the extent to which they agree or disagree to the trust in physician items on a five-point Likert scale ranging from 1 to 5 (1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Uncertain*, 4 = *Agree*, 5 = *Strongly agree*). In this experiment, the trust in physician scale demonstrated excellent internal consistency ($\alpha = 0.88$) and we computed a scale average for analysis. The trust in physician scale was then normalised by transforming the arithmetic mean for the 11 items to a value on a 0-100 scale where higher scores correspond to greater trust (Freburger et al., 2003).

Following this, participants read a hypothetical medical scenario describing a consultation with a physician for symptoms of a common cold (see the Exp.1 vignette in the Supplementary Materials). The scenario was modelled in alignment with those published by

Sirota et al. (2017) and with the National Institute for Health and Care Excellence guidelines of a situation for which antibiotics are not clinically justified (Tan et al., 2008). In the scenario, all participants received a description of the symptoms, a description of the physical examination, and a diagnosis of a respiratory tract infection. In addition to this information, participants in the complete information condition also received an explanation from the physician that the infection is viral: "After the examination your GP explains that they think a *viral* respiratory tract infection is the cause of your symptoms." and a description of the function of antibiotics and their side effects: "*Your GP mentions that antibiotics are only effective for bacterial infections, have no positive effect on viral infections, provide no symptom relief and may have side effects such as diarrhoea, vomiting and rash*." Participants then reported their expectations for antibiotics as a treatment on a four-item scale and, for each item, provide their level of agreement on a six-point Likert scale ranging from 1 to 6 (1 = *Strongly disagree,* 2 = *Disagree,* 3 = *Mildly disagree,* 4 = *Mildly agree,* 5 = A*gree,* 6 = *Strongly agree*). The dependent variable displayed excellent internal consistency in both the baseline ($\alpha = 0.94$) and information provision ($\alpha = 0.93$) conditions and so were both averaged for analysis.

Lastly, participants were asked whether they have ever visited their GP for a respiratory tract infection, if they have ever received antibiotics for a respiratory tract infection and to provide some general demographic information (age, gender, ethnicity, and employment).

Statistical analyses. For the analysis, trust in physician scores were mean-centered and information provision was dummy coded (baseline condition = 0, complete information condition = 1). To test the effect of information provision (Hypothesis 1), the effect of trust in their physician (Hypothesis 2), and whether trust in their physician moderates the effect of information provision (Hypothesis 3) on expectations for antibiotics we ran a multiple linear regression model on expectations for antibiotics as a treatment, with the information provision, trust in physicians, and their interaction term as predictors. OLS estimates were used to calculate standard errors.

To control for the influence of past consultation behaviour and antibiotic usage, we re-ran this analysis with past consultation behaviour for respiratory tract infections and past experience of receiving antibiotics for respiratory tract infections added as covariates. All analyses were carried out using R.

Results

Aligned with our first hypothesis, participants who received information about the viral nature of the infection and the lack of efficacy and side effects associated with antibiotics had lower expectations of antibiotics for a respiratory infection (M = 3.3, SD = 1.4) than those who did not receive this information (M = 1.9, SD = 1.1), b = -1.42, $t(362)$ = -10.76, $p < .001$. However, contrary to our second hypothesis, across all participants, greater trust in physicians was associated with higher, not lower, expectations for antibiotics, b = 0.01, $t(362)$ = 2.79, p = .006. We conducted post-hoc analysis to include the average marginal effect of trust in the interaction model. The main effect of information provision was unaffected, b = -1.42, 95% CI[-1.68, -1.16] , $p < .001$, but the main effect of trust was found to be non-significant, b = 0.003, 95% CI[-0.004, 0.012] , p = .374. While this analysis was not planned it suggests confidence in the original finding that greater trust in physicians is associated with higher expectations for antibiotics is not decisive. As predicted, there was a significant effect of the interaction between information provision and trust in physicians predicting expectations for antibiotics, b = -0.02, $t(362)$ = -2.72, p = .007 (see Figure 1) but not directly as expected (Hypothesis 3). In the baseline condition, participants with greater trust in physicians had significantly higher expectations for antibiotics, which was not predicted, $b = 0.01$, $t(362) = 2.79$, $p = .006$. In the complete information condition participants with greater trust in physicians had lower expectations for antibiotics, which was predicted but the pattern was not statistically significant, $b = -0.01$, $t(362) = -1.19$, $p = .235$. The overall regression model with information provision, trust in physicians, and their interaction term as predictors of expectations for antibiotics was significant, $F(3,362) = 41.42$, $p < .001$, $R^2 = .26$.

Insert please Figure 1 around here

Reported past consultation behaviour and antibiotic prescribing history for respiratory tract infections were then entered as covariates in two subsequent multiple regression models. In the model accounting for past consultation behaviour for respiratory tract infections, the effect of information provision, $b = -1.39$, $t(361) = -11.06$, $p < .001$ and the interaction between information provision and trust in physicians, $b = -0.02$, $t(361) = -2.46$, $p = .014$, remained significant predictors of expectations for antibiotics, but the effect of trust in physicians did not, $b = 0.01$, $t(361) = 1.93$, $p = .054$. In the model accounting for past receipt of antibiotic prescriptions for respiratory tract infections there were significant main effects of information provision, $b = -1.27$, $t(361) = -10.09$, $p < .001$, trust in physicians, $b = 0.01$, $t(361) = 2.41$, $p = .017$ and the interaction between information provision and trust in physicians $b = -0.02$, $t(361) = -2.77$, $p = .006$. Thus, with the exception of the effect of trust in physicians being reduced to nonsignificance when controlling for past consultation behaviour, the results did not differ substantially from the original regression model.

Experiment 2

Results from Experiment 1 showed that natural variations of participant's trust in their physician moderates the effect of information provision on patients' expectations for antibiotics. To provide causal evidence of the role of trust, in Experiment 2 we manipulated the perceived trustworthiness of the physician alongside information provision and assess the effect on inappropriate expectations for antibiotics. The manipulation of trustworthiness was designed using cues of warmth and competence, which were based on prior research (Fiske et al., 2007; Howe, Goyer, & Crum, 2017) and validated in two pre-tests (see Supplementary Materials).

In this experiment, we hypothesized that participants who receive information from a physician about the viral illness aetiology and lack of antibiotic efficacy will be less likely to expect antibiotics (Hypothesis 4). We also hypothesized that participants in the high trustworthiness condition will also be less likely to expect antibiotics (Hypothesis 5) and that the effect of information provision will be more pronounced in the high trustworthiness condition compared to the low trustworthiness condition (Hypothesis 6).

Method

Participants. Prior research manipulating physicians' warmth and competence in a factorial experimental design assumed a medium effect size ($f = 0.25 \approx \eta^2_p = .06$) and 1-β ≈ .88 (Howe et al., 2017). We opted for a smaller effect size than found in the prior literature ($f = .17 \approx f^2 = .03$) for our 2 × 2 design to account for effect size inflation due to publication bias and in alignment with the small effect assumed in Experiment 1. The resulting power analysis with $\alpha = .05$, $1\text{-}\beta = .90$, revealed a minimum sample size of 366 participants (Faul et al., 2007). We contacted participants from the general adult population via an online recruitment panel (Prolific). We applied the same inclusion criteria as in Experiment 1, with the additional specification that participants who completed the first experiment were not eligible for this experiment. Participants were paid £0.59 a rate of £5.06 per hour upon completion of the study, which took 4 minutes on average. We aimed to collect 403 participants (≈ 100 per cell) to account for an expected 10% attrition rate to the a-priori exclusion criteria (same as for Experiment 1). If after applying the a-priori exclusion criteria the valid sample size had been < 366 the contingency plan was to collect more participants (in groups of 10) until the minimum valid sample size was ≥ 366.

A total of 413 participants accessed the experiment and all consented to participate in the experiment[2]. Aligned with the a-priori exclusion criteria, we excluded six participants who did not complete the study fully and 27 who did not respond to an attention check question as instructed. The final sample consisted of 380 participants (112 were male, 267 female, and 1 other; age ranged from 18 – 75 years old, M = 35.85, SD = 13.05 years). The majority of participants identified as white (87%). Most participants were in full time employment (63%) and level of education varied between those with less than an undergraduate degree (35%), those with an undergraduate degree (47%), and those with a masters or doctoral degree (17%).

Design. We tested our hypotheses in a 2 (physician trustworthiness: low vs. high) × 2 (information provision: baseline vs. complete information) between-subjects design. The information provision factor was the same as in Experiment 1, with a baseline (i.e., no explicit information about the viral nature of the respiratory infection or about antibiotics) and complete information condition (i.e., explicit information about the viral nature of the respiratory infection and the function and potential side effects of antibiotics). For the physician trustworthiness

[2] As in Experiment 1, the reason a few more participants accessed the experiment than was intended is because the Prolific recruitment system automatically replaces participants who have 'timed-out' or 'returned' their submission with new participants even if these participants do go on to submit their data.

factor, participants were randomly assigned to either the low trustworthiness (i.e., descriptions of a cold and less competent physician behaviours) or high trustworthiness condition (i.e., descriptions of a warm and competent physician). The dependent variable was expectations for antibiotics as defined in Experiment 1. The random allocation to conditions (block randomization) was carried out using the built-in randomizer function in Qualtrics' survey flow.

Materials and procedure. After providing informed consent, participants were randomly assigned to read one of four hypothetical scenarios describing a visit to see a physician due to symptoms of acute otitis media (see the Exp.2 vignette in the Supplementary Materials). The scenario was modelled in alignment with those published by Sirota et al. (2017) and with the National Institute for Health and Care Excellence guidelines of a situation for which antibiotics are not clinically justified (Tan et al., 2008). The hypothetical scenario was similar to that in Experiment 1 (cold scenario), but in the context of a different viral infection (acute otitis media). As in Experiment 1, all participants received a description of the symptoms, a description of the physical examination, and a diagnosis (ear infection), but only participants in the complete information condition, received a description of the viral nature of the infection, the function of antibiotics and their side effects.

In line with the universal dimensions of social cognition account of trust (Fiske et al., 2007) low and high physician trustworthiness were manipulated via descriptions of the warmth and competence of the physician within the scenarios (see Table 2).

Insert please Table 2 around here

The effect of these manipulations of trust was validated in two pre-tests conducted before the first stage manuscript submission (full results are available in the Supplementary Materials). Cues of warmth and competence were combined as trustworthiness for three reasons. First, in pre-test 1 we found that our manipulations of warmth and competence were effective, but not localised. We found that manipulations of high warmth induced greater perceptions of both warmth and competence. The same was true for manipulations of competence affecting perceptions of both warmth and competence. Second, in pre-test 2, we found that combining manipulations of warmth and competence was effective in creating perceptions of low trustworthiness ($M = 3.46$, $SD = 1.23$) and high trustworthiness ($M = 5.33$, $SD = 0.83$); $t(148) = 15.041$, $p < .001$, $d_z = 1.23$. Third, in a recent clinical study, Howe et al. (2017) demonstrated that patients with positive expectations of treatments for an allergic reaction to histamine reported greater symptom relief from a placebo, but only when they perceived the attending physician to be high in both warmth *and* competence.

After reading the scenario describing a consultation with a physician for an ear infection, participants indicated their expectations for antibiotics in this scenario using the same items as in Experiment 1. These items displayed excellent internal consistency in each of the four experimental conditions (α ranging from 0.91 to 0.95). Lastly, participants reported if they had ever visited their GP for an ear infection, if they had ever received antibiotics for an ear infection, and some general demographic information (age, gender, ethnicity, and employment).

Statistical analyses. We ran a two-way factorial ANOVA to test for the main effect of complete information provision on inappropriate expectations for antibiotics (Hypothesis 4), the main effect of trustworthiness (Hypothesis 5), and the interaction between complete information provision and trustworthiness on inappropriate expectations for antibiotics (Hypothesis 6). OLS estimates were used to calculate standard errors.

We then re-ran this analysis as ANCOVA to control for the influence of past consultation behaviour and antibiotic usage. We ran one ANCOVA with past consultation for ear infections entered as a covariate and another with past experience of receiving antibiotics for ear infections entered as a covariate. All analyses were carried out in R.

Results

As shown in Figure 2, participants who received complete information provision about the viral nature of the infection and the ineffectiveness and harms of taking antibiotics for such an infection had lower expectations for antibiotics, than those who did not receive such information, $F(1,376) = 185.75$, $p < .001$, $\eta_P^2 = .33$. Furthermore, participants who read descriptions of a warm and competent physician had lower expectations for antibiotics, than those who read descriptions of a cold and less competent physician, $F(1,376) = 6.15$, $p = .014$, $\eta_P^2 = .02$. However, contrary to our expectation, the effect of the information provision was not bolstered when it was given by the trustworthy physicians compared to when it was given by the untrustworthy one as there was no significant interaction between the information provision and physician trustworthiness, $F(1,376) = 0.05$, $p = .828$, $\eta_P^2 < .01$.

Insert please Figure 2 around here

Reported past consultation behaviour and antibiotic prescribing history for ear infections were then entered as covariates in two subsequent two-way factorial ANCOVAs. The results of these analyses did not differ substantially from the original ANOVA. Even when controlling for past consultation behaviour for ear infections, providing information $F(1,375) = 204.21$, $p < .001$, $\eta_P{}^2 = .35$, and encountering a more trustworthy physician, $F(1,375) = 11.87$, $p = .001$, $\eta_P{}^2 = .03$ both reduced participant's expectations for antibiotics, and there was still no interaction ($F < 1$, $p = .713$). Similarly, when controlling for past receipt of antibiotic prescriptions for ear infections there were significant main effects of information provision, $F(1,375) = 177.29$, $p < .001$, $\eta_P{}^2 = .32$, and physician trustworthiness, $F(1,375) = 9.96$, $p = .002$, $\eta_P{}^2 = .03$ in reducing participant's expectations of antibiotics as a treatment and no interaction ($F < 1$, $p = .993$).

General Discussion

A number of studies have shown that providing information to primary care patients in clinical settings only has a limited effect on overprescribing by physicians (John Macfarlane et al., 2002; Mainous 3rd et al., 2000; Meeker et al., 2016). Based on these findings we assumed that providing complete information would not completely eliminate inappropriate expectations for antibiotics and considered trust in physicians as a possible moderator of the effect. In both experiments we found that information provision reduced inappropriate expectations for antibiotics. Participants who received information about the viral nature of the illness and the lack of efficacy and side effects of antibiotics from the physician in the vignette had substantially lower expectations for antibiotics than those who did not receive this information. Current clinical recommendations encourage primary care physicians to inform patients about the cause of their illness and whether antibiotics will be effective or harmful (Tan et al., 2008). Our findings support these clinical recommendations and demonstrate with reliability across experiments how information provision can be used as a tool by physicians to reduce inappropriate expectations for antibiotics (Branthwaite & Pechère, 1996; Eng et al., 2003).

We chose to focus on whether trust in physicians could explain why not all people are convinced by clinical information provision for two reasons in particular. First, prior research suggests that the level of trust people have in someone can explain why some people are more persuasive than others (Glaeser & Sunstein, 2013; Pornpitakpan, 2004; Tormala et al., 2006) and, more importantly, why some patients are more likely to report adhering to their physicians' instructions than others (Freburger et al., 2003; Safran et al., 1998). Second, population level surveys and qualitative interviews have proffered that public trust in physicians plays a key role in whether they will accept their physician's antibiotic prescribing decision (Ancillotti et al., 2018; André et al., 2010; Brookes-Howell et al., 2014; Faber et al., 2010).

We found mixed evidence on the role of trust across the two experiments. In Experiment 1, participants with greater reported trust in their physician actually had significantly higher expectations for antibiotics than those with less trust in their physician overall. However, in Experiment 2, where we manipulated whether the physician was trustworthy or untrustworthy based on competence and warmth, participants had lower expectations of antibiotics when consulting with the more trustworthy physician. Thus, while the finding of Experiment 2 is well aligned with the hypothesis that people with high trust in their physician would have lower expectations for antibiotics, the finding of Experiment 1 is clearly not.

Inspection of the significant interaction between information provision and reported trust in physicians can shed further light on the unexpected finding from Experiment 1. In the complete information condition, we expected participants with greater trust in their physician to have lower expectations for antibiotics, which was aligned with the observed trend in our data, but this relationship was not statistically significant. This may have been due to a floor effect given that the expectations for antibiotics in the complete condition were quite low overall, which could be masking that trust fuelled the effect of information on inappropriate expectations for antibiotics. However, post-hoc analysis using tobit regression to account for floor effects did not reveal any notable differences in the pattern of results (the full results of this unplanned analysis are available in the Supplementary Materials). More surprisingly, when no specific information about the illness or about antibiotics was provided, participants with greater trust in their physician were significantly more likely to inappropriately expect antibiotics. Although we predicted the opposite effect, one explanation for this finding could be that the participants who reported trusting their physician more might also be more comfortable expressing that they expect antibiotics (Thom et al., 2002). In Experiment 2, we found no interaction between information provision and trustworthiness, which indicates that the effect of receiving information did not depend on the trustworthiness of the physician. Prima facie, it appears that the perceived trustworthiness of the physician simply does not moderate the effect of information provision at reducing inappropriate expectations for antibiotics. However, alternative explanations might also account for this statistically non-significant finding. For instance, this finding may have also been due to a floor effect in the complete information condition, but post-hoc analysis using tobit regression again did not reveal any notable differences to support this explanation (the full results of this unplanned analysis are available in the Supplementary Materials). It is also possible that the lack of significant effect here is because the information provided might have been considered trustworthy. As the information is congruent with many public campaigns it may itself signal high competence and trustworthiness in the physician and may have nullified the effect of the untrustworthy manipulations.

Another reason we thought might account for the discrepancies between the results on the role of trust between experiments 1 and 2 could be the way trust was measured in Experiment 1 differed to the manipulations of physician trustworthiness in Experiment 2. It is possible that the general measure used in Experiment 1 measured trust in physicians at a trait-level, while the manipulations in Experiment 2 measured perceived trust in physicians, which is more context dependent. An individuals' trait-level trust in their physician and state-level perception of trust in the physician might have distinct influences on the effect of information provision at reducing inappropriate expectations for antibiotics. Unfortunately, as the general measure of trust used in Experiment 1 was not present in Experiment 2, it was not possible to further explore this possibility. However, it was possible to check if some of the individual items present in the general trust scale differed in some subtle way to the manipulations used in Experiment 2.

The items from the Trust in Physician Scale were developed to cover three dimensions of trust: dependability (that they have the patients' best interests in mind), confidence in the physician's knowledge and skills, and physician-patient confidentiality (Anderson & Dedrick, 1990). These dimensions map well onto the cues of warmth (dependability and confidentiality) and competence (the confidence in their knowledge and skill), which were manipulated in Experiment 2. But it could be that because of the more general nature of the questions asked in the scale, some items may have tapped into other more nuanced beliefs about their physician that were not present in the manipulations in Experiment 2 and driven the present findings. In light of this possibility, we conducted post-hoc regression analyses using the individual items from the Trust in Physician Scale as moderators of the effect of information on expectations. However, these post-hoc analyses revealed no notable differences in the directions of the main effect of trust in physicians or the interaction between trust in physicians and information provision and are thus unlikely to account for the observed pattern of results (full results are available in the Supplemental Materials).

We also acknowledge that demographic factors may have influenced the observed results. A limitation of the current research is that the participant samples in both experiments 1 and 2 were not sufficiently heterogenous to draw any reliable inferences from an exploratory analysis of the measured demographic variables. Future research on the role of trust in physicians and information provision which is able to sample a more heterogenous participant pool would prove valuable. The data collection and statistical analyses plans for the present research were pre-registered and any deviations have been documented. Both experiments were well powered to detect small effects and thus it is unlikely that power is an issue regarding the interpretation of the present findings. However, the power analysis could have better matched the conducted statistical tests by assuming tests of two main-effects and an interaction term where some variables are binary, rather than assuming tests of three main-effects relating to continuous variables. Another point worth noting is that while the inclusion of past consultation behaviour and antibiotic usage as covariates in Experiment 1 were important in controlling for potential confounding, in Experiment 2 (where trustworthiness was randomised) the inclusion of these covariates was not strictly necessary.

This is, to our knowledge, the only study to have used an experimental design to examine the role of trust in physicians alongside information provision on inappropriate expectations and requests for antibiotics in primary care. One limitation of the current vignette approach is that there is a clear lack of ecological validity as responses are based on imagined, not experienced, symptoms and interactions with a physician. However, the use of an experimental vignette-based design allowed for isolating the effects of trust and information provision on inappropriate expectations as well as controlling other key factors such as the illness duration, illness severity, and the behaviour of the physician. One alternative approach is to employ immersive virtual reality technology. Such an approach has been used with physicians to simulate interactions with patients who have unreasonable demands for antibiotics (Pan et al., 2016). Using this technique, the authors found that trainee physicians were more susceptible to patient pressure for antibiotics than their more experienced counterparts and that overall the physicians who took part reported the virtual situations to be convincing and realistic. These findings suggest that despite technical and logistic difficulties in implementation, this approach might be leveraged in future pre-clinical studies to enhance the ecological validity of future research on how patient-physician interactions influence inappropriate expectations for antibiotics.

Despite the absence of causal evidence that increasing trust reduces inappropriate expectations for antibiotics, there have been widespread appeals that increasing and maintaining trust in physicians ought to be a priority for antibiotic health campaigns (André et al., 2010). In 2018, Public Health England released a national campaign imploring the UK public to trust their doctor's advice about when they need antibiotics. Though the impact of this campaign is yet to be established the present findings suggest that before embarking on further trust-based campaigns more research is needed to understand exactly how trust in physicians influences inappropriate expectations for antibiotics.

Conclusion

Clinical information provision from a physician can reduce but not completely eliminate inappropriate expectations for antibiotics. Whether the limited effect of information provision is due to a lack of trust in the physician remains inconclusive. More extensive research into this area is required, particularly given the recent increase in trust-based antibiotic campaigns.

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	Experiment 1		Experiment 2			
	Baseline information (*n* = 181)	Complete information (*n* = 185)	Low trust x Baseline information (*n* = 96)	High trust x Baseline information (*n* = 93)	Low trust x Complete information (*n* = 93)	High trust x Complete information (*n* = 98)
Mean age in years (SD)	34.39 (11.74)	36.48 (12.52)	35.00 (12.83)	35.86 (13.21)	37.06 (13.27)	35.53 (13.01)
Gender						
Male	45 (25%)	57 (31%)	25 (26%)	21 (23%)	29 (31%)	37 (38%)
Female	136 (75%)	126 (68%)	70 (73%)	72 (77%)	64 (69%)	61 (62%)
Other	0 (0%)	2 (1%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)
Education						
Less than undergraduate	64 (35%)	66 (36%)	35 (36%)	35 (38%)	28 (30%)	36 (37%)
Undergraduate	80 (44%)	82 (44%)	45 (47%)	41 (44%)	47 (51%)	47 (48%)
Masters or doctorate	37 (20%)	37 (20%)	16 (17%)	17 (18%)	18 (19%)	15 (15%)
Ethnicity						
White	156 (86%)	169 (91%)	87 (91%)	79 (85%)	79 (85%)	87 (89%)
Mixed/Multiple	6 (3%)	1 (1%)	2 (2%)	7 (8%)	6 (6%)	4 (4%)
Asian	9 (5%)	7 (4%)	5 (5%)	4 (4%)	5 (5%)	3 (3%)
Black	5 (3%)	5 (3%)	1 (1%)	2 (2%)	1 (1%)	3 (3%)
Other	5 (3%)	3 (2%)	1 (1%)	1 (1%)	2 (2%)	1 (1%)
Employment						
Employed	115 (64%)	119 (64%)	62 (65%)	57 (61%)	52 (56%)	67 (68%)
Unemployed	27 (15%)	33 (18%)	14 (15%)	20 (22%)	27 (29%)	12 (12%)
Retired	8 (4%)	10 (5%)	4 (4%)	6 (6%)	4 (4%)	5 (5%)
Student	31 (17%)	23 (12%)	16 (17%)	10 (11%)	10 (11%)	14 (14%)

Table 1. Baseline participant characteristics in each arm (Experiments 1 and 2).

Physician Trustworthiness: Low		**Physician Trustworthiness: High**	
Low Warmth		*High Warmth*	
As you enter the GP does not look up from the computer on the desk to look at you	The GP sits behind the computer and does not make any attempt at eye contact throughout the consultation	As you enter the GP looks up to welcome you with a warm smile	The GP moves away from the computer and turns towards you in order to speak to you face to face throughout the consultation
Low Competence		*High Competence*	
The GP did not seem prepared for the consultation and a lot of time was wasted throughout the consultation while the GP looked for the right files and leaflets	It took two attempts to measure your respiratory rate as the GP made a mistake the first time	The GP was well prepared for the consultation. All necessary files were already open on the computer and relevant leaflets had been set out beforehand	The GP carried out the medical examination efficiently without any problems

Table 2. Cues of Warmth and Competence in both the low and high trustworthiness conditions.

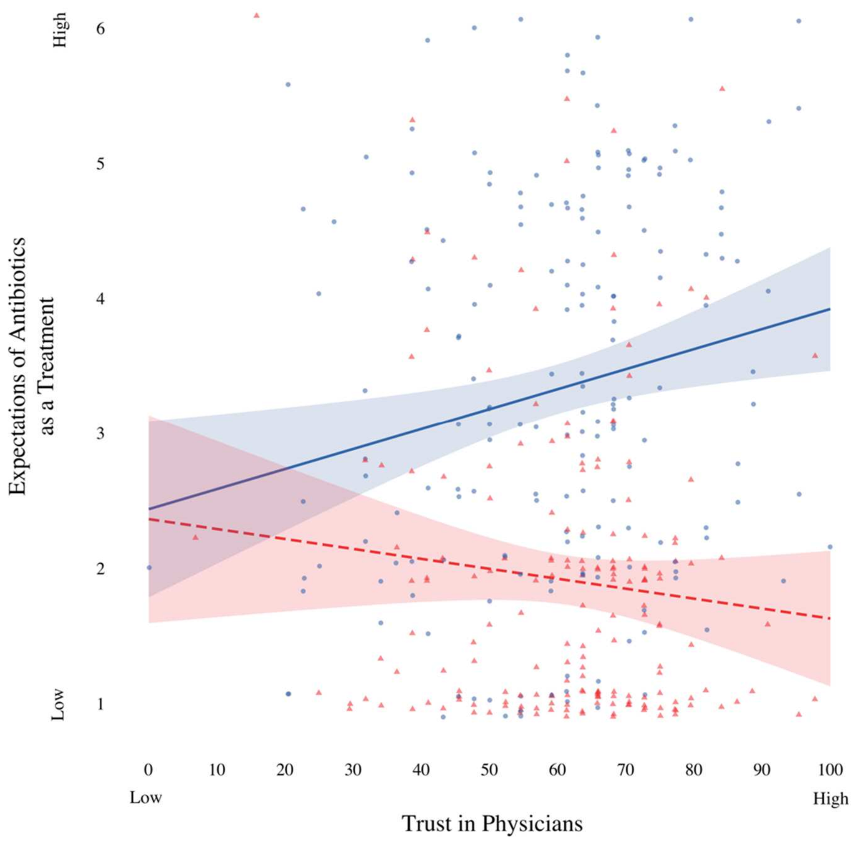

Figure 1. Effect of information provision (baseline in blue circles vs. complete information in red triangles) on expectations for antibiotics as a treatment is moderated by trust in physicians from Experiment 1 (n = 366).

Note. Baseline condition: no explicit information about the viral nature of the infection or about antibiotics) and complete information condition: explicit information about the viral nature of the infection and antibiotics. Shaded portions around the slopes represent 95% confidence intervals.

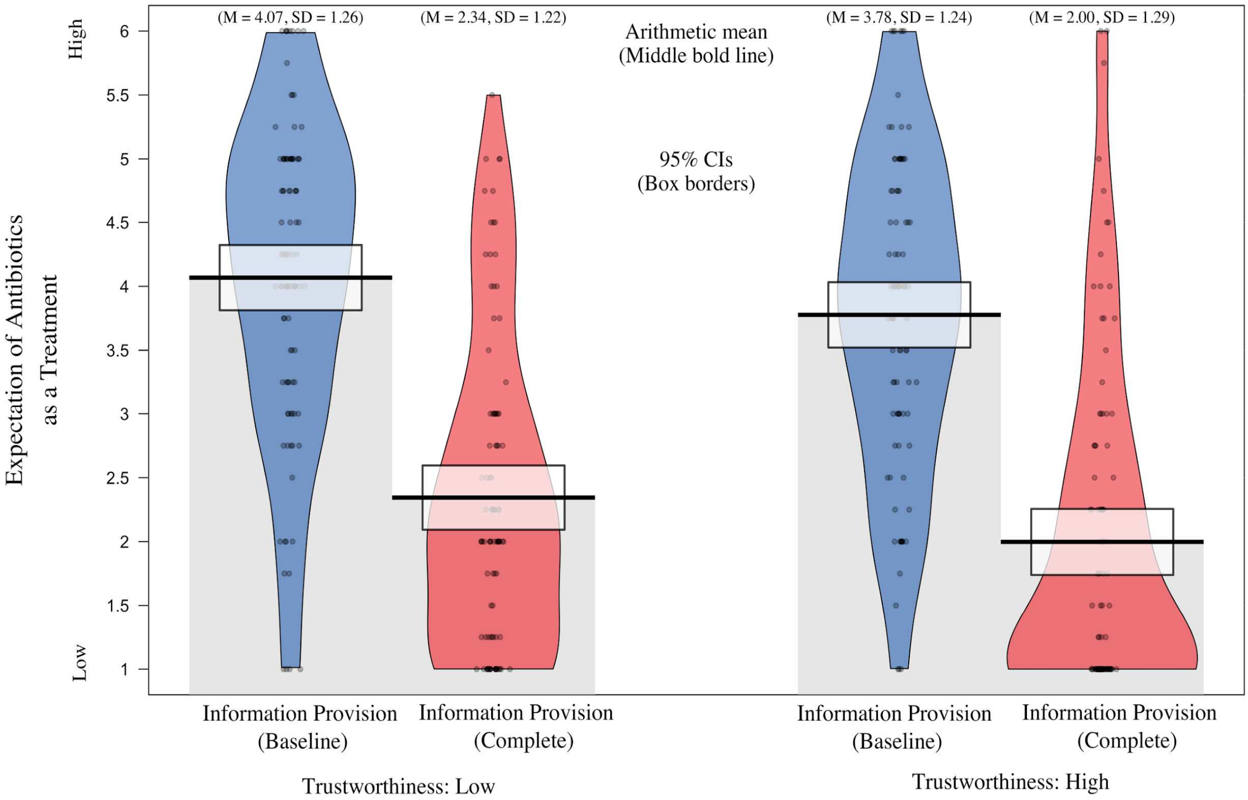

Figure 2. Effect of information provision (baseline vs. complete information) and physician trustworthiness (low vs. high) on expectations of antibiotics as a treatment from Experiment 2 (*n* = 380).