The role of information in the reduction of clinically inappropriate expectations of antibiotics

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DECLARATION

I declare that this thesis, ‘The role of information in the reduction of clinically inappropriate expectations of antibiotics’, represents my own work, except where otherwise stated. None of the work referred to in this thesis has been accepted in any previous application for a higher degree at this or any other University or institution. All quotations have been distinguished by quotation marks and the sources of information specifically acknowledged.

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Thesis Abstract

People often expect antibiotics when they are clinically inappropriate (i.e., for viral infections). This motivates physicians to prescribe antibiotics unnecessarily, causing harm to the individual and to society. To effectively reduce inappropriate expectations for antibiotics it is important to first understand how they are formed and maintained by members of the general public. Thus, the overarching aim of this thesis is to provide insight into how information about illnesses and antibiotics affects inappropriate expectations for antibiotics. The studies reported in this thesis examine how information affects individuals' expectations for antibiotics alongside illness representations and prior beliefs (Studies 1 and 2), in the context of trust in the health professional providing the information (Studies 3 and 4), and in the presence of a specific mechanism that might prevent the effect of information provision (Studies 5 to 8). The findings from these studies highlight the complex combination of variables (including: prior knowledge about the illness and antibiotics, social norm perceptions, and affective beliefs) that are associated with inappropriate expectations for antibiotics and provide novel evidence on the causal effect of information provision at reducing, but not eliminating inappropriate antibiotic expectations (Studies 1 and 2). Furthermore, these findings demonstrate how the degree to which people trust the medical professional who is providing the information moderates the effect of information (Studies 3 and 4) and proffer that an action bias can explain why some people do not respond as expected to complete information designed to reduce inappropriate expectations for antibiotics (Studies 5 to 8).

CHAPTER 1

Introduction

1.1 Overview

The overprescribing of antibiotics in primary care promotes the development of antibiotic resistance – one of the most serious and contemporary health threats worldwide. People often expect antibiotics when they are not necessary, which is known to considerably increase the likelihood of the physician prescribing them. Efforts to reduce inappropriate prescribing of antibiotics and combat antibiotic resistance typically rely on informing people that antibiotics are not necessary. But despite their known influence on physicians' prescribing behaviour, and potential extended impact on global health, little is known about how information influences inappropriate expectations for antibiotics. In particular, insight into how people process, and respond to, information designed to advise them when antibiotics are not necessary is lacking. To effectively encourage people to exhibit judicious health behaviours for such a critical health issue we must first understand how such expectations are formed and how they respond to information about illnesses and antibiotics. Hence, the main focus of the studies presented in this thesis was to leverage existing socio-cognitive theories to investigate the key variables underpinning inappropriate expectations for antibiotics.

1.2 Antibiotic resistance

1.2.1 Significance

Antibiotic resistant infections are responsible for approximately 33,000 deaths a year in the European Union alone (Cassini et al., 2019). Estimates extended to include both Europe and the United States place the yearly number of deaths from antibiotic resistant infections at 50,000 (O'Neill, 2014). The global estimate currently stands at 700,000 (O'Neill, 2014).

A *post-antibiotic era* in which minor injuries, routine surgical procedures, and common infections will become life-threatening situations is rapidly becoming reality (Andersson & Hughes, 2010). The rise of antibiotic resistant *superbugs* (strains of bacteria able to cause serious diseases, which have become resistant to almost all available classes of antibiotics) poses a serious threat to the health of people worldwide (Willyard, 2017). Unabated, by 2050 antibiotic resistant infections are predicted to claim 10 million lives each year (O'Neill, 2014).

Reports and statements from global bodies, governments, and health organizations have highlighted the severity of the threat posed by antibiotic resistance. In 2016, all 193 of the United Nations member states publicly committed to tackling the global increase of antibiotic resistance[*][†]. This was only the fourth time that the General Assembly of the United Nations has ever convened for a health issue. In the United Kingdom (UK), the release of The UK Five-year Antimicrobial Resistance Strategy by the Department of Health and Social Care in 2013 and 2019 (Davies & Gibbens, 2013; Department of Health and Social Care, 2019), established the aims of the UK government to impede the development, and inhibit the spread, of

[*] http://www.un.org/pga/71/2016/09/21/press-release-hl-meeting-on-antimicrobial-resistance/

[†] https://www.theguardian.com/society/2016/sep/20/un-declaration-antibiotic-drug-resistance

antimicrobial resistance. In the meantime, in the United States (US), The National Action Plan (House, 2015) was published to address methods for combatting the antibiotic resistance crisis. Health organizations have also mobilized to try and contribute to the prevention of antibiotic Armageddon, with both the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), releasing reports on the increasing threat of antibiotic resistance (Centers for Disease Control and Prevention, 2013; World Health Organisation, 2014).

1.2.2 Background

While efforts to combat the increasing threat of antibiotic resistance are relatively recent, the natural process of bacteria developing resistance to antibiotics is not. Antibiotics attack bacteria and have been doing so for millennia – at least (Bassett, Keith, Armelagos, Martin, & Villanueva, 1980). They do so by either impeding bacterial reproduction or by simply killing the bacteria outright (Bowater, 2016). There are two general mechanisms by which antibiotics attack bacteria: 1) target the cell structure (destroying the cell wall or membrane) and 2) target growth and replication (impeding protein/DNA synthesis) (Bowater, 2016). In response, there are three general mechanisms that bacterial microorganisms can develop to prevent antibiotics from successfully attacking them: 1) prevent the antibiotic from entering the cell, 2) modify the part of the cell that is targeted by the antibiotic, and 3) attack the antibiotic itself (Bowater, 2016).

Bacteria that evolve such mechanisms to defend themselves from being affected by antibiotics are *antibiotic resistant*. Antibiotic resistance has existed for millennia as a consequence of the natural process of spontaneous genetic mutation, lateral gene transfer, and natural selection. But in recent years, human misuse of antibiotics has critically accelerated the emergence of resistant bacteria (Bowater, 2016; D'Costa et al., 2011; Read & Woods, 2014; Ventola, 2015).

Human misuse of antibiotics covers a number of factors that contribute to fuelling the antibiotic crisis to alarming levels. These factors include: the extensive use of antibiotics as growth supplements in agriculture, economic and regulatory obstacles impeding the development of new antibiotics (i.e., insufficient incentives for pharmaceutical companies) and, the factor central to this thesis, the overprescribing of antibiotics within healthcare (Levy & Marshall, 2004; Ventola, 2015).

1.3 Overprescribing of antibiotics: Impact on antibiotic resistance

1.3.1 Overview

The term overprescribing is mostly used to describe cases where a patient receives antibiotics that are not clinically justified (i.e., for a viral infection), but it also covers situations where a prescription may be justified but the patient is then given the wrong class of antibiotic, the wrong dosage, or even the wrong course duration (Ventola, 2015). Regardless of the type of overprescribing, the outcome is that people are exposed to subinhibitory doses of antibiotics that do not target bacterial growth efficiently. As a consequence, the overprescription of antibiotics substantially fuels the progression and propagation of antibiotic resistance (Davey et al., 1996; Goossens, Ferech, Stichele, & Elseviers, 2005; Livermore, 2005). This happens because subinhibitory doses of antibiotics actually support genetic alterations of gene expression (genetic mutations) and lateral gene transfer, which increases the likelihood of bacteria obtaining antibiotic resistant properties (Davies, Spiegelman, & Yim, 2006; Viswanathan, 2014).

The effects of overprescribing of antibiotics have been shown to affect both the population as a whole (Lipsitch & Samore, 2002), and individuals too. Individuals who have taken antibiotics develop resistance to the same class of antibiotic, which is capable of spreading across the body (via the urinary and respiratory tracts and the skin) and lasting for up to 12 months (Costelloe, Metcalfe, Lovering, Mant, & Hay, 2010; Gisselsson-Solen, Hermansson, & Melhus, 2016). Overprescribing antibiotics can also unnecessarily increase the incidence of short-term adverse events in patients such as nausea, vomiting, diarrhoea, headaches, and rashes (Smith, Smucny, & Fahey, 2014).

To reduce overprescribing and limit cases where antibiotics are prescribed inappropriately, efforts have been made to clarify when antibiotic treatment is, or is not, clinically justified. In primary care, respiratory tract infections have been identified as an area where antibiotics should not be prescribed.

Respiratory tract infections are incredibly common. In the UK, a quarter of the population is estimated to visit their GP for a respiratory tract infection per year (Ashworth, Charlton, Ballard, Latinovic, & Gulliford, 2005). In the US the pattern is much the same as 37 million patients were recorded seeing a physician's practice or emergency department with a respiratory tract infection in the same time period (Schappert & Burt, 2006).

The vast majority of respiratory tract infections are self-limiting in nature and caused by viral pathogens (Gonzales et al., 2001; Little, Williamson, et al., 1997; Mossad, 1998; Rosenstein et al., 1998; Williamson et al., 2007; Young et al., 2008). Only a small proportion of respiratory tract infections develop bacterial complications and therefore do require treatment via a prescription of antibiotics (Jousimies-Somer, Savolainen, & Ylikoski, 1989; Little, Gould, et al., 1997; Winther et al., 1984). For instance, bacterial rhinosinusitis only requires clinical treatment in between 0.2 - 2% of all cases (Berg, Carenfelt, Rystedt, & Anggård, 1986; Hickner et al., 2001).

Current evidence that antibiotics are an ineffective treatment course for the majority of respiratory tract infections is overwhelming. Clinical trials repeatedly show little to no benefit to patients' health outcomes in terms of symptom reduction or complication prevention (Brickfield, Carter, & Johnson, 1986; Del Mar, 1992; Hamm, Hicks, & Bemben, 1996b; Heikkinen, Ruuskanen, Ziegler, Waris, & Puhakka, 1995; Hoagland, Deitz, Myers, & Cosand, 1950; Howie & Clark, 1970; Jones, Bigham, & Manning, 1953; Kaiser et al., 1996; Little et al., 2013; Soyka, Robinson, Lachant, & Monaco, 1975; Stott & West, 1976; Verheij, Hermans, & Mulder, 1994). Based on this evidence, the CDC issued guidelines specifically outlining the appropriate usage of antibiotics for treating respiratory tract infections (Gonzales et al., 2001; Snow, Mottur-Pilson, & Gonzales, 2001a, 2001b). Two key recommendations from the guidelines are summarized below in Table 1 (bold text represents my emphasis).

Table 1

Key recommendations from the CDC guidelines on appropriate antibiotic prescribing for respiratory tract infections

The Centers for Disease Control and Prevention Recommendations for Treating Respiratory Tract Infections
• The diagnosis of nonspecific upper **respiratory tract infection** should be used to denote an acute infection in which sinus, pharyngeal, and lower airway symptoms, although frequently present, are not prominent. **These infections are predominantly viral in origin, and complications are rare.**
• **Antibiotics should not be used to treat nonspecific upper respiratory tract infections** in previously healthy adults.

These guidelines were explicitly endorsed by the American Academy of Family Physicians, the American College of Physicians, American Society of Internal Medicine, and the Infectious Diseases Society of America (Gonzales et al., 2001). The journal that published these guidelines, *Annals of Internal Medicine*, encouraged readers to distribute them (Gonzales et al., 2001). These guidelines are also aligned with clinical guidelines from the National Institute for Health and Care Excellence (NICE) and National Health Service* (NHS) recommendations (NICE, 2008). Consequently, there is overwhelming evidence and clear clinical instruction that antibiotics should not be prescribed to primary care patients consulting with symptoms of a respiratory tract infection.

But despite substantial evidence from clinical trials and clear recommendations that antibiotics should not be used to treat respiratory tract infections, the majority of antibiotic prescriptions in primary care are provided for patients exhibiting the symptoms of respiratory tract infections (Davies, 2018; Gill et al., 2006; Gonzales, Steiner, & Sande, 1997; Gulliford et al., 2014; Hansen, Hoffmann, McCullough, van Driel, & Del Mar, 2015; Petersen & Hayward, 2007; Pouwels, Dolk, Smith, Robotham, & Smieszek, 2018; Straand, Rokstad, & Sandvik, 1998; van den Broek d'Obrenan, Verheij, Numans, & van der Velden, 2014; Verheij, Hermans, Kaptein, Wijkel, & Mulder, 1990; Wigton, Darr, Corbett, Nickol, & Gonzales, 2008).

Primary care prescriptions of antibiotics have been estimated to account for between 50 and 80% of all antibiotic prescriptions in the UK and the US (Gonzales et al., 1997; Standing Medical Advisory Committee, 1998). Hawker et al. (2014)

* https://www.nhs.uk/conditions/respiratory-tract-infection/

reported that between 1995 and 2011 antibiotic prescriptions issued for primary care patients consulting with coughs and colds in the UK ranged between 37% and 51%. Despite some progress, recent evidence shows that overprescribing is still pervasive in primary care with an estimated 20% of all prescriptions (approximately 6.3 million) identified as being given out unnecessarily each year in the UK alone (Pouwels et al., 2018; Public Health England, 2017; Smieszek et al., 2018). As a consequence, combatting the rampant overprescribing of antibiotics in primary care remains one of modern medicines top priorities (Davies, 2018).

1.3.2 The influence of non-clinical factors on overprescribing

One reason why overprescribing may persist, even though the majority of GPs report being explicitly aware that for viral infections the prescribing of antibiotics is redundant and harmful (Butler, Rollnick, Pill, Maggs-Rapport, & Stott, 1998; Gonzales et al., 2001; Hamm, Hicks, & Bemben, 1996a; Hamm et al., 1996b; Howie & Clark, 1970; Kaiser et al., 1996; Kumar, Little, & Britten, 2003), is because distinguishing between whether an infection is either bacterial or viral is a complex and difficult task (McMillan, 1993; van Buchem, Peeters, Beaumont, & Knottnerus, 1995; Varonen et al., 2004). Findings suggest that this may partly be the case, particularly for respiratory tract infections such as pharyngitis, sinusitis, and bronchitis (Arnold & Straus, 2006; Mainous, Hueston, & Eberlein, 1997; McIsaac & Butler, 2000; Murray, Mar, & O'Rourke, 2000).

But while clinically relevant factors (i.e., variations in the patient's clinical presentation and the physicians' biomedical knowledge, experience, and training) play an important role in antibiotic prescribing (Ranji et al., 2006), evidence has identified that their influence is unable to fully account for the overprescribing of antibiotics (Bradley, 1992; Brookes-Howell et al., 2012; Brookes-Howell et al., 2014;

Butler et al., 2009; Cals et al., 2007; Faber, Heckenbach, Velasco, & Eckmanns, 2010; Hajjaj, Salek, Basra, & Finlay, 2010; McNulty, Boyle, Nichols, Clappison, & Davey, 2007b; Pinder, Berry, Sallis, & Chadborn, 2015; Wood et al., 2012).

Factors unrelated to the patient's clinical presentation or the physicians' biomedical knowledge and experience that influence the prescribing and referral behaviours of medical professionals are known as non-clinical factors (Brookes-Howell et al., 2012; Hajjaj et al., 2010). Non-clinical factors are known to account for substantial variance in physicians prescribing tendencies (Bradley, 1992; Hajjaj et al., 2010; Newton, Hayes, & Hutchinson, 1991; Pinder et al., 2015) and their influence has even been suggested to be even more predictive of clinicians' decisions to provide antibiotics than clinical factors (Cockburn & Pit, 1997; Poses, Cebul, & Wigton, 1995; Vinson & Lutz, 1993).

Typically, non-clinical factors are divided into two groups. Those that are associated with the physicians' decision making tendencies and those that originate in the patient (Hajjaj et al., 2010). There are numerous examples of physician-related non-clinical factors that may influence the physicians' decisions to prescribe antibiotics (Howie, 1976; Poses et al., 1995; Sirota, Round, Samaranayaka, & Kostopoulou, 2017). Examples of these influences include physicians favouring a 'just in case' approach to prescribing (Blair et al., 2017; Bowater, 2016; Lucas, Cabral, Hay, & Horwood, 2015), being influenced by their perception of social antibiotic prescribing norms (Hallsworth et al., 2016), and by their perception of the patients' expectations for antibiotics (Cockburn & Pit, 1997; Coenen et al., 2013; Mangione-Smith et al., 2001; Sirota et al., 2017). While such physician related factors are important, they are beyond scope of this thesis, which is directed to the influence that patient-related non-clinical factors have on whether a physician will withhold or prescribe antibiotics (Macfarlane, Holmes, Macfarlane, & Britten, 1997; Pinder et al., 2015).

1.3.3 The influence of patient expectations on overprescribing

Patients presenting with symptoms of respiratory tract infections have been shown to be the most likely to have expectations for some kind of prescription (Webb & Lloyd, 1994) and multiple studies have shown that antibiotics are their go-to option (Hamm et al., 1996a; Macfarlane et al., 1997; Ranji et al., 2006). Up to 90% of adults who contact their GP with complaints of a respiratory tract infection indicate that they expect to receive antibiotics for their symptoms (Braun & Fowles, 2000). Both McNulty, Nichols, French, Joshi, and Butler (2013) and Welschen, Kuyvenhoven, Hoes, and Verheij (2004) found that half of the patients with a respiratory tract infection who consulted their GP expected antibiotics. In a multi-country study by Coenen et al. (2013), the authors discovered that patients' expectations, and requests, for antibiotics are neither associated with the severity of the presenting symptoms, nor the clinical outcome of the consultation (recovery). While meeting patient expectations is a crucial part of modern medicine, this suggests that patient expectations and requests for antibiotics are not accurate predictors for antibiotic treatment and should not be treated as such by physicians. But in contrast to these findings, an extensive body of research has established that patients' expectations for antibiotics are, in fact, one of the strongest predictors of whether a physician will withhold or prescribe them (Butler et al., 1998; Macfarlane et al., 1997; Strumiło et al., 2016; Van Driel et al., 2006; Vinson & Lutz, 1993; Welschen et al., 2004).

Webb and Lloyd (1994) found that patients who expected a prescription were almost five times more likely to receive medication as opposed to patients who had no expectations for a prescription. Cockburn and Pit (1997) reported similar findings, whereby patients who expected medication were around three times more likely (≈ 2.9) to receive medication as opposed to patients who had no expectations for a prescription. Further evidence of the importance of patient expectations was found by Macfarlane et al. (1997), who reported that antibiotics were prescribed to 85% of patients who expected them whereas 41% of patients who did not expect antibiotics received them. A greater disparity was found by Welschen et al. (2004) whereby 73% of patients who expected antibiotics received them compared to only 14% of patients who did not.

It is not clear whether patients with expectations for antibiotics often directly request them from their physician or whether physicians' misinterpretation of patients mentions about antibiotics has led to overestimates of the prevalence of direct requests (Mangione-Smith et al., 2001). However, in cases where patients do directly request a prescription of antibiotics they are very rarely refused them (McNulty et al., 2013; Palmer & Bauchner, 1997). For example, (McNulty et al., 2013) found that about 97% of patients who asked for antibiotics reported being prescribed them.

These studies firmly established the association between patients' expectations for treatment and antibiotic prescribing behaviours. But only recently was causal evidence on the effect of patient (and parent) expectations at increasing inappropriate prescribing of antibiotics provided (Sirota et al., 2017). Using clinical vignettes describing a scenario of a consultation for a patient with symptoms of a viral infection, Sirota et al., (2017) demonstrated that patients' expectations for antibiotics directly increase both the willingness of the physician to prescribe antibiotics and their ultimate prescribing decisions (to prescribe or withhold).

Despite their well-established prevalence and influence on antibiotic prescribing, current understanding of the cognitive factors underpinning inappropriate expectations is rudimentary. One reason for that is because both research and health campaigns have, to date, primarily been driven by an *information deficit* approach (Gross, 1994; Sturgis & Allum, 2004). Formally, what this means is that inappropriate expectations for antibiotics from patients are considered to be a reflection of insufficient knowledge about illnesses and antibiotics from the general public (van Rijn, Haverkate, Achterberg, & Timen, 2019).

1.4 The insufficient information hypothesis

1.4.1 The role of knowledge about illnesses and antibiotics on antibiotic expectations

For people to be effective decisions makers in the context of their health, it is generally agreed that they need to have a solid comprehension of all the relevant information regarding their illness and the risks and benefits of available the treatments for it – or the abstention of treatment (Braddock III, Edwards, Hasenberg, Laidley, & Levinson, 1999; Fagerlin et al., 2010; Strull, Lo, & Charles, 1984; Sørensen et al., 2012). According to the information deficit model, inappropriate expectations for antibiotics from patients are typically attributed to being a product of members of the public (who will eventually, and frequently, become patients) having insufficient knowledge about illnesses and antibiotics (Eng et al., 2003; Gross, 1994; Sturgis & Allum, 2004).

Aligned with the deficit approach, numerous studies have reported that public knowledge of appropriate antibiotic use and resistance is insufficient (Eng et al., 2003; Grigoryan et al., 2007; McCullough, Parekh, Rathbone, Del Mar, & Hoffmann, 2016; McNulty, Boyle, Nichols, Clappison, & Davey, 2007a). Research on public/patient knowledge is usually concerned with four key domains: 1) knowledge of illness aetiology, 2) knowledge of antibiotic efficacy, 3) knowledge of antibiotic usage, and 4) knowledge of antibiotic resistance.

First, people lack knowledge of illness aetiology. People often exhibit misperceptions regarding the causes of the common cold; a viral infection for which there is no role for antibiotic treatment (Heikkinen & Järvinen, 2003; Tan, Little, & Stokes, 2008; Turner, 2010). For example, in a study of adults (and parents on behalf of children) consulting with cold symptoms in the US, fewer than half of them (around 43%) correctly stated that viruses cause a cold (Braun et al., 2000). The authors recorded that around 50% of respondents thought that bacteria cause a cold. Numerous other studies conducted in the US and the UK have also found that a substantial proportion of respondents believe that bacteria cause a cold (Lee, Friedman, Ross-Degnan, Hibberd, & Goldmann, 2003; Vingilis, Brown, Sarkella, Stewart, & Hennen, 1999). This particular misbelief is concerning as thinking that viral infections such as colds are caused by bacteria is often positively associated with expectations of antibiotics as an effective treatment (Braun et al., 2000).

Second, people lack knowledge of antibiotic efficacy. A widespread, and critical, misconception about antibiotics is that they are effective (at least some of the time) for viral infections (Wilson, Crane, Barrett, & Gonzales, 1999). In a survey of over 7,000 adults across the UK, over half (54%) of respondents thought that antibiotics can kill viruses and 38% thought antibiotics were effective treatments for coughs and colds (McNulty et al., 2007a). Similar results were found in surveys of subsections of the Dutch and US populations, which typically found that around half of respondents incorrectly believe that antibiotics kill viruses (Cals et al., 2007; van Rijn et al., 2019; Wilson et al., 1999). This misperception has been shown to vary across countries, for instance in an Austrian sample a higher rate (72%) of respondents believed that antibiotics kill viruses and (66%) that antibiotics are effective against the common cold and the flu (Hoffmann, Ristl, Heschl, Stelzer, & Maier, 2014), while two studies using random subsamples of the Swedish and German populations found that no more than 27% of respondents believed that antibiotics kill viruses (André, Vernby, Berg, & Lundborg, 2010; Faber et al., 2010).

Third, people lack knowledge of appropriate antibiotic usage. Two key misconceptions about antibiotic usage regard non-adherence: that a course of antibiotics should be stopped when you feel better (Kardas, 2002), and self-medication: that it is okay to self-medicate with antibiotics (McNulty, Boyle, Nichols, Clappison, & Davey, 2006). Both non-adherence and self-medication limit the effectiveness of antibiotics, increase the risk of side effects and promote the development of antibiotic resistance (Bowater, 2016; Pechère, Hughes, Kardas, & Cornaglia, 2007). Between 26 and 30% of respondents from a UK study reported that it was correct to stop taking antibiotics once you feel better (McNulty, Nichols, Boyle, Woodhead, & Davey, 2010), which might explain why adherence to prescribed antibiotic courses is often low (Kardas, Devine, Golembesky, & Roberts, 2005; Midence & Myers, 1998). One reason for this misconception might be that people often rely on the somatic symptoms of an infection as a reminder/incentive to keep taking the antibiotics and when the antibiotic begins to tackle the unpleasant symptoms caused by the infection they believe it is appropriate to stop taking them (Bowater, 2016; Hawkings, Butler, & Wood, 2008). Some people also believe that it is appropriate to self-medicate with antibiotics. For instance, in the UK, between 14 and 16% of respondents stated that it is okay to keep and use leftover antibiotics (McNulty et al., 2010). Reported actual self-medication rates have been shown to vary across European countries with some reported rates as high as 21% (McNulty et al., 2007a). In the UK respondents often readily admit to both keeping leftover antibiotics for future use and taking antibiotics that had not been prescribed by a medical professional (McNulty et al., 2006; McNulty et al., 2007a).

Fourth, people lack knowledge of antibiotic resistance. Insight into public misconceptions of antibiotic resistance is much more mixed. Specifically, there appears to be some disconnect between public awareness of resistance and actual knowledge of resistance. Though overall, the public seems to be well aware of antibiotic resistance (André et al., 2010; Corbett et al., 2005; Hoffmann et al., 2014; McCullough et al., 2016) the awareness is not always linked to the quality of the knowledge of resistance (McCullough et al., 2016). McNulty et al. (2010) noted that a large proportion of English respondents (37%) did not perceive antibiotic resistance to be a problem in British hospitals and after finding that over 80% of respondents from a subsection of the Swedish population agreed that *both* humans and bacteria can become resistant to antibiotics, André et al. (2010) suggested that even if awareness of the concept of resistance and its threat may be high, understanding of the biological underpinnings remains undeveloped. The misconception that the human body can become resistant to antibiotics seems especially common. For example, van Rijn et al. (2019) found that the majority ($\approx$ 93%) of their sample of the Dutch population believed that the human body itself can become resistant to antibiotics.

But despite the established ubiquity of public misconceptions about illnesses and antibiotics, the actual degree of influence that patient knowledge has on their inappropriate expectations has not been fully assessed. Indeed, some research has even shown that increased knowledge can be associated with less optimal antibiotic use (McNulty et al., 2007a). The work of McNulty et al. (2007a) revealed that individuals with greater knowledge of antibiotics are no less likely to be prescribed antibiotics, more likely to report inappropriate self-medication with antibiotics, and more likely to acquire antibiotics without a prescription.

It may be the case that the role of prior knowledge on inappropriate expectations for antibiotics has been overstated (Formoso et al., 2013), potentially too at the cost of assessing the influence of other psychologically relevant variables (Ancillotti et al., 2018). Educational efforts rarely address how other dimensions of illness representations and antibiotic beliefs that are not directly related to knowledge affect expectations (Charani et al., 2011), despite that it is well established in health psychology that knowledge is not, in and of itself, an adequate account of health and illness behaviour (Conner & Norman, 2015; Von Wagner, Steptoe, Wolf, & Wardle, 2009).

For instance, patients' common sense models of illnesses and treatments outlined by Leventhal (Hagger, Koch, Chatzisarantis, & Orbell, 2017; Leventhal, Leventhal, & Breland, 2011) are important guides to their adoption of coping strategies (Hagger et al., 2017). An individual may know that antibiotics cannot treat a viral cold, or that antibiotics have side effects, but his or her personal representation of illness 'in situ' may also be an important guide to action. In addition, socio-cognitive models, such as the Theory of Planned Behaviour (TPB; (Ajzen, 1991)), can also draw attention to the potential influence of motivational factors (e.g., attitudes, self-efficacy and anticipated regret) on patients' health behaviours and have demonstrated considerable predictive utility (Armitage & Conner, 2001).

Empirical consideration of the influence of knowledge (e.g., viral aetiology, antibiotic efficacy, usage, and resistance) on inappropriate expectations for antibiotics alongside other theoretically derived dimensions (e.g., illness representations and antibiotic beliefs) has the potential to provide more revealing insight of the cognitive and motivational mechanisms that are important in the formation of inappropriate expectations for antibiotics but has been overlooked.

1.4.2 The role of information provision about illnesses and antibiotics on antibiotic expectations

The lack of evidence on the role of prior knowledge on inappropriate expectations for antibiotics has not tempered enthusiasm for efforts to improve public knowledge by providing information to educate people. The perceived importance of improving patient knowledge is apparent in the findings of a survey of US physicians. When asked what they believed would be the single most important strategy for reducing inappropriate antibiotics use 78% (475) said *educating patients* (Bauchner, Pelton, & Klein, 1999). For perspective, *improving diagnostic criteria* was named as the most important strategy for reducing antibiotic use by only 15% (92) of physicians.

Efforts to educate patients clearly reflect the assumptions of the information deficit model and operate with the expectation that providing information to improve knowledge will eradicate inappropriate expectations (Eng et al., 2003; Gross, 1994; Sturgis & Allum, 2004). For example, clinical guidelines instruct primary care physicians to inform patients about illness aetiology, the function and side effects of antibiotics, and alternative treatments (Tan et al., 2008), while health campaigns distribute content designed to correct misconceptions about illness aetiology and antibiotic treatments in educational materials for patients in primary care waiting areas and consultation rooms (Cross, Tolfree, & Kipping, 2017).

To date, most research on the effectiveness of public-targeted educational interventions has utilized educational materials designed for large scale health campaigns (Price et al., 2018; Ranji, Steinman, Shojania, & Gonzales, 2008). Overall, assessments of public-targeted educational efforts tend to find that they produce inconsistent and limited results (Cross et al., 2017; Haynes & McLeod, 2015; McNulty et al., 2010; L. Price et al., 2018).

Of the studies that do report positive influences of educational campaigns on public knowledge and attitudes towards antibiotics (Price et al., 2018), many come with caveats. For instance, when assessing the impact of information provision in an educational campaign in New Zealand, Curry et al. (2006) noted that patients were less likely to report positive attitudes towards taking antibiotics for an upper respiratory tract infection after the campaign (16%) compared to before (33%). However, the same study did not show any difference in patients' knowledge that antibiotics are not effective in the treatment of viral infections (before = 41% vs. after = 38%) and also found that patients were more likely to report neutral attitudes towards taking antibiotics for an upper respiratory tract infection after the campaign (31%) compared to before (15%). There was no change in negative attitudes towards taking antibiotics (53% vs. 52%). Failure to detect any improvement in public knowledge following educational campaigns is not uncommon (Huttner, Goossens, Verheij, & Harbarth, 2010; McNulty et al., 2010) and in one case, after a three-month informational campaign, respondents were actually more likely to incorrectly agree that antibiotics are effective against viruses compared to respondents from a control area where no campaign had been implemented (Formoso et al., 2013).

Whether successfully improving public knowledge of illnesses and antibiotics is sufficient to produce sustainable changes in people's behaviour also remains unknown. The effect of educational campaigns on behaviour change is typically evaluated by documenting one, or several, of the following outcomes: how often people consult for viral infections (consultation rates), how often antibiotics are prescribed for viral infections (prescribing rates), reported self-management of viral infections/use of antibiotics (self-reported use). An important consideration is that using measures such as consultation and prescribing rates to accurately evaluate the impact of educational interventions has proven challenging. These interventions often do not employ control groups or account for pre-existing prescribing trends, which substantially limits the inferences that can be made about their results (Huttner et al., 2010; Saam, Huttner, & Harbarth, 2017).

Findings on the effect of information provision and self-reported use of antibiotics are mixed. Many studies report improvements for these behaviours following educational interventions (Curry et al., 2006; Madle, Kostkova, Mani-Saada, Weinberg, & Williams, 2004; Price, MacKenzie, Metlay, Camargo, & Gonzales, 2011; Wutzke et al., 2006). However, some of these findings lack consistency (Curry et al., 2006) while others indicate associations between information provision and admission of counterproductive behaviours (Curry et al., 2006; Mainous, Diaz, & Carnemolla, 2009; McNulty et al., 2010). For example, in 2008 a campaign was undertaken specifically to inform the English public that antibiotics are ineffective against illness such as the common cold. The campaign used posters which consisted of educational statements such as “Remember, antibiotics won’t help your defences against a cold”. When assessing the impact of the campaign, McNulty et al. (2010) found that the proportion of people misusing antibiotics (keeping leftover antibiotics) during the period actually increased. Similarly, the follow up to a 2004 educational intervention focussed on Latin communities in South Carolina revealed that the proportion of adults obtaining antibiotics without a prescription had increased from 19% to 31% (Mainous et al., 2009).

One reason for these mixed results might be due to the complexity with which the information is communicated. The typical approach of information provision in these campaigns is to provide complex combinations of information regarding illnesses (e.g., durations, symptoms, causes) and antibiotics (e.g., efficacy, appropriate usage, and resistance) in leaflets, videos, or online materials (Huttner et al., 2010; Saam et al., 2017). As these campaigns employ multiple educational elements, even on occasions when they might produce the desired outcomes it is often not possible to identify which of the elements are actually effective (Huttner et al., 2010; Saam et al., 2017). For example, Price et al. (2011) found that participants who completed an educational intervention in emergency departments reported reduced desires for antibiotics. However, the multi-component nature of the intervention, which covered illness aetiology, antibiotic efficacy, severity of antibiotic resistance, and susceptibility to side effects does little to advance understanding of how much of the effect could be attributed to each of these educational components. Further methodological constraints such as the absence of a control group, not assessing the actual clinical need for antibiotics or accounting for illness severity further limits the conclusions that can be drawn about the efficacy of this and other such educational interventions (Madle et al., 2004; Price et al., 2011).

Causal evidence of how different elements of information provision affect inappropriate antibiotic expectations is lacking. Successfully isolating which educational elements, or combinations of elements, is most effective at diminishing inappropriate expectations for antibiotics would advance current understanding of how inappropriate expectations for antibiotics are formed and modified. More importantly, findings might contribute to reducing unjustified antibiotic prescribing through the improved design of interventions and educational campaigns.

1.4.3 The moderating role of trust on information provision at reducing antibiotic expectations

Given that providing information 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. A substantial contribution from research would be to identify potential moderators that might enhance the effect of information provision at eliminating inappropriate expectations for antibiotics.

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, there is a vast literature, which shows that more trustworthy sources are typically more persuasive than less trustworthy sources (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 et al., 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 et al. (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). Another worrying finding is that one of the

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* https://campaignresources.phe.gov.uk/resources/campaigns/58-keep-antibiotics-working/Overview

causes of non-adherence to a physicians' antibiotic prescribing is the reported deliberate saving of antibiotics for later usage (Hawkings et al., 2008), which shows that members of the public are willing to intentionally ignore the advice of medical professionals based on their own beliefs. Interviews have suggested that the shift in medical understanding regarding the appropriate usage of antibiotics and difficulty communicating this to the general public may explain why some people distrust the physician that withholds antibiotics. For example, parents have been reported as being aware that they used to get antibiotics freely in the past and have attributed the changes to prescribing practices to financial reasons (i.e., budget constraints) as opposed to being due to genuine medical reasons (Kai, 1996).

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.

1.4.4 The role of cognitive biases on antibiotic expectations

Another important contribution of research would be to identify other modifiable factors that might illuminate why some people might have inappropriate desires for antibiotics that are resilient to the effect of information provision (Ancillotti et al., 2018; Donald, 2016). To better understand why efforts to eliminate inappropriate desires for antibiotics by providing clinical information about illnesses and antibiotics might not eradicate inappropriate desires for antibiotics, we can draw from the substantive literature on the influence of cognitive processes and biases on the decision making tendencies of both patients and physicians (Blumenthal-Barby & Krieger, 2015; Saposnik, Redelmeier, Ruff, & Tobler, 2016).

For instance, many studies have shown that people are often influenced to a greater extent by the pathway through which an outcome occurs (i.e., by action or inaction) rather than by the information about the risks and benefits associated with the outcome (Baron & Ritov, 2004). The action bias describes occasions where an option is preferred because it is perceived as an action, despite it yielding less optimal outcomes than an alternative option of inaction (Bar-Eli, Azar, Ritov, Keidar-Levin, & Schein, 2007; Patt & Zeckhauser, 2000). This preference for action over inaction has been well documented in the decision making tendencies of both patients and physicians (Ayanian & Berwick, 1991; A. Fagerlin, Zikmund-Fisher, & Ubel, 2005; Gavaruzzi, Lotto, Rumiati, & Fagerlin, 2011; Kiderman, Ilan, Gur, Bdolah-Abram, & Brezis, 2013; Scherer, Valentine, Patel, Baker, & Fagerlin, 2018). In a recent demonstration of the bias, Scherer et al. (2018) presented participants with a description of a hypothetical cancer screening test that offered no medical benefits (no chance to save or prolong life), and had potentially adverse effects (physical, emotional, and financial harm). They found that around 30% of respondents still viewed taking the screening test as a superior option to not screening at all, even when they were explicitly aware of the lack of benefit and possible harms. Theoretically, explaining inappropriate desires for antibiotics by mapping the desire to take antibiotics onto the preference for an action with less optimal outcomes (taking antibiotics) over a superior alternative of inaction (resting) is straightforward. But empirical evidence from the general public is lacking. However, though most research has typically attributed preferences for action over inaction only to an action bias, from the current literature we also pinpoint two other potentially important sources of influence that may account for this preference.

First, people do not always process information in an unbiased manner (Lord, Ross, & Lepper, 1979). The list of methods people might adopt, which can limit how information is processed is a lengthy one. Golman, Hagmann, and Loewenstein (2017) discuss two particular methods: i) source discrediting, and ii) information neglect, which have been well evidenced in medical settings. For instance, to preserve their prior beliefs, people who are vaccine hesitant often doubt the credibility of physicians that provide positive information about vaccinations (Kata, 2012), while patients with HIV or cancer often eschew important information about their diagnosis and prognosis (Leydon et al., 2000; Sullivan, Lansky, Drake, & Investigators., 2004). Research from these domains has shown that when people are motivated to preserve their prior beliefs, or to avoid potentially unpleasant news about their health, information provision intended to engender more judicious health decisions can lead to limited and even counterproductive outcomes (Leask et al., 2012; Leydon et al., 2000). Source discrediting and information neglect may act as barriers to the effect of information provision aiming to improve people's judgment of when antibiotics are appropriate but have yet to be examined in this context.

Second, people might resist information because it conflicts with their beliefs about what they consider to be the most normal behaviour. It has been well established that the perception of the social norm is an important predictor of people's health behaviours (Conner & Norman, 2015). The work of Kahneman and Miller (1986), recognised that one reason why people are highly motivated to adhere to their perception of the normative behaviour is because negative events are experienced as worse when the normative behaviour is not followed. Within this framework, it would be expected that the perception that most people take antibiotics for a viral infection would result in a preference to comply with that perception which, in turn, might negate the effect of information provision.

1.5 Present Research

Antibiotic resistance poses an enormous threat to global health. Overprescribing of antibiotics promotes antibiotics resistance and is driven by patients' expectations for antibiotics. Despite the established importance of patients' expectations as a non-clinical influence on clinical decision-making, the cognitive mechanisms underlying patients' expectations for antibiotics are poorly understood.

The substantial body of evidence that has identified and categorised patient expectations as one of the most important non-clinical predictors of antibiotic overprescribing devotes little attention to the nature of the beliefs and decision-making processes people have that cause them to expect antibiotics from their physician. As a result, current efforts aiming to eliminate inappropriate antibiotic expectations may have been less effective than desired due to the fact that they are not able to target the most relevant variables (e.g., beliefs, knowledge, and decision-making tendencies) that underpin inappropriate antibiotic expectations in the general population.

As these variables are behavioural in nature, an appropriate target for psychological research is to identify modifiable patient variables that underlie inappropriate expectations for antibiotics. Doing so would advance theoretical understanding of how such expectations are formed, maintained, and fueled. A further, and perhaps more important, outcome of this research would be in helping to identify the most effective methods for combatting the non-clinical influence of inappropriate expectations on antibiotic prescribing in primary care. Given the importance of expectations for antibiotics on overprescribing in primary care the present research seeks to utilize theories from current socio-cognitive literature to develop understanding of how information about illnesses and antibiotics affects inappropriate expectations for antibiotics.

Chapters 2 to 5 report a mix of correlational and experimental research on the cognitive underpinnings of inappropriate expectations for antibiotics. All the research reported in this thesis was pre-registered either using AsPredicted or the Open Science Framework[*] (OSF) and the data and materials for all the studies are publicly available on the OSF. The methods sections within each chapter contain the links to view the pre-registration protocols, data, and materials for the relevant studies. Chapter 6 contains a discussion of the theoretical and practical implications of the research presented in the preceding chapters and some directions for future research.

[*] AsPredicted: https://aspredicted.org/, OSF: https://osf.io/

Chapter 2

Examining the magnitude of the relationship between antibiotic knowledge and inappropriate expectations for antibiotics

2.1 Abstract

Objective. To examine the strength of the relationship between antibiotic knowledge and inappropriate expectations and requests for antibiotics alongside other theoretically derived dimensions (e.g., antibiotic beliefs and illness perceptions). **Methods.** A correlational study in which participants (n = 402) recalled a severe experience of a cold then reported their knowledge of antibiotics, antibiotic beliefs, illness representations, and their expectations to receive and likelihood of requesting antibiotics from a family physician. **Results.** As expected, knowledge of antibiotics was negatively associated with antibiotic expectations, but we also found stronger correlations with other variables (e.g., norm perception of antibiotic use and illness coherence). **Conclusions.** Antibiotic knowledge, antibiotic beliefs and illness representations influence inappropriate desires for antibiotics. Overall these findings provide correlation evidence that a more complex network of illness and treatment beliefs is associated with inappropriate expectations and requests than is typically appreciated in health campaigns and interventions.

2.2 Introduction

Despite the substantial influence of patients' expectations for antibiotics on physicians' prescribing decisions, there is a lack of knowledge about the mechanisms that underlie inappropriate expectations. The potential for tackling inappropriate expectations is severely limited by the lack of psychological insight into the cognitive mechanisms that comprise inappropriate expectations. The first step for psychological research to contribute to greater knowledge of these expectations is to identify the key variables that are associated with inappropriate expectations. In the pre-registered correlational study described in this chapter, we aimed to establish the magnitude of the relationship between prior knowledge and inappropriate expectations for antibiotics alongside other theoretically derived dimensions (e.g., antibiotic beliefs and illness perceptions).

A dominant assumption of patient decision making is that for patients to make judicious decisions about their health they need to have a solid knowledge of illnesses and the risks and benefits of available the treatments (Braddock III et al., 1999; Fagerlin et al., 2010; Strull et al., 1984; Sørensen et al., 2012). Aligned with this assumption and given that large proportions of the public exhibit poor knowledge of illnesses and antibiotics (Eng et al., 2003; Grigoryan et al., 2007; McCullough et al., 2016; McNulty et al., 2007a), inappropriate expectations for antibiotics are typically regarded to be a product of suboptimal knowledge of illnesses and antibiotics (Eng et al., 2003).

However, the actual degree of influence that a patient's knowledge has on their inappropriate expectations has yet to be assessed. It may be the case that the role of prior knowledge on inappropriate expectations for antibiotics has been overstated, particularly in light of findings that increased knowledge is not always associated with more optimal antibiotic use (McNulty et al., 2007a).

One consequence of overstating the influence of prior knowledge is that the influence of other psychologically relevant variables has been neglected. Educational efforts rarely address how other dimensions of illness representations and antibiotic beliefs that are not directly related to knowledge affect expectations (Charani et al., 2011), despite it being well established in health psychology that knowledge alone does not provide a complete account of people's health behaviours (Conner & Norman, 2015; Von Wagner et al., 2009).

For instance, patients' common sense models of illnesses and treatments (Hagger et al., 2017; Leventhal et al., 2011) have been shown to be important guides to their adoption of coping strategies (Hagger et al., 2017). Socio-cognitive models, such as the Theory of Planned Behaviour (TPB; (Ajzen, 1991)), have also provided considerable insight into to the predictive utility of motivational factors (e.g., attitudes, self-efficacy and anticipated regret) on patients' health behaviours (Armitage & Conner, 2001).

Thus, an important goal for research is to provide empirical evidence on the magnitude of the influence that prior knowledge has on inappropriate expectations for antibiotics. Consideration of the role of the key dimensions of prior knowledge (e.g., viral aetiology, antibiotic efficacy, usage, and resistance) on inappropriate expectations for antibiotics alongside illness representations and antibiotic beliefs has the potential to provide substantial insight into the cognitive and motivational mechanisms underlying inappropriate expectations for antibiotics but has to date been overlooked.

2.2.1 The Present Research

In this correlational study we evaluated the role of knowledge alongside illness representations and treatment beliefs as specified by a revised common sense model of illness representations (Hagger et al., 2017; Leventhal, Phillips, & Burns, 2016) in explaining clinically inappropriate expectations for antibiotics. In our pre-registration we hypothesized that increased erroneous knowledge about the common cold and antibiotics would be positively associated with increased inappropriate antibiotic expectations. We also predicted that beliefs endorsing antibiotic use for the common cold would be positively associated with increased inappropriate antibiotic expectations. Additionally, given that patients who receive antibiotics from their physician are more likely to expect them in the future (e.g., Little et al., 1997) we expected that increased frequency of receiving antibiotics for both viral and bacterial infections would be associated with increased antibiotic expectations.

Study 1

2.3 Method

2.3.1 Participants

Participants from the general adult population were contacted via a recruitment panel (Prolific; https://www.prolific.co) and invited to express their opinion and about upper respiratory tract infections and treatments. A total of 422 participants started the study and were paid at a rate of £5 per hour upon completion of the study. Only participants who were residents of the United Kingdom were eligible to participate. Following a-priori criteria we excluded 20 participants: (i) 17 participants who did not fully complete the study or took over two hours to complete the study and (ii) three participants who had less than four correct answers (out of seven) to instructed bogus items to ensure high quality data (Meade & Craig, 2012).

The final sample size was sensitive enough to detect a small-to-medium correlation ($\rho = .16$), assuming $\alpha = .05$ and $1 - \beta = .90$ (Faul, Erdfelder, Lang, & Buchner, 2007). In the final sample of 402 participants, 101 identified as male, 300 female, and 1 as other. The sample age ranged from 18 to 64 years old (*M* = 35.3, *SD* = 9.9 years). The substantial majority, 97%, of participants indicated that they were registered with a family physician. Most participants identified as white (94%) and were employed (66%), with an annual median income between £30,000 and £39,999 per year. Participants' level of education varied as follows: professional trade qualification or no formal educational qualification (6%), GCSE (18%), A levels or national diplomas (33%), and undergraduate or further degree (43%). In the last 12 months, 9% of participants had not experienced a cold, 67% had experienced between one to two colds, 21% had experienced three to four, and 3% had experienced five or more colds. At the time of testing, 24% of participants had experienced a cold in the last 30 days.

2.3.2 Design

This was a correlational study with antibiotic knowledge, antibiotic beliefs, illness representations, past consultation behaviour, and past antibiotic prescriptions as independent variables. Expectations and requests for antibiotics were the dependent variables. Participants were randomised to complete the dependent variables before or after the independent variables. The presentation order of the predictive variables was also randomised as well as the order of the items within these constructs.

2.3.3 Materials and procedure

Participants first provided informed consent before responding to items assessing their antibiotic knowledge, antibiotic beliefs, illness representations, and their expectations for and likelihood of requesting antibiotics. Participants were instructed to respond to all items in the context of imagining "How it feels when you have a cold for which you would go and see your doctor". We chose the common cold for this study for four reasons. First, the general public often experience this illness during childhood (Lee & Treanor, 2016), between three to 12 times per year, (Mossad, 1998; Rosenstein et al., 1998; Turner, 2010) and throughout adulthood, between two and five times per year (Turner, 2010). In this sense, almost everyone has experience with this illness. Second, the common cold is a viral infection for which antibiotics are clearly not needed (Tan et al., 2008; Turner, 2010). Third, the common cold has a substantial impact on healthcare, as one of the most frequently recorded reasons for visits by the general public to a primary care consultant (Mossad, 1998; Sauver et al., 2013), and on the economy, as one of the primarily cited causes of absenteeism in the workplace (ONS, 2014). Fourth, the common cold can also have potentially severe health consequences, particularly for the elderly, young children, and those with a chronic respiratory disease (Izurieta et al., 2000; Treanor & Falsey, 1999). As a result, primary care physicians are frequently required to make decisions on appropriate treatments for concerned patients (and parents or representatives of younger or less able patients) who come to a consultation with symptoms of respiratory infections.

Lastly, participants were asked to provide some information regarding their consultation behaviour, antibiotic prescription frequency, and some general demographic information. All items were developed specifically for this research. Internal consistency coefficients and descriptive statistics for the measures used in Study 1 are presented in Table 2.

The pre-registration protocol for this study is available at: http://aspredicted.org/blind.php?x=z5v6rg and the data and materials for this study are publicly available on the Open Science Framework at: https://osf.io/8eub7/?view_only=24fb3247c1a942988109f9b07ac080e7.

Table 2

Descriptive Statistics and Cronbach Alpha (α) of the Questionnaire Items and Dependent Measures

	Mean ± SD	Cronbach's α
Illness beliefs: IPQ-R (For the common cold)		
Identity	3.67 ± 1.13	.95
Timeline chronic	3.15 ± 1.17	.93
Timeline cyclical	3.69 ± 0.91	.77
Consequences	2.72 ± 0.94	.80
Personal control	3.83 ± 0.93	.82
Treatment control	2.04 ± 1.18	.94
Illness coherence	4.42 ± 0.94	.88
Emotional representations	3.66 ± 1.04	.84
Antibiotic knowledge and beliefs		
Knowledge of antibiotic efficacy	4.98 ± 0.81	.56
Knowledge of appropriate antibiotic usage	5.39 ± 0.77	.74
Knowledge of antibiotic resistance	5.23 ± 0.73	.81
Negative attitudes	3.33 ± 0.88	.64
Anticipated regret concerning receiving antibiotics	3.99 ± 1.44	.96
Anticipated regret concerning not receiving antibiotics	2.25 ± 1.24	.95
Positive attitudes	2.28 ± 1.11	.93

Subjective social norm perception	2.19 ± 0.90	.80
Descriptive social norm perception	2.11 ± 0.99	.90
Self-efficacy to ask for antibiotics	2.54 ± 1.25	.90
Summary attitudes towards taking antibiotics	2.20 ± 1.15	.93
Dependent Variables		
Expectations of antibiotics as a treatment	2.33 ± 1.16	.88
Expectations of the physicians' prescribing behaviour	2.48 ± 1.29	.88
Likelihood of requesting antibiotics	1.78 ± 0.94	.89

Antibiotic knowledge. We first generated a questionnaire consisting of 14 items. We recovered a portion of these items from existing studies that have addressed knowledge about antibiotics (see Questionnaire A and Table 1 in the Appendix for all items). Aligned with the recommendations of Costello and Osborne (2005), items were subjected to exploratory factor analysis using principal axis factoring with direct oblimin rotation. Analysis of the items related to knowledge revealed three factors – with a minimum of four items – with eigenvalues greater than 1 (see Table 2 in the Appendix). These corresponded to *Knowledge of efficacy* (e.g., "Antibiotics are effective in treating infections caused by bacteria"), *Knowledge of appropriate usage* (e.g., "A course of antibiotics should always be completed"), and *Knowledge of resistance* (e.g., "The unnecessary use of antibiotics makes them ineffective"). Loadings in these factors ranged between .33 and .91. All antibiotic knowledge items were expressed on a six-point scale ranging from 1 (*Strongly disagree*), via 2 (*Disagree*), 3 (*Somewhat disagree*), 4 (*Somewhat agree*), 5 (*Agree*), to 6 (*Strongly agree*).

Antibiotic beliefs. For antibiotic beliefs, we first generated a questionnaire consisting of 54 items. We recovered a portion of these items from existing studies that have addressed beliefs about antibiotics (see Questionnaire A and Table 1 in the Appendix for all items). The remaining items were generated as specified by Ajzen's (1991) theory of planned behaviour. In addition to variables specified by that theory we also included items to assess descriptive norms and anticipated regret (Conner & Norman, 2015; Sheeran & Orbell, 1999). Results revealed nine factors with eigenvalues greater than 1. After removing three free loading items and ambiguously loaded items, repeated analysis suggested seven factors with a minimum of five items (eigenvalues greater than 1 and loadings between .31 and .92) that were consistent with the originally grouped dimensions of the theory of planned behaviour and additional variables (see Table 3 in the Appendix). These are summarised as *Summary attitudes towards taking antibiotics* (e.g., "Taking antibiotics when I have a cold would be unnecessary/necessary")*, Negative attitudes towards antibiotics* (e.g., "When I have a cold, taking antibiotics will cause me side effects such as diarrhoea")*, and Positive attitudes towards taking antibiotics* (e.g., "When I have a cold, antibiotics will help me get better more quickly", *Subjective social norm* (e.g., "People who are important to me would encourage me to take antibiotics for a cold"), *Descriptive social norm* (e.g., "People who are important to me take antibiotics when they have a cold")*, Self-efficacy to ask for antibiotics* (e.g., "If I had a cold, I would find it easy to ask my doctor for antibiotics, *Anticipated regret concerning not receiving antibiotics* (e.g., "If I visit my doctor for a cold and do not get antibiotics, I would feel disappointed")*,* and *Anticipated regret concerning receiving antibiotics* (e.g., "If I visit my doctor for a cold and get antibiotics, I would feel disappointed"). All antibiotic belief items were expressed on a six-point scale ranging from 1 (*Strongly disagree*), via 2 (*Disagree*), 3 (*Somewhat disagree*), 4 (*Somewhat agree*), 5 (*Agree*), to 6 (*Strongly agree*).

Illness representations. To measure the views of healthy adults about the common cold we adapted the Revised Illness Perception Questionnaire (IPQ-R) as recommended by the authors (Moss-Morris et al., 2002), and as practiced in other studies of the common cold (Henderson, Hagger, & Orbell, 2007). Analysis revealed 10 factors with eigenvalues greater than 1. Five items were removed from any further analysis due to low loadings (below .3) and forming two-item factors. Repeated analysis resulted in an eight-factor solution with loadings between .34 and .98 (see Table 4 in the Appendix). The eight factors corresponded to the well-established original scaling of the revised common sense model in the IPQ-R, which can be summarised as *Identity* (an indication of the severity of cold symptoms)*, Timeline* (e.g., "I think my cold will be long lasting rather than temporary")*, Cyclical timeline* (e.g., "I think the symptoms of my cold will change a great deal from day to day")*, Consequences* (e.g., "I think my cold will have important consequences on my day to day life")*, Personal control* (e.g., "I think that the course of my cold depends on me")*, Treatment control* (e.g., "I think antibiotics will be effective in treating my cold")*, Coherence* (e.g., "I have a clear picture or understanding of my cold")*,* and *Emotional representation* (e.g., "When I have a cold I feel depressed"; see Questionnaire B in the Appendix for all items)). All illness representation items were expressed on a six-point scale ranging from 1 (*Strongly disagree*), via 2 (*Disagree*), 3 (*Somewhat disagree*), 4 (*Somewhat agree*), 5 (*Agree*), to 6 (*Strongly agree*) with the exception of the identity items which were expressed on a five-point scale ranging from 1 (*Not severe at all*), via 2 (*Mild*), 3 (*Moderate*), 4 (*Severe*), to 5 (*Very severe*).

Past consultation behaviour and past antibiotic prescriptions. Participants were asked to respond to single item measures of past frequency of receiving antibiotics for viral (*How often are you prescribed antibiotics for viral infections (i.e., common cold)?*) and bacterial (*How often are you prescribed antibiotics for bacterial infections (i.e., pneumonia)?*) infections. A single item was used to assess consultation behaviour (*When I have a cold I go and see my doctor*). Responses to these three items were expressed on a five-point scale ranging from 1 (*Never*), via 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), to 5 (*Always*).

Expectations and requests for antibiotics. Past research has employed different assessments of patient expectations that are sometimes difficult to interpret or compare across studies. For example, some research asks generally if the individual expects a prescription of antibiotics (Faber et al., 2010) whereas others use a specific expectation of the physicians' behaviour (i.e., 'I would expect my GP or nurse to prescribe antibiotics' (McNulty et al., 2013, p. 430)). A patient might indicate that they do not expect to receive a prescription of antibiotics because they believe that physicians withhold them in these situations, while at the same time still expect antibiotics to treat their infection. In order to distinguish these possibilities, we operationalized three different measures of expectation: expectations of antibiotics as a treatment (e.g., "I should get a prescription of antibiotics"), expectations of the physicians' prescribing behaviour (e.g., "I think I will be prescribed antibiotics by my doctor"), and the likelihood of requesting antibiotics (e.g., "I would request a prescription of antibiotics"). Expectations of antibiotics and of the physicians' prescribing behaviour were expressed as responses to four items on a six-point scale ranging from 1 (*Strongly disagree)* via 2 (*Disagree), 3* (*Mildly disagree), 4* (*Mildly agree),* 5 (A*gree),* to 6 (*Strongly agree*), while the likelihood of requesting antibiotics was expressed as responses to four items on a six-point scale ranging from 1 (*I certainly would not)* via 2 (*I would not), 3* (*I probably would not), 4* (*I probably would),* 5 (I would*),* to 6 (*I certainly would*). The items for all three measures of expectation are shown in the supplemental materials.

2.3.4 Statistical analyses

We planned to run zero-order correlation matrices and multiple regression models to estimate the effect of antibiotic knowledge, antibiotic beliefs, illness representations, consultation behaviour and past antibiotic prescriptions, on our three dependent measures; expectations of antibiotics as a treatment, expectations of the physicians' prescribing behaviour and the likelihood of requesting antibiotics.

As failing to reject the null hypothesis does not logically necessitate accepting the null hypothesis, we planned to quantify the evidence supporting the null or alternative hypothesis by computing JZS Bayes factor (BF) equivalents for the correlation matrices and multiple regression models using default prior scales in JASP and the "Bayes-Factor" package in R respectively (Love et al., 2015; Morey & Rouder, 2014; Rouder, Morey, Speckman, & Province, 2012). The university ethics committee granted ethical approval for both studies reported in this paper.

2.4 Results

Correlation coefficients amongst study variables are shown in Figure 1. Greater knowledge of antibiotic efficacy, usage and resistance was associated with lower expectations and a reduced likelihood of requesting antibiotics, as expected. However, these associations tended to be descriptively weaker (*r*s ranging from -.20 to - .33), than the associations with dimensions related to antibiotic beliefs. For example, perceived subjective norm for taking antibiotics was correlated with expectations of antibiotics as a treatment ($r = .51$, $p < .001$), expectations of the physicians' prescribing behaviour ($r = .49$, $p < .001$), and the likelihood of requesting antibiotics ($r = .49$, $p < .001$). We also obtained positive correlations between receipt of antibiotic prescriptions for viral infections in the past and both inappropriate expectations and requests.

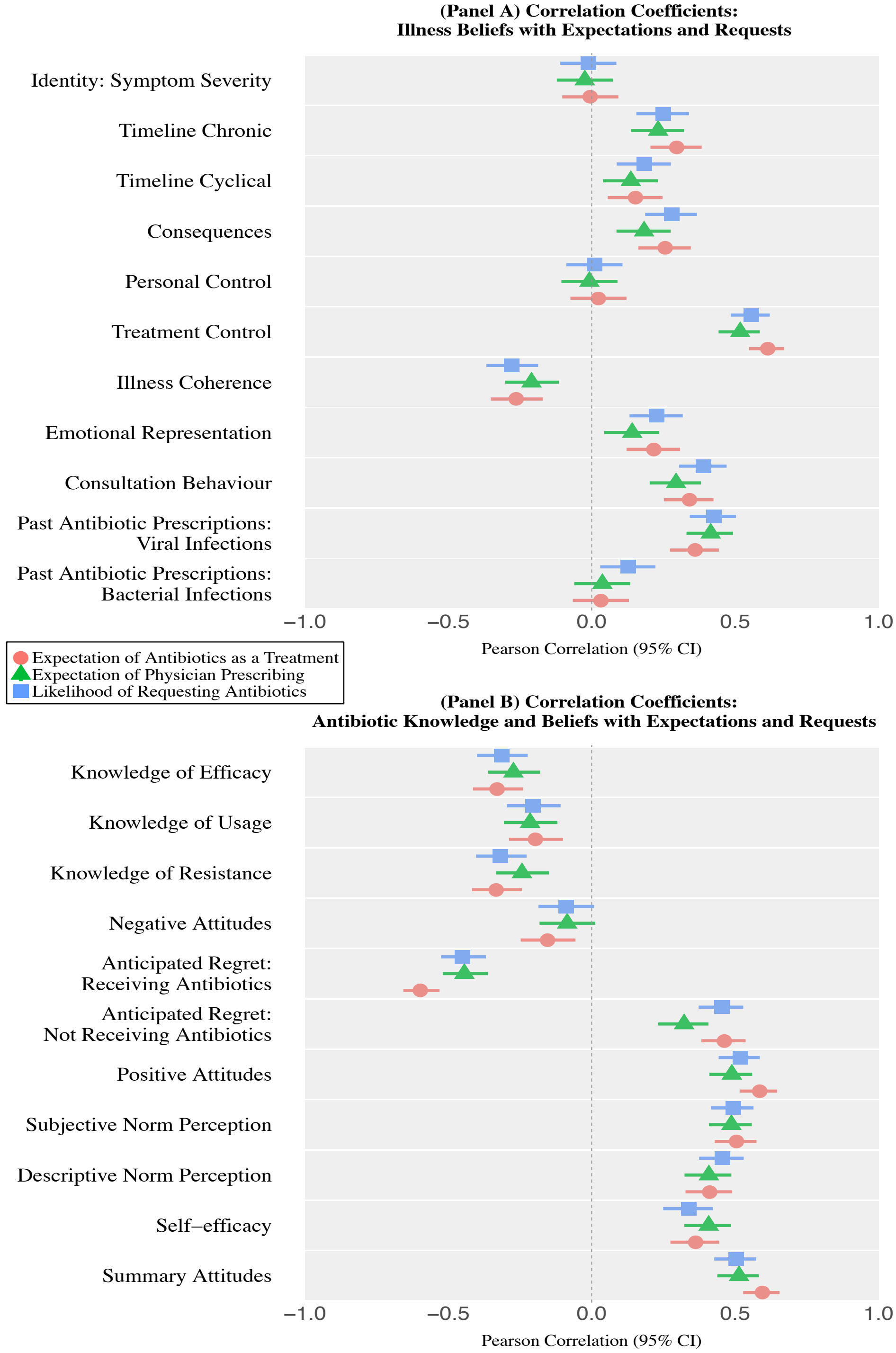

Figure 1. Correlation coefficients for dimensions of illness beliefs (Panel A), antibiotic knowledge and beliefs (Panel B) with expectations of antibiotics as a treatment, expectations of physician prescribing and the likelihood of requesting antibiotics. The point symbols represent zero-order correlations and the error bars represent 95% confidence intervals.

Expectations of antibiotics as a treatment, expectations of the physicians' prescribing behaviour, and the likelihood of requesting antibiotics were each regressed on antibiotic knowledge together with antibiotic beliefs, illness representations, consultation behaviour and past antibiotic prescriptions. Regression coefficients amongst study variables are shown in Figure 2. A significant regression equation was obtained for each dependent variable; expectations of antibiotics as a treatment, $F(22,379) = 18.77$, $p < .001$, $R^2 = .52$, expectations of the physicians' prescribing behaviour, $F(22,379) = 12.30$, $p < .001$, $R^2 = .42$, and the likelihood of requesting antibiotics $F(22,379) = 14.59$, $p < .001$, $R^2 = .46$. Inspection of beta values showed that illness representations, antibiotic beliefs and past experience obtained significant values in all three models, whereas knowledge of antibiotic efficacy, usage, and resistance were reduced to non significance in these multivariable models ($p > .05$). As recommended by Rouder and Morey (2012), we computed JZS Bayes factors to quantify evidence for the null or alternative hypothesis for each regression model. This analysis revealed that the data provide decisive evidence in favour of the expectations of antibiotics as a treatment ($BF_{10} = 1.39*10^{44}$), expectations of the physicians' prescribing behaviour ($BF_{10} = 2.50*10^{29}$), and the likelihood of requesting antibiotics ($BF_{10} = 8.63*10^{34}$) models against the intercept only models (i.e., the null model assuming no effect).

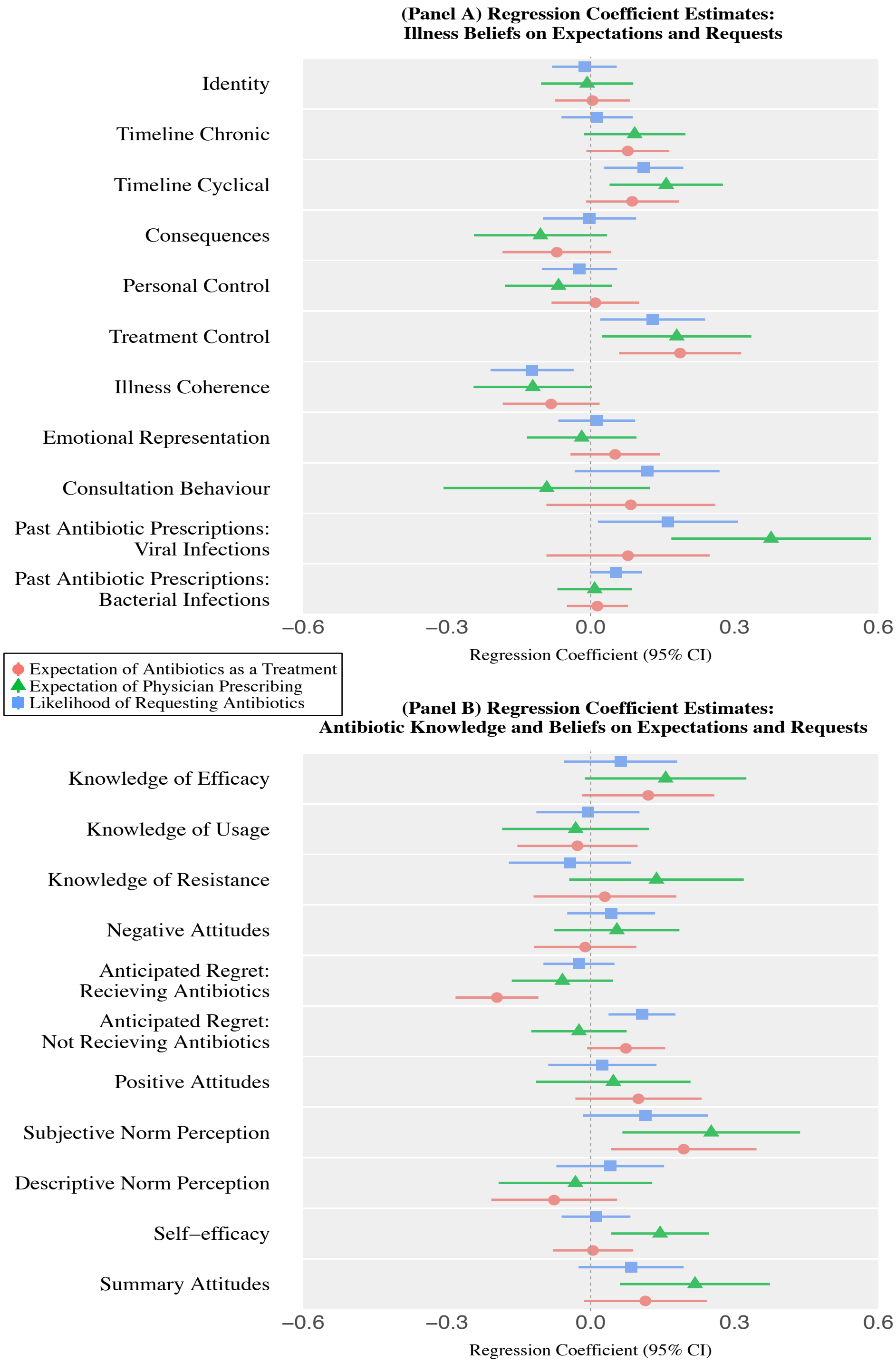

Figure 2. Regression coefficient estimates for dimensions of illness beliefs (Panel A), antibiotic knowledge and beliefs (Panel B) on expectations of antibiotics as a treatment, expectations of physician prescribing and the likelihood of requesting antibiotics. The point symbols represent regression coefficient estimates and the error bars represent 95% confidence intervals.

2.5 Discussion

Poor knowledge of viral aetiology and antibiotics was associated with increased expectations and requests for antibiotics, although in a multivariable model this relationship was reduced to non significance. Since examination of the role of knowledge in isolation cannot evaluate the magnitude of the effect, merely whether it is significant, prior knowledge was tested alongside other factors. These findings suggest that a more complex network of illness and treatment beliefs is associated with inappropriate expectations and requests than is typically appreciated in health campaigns and interventions.

An extended common sense model of self-regulation was employed in this research, as recently recommended by Hagger et al. (2017). Findings support this approach, since both illness representations and treatment beliefs contributed to the explanatory model. Participants were asked to consider a cold they had experienced that led them to go to the doctor. In this scenario, *expectations of antibiotics as a treatment for a cold* was positively associated with the belief that other people would approve of them taking antibiotics (subjective norm), the belief that antibiotics are an effective treatment and inversely associated with anticipated regret if antibiotics were prescribed- that is- people who anticipated regret if they took antibiotics were less likely to consider them an appropriate treatment. Examination of the regression of people's *expectations that a physician will prescribe them an antibiotic* was associated with a different set of variables. Participants who expected to receive a prescription reported cyclical timeline illness representations, had positive attitudes towards antibiotics and believed they would control their illness, had higher self-efficacy to ask for antibiotics and also believed that significant others would approve of them taking antibiotics. These findings endorse the idea that obtaining antibiotics is a goal driven deliberative act on the part of patients. Finally, increased *likelihood of requesting antibiotics* was reliably associated with lower illness coherence and stronger endorsement of cyclical timeline. This implies that a cold that may lead to the adoption of an antibiotic request coping response is characterised by unpredictable day-to-day variability in symptoms that are hard to comprehend (as opposed to the duration or severity of symptoms), together with the belief that antibiotics will offer an effective solution. Participants' feelings of anticipated regret if they requested and did not receive antibiotics was also associated with likelihood of requesting antibiotics, perhaps offering some insight into why physicians so often accede to requests. Anticipated annoyance and dissatisfaction both motivate the patient to ask, and perhaps motivates physicians to avoid this outcome. Given the evidence that past experience of receiving a prescription of antibiotics for a viral infection helps to drive such expectations, physicians might impact upon the frequency of requests over time by adopting this strategy to negate expectations.

To date, the success of public-targeted interventions is unconvincing (Cross et al., 2017; Haynes & McLeod, 2015). Our findings suggest that one reason why interventions focussed on patient education yield such mixed effects is that they neglect the influence of patient related non-clinical factors such as their perception of the social norm for taking antibiotics or their anticipated regret concerning leaving a consultation empty handed. Findings suggest that research interventions might go beyond mere knowledge and focus on modifying beliefs that antibiotics can treat a cold, creating more negative evaluations of antibiotics, encouraging people to consider potential regrets associated with taking antibiotics and changing the subjective norm (Prentice & Miller, 1993) by providing information that most other people think antibiotics should not be prescribed or taken for an RTI. In particular, given the previous success of social norm feedback in reducing antibiotic prescribing by physicians (Hallsworth et al., 2016), it would be expected that normative appeals to the public might be a valuable method for reducing inappropriate prescriptions. Evidence that expectations and requests arise when an individual has failed to achieve illness coherence (Leventhal et al., 2011), perhaps because the course of illness does not seem to have an improving trajectory, but instead comes and goes from day to day in spite of efforts to control symptoms suggests a further educational target. While clinical guidelines propose that physicians advise patients on average illness durations (Tan et al., 2008), education regarding normally expected variability in the progress of a cold associated with immune function activity and appropriate coping responses may also be useful.

While some theoretical consideration has been applied to physicians' beliefs regarding antibiotic use (Donald, 2016), we believe this is the only study to have systematically examined the role of illness representations and treatment beliefs on the cognitive and motivational mechanisms underlying inappropriate expectations and requests for antibiotics.

We acknowledge some limitations present in the methods employed in this research. First, we acknowledge that we cannot assert whether the relationships found here are stable over time. Future research might focus on the relationship between reductions in self-reported expectations, and requests, and patients actual consulting behaviours to enhance our understanding of how reducing expectations leads to reduced levels of inappropriate prescribing.

Second, as respondents did not physically experience any symptoms this may have limited our ability to truly assess respondents' affective/symptomatic responses to the illness and their perceived need for antibiotics. To advance current understanding and overcome this methodological constraint, future research should endeavour to recruit people who have just acquired a viral infection (an inception sample) in order to better assess the relevant relationships between their cognitive representations and expectations for antibiotics.

Third, the correlational nature of the study meant we relied on natural variations in respondents' perceptions of a cold and their ability to recall it. This approach does not allow us to provide any causal inferences, as for instance, we were not able to control for the duration and severity of the colds that respondents recalled. Future research might utilise a vignette-based approach to explore the effect of knowledge on inappropriate expectations for antibiotics. Such an approach would be able to control for illness characteristics in the vignette description and manipulate participant knowledge through information provision.

CHAPTER 3

The effect of information provision at reducing inappropriate expectations for antibiotics

3.1 Abstract

Objective. To provide causal evidence on the extent that information provision decreases inappropriate expectations for antibiotics and isolate which elements of information provision are most effective. **Methods.** Participants (*n* = 190) read a description of a hypothetical consultation of a physician for common cold symptoms before reporting their expectations to receive and request antibiotics. Information provision (by the physician) was manipulated in a 2 (viral information: present vs. absent) × 2 (antibiotic information: present vs. absent) experimental between-subjects design. **Results.** The provision of antibiotic information reduced expectations for antibiotics as a treatment and expectations of the physicians' prescribing behaviour, but not the likelihood of requesting antibiotics. Information regarding illness aetiology did not significantly influence expectations or requests. We found no interaction between the provision of viral and antibiotic information. **Conclusions.** Providing antibiotic information in a consultation diminishes but does not eliminate clinically inappropriate expectations of antibiotics. Further research should explore expectations for antibiotics that are resilient to information provision.

3.2 Introduction

Findings from Study 1 revealed that while prior knowledge was negatively associated with antibiotic expectations, other variables (i.e., norm perception and anticipated regret) appeared to have a greater influence on respondents' expectations for antibiotics. These findings cast some doubt on how much of an influence prior knowledge has on the formation of inappropriate expectations for antibiotics. However, the limitations associated with the correlational method employed in Study 1 (i.e., the inability to control for the characteristics of the colds considered by participants and relying on natural variations in participants prior knowledge) limit the inferences that can be drawn regarding the role of prior knowledge on inappropriate antibiotics expectations. One way to overcome these limitations is to use an experimental approach in which it is possible to manipulate information provision relevant to the illness and antibiotics and measure whether doing so influences people's expectations for antibiotics.

In addition to overcoming some of the limitations present in Study 1, this approach also mirrors the recommendations of clinical guidelines, which state that when antibiotics are not clinically justified physicians should inform patients about the nature of the illness aetiology, the ineffectiveness and side effects of antibiotics, and alternative treatments for managing the illness (Tan et al., 2008). Health campaigns, which aim to address the threat of increasing global bacterial resistance and optimize antibiotic prescribing practices by educating the general public on responsible antibiotic use, also adopt a similar approach (Davies & Gibbens, 2013).

With the intention to improve patients' knowledge, most educational campaigns provide complex combinations of information regarding illnesses (e.g., durations, symptoms, causes) and antibiotics (e.g., efficacy, appropriate usage, and resistance) to people in leaflets, videos, or online materials (Huttner et al., 2010; Saam et al., 2017).

Overall, the results of these public-targeted educational efforts have been mixed (Cross et al., 2017; Haynes & McLeod, 2015; John Macfarlane et al., 2002; Mainous 3rd et al., 2000; McNulty et al., 2010; Meeker et al., 2016). As one might expect, many educational interventions have been shown to improve public knowledge (Huttner, 2010; Thoolen, 2012) and reduce prescribing rates (Gonzales, 2005). However, there have been some cases where it has been reported that educational interventions have not produced improvements in public knowledge or prescribing rates (Arnold & Straus, 2006). More worrying is that, in rare instances, information provision has even been associated with increased misuse of antibiotics (McNulty et al., 2010).

One limitation that may contribute to these mixed observations is that educational efforts have typically employed complex combinations of information provision. As many of these campaigns employ multiple informational elements it is often not possible to identify which of the elements are actually having an effect (Huttner et al., 2010; Saam et al., 2017). In addition, various methodological constraints such as the absence of a control group or the inability to account for illness severity, limit the conclusions that can be drawn about the efficacy of these educational components on peoples' antibiotic knowledge and behaviours (Madle et al., 2004; Price et al., 2018).

Successfully isolating which educational elements, or combinations of elements, is most effective at diminishing inappropriate expectations for antibiotics would advance current understanding of how inappropriate expectations for antibiotics are formed and modified. More importantly, findings might contribute to reducing unjustified antibiotic prescribing through the improved design of interventions and educational campaigns.

3.2.1 The Present Research

We evaluated the causal association between the provision of information about illnesses and antibiotics and inappropriate expectations and requests for antibiotics in a pre-registered experiment. Based on normative decision-making theory it is assumed that relevant information, provided at no extra cost, should help people make better decisions. We predicted that the provision of clinical information from a family physician about the viral nature of the infection and the ineffectiveness of antibiotics would, therefore, reduce inappropriate expectations and requests for antibiotics. We presented all participants with the same cold scenario in a consultation and experimentally manipulated information provision by a physician, in order to provide a test of the causal role of knowledge. Illness representations, treatment beliefs and prior knowledge were employed as covariates, in order to isolate the independent effects of information provision.

Study 2

3.3 Method

3.3.1 Participants

We set an a-priori stopping rule of 187 participants. We recruited participants via email from the general adult population who have registered to take part in social science research. Due to recruiting participants in groups a total of 192 participants completed the experiment in the lab. Two individuals did not consent to participate in the study and did not complete the experiment. Sensitivity analysis with $\alpha = .05$ and $1\text{-}\beta = .90$ indicated the final sample size was sufficient to detect a medium effect $f =$

.24 for a 2 × 2 between subjects ANOVA (Faul et al., 2007). Participants were paid £8 in total. All participants received £4 as a show up fee and then another £4 upon completion of the study. This Experiment was funded by an ESSEXLab Seedcorn grant, awarded to Alistair Thorpe. In the final sample of 190 participants, 71 identified as male, 117 female, 1 as other, and 1 chose not to respond. The sample age ranged from 18 to 79 years old, (*M* = 32.5, *SD* = 14.1 years). The substantial majority, 97%, of participants indicated that they were registered with a family physician and were residents in the United Kingdom (83%). Most participants identified as white (71%) and were employed (61%) with an annual median income between £20,000 and £29,999 per year. Participants' level of education varied as follows: professional trade qualification or no formal educational qualification (1%), GCSE (6%), A levels or national diplomas (23%), and an undergraduate degree or further degree (70%). In the last 12 months only 12% of participants had not experienced a cold, 58% had experienced between one to two colds, 24% had experienced three to four, and 6% had experienced five or more. At the time of testing, 18% of participants had experienced a cold in the last 30 days.

3.3.2 Design

We tested our hypotheses in a 2 (Viral information: present vs. absent) × 2 (Antibiotic information: present vs. absent) factorial between-subjects design with expectations of antibiotics as a treatment, expectations of the physicians' prescribing behaviour, and likelihood of requesting antibiotics as our dependent variables. The manipulations were provided within a hypothetical medical scenario describing a consultation with a physician for cold symptoms. The scenario was modelled according to the vignette employed by Sirota et al. (2017) and aligned with guidelines from the National Institute for Health and Care Excellence of a situation in which antibiotics are not clinically justified (Tan et al., 2008). The viral information manipulation consisted of a single sentence from the family physician stating that a viral infection was the cause of the symptoms. Likewise, the antibiotic information manipulation consisted of a sentence from the physician stating 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 (see the Full Vignette: Study 2 in the appendix).

3.3.3 Materials and procedure

First, participants reported their prior knowledge, antibiotic beliefs, and illness representations by answering the same questions as described in Study 1. Participants were then randomly assigned to read one of four hypothetical medical scenarios describing a consultation with a physician for cold-like symptoms. Having read the scenario participants indicated their expectations of antibiotics as a treatment, their expectations of the physicians' prescribing behaviour, and the likelihood of requesting antibiotics. Items assessing these dependent measures were identical to those used in study 1.

Lastly, as in study 1, participants were asked to provide some information regarding their consultation behaviour and antibiotic prescription frequency, answered some unrelated questions on nutrition labels and general demographic questions. All items were developed specifically for this research. Internal consistency coefficients and descriptive statistics for the measures used in Study 1 are presented in Table 3.

The pre-registration protocol for this Experiment is available at:

http://aspredicted.org/blind.php?x=45tj4w and the data and materials are publicly available on the Open Science Framework at: https://osf.io/8eub7/?view_only=24fb3247c1a942988109f9b07ac080e7.

Table 3

Descriptive Statistics and Cronbach Alpha (α) of the Questionnaire Items and Dependent Measures

	Mean ± SD	Cronbach's α
Illness beliefs: IPQ-R (For the common cold)		
Identity	3.62 ± 1.05	.93
Timeline chronic	3.01 ± 1.15	.93
Timeline cyclical	3.58 ± 0.96	.77
Consequences	3.09 ± 0.89	.76
Personal control	4.38 ± 0.79	.71
Treatment control	2.76 ± 1.45	.93
Illness coherence	4.48 ± 1.08	.90
Emotional representations	3.70 ± 0.98	.78
Antibiotic knowledge and beliefs		
Knowledge of antibiotic efficacy	4.74 ± 0.85	.52
Knowledge of appropriate antibiotic usage	5.16 ± 0.81	.51
Knowledge of antibiotic resistance	5.18 ± 0.73	.74
Negative attitudes	3.36 ± 0.89	.65
Anticipated regret concerning receiving antibiotics	3.75 ± 1.48	.95
Anticipated regret concerning not receiving antibiotics	2.39 ± 1.44	.97

Positive attitudes	2.91 ± 1.28	.92
Subjective social norm perception	2.64 ± 1.14	.82
Descriptive social norm perception	2.74 ± 1.22	.91
Self-efficacy to ask for antibiotics	3.20 ± 1.31	.88
Summary attitudes towards taking antibiotics	2.72 ± 1.44	.93
Dependent Variables		
Expectations of antibiotics as a treatment	2.66 ± 1.42	.92
Expectations of the physicians' prescribing behaviour	2.87 ± 1.52	.92
Likelihood of requesting antibiotics	2.29 ± 1.31	.92

3.3.4 Statistical analyses

We planned to conduct a two-way factorial ANOVA to test the effect of illness and antibiotic information provision on expectations and requests for antibiotics. We also planned to run two-way factorial ANCOVAs to again test the effect of illness and antibiotic information provision on expectations and requests for antibiotics with the dimensions of antibiotic knowledge, antibiotic beliefs, illness representations, consultation behaviour and past antibiotic prescriptions as covariates. Evidence to support the null or alternative hypothesis was quantified by computing a JZS Bayes factor (BF) ANOVA and ANCOVAs with default prior scales using the "Bayes-Factor" package in R and JASP respectively (Love et al., 2015; Morey & Rouder, 2014; Rouder et al., 2012).

3.4 Results

The ANOVA (Figure 3) showed that the provision of information regarding antibiotics decreased individuals' expectations of antibiotics as a treatment $F(1,186) = 7.55$, $p = .007$, $\eta_P^2 = .04$. There was no significant effect of viral information on *expectations of antibiotics as a treatment* ($F < 1$, $p = .789$) nor was there any interaction ($F < 1$, $p = .859$). Similarly, the provision of information regarding antibiotics decreased individuals' *expectations of the physicians' prescribing behaviour* $F(1,186) = 22.78$, $p < .001$, $\eta_P^2 = .11$, but the provision of viral information did not ($F < 1$, $p = .900$). There was also no interaction ($F < 1$, $p = .891$). Descriptively, as indicated in Figure 3 (Panel C), the *likelihood of requesting antibiotics* was decreased by the provision of antibiotic information, but this was not statistically significant $F(1,186) = 3.46$, $p =.065$, $\eta_P^2 = .02$. Again, no effect of viral information ($F < 1$, $p = .843$) or interaction was found ($F < 1$, $p = .501$).

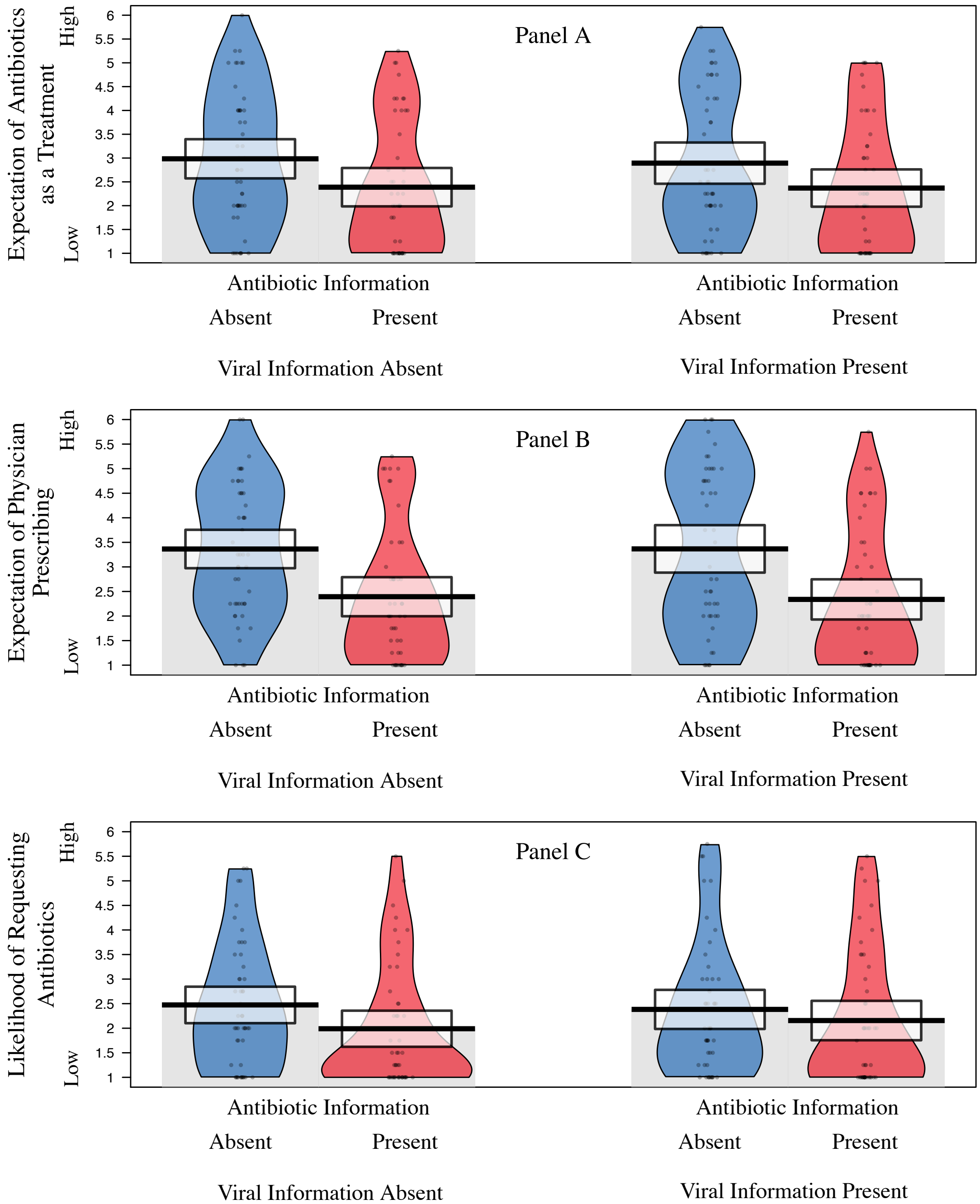

Figure 3. Effect of information provision (antibiotic information vs. viral information) on expectations of antibiotics as a treatment (Panel A), expectations of physician prescribing (Panel B), and requests for antibiotics (Panel C). The middle bold line represents the arithmetic mean and the box borders represent 95% confidence intervals.

A JZS Bayes factor ANOVA (Love et al., 2015; Morey & Rouder, 2014; Rouder et al., 2012) with default prior scales favoured the antibiotic information model to the intercept only (null) model for both expectations of antibiotics as a treatment and of the physicians' prescribing behaviour, but not for the likelihood of requesting antibiotics (see Table 4). The data provide substantial evidence that antibiotic information reduces expectations of antibiotics as a treatment ($BF_{10} = 5.33$), decisive evidence in favour for the provision of antibiotic information reducing expectations of the physicians' prescribing behaviour ($BF_{10} = 4688.88$); and no evidence that antibiotic information influences the likelihood of requesting antibiotics ($BF_{10} = 0.79$). Additionally, there was substantial evidence that data were more likely under the main effects models than the models including the interaction. This analysis is consistent with the results of the classic ANOVA and further supports the exclusive effect of antibiotic information on expectations for antibiotics.

Table 4

Quantified Evidence for Models (BFs)

	BF numerator			
BF denominator Intercept-only models	Model 1 $BF_{A/}$	Model 2 $BF_{V/}$	Model 3 $BF_{A+V/}$	Model 4 $BF_{A+V+A \times V/}$
Expectations of physician to prescribe antibiotics	4688.79	0.16	717.86	154.57
Expectations of antibiotics as a treatment	5.33	0.16	0.84	0.18
Likelihood of requesting antibiotics	0.79	0.16	0.12	0.03

Note. BF = Bayes factors; A = antibiotic information (Factor 1); V = viral information (Factor 2); A × V = interaction term of antibiotic and viral information. Evidence category for BF_{01} as described by (Wetzels et al., 2011): Evidence to support H_0: Decisive evidence (>100), very strong evidence (100 – 30), strong evidence (30 – 10), substantial evidence (10 – 3), and anecdotal evidence (3-1). Evidence to support H_1: Decisive evidence (<1/100), very strong evidence (1/100 – 1/30), strong evidence (1/30 – 1/10), substantial evidence (1/10 – 1/3), and anecdotal evidence (1/3-1). $BF_{10} = 1/BF_{01}$.

To examine the effect of information provision after controlling for initial differences in participants knowledge, antibiotic beliefs, illness representations, and past experiences, we entered these variables as covariates in subsequent two-way factorial ANCOVAs (see tables 5, 6 and 7 in the Appendix). The main effect of antibiotic information in reducing expectations of antibiotics as a treatment and expectations of physicians' prescribing behaviour was unaffected by the introduction of covariates. However, the inclusion of illness representations and antibiotic knowledge and beliefs as covariates in the analysis of likelihood of requesting antibiotics resulted in a significant main effect of provision of antibiotic information (see Table 7 in the Appendix). The emergence of this main effect only after the inclusion of covariates in the model indicates that the effect of information provision on the likelihood of making a request for antibiotics in the scenario varied according to prior beliefs.

3.5 Discussion

In this experiment we evaluated the role of information provision regarding illnesses and antibiotics on reducing expectations and requests. We controlled for illness characteristics by presenting participants with a description of a cold scenario physician consultation in vignette format, in order to provide a critical test of the causal role of information about illnesses and antibiotics and inappropriate expectations and requests for antibiotics. As predicted, we found that the provision of *information regarding the efficacy and side effects of antibiotics* decreased expectations. Contrary to our predictions, we observed no effect of information relating to the illness aetiology on expectations and no advantage in combining the two types of information.

Patients' expectations and requests for antibiotics motivate physician prescribing behaviour (Sirota et al., 2017) and increase clinically unjustified prescriptions of antibiotics in primary care (Davies, 2018). Strategies are needed that might on the one hand modify unnecessary consulting behaviour by patients and on the other hand, empower physicians to reduce requests during those consultations. The present results provide important insights that might inform such strategies.

Our findings are aligned with existing research that educational interventions may reduce desires for antibiotics (Madle et al., 2004; Price et al., 2011), but offer a distinct contribution by controlling for illness characteristics (severity and duration) and indicating that physicians might be empowered to change patient expectations during a consultation in which antibiotics are clinically inappropriate by providing information that specifically addresses ineffectiveness of antibiotics and their side effects. This is particularly important in light of prior research, which found that 23% of people who asked for an antibiotic when they visited their physician were given one without any discussion with their physician about the presenting illness (McNulty et al., 2013).

In addition to our key aims, we also address a limitation of prior research on inappropriate expectations of antibiotics. Specifically, we highlight the independence of patients' expectations of whether their physician will offer a prescription and their expectations of antibiotics as an appropriate treatment option by employing distinct multi-item measures. Specifically, visual inspection of the effect sizes shows that the provision of antibiotic information had a larger effect on respondents' expectations of the physicians' prescribing behaviour (η_P^2 = .11) compared to their expectations of antibiotics as a treatment (η_P^2= .04). This provides preliminary evidence that the scope of this effect of information provision is targeted more towards perceptions of the physicians' behaviour rather than the knowledge of antibiotics. If this effect is localised to perceptions of physicians' behaviour it would still be of value in promoting public understanding that they should not expect physicians to prescribe antibiotics for viral infections. However, it would have less of an impact on individuals who are convinced antibiotics are necessary – particularly in light of research that these individuals are likely to 'shop around' and find a physician that will prescribe them the antibiotics (Faber et al., 2010). How to successfully convince such individuals that antibiotics are not necessary for viral infections is an area that requires further consideration.

While this is the first study to provide causal evidence for the effect of clinical information provision on inappropriate antibiotic expectations and requests, we acknowledge some limitations present in the methods employed in this research. First, though the use of clinical vignettes has been validated and applied in research assessing clinical judgements of health professionals (Sirota et al., 2017), they have not received similar validation when applied to the general public. The lack of ecological validity is clear, as respondents did not physically experience any symptoms, though given our focus on the cognitive mechanisms and representations underlying inappropriate expectations and requests for antibiotics we believe that this is not a substantial drawback. Furthermore, our methods are comparable to those of mass educational campaigns, which target the general public as well as patients consulting with respiratory tract infections (Ranji et al., 2008).

Second, we acknowledge that we cannot assert whether the changes found here are stable over time, however, identifying effective techniques for campaigns to reduce inappropriate expectations and requests for antibiotics even temporarily can have a positive effect on healthcare particularly during periods of high incidences of viral infections. Future research might also focus on the relationship between reductions in self-reported expectations, and requests, and patients actual consulting behaviours to enhance our understanding of how reducing expectations leads to reduced levels of inappropriate prescribing.

To date, the success of public-targeted interventions is unconvincing (Cross et al., 2017; Haynes & McLeod, 2015). Our findings suggest that one reason why interventions focussed on patient education yield such mixed effects is that they overestimate the impact of information provision about illnesses and antibiotics. Some respondents in the complete information condition (viral and antibiotic information present) still reported expectations for antibiotics (see Figure 3). This finding appears to be at odds with normative decision making principles as it indicates a preference for a treatment that will not provide any medical benefits and may cause side effects. There are several reasons why some respondents may have still wanted antibiotics, which deserve further attention.

First, some respondents may have inferred some uncertainty about the diagnosis. In the scenario the GP gives the diagnosis "she explains that she thinks a viral respiratory tract infection is the cause of your symptoms." It could be that the tentative language elicits some uncertainty in the respondent as to whether there is a possibility that the infection might be bacterial and require antibiotic treatment. In this case, expectations for desires would not be considered as irrational, but instead might represent a loss aversive strategy to the perceived high costs of failing to treat a serious bacterial infection. Future research might explore the effect of point-of-care blood tests, which can provide objective evidence for the viral or bacterial nature of an infection.

Second, some respondents may not have fully processed the information from the physician regarding the information. This could have happened for a number of reasons. For instance, some respondents may have had an a-priori belief that the physician is not trustworthy and consequently doubted the information they provided. Indeed, there have been recent suggestions that prompting patients to trust their physicians' might lead to greater acceptance of the information provided by physicians (Ancillotti et al., 2018; André et al., 2010; Brookes-Howell et al., 2014), which in turn would ameliorate the effect of information provision at reducing inappropriate antibiotic expectations. However, whether trust in physicians' moderates the effect of information provision at reducing inappropriate expectations for antibiotics is not yet known.

CHAPTER 4

'Always take your doctor's advice': Does trust moderate the effect of information on inappropriate expectations for antibiotics?

4.1 Abstract

Objectives. To test i) whether individuals with greater trust in their physician will have lower antibiotic expectations and ii) whether individuals with greater trust in their physician will benefit more from the complete information provision and have lower expectations. **Methods.** Study 3 featured a between-subjects design (information provision: baseline vs. complete information) with a general measure of participants trust in their physician. 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. Study 4 featured a 2 (physician trustworthiness: low vs. high) × 2 (information provision: baseline vs. complete information) between-subjects design in which participants (n = 380) read a vignette of a consultation with a physician for a viral ear infection then expressed their expectations for antibiotics. **Results.** Providing complete information decreased inappropriate expectations for antibiotics. In Study 3, participants with greater reported trust in their physician expected antibiotics more, whereas, in Study 4, participants who were assigned to a more trustworthy physician expected antibiotics less. **Conclusion.** Information provision decreases inappropriate expectations for antibiotics, but exactly how trust in physicians affects antibiotic expectations alongside information provision remains unresolved and requires further investigation.

4.2 Introduction

In Chapter 3, the provision of antibiotic information in a consultation diminished, but did not eliminate clinically inappropriate expectations of antibiotics. There are several reasons why the communicated information has only a limited effect, but one obvious reason is that people may not trust the information enough. If patients with greater trust in their physicians are more accepting of the information provided by their physician (Ancillotti et al., 2018; André et al., 2010; Brookes-Howell et al., 2014) this could, in turn, lead to a greater effect of information provision at reducing inappropriate antibiotic expectations from primary care patients.

There is substantial evidence indicating that more trustworthy sources are more persuasive (Glaeser & Sunstein, 2013; Pornpitakpan, 2004; Tormala et al., 2006). In health communication patients' trust in their physician has particular importance with regards to the effectiveness of physician communications intended to guide patients' treatment decisions (Hall et al., 2002; Katz, 2002; Thom, 2000; Thom et al., 2004; Thom et al., 2002). Trusting patients are more likely to report being satisfied with the care provided by their physician, to openly communicate medical problems, and to report greater adherence to their physicians' instructions (Freburger et al., 2003; Safran et al., 1998).

The idea that enhancing trust in physicians will bolster the benefits of information provision is supported by population level data. For example, André et al. (2010) suggested that Sweden's low antibiotic prescribing rates reflect the high levels of public trust in physicians' judgments of when to prescribe antibiotics, as well as high knowledge of antibiotic usage and resistance. Qualitative interviews with patients also promote 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, the causal evidence that patients who trust their physician are more receptive to information from their physician about whether they need antibiotics and, in turn, less likely to expect them is lacking. While both population level data and primary care level interviews provide useful insights into the potential role of trust, the 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 et al., 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. In addition, these findings would also provide theoretical insight into the information processing mechanisms underlying the formation, and maintenance, of inappropriate expectations for antibiotics.

4.2.1 The 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 Study 3, 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. First, we expect to replicate the effect of information provision from Study 2 and 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, given that high levels of public trust in physicians is associated with lower antibiotic prescribing rates, we hypothesize that individuals with greater trust in their physician will have lower expectations for antibiotics (Hypothesis 2). Third, as trusting patients report greater adherence to their physician's instruction, we hypothesize that participants' trust in their physicians 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 Study 4, 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, as in Study 3, we expect to replicate the effect of information provision and hypothesize that information from a physician will reduce inappropriate expectations for antibiotics (Hypothesis 4). Second, again derived from the observed association between public trust in physicians and antibiotic prescribing, we hypothesize that descriptions of high physician trustworthiness will decrease expectations compared to descriptions of low physician trustworthiness (Hypothesis 5). Third, based on the reported effect of trust on adherence to physician instruction, 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. Study 3 will provide insight into how trust in physicians moderates the effect of information provision when trust is naturally distributed within the sample, while Study 4 will provide causal evidence for the effect of trust in physicians on the facilitative effect of information provision to patients.

Study 3

4.3 Method

4.3.1 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 α = .05 and 1-β = .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 et al., 2007). This calculation resulted in a total sample size of 353 participants. To ensure high quality data, participants who: (i) did not complete the study fully (defined as reaching the debrief screen), and (ii) those who did not respond to an attention check question as instructed (see Attention check: Study 3 in the Appendix) were excluded from the analysis. As 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 is ≥ 353.

We contacted participants from the general adult population via an online recruitment panel (Prolific). Only participants who: (i) have achieved at least 90% approval rate in previous studies, (ii) indicate that they reside in the United Kingdom, and (iii) are at least 18 years old were eligible to participate. A total of 393 participants began the study; one participant did not consent to participate the study and thus did not complete the experiment. Aligned with the pre-specified exclusion criteria, we excluded two participants did not complete the study fully and 24 who did not respond to an attention check question as instructed. 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 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%). Participants were paid £0.93 upon completion of the study, which was estimated to take 11 minutes. Based on the average completion time the average reward per hour for participants was £13.95.

4.3.2 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 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 was carried out using the built-in randomizer function in Qualtrics' survey flow.

4.3.3 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 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*). The trust in physician scale was summarised 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). Assuming sufficient internal consistency (Cronbach's $\alpha \geq 0.7$), it was planned that the trust in physician scale would be averaged for analysis (Bland & Altman, 1997). If $\alpha < 0.7$, the contingency plan was to omit the item with the lowest correlation to the summated score for all other items (Corrected Item-Total Correlation) and re-run Cronbach's α. We would repeat this procedure until the internal consistency of the scale reaches the a-priori threshold of $\alpha = 0.7$. If we could not reach the $\alpha = 0.7$ threshold with this procedure, we would choose one item "I trust my doctor's judgments about my medical care" as the dependent variable on which we test the hypotheses. In this study, the trust in physician scale demonstrated excellent internal consistency ($\alpha = 0.88$) and so was averaged for analysis.

Following this, participants read a hypothetical medical scenario describing a consultation with a physician for symptoms of a common cold (see the Study 3: Vignette in the Appendix). The scenario was modelled in alignment with those published by Sirota et al. (2017) and according to 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, provided 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 = Agree*,* 6 = *Strongly agree*). Assuming sufficient internal consistency (Cronbach's $\alpha \geq 0.7$), it was planned that the dependent variable (expectations for antibiotics as a treatment) would be averaged for analysis (Bland & Altman, 1997). If $\alpha < 0.7$, the contingency plan was to apply the same procedure as described for the trust in physician scale. If we did not reach the $\alpha = 0.7$ threshold with this procedure, we would choose one item "I should get a prescription of antibiotics" as the dependent variable on which we test the hypotheses. 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 (see the Trust in Physician Scale: Study 3 and the Dependent variables: Study 3 in the Appendix for all items).

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).

This chapter was prepared as a Registered Report and the approved stage 1 protocol, data, and materials for both the experiments presented in this chapter are publicly available on the Open Science Framework at: https://osf.io/jdcza/?view_only=14508e3ecb9542d69f51b33dab0047a5

4.3.4 Statistical analyses

We planned to check the percentage of participants recruited into each experimental condition who dropped out (i.e., those who started but did not fully complete the experiment). If we found a substantial number of dropouts (>20%; (Van Tulder, Furlan, Bombardier, Bouter, & Group, 2003; Zhou & Fishbach, 2016)), we would then perform a chi-squared test for association to examine whether the dropout rates differ significantly across the two experimental conditions. If we found that they do, we planned to check if any demographic variables differ across conditions and then, in addition to running the planned analysis, we would run the regression model with these specific demographic variables entered as covariates.

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.

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.

4.4 Results

As there were only four total dropouts (individuals who started but did not fully complete the experiment), no analyses were carried out for comparing participant characteristics between conditions.

The overall regression model with information provision, trust in physicians, and their interaction term as predictors of expectations for antibiotics was significant, $F(3, 362) = 41.42$, $p < .001$, $R^2 = .26$. Within this model, information provision significantly predicted expectations for antibiotics $b = -1.42$, $t(362) = -10.76$, $p < .001$. As predicted, 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 than those who did not receive this information. Trust in physicians was also a significant predictor of expectations for antibiotics, but contrary to the prediction of hypothesis 2, greater trust in physicians was associated with higher expectations for antibiotics $b = 0.01$, $t(362) = 2.79$, $p = .006$. There was also a significant effect of the interaction between information provision and trust in physicians predicting expectations for antibiotics, $b = -0.02$, $t(362) = -2.72$, $p = .006$ (Figure 4). In the baseline condition (where the physician did not inform the participant their infection was viral and that antibiotics would be ineffective and possibly harmful), participants with greater trust in physicians had significantly higher expectations for antibiotics $b = 0.01$, $t(362) = 2.79$, $p = .006$. In the complete information condition (where the physician informed the participant of the viral nature of the infection and the ineffectiveness and possible harms of taking antibiotics) participants with greater trust in physicians had lower expectations for antibiotics, but this was not significant, $b = -0.01$, $t(362) = -1.19$, $p = .235$.

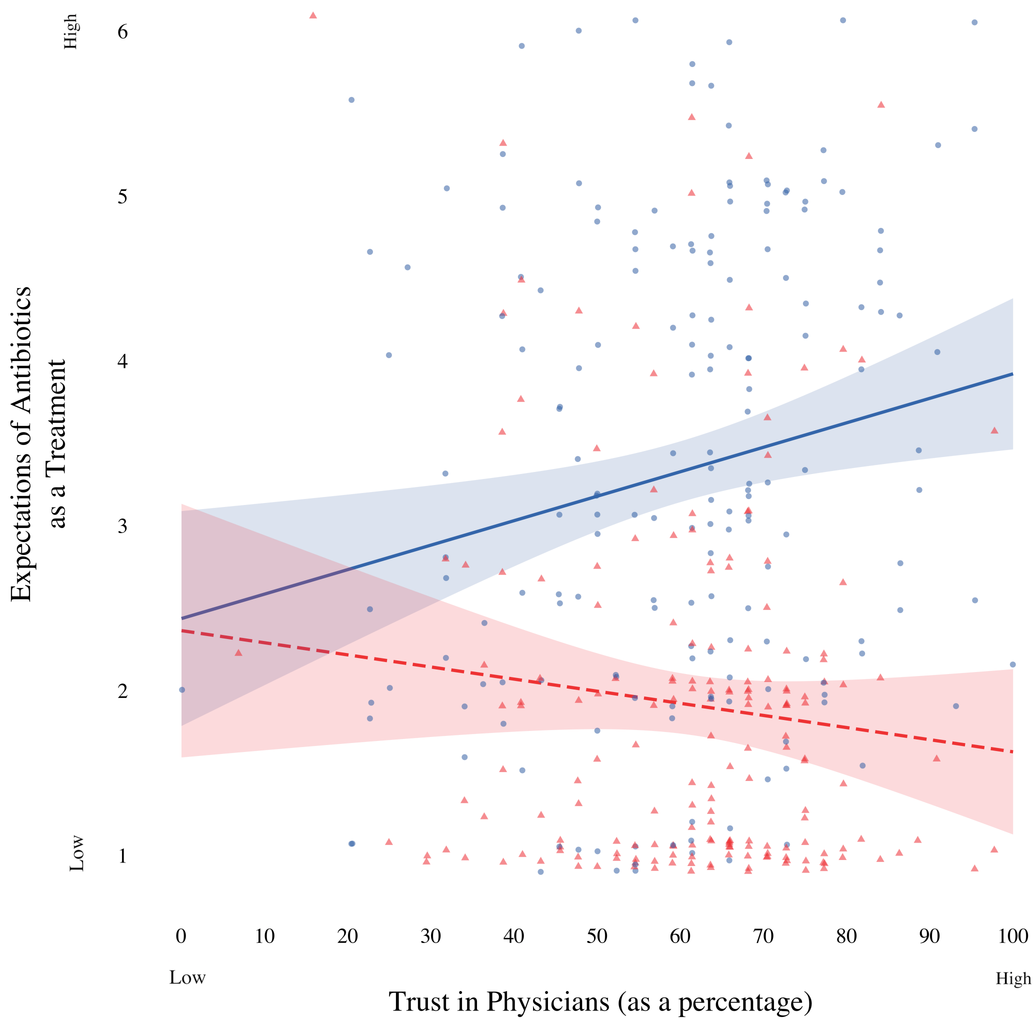

Figure 4. Showing the simple slopes of information provision (baseline vs. complete information) on expectations for antibiotics as a treatment for a respiratory tract infection, moderated by trust in physicians. The baseline condition (no explicit information about the viral nature of the infection or about antibiotics) is shown with the blue full line and circular data points. The complete information condition (explicit information about the viral nature of the infection and antibiotics) is shown with the red dotted line and triangular data points. Shaded portions around the slopes represent 95% confidence intervals.

Participant's past consultation behaviour and antibiotic prescribing history for ear 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 antibiotics 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 non-significance when controlling for past consultation behaviour, the results of these analyses did not differ substantially from the original regression model.

Study 4

Results from Study 3 showed that natural variations of participant's trust in their physician moderate the effect of information provision on patients' expectations for antibiotics. To provide further evidence of the role of trust, in Study 4 we manipulated the perceived trustworthiness of the physician alongside information provision and assessed 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.

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).

4.5 Method

4.5.1 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 $1\text{-}\beta \approx .88$ (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 Study 3. The resulting power analysis with $\alpha = .05$, $1\text{-}\beta = .90$, revealed a minimum sample size of 366 participants (Faul et al., 2007). 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 Study 3). This was expected to give us enough power to detect an effect of information provision from a physician on inappropriate expectations for antibiotics (Hypothesis 4), an effect of trustworthiness (Hypothesis 5), and an interaction (Hypothesis 6). If after applying the a-priori exclusion criteria the valid sample size is < 366, the contingency plan was to collect more participants (in groups of 10) until the minimum valid sample size is ≥ 366.

We contacted participants from the general adult population via an online recruitment panel (Prolific) applying the same inclusion criteria as in Study 3. A total of 413 participants began the study; all participants consented to participate in the study. Aligned with the a-priori exclusion criteria, we excluded six participants who did not complete the study full 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%). Participants were paid £0.59 upon completion of the study, which was estimated to take 7 minutes. Based on the actual average completion time the average reward per hour for participants was £11.80.

4.5.2 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 Study 3, 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). The physician trustworthiness factor was split between a low trustworthiness (i.e., descriptions of a cold and less competent physician behaviours) and high trustworthiness condition (i.e., descriptions of a warm and competent physician). The dependent variable was expectations for antibiotics as defined in Study 3. The random allocation to conditions was carried out using the built-in randomizer function in Qualtrics' survey flow.

4.5.3 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 Study 4: Vignette in the Appendix). The scenario was be modelled in alignment with those published by Sirota et al. (2017) and according to 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 Study 3 (cold scenario), but in the context of a different viral infection (acute otitis media). As in Study 3, 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 5).

Table 5

Cues of warmth and competence in both the low and high trustworthiness conditions

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

The effect of these manipulations of trust was validated in two pre-tests (see Study 4: Pre-test 1 and Study 4: Pre-test 2 in the Appendix for the full methods and results). 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 then indicated their expectations for antibiotics in this scenario using the same items as in Study 3. We applied the same process to assess the internal consistency of the items on expectations for antibiotics as in Study 3. These items displayed excellent internal consistency in each of the four experimental conditions (α ranging from = 0.91 to 0.95). Lastly, participants were asked if they have ever visited their GP for an ear infection, if they have ever received antibiotics for an ear infection, and to provide some general demographic information (age, gender, ethnicity, and employment).

4.5.4 Statistical analyses

We planned to check the percentage of participants recruited into each experimental condition who dropped out (i.e., those who started but did not fully complete the experiment). If we found a substantial number of dropouts (>20(Van Tulder et al., 2003; Zhou & Fishbach, 2016)), we would then perform a chi-squared test for association to examine whether the dropout rates differ significantly across the four experimental conditions. If we found that they did, we would check if any demographic variables differ across conditions and then, in addition to running the planned analysis, we would run ANCOVAs with the specific demographic variables entered as covariates.

We conducted 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).

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.

4.6 Results

As there were only six total dropouts (individuals who started but did not fully complete the experiment), no analyses were carried out for comparing participant characteristics between conditions.

Consistent with hypotheses 4 and 5, the ANOVA (Figure 5) revealed a significant main effect of information provision, $F(1,376) = 185.75$, $p < .001$, $\eta_P^2 =$

.33, and physician trustworthiness, $F(1,376) = 6.15$, $p = .014$, $\eta_P^2 = .02$. 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 ($M = 2.17$; 95% CIs [1.99, 2.35], $SD = .09$), than those who did not receive such information ($M = 3.92$; 95% CIs [3.74, 4.10], $SD = .09$). Participants who read descriptions of a warm and competent physician had lower expectations for antibiotics ($M = 2.89$; 95% CIs [2.71, 3.07], $SD = .09$), that those who read descriptions of a cold and less competent physician ($M = 3.21$; 95% CIs [3.03, 3.39], $SD = .09$).

However, there was no significant interaction between the information provision and physician trustworthiness, $F(1,376) = 0.05$, $p = .828$, $\eta_P^2 < .01$. Thus, hypothesis 6, that the effect of information provision would be stronger in the high trustworthiness condition compared to the low trustworthiness condition, was not confirmed.

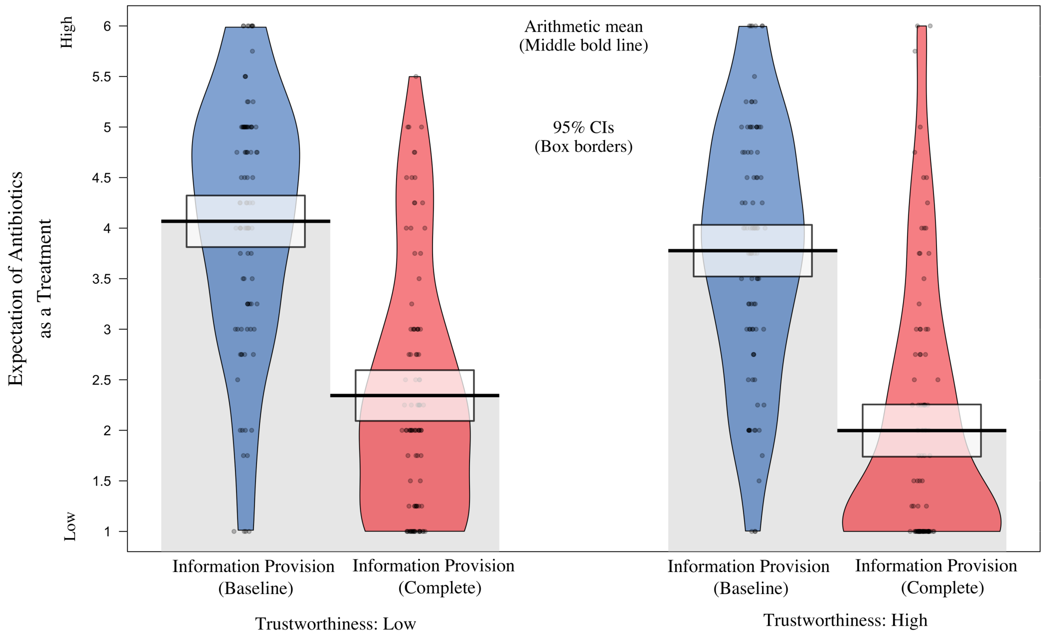

Figure 5. Showing the effect of information provision (baseline vs. complete information) and physician trustworthiness (low vs. high) on expectations of antibiotics as a treatment. The middle bold line represents the arithmetic mean and the box borders represent 95% confidence intervals.

Participants' 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. In the model accounting for past consultation behaviour for ear infections there were significant main effects of information provision, $F(1,375) = 204.21$, $p < .001$, $\eta_P{}^2 = .35$, and physician trustworthiness, $F(1,375) = 11.87$, $p = .001$, $\eta_P{}^2 = .03$ in reducing expectations of antibiotics as a treatment and no interaction ($F < 1$, $p = .713$). Similarly, in the model accounting for past receipt of antibiotics 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 expectations of antibiotics as a treatment and no interaction ($F < 1$, $p = .993$).

4.7 Discussion

The main aim of the two experiments presented in this chapter was to establish whether trust in physicians moderates the effectiveness of information provision at reducing inappropriate expectations for antibiotics. The findings from the two experiments replicate those of Chapter 3 and establish that providing complete information about the viral nature of the illness and the ineffectiveness and side effects of antibiotics reduces but does not completely eliminate inappropriate expectations for antibiotics. However, evidence on whether greater trust in physicians substantially enhances the effect of information was less conclusive and requires further investigation.

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). The results from the two experiments support these clinical recommendations and provide supplemental evidence of the importance of this information provision as a tool to reduce inappropriate expectations for antibiotics. In both Study 3 and Study 4, participants who received complete 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 significantly lower expectations for antibiotics than those who did not receive this information.

Contrary to our original prediction in Study 3, individuals with greater trust in their physician had significantly higher expectations for antibiotics. Furthermore, inspection of the effects driving the interaction between information provision and trust in physicians revealed that in the complete information condition, participants with greater trust in their physician had descriptively lower expectations for antibiotics, but this relationship was not 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 the full effect of trust. In the baseline condition, participants with greater trust in their physician were significantly more likely to inappropriately expect antibiotics.

These findings do not support the hypothesis that people with high trust in their physician would have lower expectations for antibiotics nor the hypothesis that individuals with greater trust in their physician will benefit more from the information provision and, in turn, have lower expectations for antibiotics. One explanation for this is that people with high trust in their physician may be more willing to express their expectation of a certain treatment than those who trust their physicians less (Thom et al., 2002). For participants in the baseline condition, it could be that those who trust their physician might be particularly comfortable expressing that they expect a certain treatment in a situation where there is uncertainty about the diagnosis and the appropriate treatment.

However, in Study 4, the inclusion of cues that the physician was trustworthy did significantly reduce inappropriate expectations. This was a small effect ($\eta_P{}^2 = .02$), which again may be masked to some degree by a floor effect in the complete information conditions. There was no interaction between information provision and trustworthiness, which indicates that the effect of high physician trustworthiness reducing antibiotics did not differ based on how much information the physician provided about the nature of the illness or about antibiotics.

There are several reasons that might explain the discrepancies between the results on the role of trust between studies 3 and 4. For instance, the different illnesses covered in the vignettes may have had some influence. However, as ear infections are less common, and have received less coverage regarding antibiotic use publicly, it would be reasonable to assume that the pattern of results seen in Study 3 with the scenario of a respiratory infection would actually be amplified in Study 4. Another possibility is that the way trust was measured in Study 3 differed in some way to the manipulations of physician trustworthiness in Study 4. The items from the Trust in Physician Scale were developed to cover three dimensions: dependability of the physician (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 Study 4. But it could be that the more general nature of the questions asked in the scale may have tapped into other more nuanced beliefs not present in the manipulations in Study 4.

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). Despite the absence of causal evidence that increasing trust reduces inappropriate expectations for antibiotics, in 2018, Public Health England released a national campaign imploring the UK public to always 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.

This is, to our knowledge, the only study to have used an experimental design to examine the role of trust in physicians on inappropriate expectations and requests for antibiotics in primary care. The use of an experimental vignette-based design allowed for isolating the effects of trust and information provision on inappropriate expectations. This design also allowed for the controlling of other key factors such as the illness duration, illness severity, and the behaviour of the physician. One limitation of the vignette approach is that as responses are based on imagined, not experienced, symptoms and interactions with a physician, there is a clear lack of ecological validity. Some research has employed immersive virtual reality technology with physicians to simulate interactions with patients who have unreasonable demands for antibiotics (Pan et al., 2016). Despite potential technical difficulties in implementation, this is one approach that might be leveraged to enhance the ecological validity of future research on how patient-physician interactions influence inappropriate expectations for antibiotics.

CHAPTER 5

Action bias in the public's clinically inappropriate expectations for antibiotics

5.1 Abstract

Objective. To test whether information provision about illnesses and antibiotics would reduce but not eliminate inappropriate desires for antibiotics and whether a set of four cognitive biases could explain why some people resist the effect of information provision. **Methods.** In two experiments, participants (n_1 = 424; n_2 = 434) either received information about the viral aetiology of their infection (incomplete information) or information about viral aetiology and about antibiotics (complete information), before deciding whether to rest or take antibiotics. Those in the complete information conditions expressed their agreement to items on four biases: action bias, social norm, source discrediting, and information neglect. In two follow-up experiments (n_1 = 150; n_2 = 732), we aimed to counteract the action bias by nudging half of the participants to perceive resting as an action. **Results.** Information provision reduced but did not eliminate inappropriate preferences for antibiotics. Preferences for antibiotics despite having complete information were associated with an action bias. The experiment aiming to counter the action bias failed to significantly decrease inappropriate antibiotic preferences. **Conclusions.** Around 10% of people want antibiotics even when they are informed they are harmful and offer no benefit. An action bias underpins this preference and appears challenging to counteract.

5.2 Introduction

Efforts to educate patients reflect the common assumption that imperfect knowledge is responsible for inappropriate desires for antibiotics and that providing information to improve patient knowledge will be effective at eradicating such desires (Eng et al., 2003). However, the findings from chapters 3 and 4 show that providing information about illness aetiology and antibiotic efficacy to patients in primary care results only in modest reductions in people's inappropriate expectations for antibiotics. Combined with the finding that providing information about illness aetiology and antibiotic efficacy to patients in primary care has resulted only in modest reductions of antibiotic overprescribing (Arnold & Straus, 2006; Haynes & McLeod, 2015; John Macfarlane et al., 2002), it is clear that while information provision may be necessary, it is not sufficient to convince patients that antibiotics are not always helpful (Ancillotti et al., 2018; van Rijn et al., 2019).

To better understand why efforts to eliminate inappropriate desires for antibiotics by providing clinical information about illnesses and antibiotics might not eradicate inappropriate desires for antibiotics, it is necessary to draw on other theoretical frameworks and consider other factors that might also be important drivers of inappropriate desires for antibiotics (Ancillotti et al., 2018; Donald, 2016). The substantive literature on the influence of people's cognitive processes and biases, for instance, has shed light on the mechanisms underpinning sub-optimal decision making across a number of medical domains (Blumenthal-Barby & Krieger, 2015; Saposnik et al., 2016).

For example, many studies have shown that people are often influenced to a greater extent by the pathway through which an outcome occurs (i.e., by action or inaction) rather than by the information about the risks and benefits associated with the outcome (Baron & Ritov, 2004). What this means, is that in some cases people are willing to accept worse outcomes because of the importance they place on how that outcome is achieved (i.e., either by them acting or not acting).

The *action bias* describes occasions where an option is preferred because it is perceived as an action, despite it yielding less optimal outcomes than an alternative option of inaction (Bar-Eli et al., 2007; Patt & Zeckhauser, 2000). Such a preference for action over inaction has been well documented in healthcare with both patients and physicians observed to display the action bias (Ayanian & Berwick, 1991; Fagerlin et al., 2005; Gavaruzzi et al., 2011; Kiderman et al., 2013; Scherer et al., 2018). Theoretically, explaining inappropriate desires for antibiotics by mapping the desire to take antibiotics onto the preference for an action with less optimal outcomes (taking antibiotics) over a superior alternative of inaction (resting) is straightforward. But empirical evidence from the general public is lacking.

However, though most research has attributed preferences for action over inaction only to an action bias, this evidence alone does not preclude the influence of other sources of bias, two of which are discussed here. First, people do not always process information in an unbiased manner (Lord et al., 1979). The list of methods people might adopt, which can limit how information is processed is a lengthy one. Golman et al. (2017) discuss two particular methods: i) source discrediting, and ii) information neglect, which have been well evidenced in medical settings. Research from these domains has shown that when people are motivated to preserve their prior beliefs, or to avoid potentially unpleasant news about their health, information provision intended to engender more judicious health decisions can lead to limited and even counterproductive outcomes (Leask et al., 2012; Leydon et al., 2000). Source discrediting and information neglect may act as barriers to the effect of information provision aiming to improve people's judgment of when antibiotics are appropriate but have yet to be examined in this context.

Second, people might resist information because it conflicts with their beliefs about what they consider to be the most normal behaviour. It has been well established that the perception of the social norm is an important predictor of people's health behaviours (Conner & Norman, 2015). The work of Kahneman and Miller (1986) recognised that one reason why people are highly motivated to adhere to their perception of the normative behaviour is because negative events are experienced as worse when the normative behaviour is not followed. Within this framework, it would be expected that the perception that most people take antibiotics for a viral infection would result in a preference to comply with that perception which, in turn, might negate the effect of information provision.

5.2.1 The Present Research

The present chapter has three key goals. The first goal is to examine the effect that information provision has on inappropriate desires for antibiotics. To achieve this goal, in studies 5 and 6 we manipulated information provision from a physician (incomplete vs. complete) and hypothesized that the provision of complete information regarding the effectivity and costs associated with taking antibiotics would reduce inappropriate decisions to take antibiotics (Hypothesis 1). The second goal is to provide evidence that some people have a bias for taking antibiotics. We hypothesized that complete information provision would not completely eliminate decisions to take antibiotics (Hypothesis 2). Confirming this hypothesis, that some people will still want to take antibiotics even after receiving complete and unambiguous information that they are not beneficial and potentially harmful, would satisfy conditions for evidence that an action bias underpins inappropriate desires for antibiotics. However, this evidence would not exclude the influence of other processes on the bias for taking antibiotics. Thus, the third goal is to offer ancillary evidence that an action bias underpins the preference towards taking antibiotics despite having complete information. To do so, we asked participants to justify their treatment preferences and hypothesized that decisions to take antibiotics in the presence of complete information would be positively associated with four established cognitive biases: action bias, social norm perception, source discrediting, and information neglect (Hypothesis 3). Finally, building on the results from studies 5 and 6 (showing the prominent role of the action bias), in studies 7 and 8, we tested whether presenting the alternative to taking antibiotics (resting) as an action would reduce inappropriate desires for antibiotics (Hypothesis 4).

Study 5

5.3 Method

5.3.1 Participants

Participants were recruited using convenience sampling and with first year and second year undergraduate students. First and second year undergraduate students, who completed the experiment as part of their research methods course, received 0.2 credits as a reward for completing the study. We recorded a total number of 546 attempts to access the online experiment. Two individuals did not consent to participating in the study and thus did not complete the experiment. Following a-priori pre-registered exclusion criteria we excluded 96 participants who did not fully complete the study and 24 participants who completed the study in a very short time in order to minimise careless responses (1/3 of median time). Assuming $\alpha = .05$ and $1- \beta = .90$, the final sample size was sensitive enough to detect a small to medium effect size ($\varphi = .16$) for a Pearson's chi-square test to test the effect of information provision on choice of treatment (hypothesis 1), a small effect size (d = .18) for a one-sample t-test to test whether the provision of complete information regarding illness aetiology and antibiotic effectivity completely diminishes individuals' decisions to take antibiotics (hypothesis 2), and a small-to-medium effect size (ρ = .18) for a point-biserial correlation to test whether the choice to take antibiotics is associated with items relating to the action bias, social norm perception, source discrediting, and information neglect (hypothesis 3) (Faul et al., 2007).

The final sample consisted of 424 participants (148 were male, 273 female, and 3 other; age ranged from 18 to 68 years old, M = 25.9, SD = 10.3 years). The majority (90%) of participants indicated that they are registered with a family physician and are residents in the United Kingdom (83%). Most participants identified as white (80%) and were either students (51%) or in full time employment (41%). Level of education varied between those with less than undergraduate degree (57%), those with an undergraduate degree (29%), and those with a masters or doctoral degree (14%).

5.3.2 Design

In a between-subjects design participants decided whether to take antibiotics or rest in two information conditions (incomplete information condition: viral nature of the illness only vs. complete information condition: viral nature of the illness and antibiotic information). Participants were randomly allocated to one of the two conditions with a 1:3 ratio, with 107 participants in the incomplete information condition and 317 participants in the complete information condition. The incomplete information condition featured a vignette describing cold-like symptoms with the results of a blood test confirming the viral nature of the infection (Cooke et al., 2015; Meili, Muller, Kulkarni, & Schutz, 2015). In the complete information condition, a sentence was added: “She tells you not to worry and goes on to assure you that in this case, antibiotics will not work and will not help you recover any sooner than doing nothing. She adds that if you were to take antibiotics you may experience side effects such as diarrhoea, vomiting and rash” (see the Study 5: Vignette in the Appendix).

5.3.3 Materials and procedure

All research presented in this chapter was approved by the university ethics committee. After providing consent, participants read a hypothetical medical scenario of a consultation with a physician for cold-like symptoms before expressing their treatment choice: “Take antibiotics” or “Rest only (without taking antibiotics)”. The scenario was modelled in alignment with the vignette employed by Sirota et al. (2017) and described a situation in which a patient suffers from an illness for which antibiotics should not be prescribed according to the guidelines from the National Institute for Health and Care Excellence (Tan et al., 2008). Participants in the complete information condition then answered four questions on what motivated their treatment decision, one question for action bias "I would rather do something that may have side effects (i.e., take antibiotics), when I have a cold like this, rather than do nothing (i.e., rest only)"; for the social norm perception “Because other people like me would take antibiotics in this situation”; for source discrediting “Because I would not change my beliefs about taking antibiotics, when I have a cold like this, based only on the opinion of one GP”; and for information neglect “Because I did not consider the information about antibiotics not working, when I have a cold like this, when making my decision”. Participants rated their level of agreement to these four cognitive bias items on a six-point scale ranging from 1 to 6 (1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Somewhat disagree*, 4 = *Somewhat agree*, 5 = *Agree*, 6 = *Strongly agree*).

Lastly, participants were asked to provide some information regarding their typical medical behaviour and some general demographic questions.

The pre-registration protocols, data, and materials for all the experiments presented in this chapter are publicly available on the Open Science Framework at: https://osf.io/5hqfy/?view_only=46c18c966e83497aaa0daacdcd4f08e6.

5.3.4 Statistical analyses*

We ran a Pearson's chi-squared test for association with Yates' continuity correction to test whether the provision of complete information regarding antibiotic effectivity would reduce decisions to take antibiotics by examining any differences between the proportion of individuals who choose to take antibiotics in the incomplete information condition and the proportion of individuals who choose to take antibiotics in the complete information condition (Hypothesis 1).

We also ran a one-sample *t*-test to test whether the provision of complete information regarding antibiotic effectivity completely diminishes individuals' decisions to take antibiotics by examining any differences between the proportion of individuals who chose to take antibiotics in the complete information condition and zero (Hypothesis 2).

We ran zero-order point-biserial correlations to analyse whether the choice to take antibiotics is associated with items relating to the action bias, social norm perception, source discrediting, and information neglect (Hypothesis 3). To complement this analysis, we ran a multiple logistic regression to see which cognitive biases best predicted treatment choice.

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* Originally, we pre-registered different analysis, but we realised that the pre-registered analysis plan was not appropriate to test the pre-specified hypotheses and so ran the analyses reported here.

5.4 Results

Consistent with the first hypothesis, a greater proportion of participants chose to take antibiotics in the incomplete information condition (40.19%) compared to the complete information condition (15.46%). Providing information about the efficacy and side effects of antibiotics significantly reduced inappropriate decisions to take antibiotics χ^2 (1) = 27.36, $p < .001$, φ = .25. However, consistent with the second hypothesis, the provision of complete information was not enough to completely eliminate desires for antibiotic treatment. The proportion of people taking antibiotics in the complete information condition was significantly higher than 0, which we would expect after having all the necessary information, $t(316) = 7.601$, $p < .001$, d = 0.43. Lastly, consistent with the third hypothesis, decisions to take antibiotics were positively associated with all four cognitive biases (black circles in Figure 6 show the correlation coefficients) and most strongly so with an action bias $r_{pb} = .68$, $p < .001$, 95% CI [0.62, 0.74]. In a multiple logistic regression with biases as predictors and preferred treatment decision as the binary criterion, the action bias significantly increased decisions to take antibiotics, B = 1.20, OR = 3.31, 95% CI [2.34, 4.97], z = 6.27, $p < .001$, as did agreement with the social norm perception bias, B = 0.44, OR = 1.55, 95% CI [1.11, 2.19], z = 2.58, p = .010 (see Table 6). While the same directional pattern was observed for source discrediting and information neglect, these predictors did not reach significance (B = 0.29, OR = 1.34, 95% CI [0.95, 1.89], z = 1.67, p = .095; B = 0.22, OR = 1.25, 95% CI [0.88, 1.77], z = 1.24, p = .214, respectively).

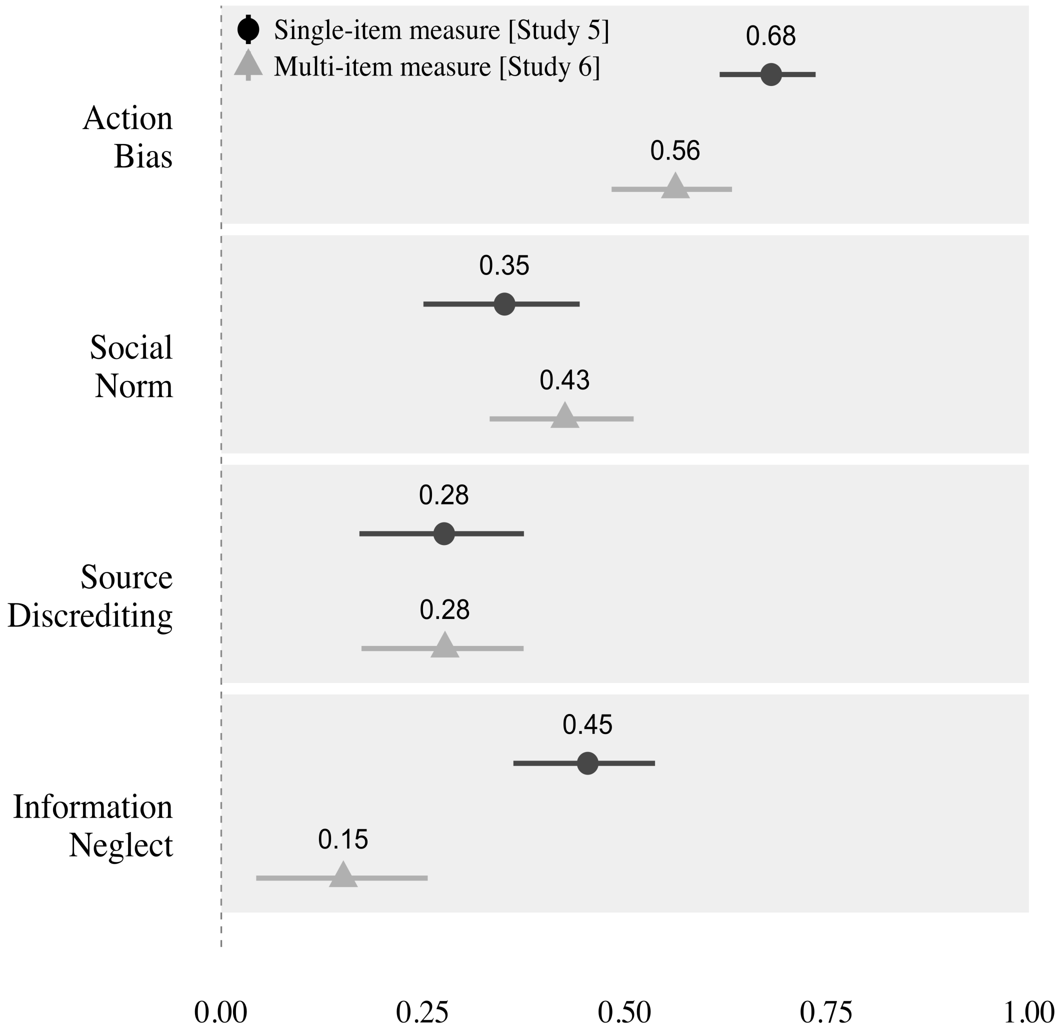

Figure 6. Correlation coefficients for the cognitive bias measures with decisions to take antibiotics across both viral scenarios [Study 5 and Study 6]. The point symbols represent zero-order point-biserial correlation coefficient estimates and the error bars represent 95% confidence intervals.

Table 6

Pearson Point-Biserial correlation coefficients, descriptive statistics and multicollinearity diagnostics for the cognitive bias items

	1	2	3	4	Mean ± SD	VIF
Study 5 (Single-item)						
1 Action Bias	-	.41	.34	.59	2.13 ± 1.36	1.15
2 Social Norm Perception	-	-	.21	.38	2.22 ± 1.30	1.01
3 Source Discrediting	-	-	-	.36	2.87 ± 1.57	1.02
4 Information Neglect	-	-	-	-	2.36 ± 1.47	1.17

Study 6

Results of Study 5 showed that information provision does reduce inappropriate preferences to take antibiotics. Some people, however, still wanted to take antibiotics even when they were informed that they had a viral infection, that antibiotics are not effective for viruses and that they can cause harm; this preference was most strongly associated with agreement that an action bias and social norm perception motivated their decision. In Study 6, we set out to provide a conceptual replication of Study 5 and retest the hypotheses in the context of a different illness (Lindsay, 2015). We also made slight changes to the scenario to address a few methodological shortcomings present in Study 5. First, we changed the wording in the scenario so that respondents were asked to think about the two treatment options rather than being suggested them by the physician as that may have endorsed the option to take antibiotics. Second, we developed and employed multi-item measures for the cognitive biases to enhance reliability and validity.

5.5 Method

5.5.1 Participants

Participants from the general adult population were invited via a recruitment panel to take part in an experiment paid at a rate of £5.04 per hour. In order to reach 400 participants while accounting for an expected 10% attrition rate, we set an a-priori stopping rule of 440 participants. We recorded a total number of 441 attempts to access the online experiment; all individuals consented to participating in the study. Following a-priori pre-registered exclusion criteria, we excluded one participant who did not fully complete the study and six participants who did not respond to an attention check question as instructed. Assuming $\alpha = .05$ and $1- \beta = .90$, the final sample size was sensitive enough to detect a small-to-medium effect size ($\varphi = .16$) for a Pearson's chi-square test to test the effect of information provision on choice of treatment (hypothesis 1), a small effect size (d = .18) for a one-sample t-test to test whether the provision of complete information regarding illness aetiology and antibiotic effectivity completely diminishes individuals' decisions to take antibiotics (hypothesis 2), and a small-to-medium effect size (ρ = .18) for a point-biserial correlation to test whether the choice to take antibiotics is associated with items relating to the action bias, social norm perception, source discrediting, and information neglect (hypothesis 3) (Faul et al., 2007).

The final sample consisted of 434 participants (180 were male, 251 female, and 3 other; age ranged from 18 to 74 years old, M = 37.18, SD = 12.09 years). All participants were residents from the United Kingdom and the majority of participants identified as white (92%). Most participants were in full time employment (70%) and level of education varied between those with less than an undergraduate degree (43%), those with an undergraduate degree (43%), and those with a masters or doctoral degree (15%).

5.5.2 Design

The experimental design was the same as Study 5, but with a different illness vignette (acute otitis media). Again, participants were randomly allocated to one of the two conditions with a 1:3 ratio, with 108 participants in the incomplete information condition and 326 participants in the complete information condition.

5.5.3 Materials and procedure

With the exception of two changes, the materials and procedure were the same as in Study 5. First, multi-item measures of the bias items were shown to participants in the complete information condition instead of single-item measures. Six items were used to measure each of the four biases (see Study 6: Self-report items in the

Appendix for the full items), which again corresponded to *Action bias* (e.g., "I preferred to do something, rather than just do nothing")*, Social norm perception* (e.g., "Other people like me would have taken antibiotics")*, Source discrediting*[*] (e.g., "I would not change my beliefs about antibiotics based only on the opinion of one GP"), and *Information neglect* (e.g., "I did not fully consider the information about antibiotics"). Participants expressed their agreement on a six-point scale ranging from 1 to 6 (1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Somewhat disagree*, 4 = *Somewhat agree*, 5 = *Agree*, 6 = *Strongly agree*). All scales displayed excellent internal consistency – with Cronbach's α ranging from .81 to .88 (see Table 7) and hence for each bias, responses were averaged for analysis. Second, participants in the complete information condition who chose to take antibiotics were also given the opportunity to report other reasons for their treatment decision as an open response.

5.5.4 Statistical analyses

We ran a Pearson's chi-squared test for association to test whether the provision of complete information regarding antibiotic effectivity would reduce decisions to take antibiotics by examining any differences between the proportion of individuals who choose to take antibiotics in the incomplete information condition and the proportion of individuals who choose to take antibiotics in the complete information condition (Hypothesis 1).

We also ran a one-sample *t*-test to test whether the provision of complete information regarding antibiotics effectivity completely diminishes individuals' decisions to take antibiotics by examining any differences between the proportion of

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[*] Labelled in the pre-registration as "source credibility" we renamed this measure to be more congruent with the direction of the items within the measure.

individuals who chose to take antibiotics in the complete information condition and zero (Hypothesis 2).

We ran zero-order point-biserial correlations to analyse whether the choice to take antibiotics is associated with items relation to the action bias, social norm perception, source discrediting, and information neglect (Hypothesis 3). To complement this analysis, we ran a multiple logistic regression to see which cognitive biases predicted treatment choice.

5.6 Results

Consistent with the first hypothesis, a greater proportion of participants chose to take antibiotics in the incomplete information condition (41.67%) compared to the complete information condition (7.98%). Providing information about the efficacy and side effects of taking antibiotics again significantly reduced inappropriate decisions to take antibiotics, χ^2 (1) = 64.86, $p < .001$, $\varphi = .39$. However, consistent with the second hypothesis, the provision of complete information was not enough to completely eliminate desires for antibiotic treatment. The proportion of people taking antibiotics in the complete information condition was significantly higher than 0, which we would expect after having all necessary information, $t(325) = 5.307$, $p < .001$, $d = 0.29$. Finally, consistent with the third hypothesis, decisions to take antibiotics were positively associated with all four cognitive biases (grey triangles in Figure 6 show the correlation coefficients) and most strongly with an action bias, $r_{pb} = .56$, $p < .001$, 95% CI [0.48, 0.63]. In a multiple logistic regression with biases as predictors and preferred treatment decision as the binary criterion, the action bias significantly increased decisions to take antibiotics, $B = 2.94$, $OR = 18.89$, 95% CI [7.02, 71.04], $z = 5.08$, $p < .001$, as did agreement with the social norm perception bias, $B = 1.65$, $OR = 5.21$, 95% CI [1.98, 17.27], $z = 3.04$, $p = .002$ (see Table 7).

While the same directional pattern was observed for source discrediting and information neglect these predictors again did not reach significance ($B = 0.81$, $OR = 2.25$, 95% CI [0.87, 6.51], $z = 1.61$, $p = .108$; $B = 0.63$, $OR = 1.88$, 95% CI [0.78, 4.73], $z = 1.40$, $p = .161$, respectively). The results were thus very similar to those observed in Study 5.

Table 7

Pearson Point-Biserial correlation coefficients, descriptive statistics, reliability (α) and multicollinearity diagnostics for the cognitive bias items

	1	2	3	4	Mean ± SD	VIF	Cronbach's α
Study 6 (Multi-item)							
1 Action Bias	-	.43	.29	.18	2.94 ± 0.97	1.39	0.82
2 Social Norm Perception	-	-	.34	.19	3.29 ± 0.95	1.07	0.81
3 Source Discrediting	-	-	-	.37	2.22 ± 0.85	1.33	0.86
4 Information Neglect	-	-	-	-	1.94 ± 0.27	1.29	0.88

Study 7

In the previous two experiments we found that an action bias was the most prominent reason motivating decisions to take antibiotics. In Study 7 we had two goals. First, to show that the options "take antibiotics" and "rest" differ in terms of being perceived as an action or inaction. Second, to try and see if we could change the perception of "rest" by framing it differently without losing the meaning.

5.7 Method

5.7.1 Participants

Participants from the general adult population were invited via a recruitment panel to take part in an experiment paid at a rate of £5.04 per hour. A total of 150 participants completed the study. Participation was restricted to individuals who were residents from the United Kingdom and at least 18 years of age. We did not collect any further demographic information (e.g., age, gender, or employment).

5.7.2 Design

In a completely within-subjects design, all participants were sequentially presented with two differently framed antibiotic treatment options and six differently framed rest options. The dependent variable was the perception of the treatment options as inaction or action.

5.7.3 Materials and procedure

After providing informed consent, participants were told to "*imagine that during a consultation with a GP you are given the following treatment option:*" Participants then saw the eight treatment options in random order and for each one indicated whether they would consider the treatment option to be inaction or action (0 = *inaction*, 1 = *action*). Randomization was carried out using the Question Randomization function in Qualtrics.

5.8 Results

Ratings of the treatment options are shown in Table 8. Consistent with the action bias account, the option “Take antibiotics” was overwhelmingly rated as an action (97%), while the rest-as-inaction option, used in studies 5 and 6, “Rest only (without taking antibiotics)” was perceived as inaction by a majority (61%). We tried several variations for wording the option to rest and the option most perceived as an action was “Action: The GP prescribes that you go and take three days rest” with 57% of participants rating it as an action. Thus, we were not able to reframe the option “to rest” to be perceived as equivalent to the “Take antibiotics” option as an action.

Table 8

Participant responses of whether the various treatment options were perceived as either inaction or action

	Inaction (*n*)	Action (*n*)
Treatment option (Antibiotics)		
Take antibiotics	3% (5)	97% (145)
Action: Take antibiotics	1% (1)	99% (149)
	Inaction (*n*)	Action (*n*)
Treatment option (Rest)		
Action: Go and rest	51% (77)	49% (73)
Rest only (without taking antibiotics)	61% (91)	39% (59)
Action: The GP prescribes that you go and take three days rest	43% (65)	57% (85)
Fight the infection by taking three days rest	49% (74)	51% (76)
Take three days to look after yourself	51% (76)	49% (74)
Go and take three days to overcome the infection	56% (84)	44% (66)

Study 8

In studies 5 and 6 we found that some people wish to take antibiotics even if they know they are not effective for their illness and that they have potential side effects. An action bias was the most prominent reason motivating these decisions in both experiments. In Study 7, we found that taking antibiotics was more perceived as an action than the "rest" option however it was framed. In Study 8, we set out to inform participants about antibiotics and try to counteract the action bias and its effect on antibiotic desires by presenting the option 'to rest' alongside another medicating action. We hypothesized that presenting the choice of 'rest' alongside an action would reduce the proportion of people who would decide to take antibiotics in a scenario of a viral infection compared to presenting the option of 'rest' alone as inaction (Hypothesis 4).

5.9 Method

5.9.1 Participants

We conducted a-priori power analysis using G*Power (Faul et al., 2007) to determine the number of participants needed, assuming $\alpha = .05$ and $1-\beta = .95$, to detect a 10% deviation from an expected 20% baseline proportion ($\varphi = .14$), for a Pearson's chi-square test (testing hypothesis 4). This resulted in a minimum sample size of 658 participants (329 in each condition). Participants were from the general adult population and invited to take part via a recruitment panel and paid at a rate of £5.01 per hour. To account for expected attrition rate due to a-priori exclusion criteria (estimated around 10%), we collected a total of 740 participants. Two people did not consent to participating in the study and thus did not complete the experiment. Following a-priori exclusion criteria we excluded a further six participants who did not fully complete the study. All remaining participants responded to an attention check question as instructed. The final sample consisted of 732 participants (268 were male, 463 female, and 1 other; age ranged from 18 to 75 years old, $M = 35.75$, $SD = 12.60$ years). All participants were residents from the United Kingdom and the majority of participants identified as white (87%). Most participants were in full time employment (69%) and level of education varied between those with less than an undergraduate degree (39%), those with an undergraduate degree (45%), and those with a masters or doctoral degree (16%).

5.9.2 Design

In a between-subjects design (rest-as-inaction vs. rest-as-action), participants chose between either taking antibiotics or rest only (without taking antibiotics). In the rest-as-inaction condition the option to rest was presented alone as inaction "**Treatment option:** Rest (without taking antibiotics)" and the alternative option was presented as "**Treatment option:** Take antibiotics". In the rest-as-action condition the option to rest was presented alongside an action "**Treatment option:** Take painkillers and rest (without antibiotics)" as was the alternative option "**Treatment option:** Take painkillers and antibiotics". We decided to present the rest and antibiotic options alongside taking painkillers in the rest-as-action condition based on the results of a pre-test (Table 8 in the supplementary materials), with the same design as Study 7, in which we found that pairing the option to rest with a medicating action ("Take painkillers and rest") led to the option being perceived as an action (inaction = 15%, action = 85%).

5.9.3 Materials and procedure

After providing informed consent, participants read a vignette describing symptoms of acute otitis media. All participants received complete information about the viral nature of the infection and that antibiotics will not work, will not help them recover any sooner than doing nothing, and may cause side effects. Within the vignette, participants were then asked to think about the two treatment options. After reading the vignettes, all participants made their final choice of treatment (Take antibiotics vs. Rest only (without taking antibiotics)) and then provided some general demographic information. Lastly, participants were asked to provide some general demographic information.

5.9.4 Statistical analyses

We planned to run a Pearson's chi-squared test for association to test whether presenting the option to rest alongside an action would reduce decisions to take antibiotics by examining any differences between the proportion of individuals who choose to take antibiotics in the rest-as-action condition and the proportion of individuals who choose to take antibiotics in the rest-as-inaction condition.

5.10 Results

Only a very small proportion of participants chose to take antibiotics in the rest-as-action condition (9.81%) compared with the rest-as-inaction condition (12.33%). The difference was in the predicted direction, but it was not statistically significant, χ^2 (1) = 0.94, p = .333, φ = .04. Thus, our hypothesis was not confirmed. These findings indicate that counteracting the action bias by presenting the alternative "rest" option, alongside an action does not diminish the bias. The null effect we observed might have been due to the possibility that this proportion of participants have such a strong representation of taking antibiotics as an action that they are more difficult to convince that taking antibiotics is not the most 'active' response. Alternatively, these participants may have been worried about future bacterial complications and perceived that choosing the rest option would exclude the possibility of having antibiotics in the future if the infection were to worsen (Gavaruzzi et al., 2011).

5.11 Discussion

The present research establishes three important findings. First, that most people respond well to information from a physician that an objective point-of-care test indicates an infection is viral and that antibiotics are not necessary and may have harmful side effects if taken. Our findings support clinical recommendations for physicians to educate patients about illness aetiology and the ineffectiveness and side effects regarding antibiotic treatment for viral infections (Tan et al., 2008) as this information provision appears to play an important role in reassuring patients when antibiotics are not necessary.

Second, we find that a proportion of people (around 1 in 10) still prefer to take antibiotics even when they have complete and unambiguous information from a physician that they will provide no benefit and possible harms. This finding violates assumptions of normative decision-making theory and establishes the presence of an action bias for taking antibiotics in spite of complete information. All of our scenarios were void of any diagnostic or treatment uncertainty as participants were offered clinical certainty of the viral aetiology of the infection from a blood test. These tests are not always available in primary care, but their inclusion was necessary to establish clearly that in those situations, taking antibiotics was a not a good decision.

A third important finding of the present research is that the bias for taking antibiotics despite complete information is associated with known cognitive biases. All four of the cognitive biases (action bias, social norm perception, source discrediting, and information neglect) were positively correlated with the suboptimal preference for taking antibiotics, but only the action bias and social norm perception were statistically significant predictors of this preference. We find that people who were biased towards taking antibiotics were aware and willing to admit that their penchant for action and their social norm perception motivates their preference for sub-optimal treatment in this context.

The experiments presented here, advance current understanding of the cognitive processes underpinning such desires and why efforts to educate patients are often not as successful as intended. A key implication of the present findings is that information provision from a primary care physician can substantially reduce inappropriate desires to take antibiotics, but some people are resistant to this information and efforts to address them should focus on counteracting the influence of cognitive biases such as the action bias.

Our findings support current research that has identified a proportion of people have an action bias to receive cancer screenings, which appears to be insensitive to information provision about the clinical benefits and harms (Fagerlin et al., 2005; Gavaruzzi et al., 2011; Scherer et al., 2018), but extends it in an important and novel way as the first to establish the presence of this bias in the context of inappropriate antibiotic desires. In addition, supplementing the indirect evidence of an action bias (preference for antibiotics when they risk side effects and offer no benefit) with direct post-hoc measures notably strengthens the evidence supporting the presence of the action bias.

Aligned with the norm theory account (Bar-Eli et al., 2007; Kahneman & Miller, 1986), the perception that the social norm is to take antibiotics also significantly predicted inappropriate decisions to take antibiotics. Given the positive impact of attempts to leverage social norm on antibiotic behaviour of physicians (Hallsworth et al., 2016) and the general public (Ronnerstrand & Andersson Sundell, 2015), considerable efforts should be made to maintain momentum in fostering the perception that most people do not take, or even want, antibiotics for viral infections. The bivariate correlation analyses from studies 5 and 6 also revealed positive relationships between inappropriate decisions to take antibiotics and both the source discrediting measures and the information neglect measures, though in multivariable analyses these were not significant predictors. Aligned with insights from other health domains (e.g., vaccination research), this provides tentative evidence that patients may attempt to protect their desire to take antibiotics by dismissing the objectivity and competence of the physician (Kata, 2012) or neglecting the information (Leydon et al., 2000). Further research might explore whether strategies to help physicians emphasise the pertinent information or to reassure patients of their medical credibility might prove effective in promoting acceptance of antibiotic information.

Patients frequently report desires for antibiotics (McNulty et al., 2013) and physicians would benefit substantially from strategies to effectively convince patients with inappropriate desires for antibiotics to manage self-limiting viral infections without them (Tonkin-Crine et al., 2015). In Study 8, we aimed to illustrate how a simple intervention might convince individuals who are resistant to information to exhibit more judicious antibiotic desires. Contrary to our hypothesis, we did not find an effect of the intervention on inappropriate decisions to take antibiotics. In this context, we found the action bias was difficult to counteract as presenting an over the counter form of treatment (painkillers) alongside the rest option did not significantly reduce the proportion of people who wanted to take antibiotics which provides some insight into the potential steadfast nature of the preference for taking antibiotics. Given that primary care physicians would certainly benefit from the development of alternative behavioural strategies to limit the impact of this bias, we recommend that future research attempt alternative designs that might prove more effective.

We identify and discuss limitations of the present research. First, Study 5 contained a number of methodological shortcomings. However, we addressed these limitations with minor tweaks to the design and procedure in Study 6 and still found very similar results. But even though findings from both the single-item and multi-item bias measures are well aligned, the multi-item measures employed in Study 6 would benefit from further validation in future research and with application to clinical populations (i.e., patients consulting in primary care).

Second, in all the experiments presented here, participants were only given a choice between resting or taking antibiotics (or resting and taking painkillers in Study 8), which limits ecological validity. During an actual primary care consultation patients and physicians can discuss other options. However, the forced choice paradigm was required to provide a clear demonstration of the presence of an action bias as a preference of an action (taking antibiotics) over inaction (resting). Further investigation of patients' decisions in clinical settings where patients have the chance to discuss other options (e.g., delayed prescriptions) could shed further light on the influence of the cognitive processes found here.

A third limitation of the present research is that participants' decisions were based on reading hypothetical vignettes about illnesses. As participants were only imagining the symptoms and not actually experiencing them, it is possible that they did not take the scenarios seriously and gave trivial responses. However, we had several checks in place to minimise the chance of this. Participants were only eligible to take part if they had an approval rating of at least 90%, based on their successful completion of previous online studies. In addition, eligible participants were all rewarded (either financially or with course credit) for their engagement in the experiments and those who did not respond as instructed to attention checks were excluded. Furthermore, there are also clear advantages to employing these methods with the aim to establish and isolate the mechanisms that motivate inappropriate desires for antibiotics. The use of hypothetical vignettes, which have been applied to members of the general public in other research on antibiotic use (Ronnerstrand & Andersson Sundell, 2015) and cancer treatment preferences (Fagerlin et al., 2005; Gavaruzzi et al., 2011; Scherer et al., 2018), allowed us to control for important potentially confounding elements (e.g., symptom severity/duration and physician behaviour) and assess the causal influence of other elements (e.g., information provision and treatment presentation).

CHAPTER 6

General Discussion

6.1 Overview

Antibiotic resistance is one of the most serious contemporary threats to public health. Around 700,000 people die each year from a bug that is resistant to antibiotics and this figure is forecast to reach 10 million by 2050 (O'Neill, 2014). The prescribing of antibiotics in primary care without clinical justification (known as overprescribing) substantially contributes to the progression and propagation of antibiotic resistance (Davey et al., 1996; Goossens et al., 2005; Livermore, 2005). While many factors contribute to physicians overprescribing antibiotics, including clinical presentation and physician characteristics, evidence suggests that a good deal of inappropriate prescribing originates in patients themselves. As patients suffering from viral infections do not require antibiotic treatment, it is important that they do not expect to receive antibiotics because doing so increases the likelihood that their physician will prescribe them without clinical justification (Sirota et al., 2017). Evidence that patients' expectations for antibiotics increases overprescribing is unequivocal (Butler et al., 1998; Macfarlane et al., 1997; McNulty et al., 2013; Palmer & Bauchner, 1997; Sirota et al., 2017; Strumiło et al., 2016; Van Driel et al., 2006; Vinson & Lutz, 1993; Welschen et al., 2004), but understanding of the cognitive mechanisms underpinning the formation and maintenance of patient expectations have been neglected.

One reason for this is that accurate knowledge of illnesses and available treatments is often assumed to be sufficient for patients to make effective decisions about their health (Braddock III et al., 1999; Fagerlin et al., 2010; Strull et al., 1984;

Sørensen et al., 2012). As public knowledge about illnesses and antibiotics is imperfect (Eng et al., 2003; Grigoryan et al., 2007; McCullough et al., 2016; McNulty et al., 2007a), inappropriate expectations for antibiotics have generally been considered to be simply an outcome of this suboptimal knowledge (Eng et al., 2003).

Guided by this assumption, a great number of educational efforts have been deployed in the hope that providing information to improve knowledge about illnesses and antibiotics will eradicate inappropriate expectations for antibiotics (Eng et al., 2003). For example, clinical guidelines instruct primary care physicians to inform patients about illness aetiology, the function and side effects of antibiotics, and alternative treatments (Tan et al., 2008). In addition, health campaigns have primarily focussed on distributing content designed to correct misconceptions about illness aetiologies and antibiotic treatments in educational materials for patients in primary care waiting areas and consultation rooms (Cross et al., 2017).

However, research on the cognitive underpinnings of patient expectations is lacking. As a consequence, current understanding of the influence that prior knowledge has on inappropriate expectations for antibiotics and whether information provision aiming to increase knowledge always effectively eliminates inappropriate expectations for antibiotics remains rudimentary. A better comprehension of how expectations for antibiotics are formed and maintained is required. Thus, the main goal of this thesis was to leverage current socio-cognitive and decision making theories to identify the key dimensions underpinning inappropriate expectations for antibiotics.

The studies reported in this thesis have explored the role of prior knowledge and information provision on inappropriate expectations for antibiotics. By drawing on a range of socio-cognitive and decision making frameworks the studies reported in this thesis have also identified important factors that can facilitate, and impede, the effect of information provision at reducing inappropriate expectations for antibiotics.

These findings can be applied to inform the design of public targeted campaigns, which also aim to target healthy populations with educational messages to promote more appropriate antibiotic behaviours. Employing experimental vignette methods and using healthy populations these studies also provide the first steps towards potential future studies with clinical populations. Verification of these findings in clinical settings may have important implications for efforts aiming to combat the growing threat of antibiotic resistance by encouraging people to exhibit more judicious antibiotic consulting behaviours.

6.2 Summary of findings

6.2.1 The role of knowledge about illnesses and antibiotics on antibiotic expectations

In Chapter 2, the relationship between prior knowledge (of illnesses and antibiotics) and inappropriate expectations and requests for antibiotics was assessed in a cross-sectional correlational study. Since such a test in isolation cannot truly evaluate the magnitude of the relationship, but merely whether it is significant, other theoretically derived dimensions were assessed alongside prior knowledge.

Results from the study in Chapter 2 revealed that, as predicted, greater knowledge about illnesses and antibiotics was associated with lower inappropriate expectations for antibiotics. But although knowledge about illnesses and antibiotics was negatively associated with inappropriate expectations for antibiotics, overall a more complex network of illness and treatment beliefs appeared to be associated with inappropriate expectations than is typically appreciated in health campaigns and interventions.

Correlations between the other theoretically relevant variables that were considered (i.e., illness and treatment beliefs) and inappropriate expectations for antibiotics tended to be stronger than the correlations between prior knowledge and antibiotic expectations. In multivariate analysis, variables related to illness perception (e.g., cyclical timeline and illness coherence) and antibiotics beliefs (e.g., social norm perception and anticipated regret) significantly predicted expectations for antibiotics. As none of the prior knowledge variables significantly predicted expectations for antibiotics within these models, these findings suggest that the relationship between prior knowledge and expectations for antibiotics is both less straightforward and less comprehensive than is typically assumed by the insufficient information approach (Eng et al., 2003). Expecting to receive antibiotics, therefore, appears to be a goal driven deliberative act on the part of patients supported by a multitude of social and affective factors (social norm perception, anticipated regret, self-efficacy), illness perceptions (cyclical timeline, illness coherence) and treatment beliefs as well as past behaviour and prior knowledge.

These results are well aligned with literature within health psychology, which proffers that knowledge is not, in itself, an adequate account of health and illness behaviour (Conner & Norman, 2015; Von Wagner et al., 2009). The present findings also lend support to the use of the extended common sense model of self-regulation (Hagger et al., 2017) as a framework for assessing how illness beliefs and treatment representations might influence people's coping strategies.

The findings of this chapter provide preliminary evidence that future research into public-targeted interventions might benefit by going beyond mere knowledge in order to try and modify expectations that antibiotics can treat viral infections. Creating more negative evaluations of antibiotics, encouraging people to consider potential regrets associated with taking antibiotics, and changing the subjective norm all appear to be promising avenues deserving of further investigation. In addition, educational efforts might be better off targeting the specific components of illness representations that have been identified here. Clinical guidelines do currently propose that physicians advise patients on average illness durations (Tan et al., 2008), but the current findings indicate that education regarding the normally expected variability in the progress of a cold associated with immune function activity may also be useful.

It is important to acknowledge that the cross sectional and correlation nature of the study presented in Chapter 2 limits the drawing of any causal inferences about the relationships observed. It should be noted that several potentially confounding factors such as the participant's ability to recall a cold, the characteristics of the cold they recalled (duration, symptoms, or severity), and the participant's interaction with (or absence of) their physician might actually explain some of the variance in the results found in this study. Future research that can overcome these methodological limitations would be well placed to provide further insight into the mechanisms underlying expectations for antibiotics and to inform efforts aiming to reduce overprescribing in primary care.

6.2.2 The role of information provision about illnesses and antibiotics on antibiotic expectations

To supplement the correlational evidence on the role of knowledge in Chapter 2, the study presented in Chapter 3 provided a causal test of the role of knowledge through clinical information provision about illness aetiology and the function and side effects of antibiotics. By presenting and manipulating information within the descriptive vignettes, the influence of potential confounds such as the characteristics of the cold being considered by the participant (duration/severity), their interaction with the physician could be controlled for. Using this approach, it was possible to account for natural variations in participants' prior knowledge and assess how they would behave when in possession of full knowledge regarding what caused the illness and whether antibiotics will help.

As predicted, the provision of *information regarding the efficacy and side effects of antibiotics* decreased inappropriate expectations for antibiotics. This finding indicates that physicians might be empowered to change patient expectations during a consultation in which antibiotics are inappropriate by stressing information that specifically communicates the ineffectiveness of antibiotics and their side effects to patients. It could be that the information about the efficacy and side effects associated with taking antibiotics for a viral infection may have different weights. In this study, the information regarding the efficacy and side effects of antibiotics was presented together as recommended by NICE guidelines (Tan et al., 2008). While this information provision was effective at reducing inappropriate expectations for antibiotics it does not enable one to provide any sound inferences concerning which of the two elements (efficacy vs. side effects) contributed most to this effect. Given that prior knowledge of the efficacy of antibiotics was more strongly correlated with inappropriate expectations for antibiotics than prior knowledge of side effects, it could be that information regarding the efficacy of antibiotics had a greater influence than stressing the side effects associated with taking them unnecessarily. Empirical research into this is needed and would help primary care physicians to stress the most relevant and effective information when communicating with their patients.

A second prediction was that the provision of *information confirming the viral nature of the infection* would decrease inappropriate expectations for antibiotics.

Participants who were told that the symptoms were caused by a viral infection were no less likely to expect antibiotics than those who did not receive this information. Thus, the findings of the experiment did not provide any evidence supporting this prediction. Given that so many adults think that antibiotics can kill viruses (Cals et al., 2007; Hoffmann et al., 2014; McNulty et al., 2007a; van Rijn et al., 2019; Wilson et al., 1999), the obvious explanation for this is that a large proportion of the participants in this experiment believed that antibiotics are effective at treating viruses. In this case, simply providing information confirming that the infection was viral would not change their belief that antibiotics would be an appropriate treatment. This is an important consideration for physicians who might only choose to focus on educating patients about the nature of their infection.

Contrary to the final prediction in this chapter, that the provision of complete information about antibiotic efficacy and the nature of the infection would have the greatest reduction for inappropriate expectations, there was no advantage in reducing expectations for antibiotics from combining the two types of information. In this condition, participants received complete information from a physician that the infection was viral and that antibiotics would not help but may cause harmful side effects. Despite the provision of this complete information from a medical professional some participants still expected that antibiotics would be a suitable treatment.

There are many possible reasons why individuals with a prior belief that antibiotics work for viruses might not be convinced otherwise just by being told so by their physician. Two particular explanations, investigated further in Chapters 4 and 5, are that i) individuals who do not fully trust the physician are less likely to be convinced by the information that the physician provided to them, and ii) some individuals have a bias for action, which is insensitive to information regarding the risks and benefits of antibiotic treatment.

6.2.3 The moderating role of trust on information provision at reducing antibiotic expectations

Chapters 2 and 3 established that both prior knowledge and information provision play an important role at reducing inappropriate expectations for antibiotics. However, Chapter 3 specifically revealed that the information provision did not affect all people the same way. In Chapter 3, some people were less convinced that they should not expect antibiotics than others and, ultimately, providing information alone was not able to completely eliminate inappropriate expectations for antibiotics.

In Chapter 4, peoples' trust in their physician was considered as a potential moderator of the effect of information provision. The role of trust has a rich history in general communication with trustworthy sources typically seen as more persuasive than less trustworthy sources (Glaeser & Sunstein, 2013; Pornpitakpan, 2004). Within the physician-patient relationship trust is also well known to play a crucial role. For instance, more trusting patients better communicate with their physician, which increases their chances of having positive health outcomes (Hall et al., 2002; Katz, 2002; Thom, 2000; Thom et al., 2004; Thom et al., 2002). Based on this, it was expected that people with greater trust in their physician would be more receptive to the information provided by their physician, and, in turn, be less likely to inappropriately expect antibiotics.

In both studies 3 and 4, information about the illness (viral aetiology) and antibiotics (efficacy and side effects) from a physician clearly reduced but did not eliminate inappropriate expectations for antibiotics, replicating well the original effect of information provision from Chapter 3. However, across both experiments the evidence on the role of trust was less consistent.

In Study 3, participants reported the degree to which they trust their physician before being assigned to either the baseline (no explicit information about the viral nature of the infection or about antibiotics) or complete information (explicit information about the viral nature of the infection and antibiotics) condition. Overall, participants with greater reported trust in their physician had higher expectations for antibiotics to treat a respiratory tract infection. In the baseline condition (participants who did not receive information about viral nature of the illness or about antibiotics), participants with greater trust in their physician were significantly more likely to inappropriately expect antibiotics. In contrast, in the complete information condition, participants with greater trust in their physician did have descriptively lower expectations for antibiotics, but this relationship was not significant.

In Study 4, by using cues of warmth and competence, physician trustworthiness was manipulated (low vs. high) alongside information provision (baseline vs. complete information). As expected, participants who were assigned to the more trustworthy physician had significantly lower expectations for antibiotics to treat an ear infection than those who were assigned to the less trustworthy physician, however the predicted interaction between information provision and trustworthiness was not present.

These findings offer somewhat conflicting evidence as to how trust in physicians influences inappropriate expectations for antibiotics and as to exactly how trust in physicians and information provision interact. Alongside information provision, high trust in the physician did appear to be positively associated with lower inappropriate expectations for antibiotics, however, this effect was either non-significant (Study 3) or weak (Study 4). More concerning was that in the absence of information provision regarding the viral nature of the illness and antibiotic efficacy, greater self-reported trust in physicians was associated with higher inappropriate expectations for antibiotics. Although this finding was not seen across both experiments it suggests that caution should be taken when attempting to increase trust in physicians ubiquitously as it may have a counterproductive effect when not paired with specific information. Further investigations into the role of trust under more real-world circumstances are desirable and would greatly benefit the design of trust-based antibiotic campaigns targeted at the general public and interventions aiming to improve physician communication behaviours.

6.2.4 The role of cognitive biases on antibiotic expectations

The focus of the final empirical chapter of this thesis was to further investigate the finding from Chapters 3 and 4 that complete information provision from a physician did not completely eliminate inappropriate expectations for antibiotics.

The first goal was to conceptually replicate the effect of information provision at reducing inappropriate expectations for antibiotics, found in Chapters 3 and 4, with a choice task (either to take antibiotics or not). Findings from three experiments confirmed the hypothesis that the provision of complete information regarding the effectivity and costs associated with taking antibiotics would reduce inappropriate preferences for taking antibiotics. When presented with complete information about the viral nature of the infection and that antibiotics do not have an effect against viruses but may cause side effects, most participants did not want to take antibiotics.

The second goal was to establish the presence of a bias for taking antibiotics despite having complete information. This hypothesis, that complete information provision would reduce but not eliminate decisions to take antibiotics, was again confirmed in all three experiments in which this hypothesis was tested. Despite being fully informed that an objective blood test confirmed the viral nature of their infection and that antibiotics will not help but may cause side effects, around 10% of participants still wanted to take antibiotics rather than rest. According to normative theories of decision making, when deciding between two treatment options people ought to make their decision based on an assessment of which treatment offers the best balance of risks and benefits. The finding that a proportion of people preferred the less optimal option violates this assumption and establishes the presence of a bias for taking antibiotics.

That some people would rather take antibiotics than rest even when they know it is a less optimal treatment satisfies the conditions of evidence for an *action bias*. The conditions of an action bias can be formally described as the preference to act when an alternative option of inaction would produce equal or lesser risks. While overenthusiasm for cancer screenings that offer no benefit and possible harms has been well demonstrated in previous research, and attributed to an action bias, this is the first research to demonstrate the same effect in the context of antibiotic expectations.

Often considered as a group level bias, research finding that some people have a consistent preference for action even when most other people do not, has highlighted notable individual differences in action bias (Baron & Ritov, 2004; Connolly & Reb, 2003; Scherer et al., 2018). Such individual differences in action bias have typically been attributed to some people having a heuristic for 'doing something' rather than 'doing nothing' (e.g., Baron & Ritov, 2004), but from the relevant literature, three alternative explanations for why people might not respond as expected to the information provision were also considered. First, people choose to discredit the sources of information that conflicts with their prior beliefs (source discrediting). Second, people may choose not to pay attention to information about their health that might be upsetting or unpleasant (information neglect). Third, people may defer to the normative behaviour (norm perception) when the information provision conflicts with people's perception of the expected behaviour.

Therefore, the third goal was to offer supporting evidence that it truly is an action bias, which is underpinning the preference towards taking antibiotics despite having complete information. Across two experiments, decisions to take antibiotics by participants, who were aware of the viral nature of the infection and the ineffectiveness and harms of taking antibiotics, were most strongly and positively associated with greater agreement by participants that they have a bias towards acting. These results offer ancillary evidence that an action bias underpins inappropriate expectations for antibiotics.

Also, as predicted, decisions to take antibiotics despite the complete information provision were also positively associated with the perception that the normative behaviour is to act (norm perception), discrediting the physician (source discrediting), and not paying attention to the information about antibiotics (information neglect). However, in the multivariate logistic regression analyses, only the action bias and norm perception variables significantly predicted inappropriate decisions to take antibiotics.

After establishing the action bias as a key determinant of inappropriate expectations for antibiotics, the next step was to try and design a simple intervention that might counteract the bias. The treatment options presented in the prior experiments ("take antibiotics" and "rest") clearly differed in terms of being perceived as an action and as inaction, respectively. Framing the treatment option "rest" differently (i.e., "Fight the infection by taking three days rest") did not result in it being perceived as an action, but it was possible to do so by adding the action to take over-the-counter medication ("Take painkillers and rest"). However, presenting an over the counter form of treatment (painkillers) alongside the rest option did not significantly reduce the proportion of people who wanted to take antibiotics. One possibility is that participants with an action bias have such a strong representation of taking antibiotics as an action that they are more difficult to convince that an alternative option (painkillers and rest) is more of an action than taking antibiotics.

An alternative possibility is that the desire to take antibiotics is also partly drive by the worry that choosing the rest option might rule out the possibility of taking antibiotics if the infection were to worsen (i.e., develop bacterial complications). In the context of cancer diagnoses, (Gavaruzzi et al., 2011) found that similarly biased preferences for active treatment could be explained by such an effect of 'exclusivity'. The authors found that making participants aware that the option of inaction (watchful waiting) did not preclude action (invasive surgery) if the cancer were to develop reduced biased preferences for invasive surgery over watchful waiting. Thus, it may be that preferences for taking antibiotics over resting are at least partly driven by whether they are perceived as mutually exclusive or not.

6.6 Future directions

There are several areas of future research that may build on the findings presented in this thesis. For instance, in order to build on the findings from Chapter 2 (which relied on healthy volunteers) future research might explore ways to collect data on the illness representations, treatment beliefs, and coping strategies of individuals who have just contracted an acute viral infection. Given the dynamic nature of the Common Sense Model (Hagger et al., 2017), accessing such a sample and following their progression through the infection would substantially advance current understanding of exactly how patients suffering from acute viral illnesses represent their illness, potential treatments (i.e., antibiotics), and how these representations relate to potential coping strategies and health outcomes. It would also present an opportunity to test the efficacy of interventions aimed at specific illness or treatment representations. Based on the findings of Chapter 2, one example of an intervention could be to target participants' self-efficacy by providing information to reinforce their belief that they can manage their acute viral infection without medical treatment. Another example would be to target anticipated regret and remind people that, in the longer term, they are more likely to regret taking antibiotics than not taking them.

Results from Chapter 3 show that information from a physician that an infection is viral and that antibiotics are ineffective and harmful reduces inappropriate expectations for antibiotics without completely eliminating them. In this study, participants saw both the information about the efficacy and potential side-effects together. This was done intentionally in order to be aligned with clinical guidance for primary care physicians (Tan et al., 2008). One drawback of this is that it is not possible to disentangle, which of those two elements was most effective. Using a similar vignette-based experimental approach, it would be straightforward for future research to disentangle the effect of information about antibiotic efficacy and the side effects of antibiotics. It would also be of interest to explore the influence of a wider range of costs associated with taking antibiotics inappropriately rather than focussing exclusively on the short-term side effects to the individual. For instance, it may be that communicating i) how taking antibiotics might make them less likely to work for the individual in the future or ii) how increasing antibiotic resistance costs wider society would be more effective at reduce antibiotic expectations than merely highlighting short-term adverse effects.

Since findings from Chapter 4 on the role of trust were largely inconclusive there is plenty of scope for future research within this domain. The consistent use of trust measures and manipulations of trust in future research would be beneficial for clearly interpreting future findings, which might then better inform trust-based campaigns, health policy, clinical guidelines and specific physician training. Despite potential technical difficulties in implementation, the use of virtual reality technology (Pan et al., 2016) or actors (Kostopoulou, Porat, Corrigan, Mahmoud, & Delaney, 2017) might prove effective at improving the ecological validity of future research on how trust in the physician influences inappropriate expectations for antibiotics. Future research might also explore whether trust in the physician differs from when they don't prescribe compared to when they do. It was not possible to fully explore or account for how trust is affected by the physicians' decision to withhold or prescribe antibiotics. Patient trust in physicians has long been viewed as an iterative process that develops over time (Mechanic & Meyer, 2000) and it would be interesting to see how the information provided by the physician and their antibiotic prescribing decisions influence this process in the long term.

In Chapter 5 the findings suggest that an action bias can explain why some people have inappropriate expectations for antibiotics even after receiving complete information that should eliminate such expectations. In addition to the action bias, other biases (social norm perceptions, source credibility, and information neglect) also appeared to play a role. Future research might focus on understanding how these biases relate to each other and also whether they might present suitable targets for corrective interventions (i.e., creating the social norm perception that most people do not take antibiotics for viral infections). Research should also investigate whether this preference for taking antibiotics over resting might depend on whether the options are framed as mutually exclusive. Past research has shown that people opted for a less optimal, but more active treatment (invasive surgery), because they believed that choosing the inactive option (watchful waiting) meant that they could not have the treatment later if their condition worsened (Gavaruzzi et al., 2011). One direct way to test this would be to examine whether the effect of the action bias persists when there is the possibility of delayed prescriptions or to clearly explain that antibiotics would be available if the infection developed bacterial complications. Should this be the case for inappropriate antibiotic preferences, it would greatly inform how physicians should communicate treatment options (e.g., resting, taking antibiotics or taking a delayed prescriptions of antibiotics) to their patients.

6.7 Final comments

To date, there has been little research devoted to explaining how inappropriate expectations for antibiotics are formed and how they are affected by information. The findings presented in this thesis provide important contributions to this area of research.

The present work consistently demonstrated that people with more information about their illness and antibiotics had lower inappropriate expectations for antibiotics. Information provision from a physician that an infection is viral and that antibiotics will not be effective but may cause side effects substantially reduced inappropriate expectations for antibiotics in otherwise healthy adults. These findings are aligned with the *insufficient information* approach to tackling inappropriate antibiotic expectations by improving public knowledge (Branthwaite & Pechère, 1996; Eng et al., 2003) and provide experimental evidence to support clinical recommendations for physicians to inform patients about their illness and antibiotics as it can notably reduce their expectations of antibiotics (Tan et al., 2008). However, it was also consistently clear that this clinically recommended combination of information provision is not able to convince all people that antibiotics are not necessary for viral infections and that they should not expect them.

A variety of socio-cognitive explanations were considered to try and understand why some people did not respond as expected to the clinical information provision. The correlational evidence reported here suggests that inappropriate expectations for antibiotics are also strongly influenced by social and affective factors (e.g., the belief that everyone else is taking antibiotics or the worry that you will regret not taking antibiotics). This finding highlights the value of using established health behaviour frameworks such as the common sense model of illness regulation to identify important drivers of people's health behaviours regarding antibiotics (Hagger et al., 2017).

Even though trust in physicians is known to play a crucial role in the physician-patient relationship, physician-patient communication, and patients experience with their medications (Hall et al., 2002; Katz, 2002; Thom, 2000; Thom et al., 2004; Thom et al., 2002), the experimental evidence on the role of trust in the physician as a moderator of information provision was largely inconclusive. The effect of trust in the physician as a moderator was generally weak and appeared to vary based on whether this trust was self-reported by respondents or manipulated within the physician. More extensive research into this area is required, particularly given the recent increase in trust-based antibiotic campaigns.

The experimental evidence that an *action bias* can explain why some people want to take antibiotics even after receiving complete information was more convincing. Similar to findings from research on cancer screening preferences (Fagerlin et al., 2005; Gavaruzzi et al., 2011; Scherer et al., 2018), repeated findings showed that some people (around 10%) still want to take antibiotics even when they know they are harmful and will not offer any medical benefit. Finding ways to counteract the influence of this bias appears difficult to do but would likely facilitate more judicious expectations for antibiotics from the general public.

There are many clear directions for future work to build on these initial findings. All of the studies presented here would clearly benefit from validation through well-powered and well-controlled experimental studies in clinical settings. In the present studies the respondents did not experience any actual illnesses, they did not have any actual interactions with a physician and no behavioural outcomes were measured (e.g., reduced inappropriate consultations, reduced requests for antibiotics, reduced receipt of antibiotics). Hence, it is not possible to know exactly how well the present findings generalize to clinical practice. Furthermore, it would also be of interest to see if the findings from these studies can be replicated in countries with different public health systems and different levels of public knowledge. All the scenarios were specifically designed in the context of the English health care system, which differs substantially from other health systems across the world. Prior research has also shown that public knowledge and attitudes towards antibiotics varies substantially across countries (Grigoryan et al., 2007), which raises questions on how well these findings would generalise. Though future work is required, the present findings offer important insights into how inappropriate expectations for antibiotics from healthy members of the public are affected by information about illnesses and antibiotics and provide a promising foundation for future research on differing populations and within clinical settings.

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APPENDIX

Questionnaire A (Antibiotics Questionnaire)

(Response scale for all items unless stated otherwise: 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree)

Items in blue font represent reverse coded items

Items in red font represent items dropped from analysis following EFA

Knowledge of antibiotic efficacy

Most colds clear up by themselves without the need for antibiotics (1)

Antibiotics are effective in treating infections caused by bacteria (2)

Antibiotics are effective in treating infections caused by viruses (3)

Antibiotics are effective as painkillers: they can be used to relieve pain (4)

Knowledge of appropriate antibiotic usage

A course of antibiotics should always be completed (1)

You do not need to finish a course of antibiotics if you are feeling better (2)

You should not take antibiotics which have expired (are out of date) (3)

You should save antibiotics for later use if you have some left over (4)

If a doctor gives you a prescription of antibiotics for a cold you always have to take them (5)

Knowledge of antibiotic resistance

Bacteria can become less susceptible (more resistant) to antibiotics (1)

Some of the antibiotics we use to treat infections are no longer working; this is because the bacteria, which cause these infections, are becoming resistant (2)

It does not matter how many times a person takes antibiotics they will not do any harm (3)

If antibiotics are used too often they are less likely to work in the future (4)

The unnecessary use of antibiotics makes them ineffective (5)

Anticipated regret concerning not receiving antibiotics: Response scale: anchored at each label 1 – 6 with increments of 1

If I visit my doctor for a cold and do not get antibiotics, I would feel:

Dissatisfied - Satisfied (1)

Displeased - Pleased (2)

Disappointed – Not Disappointed (3)

Worried - Relieved (4)

Annoyed – Content (5)

Embarrassed – Comfortable (6)

Anticipated regret concerning receiving antibiotics: Response scale: anchored at each label 1 – 6 with increments of 1

If I visit my doctor for a cold and get antibiotics, I would feel:

Dissatisfied - Satisfied (1)

Displeased - Pleased (2)

Disappointed – Not Disappointed (3)

Worried - Relieved (4)

Annoyed – Content (5)
Embarrassed – Comfortable (6)

Summary attitudes towards taking antibiotics: Response scale: anchored at each label 1 – 6 with increments of 1
Taking antibiotics when I have a cold is/would be:
Unnecessary - Necessary (1)
Unimportant – Important (2)
Useless – Useful (3)
Bad – Good (4)
Unpleasant – Pleasant (5)
Harmful – Harmless (6)
Undesirable – Desirable (7)

Trust of medical experts to prescribe
Doctors often prescribe antibiotics for colds when they are not needed (1)
Doctors try to put you off taking antibiotics for colds even if they are needed (2)
I trust my doctor's advice as to whether I need antibiotics or not for a cold (3)
Antibiotics should be available for a cold without prescription (4)

Subjective social norm perception
People who are important to me would encourage me to take antibiotics for a cold (1)
The people who I work with would put pressure on me to take antibiotics when I have a cold (2)
My friends would discourage me from taking antibiotics for a cold (3)
Members of my family would encourage me to take antibiotics for a cold (4)
My doctor would encourage me to take antibiotics for a cold (5)

Descriptive social norm perception
People who are like me take antibiotics when they have a cold (1)
People I work with take antibiotics when they have a cold (2)
Members of my family take antibiotics when they have a cold (3)
My friends take antibiotics when they have a cold (4)
Most people my age take antibiotics when they have a cold (5)

Self-efficacy to ask for antibiotics
If I had a cold, I would find it easy to ask my doctor for antibiotics (1)
If I had a cold, I would not feel comfortable asking my doctor for antibiotics (2)
If I had a cold, I would find it difficult to ask my doctor for antibiotics (3)
If I had a cold, I would not feel anxious asking my doctor for antibiotics (4)
If I had a cold, I would not feel confident asking my doctor for antibiotics (5)
If I had a cold, I would be nervous about asking my doctor for antibiotics (6)
If I had a cold, asking my doctor for antibiotics would be under my control (7)

Positive attitudes
When I have a cold, antibiotics will help prevent a more serious illness (1)
When I have a cold, antibiotics will help me to get better more quickly (2)
When I have a cold, antibiotics will prevent the development of more symptoms or complications (3)

When I have a cold, antibiotics will make me less likely to spread my infection to others (4)
When I have a cold, antibiotics will help control the severity of my symptoms (5)
When I have a cold, antibiotics will make me less likely to contract the infection again (6)

Negative attitudes
When I have a cold, taking antibiotics will cause me allergies/reactions (1)
When I have a cold, there is a danger of overdose when taking antibiotics (2)
When I have a cold, taking antibiotics will cause me side effects such as diarrhoea (3)
When I have a cold, taking antibiotics will kill useful bacteria and other microorganisms that normally live in the gut (digestive tract), or on the skin, increasing my vulnerability to opportunistic infections (4)
When I have a cold, taking antibiotics will make them less likely to work for me in the future (5)

Likelihood estimations
Please rate what you believe is the likelihood of the following statements on the scale:
Antibiotic resistant bacteria will infect me if I take antibiotics for a cold (0 -100)
I will experience side effects from taking antibiotics for a cold (0- 100)
I will experience health benefits from taking antibiotics for a cold (0- 100)

Table 1

Questionnaire items sourced from existing literature

Author(s) – Publication Year	Item
Barah, Morris, & Goncalves – 2009	When I have a cold, taking antibiotics will cause me allergies/reactions When I have a cold, there is a danger of overdose when taking antibiotic
Cals et al., – 2007	Antibiotics are effective in treating infections caused by bacteria Antibiotics are effective in treating infections caused by viruses Bacteria can become less susceptible (more resistant) to antibiotics
Cho, Hong, & Park – 2004	When I have a cold, antibiotics will prevent the development of more symptoms or complications
Emslie & Bond, – 2003	Most colds clear up by themselves without the need for antibiotics Some of the antibiotics we use to treat infections are no longer working; this is because the bacteria, which cause these infections, are becoming resistant

	It does not matter how many times a person takes antibiotics they will not do any harm Doctors often prescribe antibiotics for colds when they are not needed Doctors often try to put you off taking antibiotics for colds even if they are needed
Eng et al., – 2003	When I have a cold, antibiotics will prevent a more serious illness When I have a cold, antibiotics will help me to get better more quickly
Faber, Heckenbach, Velasco, & Eckmanns – 2010	If antibiotics are used too often, they are less likely to work in the future Antibiotics should be available for a cold without prescription When I have a cold, taking antibiotics will kill useful bacteria and other microorganisms that normally live in the human gut (digestive tract), or on the skin, increasing my vulnerability to opportunistic infections
Hoffmann, Ristl, Heschl, Stelzer, & Maier – 2014	The unnecessary use of antibiotics makes them ineffective

	When I have a cold, taking antibiotics will cause me side effects such as diarrhoea
McNulty et al., – 2016	You do not need to finish a course of antibiotics if you are feeling better I trust my doctor's advice as to whether I need antibiotics or not for a cold
McNulty et al., – 2007	A course of antibiotics should always be completed

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Table 2

Factor Loadings for the Antibiotic Knowledge items: Exploratory Factor Analysis With Direct Oblimin Rotation, Study 1 (n = 402)

Item	Factor 1	Factor 2	Factor 3
Knowledge of antibiotic resistance			
Some of the antibiotics we use to treat infections are no longer working; this is because the bacteria, which cause these infections, are becoming resistant	**0.847**	-0.063	0.011
Bacteria can become less susceptible (more resistant) to antibiotics	**0.75**	0.051	-0.029
If antibiotics are used too often they are less likely to work in the future	**0.72**	-0.007	0.025
The unnecessary use of antibiotics makes them ineffective	**0.668**	-0.01	0.002
It does not matter how many times a person takes antibiotics they will not do any harm	**0.329**	0.086	0.138
Knowledge of appropriate antibiotic use			
A course of antibiotics should always be completed	0.02	**0.905**	-0.146
You do not need to finish a course of antibiotics if you are feeling better	0.078	**0.792**	-0.068
You should save antibiotics for later use if you have some left over	-0.079	**0.529**	0.266
You should not take antibiotics which have expired (are out of date)	-0.005	**0.342**	0.058
Knowledge of antibiotic efficacy			
Antibiotics are effective in treating infections caused by viruses	-0.008	-0.03	**0.65**
Antibiotics are effective in treating infections caused by bacteria	0.007	0.002	**0.4**
Antibiotics are effective as painkillers: they can be used to relieve pain	0.167	0.127	**0.391**
Most colds clear up by themselves without the need for antibiotics	0.111	0.021	**0.341**

Table 3

Factor Loadings for Antibiotic Beliefs Theory of Planned Behaviour items: Exploratory Factor Analysis With Direct Oblimin Rotation, Study 1 (n = 402)

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Summary attitudes towards taking antibiotics							
Taking antibiotics when I have a cold is/would be: - Unnecessary:Necessary	**0.789**	-0.049	-0.083	-0.041	0.079	-0.02	-0.047
Taking antibiotics when I have a cold is/would be: - Unimportant:Important	**0.708**	-0.101	0	-0.054	0.077	-0.062	-0.052
Taking antibiotics when I have a cold is/would be: - Undesirable:Desirable	**0.675**	-0.106	-0.047	-0.024	-0.086	-0.133	0.018
Taking antibiotics when I have a cold is/would be: - Bad:Good	**0.671**	-0.002	-0.042	0.021	-0.06	-0.2	-0.061
Taking antibiotics when I have a cold is/would be: - Useless:Useful	**0.665**	-0.03	0.02	-0.069	-0.022	-0.018	-0.212
Taking antibiotics when I have a cold is/would be: - Unpleasant:Pleasant	**0.408**	0.025	0.007	0.05	-0.145	-0.23	-0.12
Anticipated regret concerning not receiving antibiotics							
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Annoyed:Content	-0.055	**0.915**	-0.046	0.075	-0.034	0.009	-0.037
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Displeased:Pleased	-0.031	**0.893**	0.002	0.041	0.01	0.076	-0.002
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Dissatisfied:Satisfied	-0.071	**0.873**	0.011	0.047	-0.002	0.015	0.001
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Worried:Relieved	0.023	**0.841**	0.017	-0.056	0.03	0.086	-0.017
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Disappointed:Not Disappointed	-0.062	**0.822**	0.042	0.023	-0.02	0.016	0.024
If I visit my doctor for a cold and do not get antibiotics, I would feel: - Embarrassed:Comfortable	0.092	**0.77**	0	-0.081	0.002	-0.068	0.07
Social norm perception of taking antibiotics							
My friends take antibiotics when they have a cold	-0.065	0.011	**-0.886**	0.056	-0.05	-0.044	0.017
People I work with take antibiotics when they have a cold	-0.109	0.018	**-0.864**	-0.02	-0.017	-0.006	0.017

Most people my age take antibiotics when they have a cold	-0.008	-0.001	**-0.734**	0.026	0.032	0.024	-0.098
People who are like me take antibiotics when they have a cold	0.054	-0.006	**-0.647**	-0.1	-0.028	-0.087	-0.061
The people who I work with would put pressure on me to take antibiotics when I have a cold	0	-0.086	**-0.644**	0.01	0.12	0.05	-0.001
Members of my family take antibiotics when they have a cold	0.019	-0.037	**-0.629**	-0.054	-0.01	-0.107	-0.032
Members of my family would encourage me to take antibiotics for a cold	0.231	-0.01	**-0.593**	0.058	0.052	-0.022	-0.044
People who are important to me would encourage me to take antibiotics for a cold	0.181	-0.035	**-0.581**	0.008	0.106	-0.05	-0.097
My doctor would encourage me to take antibiotics for a cold	0.222	0.03	**-0.488**	-0.179	-0.021	0.069	-0.151
My friends would discourage me from taking antibiotics for a cold	0.046	-0.032	**-0.31**	-0.124	-0.121	-0.05	0.027
Self-efficacy to ask for antibiotics							
If I had a cold, I would not feel confident asking my doctor for antibiotics	-0.061	-0.001	0.005	**-0.869**	0.063	-0.034	-0.047
If I had a cold, I would find it difficult to ask my doctor for antibiotics	0.035	0.009	0.035	**-0.826**	-0.027	-0.021	0.017
If I had a cold, I would be nervous about asking my doctor for antibiotics	-0.025	-0.011	0.013	**-0.821**	-0.028	0.013	-0.025
If I had a cold, I would not feel comfortable asking my doctor for antibiotics	0.077	-0.028	-0.021	**-0.753**	0.034	-0.038	0.006
If I had a cold, I would find it easy to ask my doctor for antibiotics	0.03	0.014	-0.158	**-0.568**	0.037	-0.026	-0.15
Negative attitudes							
When I have a cold, taking antibiotics will cause me allergies/reactions	0.021	0.011	0.006	-0.099	**0.685**	-0.058	-0.019
When I have a cold, taking antibiotics will cause me side effects such as diarrhoea	-0.057	-0.015	0	-0.041	**0.631**	-0.065	0.114
When I have a cold, taking antibiotics will kill useful bacteria and other microorganisms that normally live in the gut (digestive tract), or on the skin, increasing my vulnerability to opportunistic infections	0.047	0.013	-0.006	0.124	**0.433**	0.123	0.054

When I have a cold, there is a danger of overdose when taking antibiotics	0.018	-0.025	-0.05	-0.018	**0.425**	0.041	-0.051
When I have a cold, taking antibiotics will make them less likely to work for me in the future	-0.12	0.105	0.072	0.241	**0.372**	-0.06	-0.029
Anticipated regret concerning receiving antibiotics							
If I visit my doctor for a cold and get antibiotics, I would feel: - Disappointed:Not Disappointed	-0.033	-0.024	-0.034	0.012	-0.007	**-0.901**	-0.032
If I visit my doctor for a cold and get antibiotics, I would feel: - Dissatisfied:Satisfied	0.001	-0.053	-0.006	0.043	-0.008	**-0.897**	-0.061
If I visit my doctor for a cold and get antibiotics, I would feel: - Annoyed:Content	0.054	-0.013	0.007	0.015	0.019	**-0.869**	-0.041
If I visit my doctor for a cold and get antibiotics, I would feel: - Displeased:Pleased	0.035	-0.084	-0.026	0.007	0.028	**-0.847**	-0.047
If I visit my doctor for a cold and get antibiotics, I would feel: - Worried:Relieved	0.078	-0.063	-0.081	-0.023	-0.031	**-0.724**	0.006
If I visit my doctor for a cold and get antibiotics, I would feel: - Embarrassed:Comfortable	0.077	0.051	0.007	-0.132	0.028	**-0.686**	0.002
Positive outcomes from taking antibiotics							
When I have a cold, antibiotics will prevent the development of more symptoms or complications	-0.026	-0.009	0.044	-0.016	0.015	-0.052	**-0.891**
When I have a cold, antibiotics will help control the severity of my symptoms	0.09	-0.087	-0.004	0.036	-0.02	0.005	**-0.812**
When I have a cold, antibiotics will help prevent a more serious illness	-0.036	-0.005	0.002	-0.008	0.052	-0.078	**-0.812**
When I have a cold, antibiotics will help me to get better more quickly	0.093	-0.071	0.015	-0.05	-0.062	-0.009	**-0.755**
When I have a cold, antibiotics will make me less likely to spread my infection to others	-0.02	-0.01	-0.179	-0.079	-0.064	-0.049	**-0.618**
When I have a cold, antibiotics will make me less likely to contract the infection again	0.115	0.012	-0.153	-0.052	-0.037	0.015	**-0.51**

Table 4

Factor Loadings for the Illness beliefs (IPQ-R): Exploratory Factor Analysis With Direct Oblimin Rotation, Study 1 (n = 402)

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Timeline chronic								
I think my cold will pass quickly	**0.979**	0.032	0.017	0.013	-0.015	-0.018	0.011	-0.081
I think my cold will clear up quickly	**0.913**	0.023	-0.029	-0.019	0.015	-0.013	0.006	-0.01
I think my cold will last for a long time	**0.702**	0.006	0.042	-0.087	-0.102	0.121	0.025	0.183
I think my cold will be long lasting rather than temporary	**0.642**	0.008	0.046	-0.065	-0.169	0.088	0.046	0.169
Identity								
Symptom: - Runny nose	-0.01	**0.894**	-0.012	-0.028	-0.048	-0.07	-0.001	0.005
Symptom: - Congestion	-0.014	**0.886**	0.004	0.054	0.031	0.013	0.043	0.017
Symptom: - Feeling under the weather	0.019	**0.877**	-0.023	-0.044	0.034	-0.023	-0.016	0.045
Symptom: - Sneezing	-0.003	**0.874**	0.031	-0.042	-0.057	-0.006	-0.042	-0.029
Symptom: - Headache	-0.043	**0.808**	0.054	-0.039	0.067	0.08	0.002	0.012
Symptom: - Sore throat	0.023	**0.793**	-0.022	0.017	0.039	-0.006	0.03	-0.001
Symptom: - Chills	0.011	**0.788**	-0.002	0	0.038	-0.007	-0.021	0.024
Symptom: - Cough	0.034	**0.773**	-0.033	0.058	-0.065	0.058	0.042	-0.053
Personal control								
I think that what I do can determine whether my cold will get better or worse	0.075	0.001	**0.76**	-0.021	-0.005	0.054	0.08	0.012
I think I have the power to influence my cold	-0.065	-0.009	**0.752**	-0.084	0.007	-0.018	-0.005	0.07
I think that the course of my cold depends on me	-0.026	-0.056	**0.695**	-0.012	-0.041	0.102	-0.032	0.065
I think that there is a lot which I can do to control my symptoms	-0.062	0.054	**0.678**	0.07	0.064	0.037	-0.019	0.029
I think that nothing I do will affect my cold	0.083	0.002	**0.557**	0.088	0.022	-0.119	0.005	-0.117
Illness coherence								

My cold doesn't make any sense to me	0.036	-0.024	-0.009	**0.861**	-0.024	-0.044	-0.043	0.005
I don't understand my cold	0.007	0.034	-0.058	**0.843**	0.059	-0.044	-0.058	0.022
My cold is a mystery to me	0.05	0.006	0.015	**0.823**	0.016	-0.051	-0.014	-0.025
I am puzzled by the symptoms of my cold	0.016	0.003	0.018	**0.776**	0.046	-0.042	-0.011	-0.082
I have a clear picture or understanding of my cold	-0.118	-0.025	0.071	**0.481**	-0.056	0.094	0.001	0.033
Treatment control								
I think antibiotics can control my cold	0.035	-0.004	-0.013	0.035	**-0.941**	0.016	0.011	0.033
I think antibiotics will be effective in treating my cold	0.027	-0.019	0.004	0.032	**-0.928**	-0.004	0.033	-0.006
I think the negative effects of my cold can be prevented (avoided) by taking antibiotics	0.035	-0.018	-0.065	-0.025	**-0.871**	-0.025	0.018	0.003
Timeline cyclical								
I think I will go through cycles in which my cold will get better and worse	0.024	0.084	0.035	0.033	-0.045	**0.854**	-0.06	-0.083
I think my symptoms will come and go in cycles	-0.027	0.021	0.071	0.045	-0.02	**0.744**	0.055	0.019
I think the symptoms of my cold will change a great deal from day to day	0.012	0.018	-0.054	0.029	0.049	**0.584**	0.011	0.022
I think my cold is very unpredictable	0.054	-0.094	-0.007	-0.167	-0.004	**0.531**	0.05	0.008
Emotional representation								
When I have a cold I feel annoyed	0.013	0.024	-0.017	-0.011	-0.057	-0.049	**0.795**	-0.111
When I have a cold I feel frustrated	0.069	0.006	-0.027	0.067	0.053	0.062	**0.735**	-0.078
When I have a cold I feel angry	-0.075	0.012	0.053	-0.127	-0.061	0.019	**0.652**	0.07
When I have a cold I feel depressed	0.049	-0.041	0.029	-0.088	0.047	0.057	**0.618**	0.13

When I have a cold I feel upset	-0.046	0.056	0.032	-0.003	-0.058	-0.019	**0.599**	0.204
Consequences								
I think my cold will have important consequences on my day to day life	0.076	-0.029	-0.019	0.045	0.064	0.038	0.049	**0.811**
I think my cold will cause difficulties for those who are close to me	0.018	0.003	-0.015	0.041	0.021	0.028	0.08	**0.603**
I think my cold is a serious condition	0.137	0.077	0.055	-0.117	-0.185	-0.043	-0.101	**0.599**
I think my cold will have important financial consequences	0.004	0.008	0.088	-0.105	-0.063	-0.023	-0.008	**0.58**
I think my cold will strongly affect the way others see me	-0.069	0.055	0.01	-0.05	-0.124	0.017	0.042	**0.563**
I think my cold will not have much effect on my day to day life	0.251	0.034	-0.109	0.069	0.103	-0.055	0.093	**0.341**

Questionnaire B (Illness beliefs: IPQ-R Adapted for the common cold)

(Response scale for all items unless stated otherwise: 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree)

Items in blue font represent reverse coded items

Items in red font represent items dropped from analysis following EFA

Identity: Response scale: 1 = Not severe at all, 2 = Mild, 3 = Moderate, 4 = Severe, 5 = Very severe

Listed below are a number of symptoms that you may or may not experience. Thinking about how it feels when you have a cold for which you would go and see your doctor (GP), please indicate the severity of each symptom:

Headache (1)
Sneezing (2)
Runny nose (3)
Feeling under the weather (4)
Congestion (5)
Cough (6)
Chills (7)
Sore Throat (8)

Timeline Chronic

I think my cold will clear up quickly (1)
I think my cold will be long lasting rather than temporary (2)
I think my cold will last for a long time (3)
I think my cold will pass quickly (4)

Consequences

I think my cold is a serious condition (1)
I think my cold will have important consequences on my day to day life (2)
I think my cold will not have much effect on my day to day life (3)
I think my cold will strongly affect the way others see me (4)
I think my cold will have important financial consequences (5)
I think my cold will cause difficulties for those who are close to me (6)

Personal Control

I think that there is a lot which I can do to control my symptoms (1)
I think that what i do can determine whether my cold will get better or worse (2)
I think that the course of my cold depends on me (3)
I think that nothing I do will affect my cold (4)
I think I have the power to influence my cold (5)

Treatment Control

I think there is very little that can be done to improve my cold (1)
I think antibiotics will be effective in treating my cold (2)
I think the negative effects of my cold can be prevented (avoided) by taking antibiotics (3)
I think antibiotics can control my cold (4)
I think there is nothing which can help my cold (5)

Illness Coherence
I am puzzled by the symptoms of my cold (1)
My cold is a mystery to me (2)
I don't understand my cold (3)
My cold doesn't make any sense to me (4)
I have a clear picture or understanding of my cold (5)

Timeline Cyclical
I think the symptoms of my cold will change a great deal from day to day (1)
I think my symptoms will come and go in cycles (2)
I think my cold is very unpredictable (3)
I think I will go through cycles in which my cold will get better and worse (4)

Emotional Representation
When I have a cold I feel depressed (1)
When I have a cold I feel upset (2)
Having a cold does not worry me (3)
When I have a cold I feel anxious (4)
When I have a cold I feel afraid (5)
When I have a cold I feel annoyed (6)
When I have a cold I feel frustrated (7)
When I have a cold I feel angry (8)

Cause
We are interested in what you consider may be the cause of such a cold. We are most interested in your own views about the factors that cause a cold rather than what others including doctors or family may have suggested to you. Please indicate how much you agree or disagree that the following are causes of a cold by ticking the appropriate box:
Stress or worry (1)
Hereditary - it runs in my family (2)
A bacterial infection (3)
Diet or eating habits (4)
Chance or bad luck (5)
Poor medical care in my past (6)
Pollution in the environment (7)
My own behaviour - getting wet or chilled (8)
My mental attitude e.g. thinking about life negatively (9)
Family problems or worries (10)
Overwork (11)
My emotional state e.g. being lonely (12)
Ageing (13)
Alcohol (14)
Smoking (15)
Accident or injury (16)
My personality (17)
Altered immunity (18)
A viral infection (19)

Expectation measures (Chapter 2)

(Response scale: 1 = Strongly disagree, 2 = Disagree, 3 = Mildly disagree, 4 = Mildly agree, 5 = Agree, 6 = Strongly agree)

Items in blue font represent reverse coded items

Expectations of antibiotics as a treatment

I should get a prescription of antibiotics (1)

I should be offered a prescription of antibiotics (2)

I would want my doctor to give me a prescription of antibiotics (3)

I would not want my doctor to offer me a prescription of antibiotics (4)

Expectations of the physicians' prescribing behaviour

I would not be surprised if my doctor gave me a prescription of antibiotics (1)

I would expect that my doctor will offer me antibiotics (2)

I would be surprised if my doctor offered me a prescription of antibiotics (3)

I think I will be prescribed antibiotics by my doctor (4)

(Response scale: 1 = I certainly would not, 2 = I would not, 3 = I probably would not, 4 = I probably would, 5 = I would, 6 = I certainly would)

Likelihood of requesting antibiotics

I would request a prescription of antibiotics (1)

I would mention antibiotics to my doctor (2)

I would suggest that I should have antibiotics (3)

I would demand a prescription of antibiotics (4)

Full vignette: Study 2 (Chapter 3)

Please read the text below <u>*carefully*</u> *and imagine as if the situation described in the text were real.*

For over a week you have been feeling really ill and experiencing cold-like symptoms. You have had a number of headaches and a high temperature (around 38°C – 39°C). Repeated coughing has caused you to develop a sore throat. Throughout the day your nose is either runny or congested (blocked) and you have been sneezing a lot. The symptoms persist during the day and throughout the evening. Since the symptoms started they have not really improved. Today, you decided to see your GP. During the consultation, you discuss your symptoms, your previous illnesses and past medication usage. Your GP examines you and checks your lungs, nose, throat, and ears. Listening to your lungs with a stethoscope she tells you that she does not hear any crackling or wheezing. She mentions that the inside of your throat looks very red and she can feel swelling on the outside of your throat. She also feels swelling around your nose and notes that your sinuses are congested. She also records your pulse and respiratory rate.

After the examination she explains that she thinks a viral respiratory tract infection is the cause of your symptoms. *While discussing potential treatments and coping strategies with you, she mentions that antibiotics are only effective for Bacterial, have no positive effect on viral infections, provide no symptom relief and may have side effects such as diarrhoea, vomiting and rash*. She tells you not to worry about it and then gives you advice about managing the symptoms with painkillers and something to reduce the fever.

Key:

Bolded text represents illness aetiology information provision

Italicized text represents antibiotic information provision

Table 5

2 x 2 ANCOVAs (with Bayes factors) on expectations of antibiotics as a treatment, Study 2 (n = 190)

	MSE	F	*p*	*Np2*	BF_{10}
Knowledge of antibiotic efficacy					
Antibiotic information	11.34	8.07	.01	0.04	6.62
Viral information	0.69	0.49	.48	0.00	0.19
Interaction	0.18	0.13	.72	0.00	0.30
Knowledge of antibiotic usage					
Antibiotic information	15.26	8.75	< .001	0.05	8.82
Viral information	1.07	0.61	.43	0.00	0.20
Interaction	0.03	0.01	.90	0.00	0.38
Knowledge of antibiotic resistance					
Antibiotic information	16.30	9.14	< .001	0.05	10.79
Viral information	0.46	0.26	.61	0.00	0.17
Interaction	0.15	0.08	.78	0.00	0.44
Anticipated regret concerning not receiving antibiotics					
Antibiotic information	15.49	9.68	< .001	0.05	14.05
Viral information	0.20	0.12	.73	0.00	0.17
Interaction	0.05	0.03	.86	0.00	0.51
Anticipated regret concerning receiving antibiotics					
Antibiotic information	17.09	11.97	< .001	0.06	38.35
Viral information	0.31	0.22	.64	0.00	0.19
Interaction	0.22	0.15	.69	0.00	1.57
Subjective social norm					
Antibiotic information	20.83	14.21	< .001	0.07	93.53
Viral information	1.23	0.84	.36	0.00	0.21
Interaction	0.64	0.43	.51	0.00	5.79
Descriptive social norm					
Antibiotic information	14.22	9.37	< .001	0.05	12.08
Viral information	1.11	0.73	.39	0.00	0.22
Interaction	0.43	0.29	.59	0.00	0.63
Self-efficacy					
Antibiotic information	11.18	6.55	.01	0.03	3.52
Viral information	0.18	0.10	.75	0.00	0.17
Interaction	0.60	0.35	.55	0.00	0.15
Positive health outcomes					
Antibiotic information	15.62	11.23	< .001	0.06	28.31

Viral information	0.16	0.11	.74	0.00	0.16
Interaction	0.28	0.20	.65	0.00	1.02
Side effects					
Antibiotic information	16.98	9.48	< .001	0.05	12.45
Viral information	0.00	0.00	.97	0.00	0.16
Interaction	0.36	0.20	.66	0.00	0.46
Summary attitudes					
Antibiotic information	10.70	8.45	< .001	0.04	8.21
Viral information	0.50	0.40	.53	0.00	0.19
Interaction	0.19	0.15	.70	0.00	0.37
Identity					
Antibiotic information	14.94	7.56	.01	0.04	5.40
Viral information	0.04	0.02	.88	0.00	0.15
Interaction	0.03	0.02	.89	0.00	0.19
Timeline chronic					
Antibiotic information	15.91	8.34	< .001	0.04	7.59
Viral information	0.34	0.18	.67	0.00	0.17
Interaction	0.09	0.05	.83	0.00	0.26
Consequences					
Antibiotic information	16.78	9.40	< .001	0.05	12.03
Viral information	0.48	0.27	.61	0.00	0.18
Interaction	0.68	0.38	.54	0.00	0.66
Personal control					
Antibiotic information	14.49	7.31	.01	0.04	4.97
Viral information	0.13	0.07	.80	0.00	0.16
Interaction	0.07	0.04	.85	0.00	0.17
Treatment control					
Antibiotic information	12.18	9.14	< .001	0.05	11.11
Viral information	0.91	0.68	.41	0.00	0.21
Interaction	0.01	0.01	.94	0.00	0.51
Illness coherence					
Antibiotic information	17.55	9.15	< .001	0.05	10.06
Viral information	1.06	0.55	.46	0.00	0.18
Interaction	0.43	0.22	.64	0.00	0.47
Timeline cyclical					
Antibiotic information	14.16	7.29	.01	0.04	4.72
Viral information	0.49	0.25	.62	0.00	0.19
Interaction	0.01	0.00	.95	0.00	0.18

Emotional representations					
Antibiotic information	14.71	7.57	.01	0.11	5.39
Viral information	0.09	0.05	.83	0.00	0.16
Interaction	0.04	0.02	.89	0.00	0.19
Consultation behaviour					
Antibiotic information	10.05	5.80	.02	0.03	2.52
Viral information	0.00	0.00	1.00	0.00	0.16
Interaction	0.43	0.25	.62	0.00	0.09
Past antibiotic prescriptions: Viral					
Antibiotic information	7.66	4.59	.03	0.02	1.46
Viral information	0.01	0.01	.94	0.00	0.15
Interaction	0.74	0.44	.51	0.00	0.06
Past antibiotic prescriptions: Bacterial					
Antibiotic information	14.51	7.41	.01	0.04	4.99
Viral information	0.28	0.14	.70	0.00	0.17
Interaction	0.03	0.01	.91	0.00	0.18

Table 6

2 x 2 ANCOVAs (with Bayes factors) on expectations of physicians' prescribing behaviour, Study 2 (n = 190)

	MSE	F	*p*	*Np2*	BF_{10}
Knowledge of antibiotic efficacy					
Antibiotic information	41.37	25.80	< .001	0.12	16689.26
Viral information	0.36	0.23	.64	0.00	0.17
Interaction	0.67	0.42	.52	0.00	724.33
Knowledge of antibiotic usage					
Antibiotic information	48.31	28.43	< .001	0.13	51680.55
Viral information	1.06	0.62	.43	0.00	0.21
Interaction	0.10	0.06	.81	0.00	2205.56
Knowledge of antibiotic resistance					
Antibiotic information	49.18	24.61	< .001	0.12	10453.84
Viral information	0.15	0.08	.78	0.00	0.16
Interaction	0.01	0.01	.94	0.00	345.79
Anticipated regret concerning not receiving antibiotics					
Antibiotic information	48.25	25.63	< .001	0.12	15621.60
Viral information	0.05	0.03	.87	0.00	0.16
Interaction	0.30	0.16	.69	0.00	557.89
Anticipated regret concerning receiving antibiotics					
Antibiotic information	50.80	30.34	< .001	0.14	106845.22
Viral information	0.11	0.07	.80	0.00	0.16
Interaction	0.68	0.40	.53	0.00	4297.91
Subjective social norm					
Antibiotic information	58.69	40.10	< .001	0.18	4.758e +6
Viral information	0.98	0.67	.41	0.00	0.21
Interaction	1.83	1.25	.27	0.01	355881.30
Descriptive social norm					
Antibiotic information	46.12	30.46	< .001	0.14	111427.84
Viral information	0.88	0.58	.45	0.00	0.21
Interaction	1.46	0.97	.33	0.01	7564.43
Self-efficacy					
Antibiotic information	39.68	22.81	< .001	0.11	5607.13
Viral information	0.05	0.03	.86	0.00	0.16
Interaction	1.83	1.05	.31	0.01	266.14
Positive health outcomes					
Antibiotic information	48.64	30.26	< .001	0.14	103970.20

Viral information	0.04	0.02	.87	0.00	0.16
Interaction	0.82	0.51	.48	0.00	4750.07
Side effects					
Antibiotic information	49.89	24.86	< .001	0.12	11596.32
Viral information	0.00	0.00	.98	0.00	0.16
Interaction	0.00	0.00	.98	0.00	381.23
Summary attitudes					
Antibiotic information	40.37	26.75	< .001	0.13	25238.29
Viral information	0.23	0.15	.70	0.00	0.17
Interaction	0.67	0.44	.51	0.00	1120.11
Identity					
Antibiotic information	47.63	23.04	< .001	0.11	5425.08
Viral information	0.02	0.01	.92	0.00	0.16
Interaction	0.10	0.05	.83	0.00	188.89
Timeline chronic					
Antibiotic information	48.59	23.55	< .001	0.11	6568.92
Viral information	0.10	0.05	.83	0.00	0.16
Interaction	0.31	0.15	.70	0.00	230.88
Consequences					
Antibiotic information	50.98	27.26	< .001	0.13	28151.04
Viral information	0.27	0.14	.71	0.00	0.16
Interaction	1.79	0.96	.33	0.01	1504.44
Personal control					
Antibiotic information	45.53	21.81	< .001	0.11	3179.16
Viral information	0.02	0.01	.92	0.00	0.15
Interaction	0.01	0.01	.93	0.00	113.63
Treatment control					
Antibiotic information	42.88	27.79	< .001	0.13	39395.52
Viral information	0.51	0.33	.57	0.00	0.19
Interaction	0.12	0.08	.78	0.00	1644.79
Illness coherence					
Antibiotic information	52.57	26.13	< .001	0.12	16029.38
Viral information	0.85	0.42	.52	0.00	0.18
Interaction	1.46	0.72	.40	0.00	858.24
Timeline cyclical					
Antibiotic information	46.49	22.41	< .001	0.11	4198.18
Viral information	0.17	0.08	.78	0.00	0.16
Interaction	0.10	0.05	.83	0.00	149.70

Emotional representations					
Antibiotic information	47.28	22.71	< .001	0.11	4751.87
Viral information	0.02	0.01	.92	0.00	0.16
Interaction	0.20	0.10	.75	0.00	169.85
Typical consulting behaviour for a cold					
Antibiotic information	39.72	20.63	< .001	0.10	1890.17
Viral information	0.02	0.01	.92	0.00	0.16
Interaction	0.89	0.46	.50	0.00	79.18
Past antibiotics prescriptions: Viral					
Antibiotic information	32.04	18.71	< .001	0.09	901.44
Viral information	0.02	0.01	.92	0.00	0.16
Interaction	2.00	1.17	.28	0.01	49.04
Past antibiotics prescriptions: Bacterial					
Antibiotic information	46.83	22.58	< .001	0.11	4565.09
Viral information	0.11	0.05	.82	0.00	0.17
Interaction	0.08	0.04	.85	0.00	147.06

Table 7

2 x 2 ANCOVAs (with Bayes factors) on likelihood of requesting antibiotics, Study 2 (n = 190)

	MSE	F	*p*	*Np2*	BF_{10}
Knowledge of antibiotic efficacy					
Antibiotic information	3.96	3.20	.08	0.02	0.70
Viral information	0.03	0.02	.88	0.00	0.16
Interaction	0.06	0.05	.82	0.00	0.02
Knowledge of antibiotic usage					
Antibiotic information	6.23	4.09	.04	0.02	1.06
Viral information	0.14	0.09	.76	0.00	0.16
Interaction	0.64	0.42	.52	0.02	0.05
Knowledge of antibiotic resistance					
Antibiotic information	7.07	4.77	.03	0.03	1.44
Viral information	0.01	0.01	.94	0.00	0.15
Interaction	1.08	0.73	.39	0.00	0.07
Anticipated regret concerning not receiving antibiotics					
Antibiotic information	6.44	5.08	.03	0.03	1.69
Viral information	0.04	0.03	.87	0.00	0.15
Interaction	0.13	0.11	.75	0.00	0.06
Anticipated regret concerning receiving antibiotics					
Antibiotic information	7.42	6.17	.01	0.03	2.74
Viral information	0.01	0.01	.94	0.00	0.16
Interaction	0.03	0.03	.87	0.00	0.09
Subjective social norm					
Antibiotic information	9.41	6.95	.01	0.04	3.85
Viral information	0.14	0.11	.75	0.00	0.17
Interaction	0.00	0.00	.98	0.00	0.14
Descriptive social norm					
Antibiotic information	5.61	4.18	.04	0.02	1.12
Viral information	0.14	0.10	.75	0.00	0.16
Interaction	0.00	0.00	.97	0.00	0.04
Self-efficacy					
Antibiotic information	4.10	2.63	.11	0.01	0.56
Viral information	0.05	0.03	.86	0.00	0.15
Interaction	0.00	0.00	.98	0.00	0.02
Positive health outcomes					
Antibiotic information	6.44	5.21	.02	0.03	1.78

Viral information	0.06	0.05	.83	0.00	0.16
Interaction	0.03	0.02	.88	0.00	0.08
Side effects					
Antibiotic information	6.92	4.17	.04	0.02	1.09
Viral information	0.23	0.14	.71	0.00	0.17
Interaction	1.27	0.76	.38	0.00	0.06
Summary attitudes					
Antibiotic information	3.47	3.39	.07	0.02	0.79
Viral information	0.01	0.00	.94	0.00	0.16
Interaction	0.04	0.04	.85	0.00	0.02
Identity					
Antibiotic information	6.01	3.44	.07	0.02	0.80
Viral information	0.08	0.05	.83	0.00	0.16
Interaction	0.77	0.44	.51	0.00	0.03
Timeline chronic					
Antibiotic information	6.84	4.21	.04	0.02	1.11
Viral information	0.00	0.00	1.00	0.00	0.15
Interaction	0.03	0.02	.89	0.00	0.05
Consequences					
Antibiotic information	7.37	4.90	.03	0.03	1.51
Viral information	0.01	0.00	.94	0.00	0.15
Interaction	0.10	0.06	.80	0.00	0.05
Personal control					
Antibiotic information	6.28	3.60	.06	0.02	0.87
Viral information	0.06	0.03	.86	0.00	0.16
Interaction	0.71	0.40	.53	0.00	0.03
Treatment control					
Antibiotic information	4.38	3.88	.05	0.02	0.93
Viral information	0.09	0.08	.78	0.00	0.17
Interaction	0.53	0.47	.49	0.00	0.04
Illness coherence					
Antibiotic information	7.90	4.72	.03	0.02	1.39
Viral information	0.20	0.12	.73	0.00	0.17
Interaction	0.01	0.01	.94	0.00	0.05
Timeline cyclical					
Antibiotic information	5.33	3.22	.07	0.02	0.72
Viral information	0.05	0.03	.86	0.00	0.16
Interaction	0.42	0.26	.61	0.00	0.03

Emotional representations					
Antibiotic information	5.89	3.45	.06	0.02	0.81
Viral information	0.12	0.07	.79	0.00	0.16
Interaction	0.18	0.11	.74	0.00	0.05
Typical consulting behaviour for a cold					
Antibiotic information	2.77	1.96	.16	0.01	0.40
Viral information	0.49	0.35	.56	0.00	0.18
Interaction	0.03	0.02	.89	0.00	0.02
Past antibiotics prescriptions: Viral					
Antibiotic information	1.53	1.14	.29	0.01	0.27
Viral information	0.33	0.25	.62	0.00	0.17
Interaction	0.13	0.10	.75	0.00	0.01
Past antibiotics prescriptions: Bacterial					
Antibiotic information	5.92	3.39	.07	0.02	0.76
Viral information	0.04	0.02	.88	0.00	0.17
Interaction	0.73	0.42	.52	0.00	0.03

Attention check: Study 3 (Chapter 4)

Please read the text below carefully and imagine that the situation described is real.

For a couple of days you have been feeling really ill and experiencing some unpleasant symptoms. You have had two or three sudden cases of watery diarrhoea each day and you have been feeling sick, which has resulted in an upset stomach and a loss of appetite. You have some slight muscle aches and when you take your temperature you record a mild fever (around 37°C). The symptoms have persisted both during the day and throughout the evening.

Today, you decided to see your GP. After taking your history and discussing your symptoms, she examines your ears and throat. She also records your pulse, temperature, and respiratory rate. Your GP tells you that your presenting symptoms indicate that you have a viral stomach infection. She explains that viral stomach infections like these are most commonly caused by noroviruses and you should make a full recovery within a day or so. Your GP tells you not to worry and then gives you advice about managing the symptoms with painkillers and keeping well hydrated. Lastly she mentions that if your symptoms worsen, or continue for a few more days, you should come back for a clinical review.

Please select 'I should have worn a hat' from the options below to show you have read the text.

Attention check responses (single answer)

1. I should get a prescription of antibiotics
2. I should be offered the opinion of another GP
3. I would want to hear more information about the infection
4. I should have worn a hat

Trust in Physician Scale: Study 3 (Chapter 4)

(Response scale for all items: from 1 (*Strongly disagree*) via 2, (*Disagree*), 3 (*Uncertain*), 4 (*Agree*), to 5 (*Strongly agree*). (R) Represents reverse coded items

Wording: 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.

Please rate the extent to which you agree or disagree with the following sentences.

1. I doubt that my doctor really cares about me as a person (R)

2. My doctor is usually considerate of my needs

3. I trust my doctor so much I always try to follow his/her advice

4. If my doctor tells me something, then it must be true

5. I sometimes distrust my doctor's opinion and would like a second one (R)

6. I trust my doctor's judgments about my medical care

7. I feel my doctor does not do everything he/she should for my medical care (R)

8. I trust my doctor to put my medical needs above all other considerations when treating my medical problems

9. My doctor is a real expert in taking care of medical problems like mine

10. I trust my doctor to tell me if a mistake was made about my treatment

11. I sometimes worry that my doctor may not keep the information we discuss totally private (R)

Dependent variables: Study 3 and 4 (Chapter 4)
(R) Represents reverse coded items

Wording: In the situation described above…

Expectations for antibiotics as a treatment
1. I should get a prescription of antibiotics
2. I should be offered a prescription of antibiotics
3. I would want my doctor to give me a prescription of antibiotics
4. I would not want my doctor to offer me a prescription of antibiotics (R)

Response scale: 1 = Strongly disagree, 2 = Disagree, 3 = Mildly disagree, 4 = Mildly agree, 5 = Agree, 6 = Strongly agree

Study 3: Vignette (Chapter 4)

Please read the text below carefully and imagine that the situation described is real.

For over a week you have been feeling really ill and experiencing cold-like symptoms. You have had a number of headaches and a high temperature (around 38°C – 39°C). Repeated coughing has caused you to develop a sore throat. Throughout the day your nose is either runny or blocked and you have been sneezing a lot. The symptoms persist during the day and throughout the evening. Since the symptoms started they have not really improved.

Today, you decided to see your GP. During the consultation, you discuss your symptoms, your previous illnesses and past medication usage. Your GP examines you and checks your lungs, nose, throat, and ears. Listening to your lungs with a stethoscope she tells you that she does not hear any crackling or wheezing. Your GP mentions that the inside of your throat looks very red and that they can feel swelling on the outside of your throat. Your GP also feels swelling around your nose and notes that your sinuses are congested. Your GP also records your pulse and respiratory rate.

After the examination your GP explains that a **viral** respiratory tract infection is the cause of your symptoms. **Your GP explains 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**. Your GP then discusses potential treatments and coping strategies with you and then gives you advice about managing the symptoms with painkillers and something to reduce the fever.

Key:
Bolded text represents complete information provision (viral aetiology and antibiotic)

Study 4: Vignette (Chapter 4)

<u>Please read the text below carefully and imagine that the situation described is real.</u>

In the last two days, you have experienced a lot of pain in your right ear. In addition, you felt pressure inside your ear and the skin around it was itchy and irritated. Since yesterday, the ear has felt blocked and you cannot hear properly. You feel feverish and when you checked you had a high temperature (around 39.0°C). The fever responds to ibuprofen but rises again after a few hours. You do not have a cough or breathing problems.

Today, as the earache is getting worse, you decide to see your GP. (*As you enter your GP does not look up from the computer on the desk to look at you.* **| *As you enter your GP looks up to welcome you with a warm smile*.**) (*Your GP did not seem prepared for the consultation and a lot of time was wasted throughout the consultation while your GP looked for the right files and leaflets.* | ***Your GP was well prepared for the consultation. All necessary files were already open on the computer and relevant leaflets had been set out beforehand*.**) During the consultation, you discuss your symptoms, your previous illnesses and past medication usage. (*Your GP sits behind the computer and does not make any attempt at eye contact throughout the consultation.* **| *Your GP moves away from the computer and turns towards you in order to speak to you face to face throughout the consultation*.**) Your GP examines you and checks your ears and throat. Your GP also records your pulse and respiratory rate. (*It took two attempts to measure your respiratory rate as your GP made a mistake the first time* | ***Your GP carried out the medical examination efficiently without any problems.***)

After the examination your GP explains that a **viral** ear infection is the cause of your symptoms. **Your GP explains 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**. Your GP then discusses potential treatments and coping strategies with you and then gives you advice about managing the symptoms with painkillers and something to reduce the fever.

Key:
Trustworthiness manipulations are contained within parenthesis (*low* | ***high***)
Bolded text represents complete information provision (viral aetiology and antibiotic)

Study 4: Pre-test 1 (Chapter 4)

Aim 1: To establish effective manipulations of warmth and competence
Aim 2: To establish that manipulations of warmth and competence were localised (i.e., that manipulations of warmth did not also affect perceptions of competence and that manipulations of competence did not also affect perceptions of warmth.)

This pre-test was run on Prolific. In a simple within-subjects design, we presented participants (n = 151) with six variations of *high vs. low* manipulations of competence and six variations of *high vs. low* manipulations of warmth. Participants were asked to rate each manipulation on warmth ("This GP is warm") and competence ("This GP is competent"). Both ratings were made on a six-point scale (1 - strongly disagree, 2 - disagree, 3 - somewhat disagree, 4 - somewhat agree, 5 - agree, 6 - strongly agree).

Findings (Aim 1): We found that overall our manipulations were very successful in manipulating participants' perceptions of warmth and competence (e.g., cases where Cohen's d_z = 2.9).
Findings (Aim 2): We found that there was also substantial spill over (or leakage). Almost all manipulations of warmth also substantially and significantly affected perceptions of competence. The same was generally true for manipulations of competence affecting perceptions of warmth.

Competence manipulations (Effect sizes, p values, means and standard deviations for low and high)	d_z	p	Low ($\bar{x}$, σ)	High ($\bar{x}$, σ)
The GP's room is disorganised and there are papers scattered over the desk and floor. vs. The GP's room is organised and all the documents and papers are arranged neatly.				
- This GP is warm	0.85	< .001	3.19, 1.12	4.40, 0.79
- This GP is competent	1.61	< .001	2.61, 1.16	4.97, 0.73
It took two attempts to measure your respiratory rate as the GP made a mistake the first time. vs. The GP carried out the medical examination efficiently without any problems.				
- This GP is warm	.90	< .001	3.62, 0.95	4.57, 0.81
- This GP is competent	1.74	< .001	3.17, 1.12	5.27, 0.71

After the examination, the GP spent some time looking up your symptoms in a medical textbook from their shelf to aid with their diagnosis. vs. The GP made their diagnosis without needing to consult the medical textbook on their shelf.				
- This GP is warm	.16	.059	4.09, 0.95	4.25, 0.91
- This GP is competent	.55	< .001	3.96, 1.23	4.79, 0.91
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. vs. 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.				
- This GP is warm	1.36	< .001	2.85, 0.97	4.70, 0.87
- This GP is competent	2.20	< .001	2.47, 0.99	5.36, 0.75
The GP spent some time entering your symptoms into a decision support system on the computer to aid with their diagnosis. vs. The GP made their diagnosis without needing to consult the decision support system on the computer.				
- This GP is warm	.24	.005	3.88, 0.97	4.15, 0.93
- This GP is competent	.44	< .001	3.91, 1.10	4.58, 1.10
As your regular GP is unavailable you are seen by a junior GP who is in the second year of their three year training programme. vs. As your regular GP is unavailable you are seen by a senior GP with specialist knowledge on infectious diseases and treatments.				
- This GP is warm	.04	.549	4.15, 0.80	4.11, 0.78
- This GP is competent	.81	< .001	3.83, 0.81	4.82, 0.97

Warmth manipulations (Effect sizes, p values, means and standard deviations for low and high)	d_z	*p*	Low ($\bar{x}$, σ)	High ($\bar{x}$, σ)
As you enter the GP does not look up from the computer on the desk to look at you. vs. As you enter the GP looks up to welcome you with a warm smile				
- This GP is warm	2.92	< .001	2.01, 0.93	5.48, 0.62
- This GP is competent	1.01	< .001	3.38, 0.99	4.60, 0.90
Without any acknowledgement or greeting the GP begins the clinical consultation. vs. Before beginning the clinical part of the consultation the GP asks you a few questions about your general well-being.				
- This GP is warm	2.51	< .001	2.11, 0.99	5.07, 0.73
- This GP is competent	1.24	< .001	3.58, 1.11	5.11, 0.62
The GP sits behind the computer and does not make any attempt at eye contact throughout the consultation. vs. The GP moves away from the computer and turns towards you in order to speak to you face to face throughout the consultation.				
- This GP is warm	2.93	< .001	1.81, 0.82	5.26, 0.77
- This GP is competent	1.43	< .001	3.20, 1.07	4.94, 0.83
You notice that midway through the consultation the GP refers to you by the wrong name. vs. Throughout the consultation, the GP uses your first name when addressing you.				
- This GP is warm	1.74	< .001	2.74, 1.06	4.93, 0.82

- This GP is competent	1.43	< .001	2.73, 1.17	4.55, 0.87
During the consultation, the GP leaned away from you with their arms crossed. vs. During the consultation, the GP leaned towards you from a comfortable distance.				
- This GP is warm	1.57	< .001	2.66, 0.94	4.67, 0.89
- This GP is competent	.56	< .001	3.73, 0.99	4.33, 0.89
On the desk, you notice there are no pictures of the GP's family or friends. vs. On the desk, you notice there are some pictures of the GP's family and friends.				
- This GP is warm	1.00	< .001	3.68, 1.06	4.89, 0.79
- This GP is competent	.13	.148	4.45, 0.79	4.35, 0.82

Study 4: Pre-test 2 (Chapter 4)

Aim 1: To establish effective manipulations of trustworthiness within a vignette scenario

This pre-test was run on Prolific. In a simple within-subjects design (*n* = 149) we manipulated the trustworthiness of the GP (low vs. high) in two vignettes of consultation for symptoms of a common cold. The four manipulations were selected from pre-test 1 (two competence and two warmth) to add to the common cold vignette (see Study 3: Vignette) as they had the highest summed effect sizes for warmth and competence. The low trustworthiness condition contained the two low warmth and two low competence statements. The high trustworthiness condition contained the two high warmth and two high competence statements.

Low Trustworthiness		**High Trustworthiness**	
Low Warmth	*Low Competence*	*High Warmth*	*High Competence*
As you enter the GP does not look up from the computer on the desk to look at you	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	As you enter the GP looks up to welcome you with a warm smile	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 sits behind the computer and does not make any	It took two attempts to measure your	The GP moves away from the computer and	The GP carried out the medical examination

attempt at eye contact throughout the consultation	respiratory rate as the GP made a mistake the first time	turns towards you in order to speak to you face to face throughout the consultation	efficiently without any problems

The dependent variables were:
Warmth: This GP is warm
Competence: This GP is competent
Trustworthiness: This GP is trustworthy
All were rated as (1 - strongly disagree, 2 - disagree, 3 - somewhat disagree, 4 - somewhat agree, 5 - agree, 6 - strongly agree)

Findings (Aim 1): We found that overall the cues in the vignettes were very successful in manipulating participants' perceptions of warmth (Cohen's $d_z = 2.05$), competence (Cohen's $d_z = 1.34$), and trustworthiness (Cohen's $d_z = 1.23$). We also averaged the three dependent variables into one combination measure, which resulted in the same finding (Cohen's $d_z = 1.75$).

Trustworthiness manipulations					
(Effect sizes, p values, correlations, means, and standard deviations)	d_z	p	r	Low ($\bar{x}$, σ)	High ($\bar{x}$, σ)
- This GP is warm	2.05	< .001	- .238	2.21, 1.152	5.47, .851
- This GP is competent	1.34	< .001	- .078	3.36, 1.242	5.42, .823
- This GP is trustworthy	1.23	< .001	- .051	3.46, 1.228	5.33, .826
- Combination measure (average of three DVs)	1.75	< .001	- .154	3.01, 1.016	5.41, .774

Study 5: Vignette (Chapter 5)

<u>Please read the text below carefully and imagine that the situation described is real.</u>

For over a week you have been feeling really ill and experiencing cold-like symptoms. You have had a number of headaches and a high temperature (around 38°C – 39°C). Repeated coughing has caused you to develop a sore throat. Throughout the day your nose is either runny or congested (blocked) and you have been sneezing a lot. The symptoms persist during the day and throughout the evening. Since the symptoms started they have not really improved.

Today, you decided to see your GP. During the consultation, you discuss your symptoms, your previous illnesses and past medication usage. Your GP examines you and checks your lungs, nose, throat, and ears. Listening to your lungs with a stethoscope she tells you that she does not hear any crackling or wheezing. She mentions that the inside of your throat looks very red and she can feel swelling on the outside of your throat. She also feels swelling around your nose and notes that your sinuses are congested. She also records your pulse and respiratory rate before using a 'Fingerstick' to take a blood sample. The test is able to distinguish between viral and bacterial infections.

The results of the blood test are positive for a viral infection. Your GP tells you that the outcome of your blood sample and your presenting symptoms indicate that you have a viral throat infection. She explains that viral throat infections like these are most commonly caused by rhinoviruses entering your body through either your mouth, nose, or eyes.

After the examination she explains that for such symptoms there are two potential treatment options:

Treatment option: Take antibiotics
Treatment option: Rest only (without taking antibiotics)

She tells you not to worry and goes on to assure you that in this case, antibiotics will not work and will not help you recover any sooner than doing nothing. She adds that if you were to take antibiotics you may experience side effects such as diarrhoea, vomiting and rash. Lastly she mentions that if your symptoms worsen, or continue for a few more days, you should come back for a clinical review.

Key:
Italicized text represents the antibiotic information provided to participants in the complete information condition

Study 6: Self-report items (Chapter 5)

(Response scale for all items: 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Somewhat agree, 5 = Agree, 6 = Strongly agree)
(R) Represents reverse coded items

Wording: Please consider the decision you have just made (to take antibiotics / to rest only) and rate the extent to which you agree or disagree with the following sentences.

Action bias items:
In the previous situation…
1. I felt it would be best to wait and see rather than rush into acting (R)
2. I preferred to do something, rather than just do nothing
3. I wanted to take some action
4. I just wanted to get on and do something to try and solve the problem
5. I preferred to do nothing rather than act in a way that might backfire (R)
6. I thought it was better to do nothing and just rest instead (R)

Social norm items:
In the previous situation…
1. Other people like me would have taken antibiotics
2. Members of my family would have taken antibiotics
3. My friends would have taken antibiotics
4. Most people my age would not have taken antibiotics (R)
5. Most people I know would not have taken antibiotics (R)
6. I do not think that people who are similar to me would have taken antibiotics (R)

Information neglect items:
When making my decision…
1. I did not fully consider the information about antibiotics
2. I did not focus on the information about antibiotics
3. I did not pay a lot of attention to the information about antibiotics
4. I took the information about antibiotics into account (R)
5. I made sure I considered the information about antibiotics (R)
6. I took a moment to reflect on the information about antibiotics (R)

Source discrediting items:
In the previous situation…
1. I would not change my beliefs about antibiotics based only on the opinion of one GP
2. I did not think that the GP was telling the whole truth about antibiotics
3. I did not fully trust what the GP said about antibiotics
4. I thought that the GP was being totally honest with me about antibiotics (R)
5. I was confident that what the GP told me about antibiotics was trustworthy (R)
6. I completely believed what the GP told me about antibiotics (R)

Table 8

Participant responses of whether various treatment options were perceived as either inaction or action (n = 27).

	Inaction (*n*)	Action (*n*)
Treatment option (Antibiotics)		
Take antibiotics	0% (0)	100% (27)
Action: Take antibiotics	4% (1)	96% (26)
Rest (with antibiotics)	15% (4)	85% (23)
Treatment option (Rest)		
Action: Go and rest	59% (16)	41% (11)
Rest only (without taking antibiotics)	67% (18)	33% (9)
Action: The GP prescribes that you go and take three days rest	44% (12)	56% (15)
Fight the infection by taking three days rest	48% (13)	52% (14)
Take three days to look after yourself	56% (15)	44% (12)
Go and take three days to overcome the infection	74% (20)	26% (7)
Treatment option (Painkillers and Rest)		
Take painkillers and rest	15% (4)	85% (23)
Action: Take painkillers and rest for three days	18% (5)	82% (22)