The Use of "No Evidence" Statements in Public Health

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Abstract: Public health communication makes extensive use of a linguistic formulation that will be called the "no evidence" statement. This is a written or spoken statement of the form "There is *no evidence* that P" where P stands for a proposition that typically describes a human health risk. Danger lurks in these expressions for the hearer or reader who is not logically perspicacious, as arguments that use them are only warranted under certain conditions. The extent to which members of the public are able to determine what those conditions are will be considered by examining data obtained from 879 subjects. The role of "no evidence" statements as cognitive heuristics in public health reasoning is considered.

Résumé: La communication sur la santé publique emploie souvent une expression linguistique qu'on nommera «énoncé d'absence de preuve». C'est un énoncé écrit ou oral dont la forme est «Il n'existe aucune preuve que *P* » où *P* signifie une proposition qui décrit généralement un risque pour la santé humaine. Les arguments qui utilisent ces énoncés ne sont probants que dans certaines conditions. On examinera des données obtenues de 879 sujets pour déterminer la mesure dans laquelle les membres du public peuvent identifier ces conditions. On étudiera le rôle des énoncés d'absence de preuve comme heuristique employée dans les raisonnements sur la santé publique.

Keywords: argument from ignorance; health communication; heuristic; informal fallacy; logic; public health; reasoning; risk assessment; uncertainty

1. Introduction

One consequence of the rapid expansion of media reporting in the late 20th and early 21st centuries is that it can seem that we live in an age of constant health scares and other public health crises. On a daily basis we are confronted with stories about the safety of food, the risks associated with prescribed medications and immunizations, and potential harms associated with exposure to environmental toxins and to outbreaks of infectious dis-

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ease. Some of the most noteworthy of these episodes in recent years have involved the safety of beef for human consumption following the emergence of bovine spongiform encephalopathy (BSE) in cattle, the risk of thrombosis associated with the oral contraceptive pill and the role of measles, mumps and rubella (MMR) immunization in the development of autism in children, and outbreaks of SARS and avian and swine influenzas which have the potential to traverse the globe within hours of their first detection. Public reactions to these events have ranged from indifference to hysteria. Between these extremes in response lie the large majority of citizens who wish to receive rational, evidence-based advice from public health officials and political leaders. While this is an entirely reasonable expectation on the part of the public, it is also an expectation that is not readily satisfied in most of the public health crises that have emerged in recent years. This is because so many of these crises have involved pathogens (e.g., BSE, SARS), modes of transmission (e.g., international air travel) and diseases or disorders (e.g., autism) that are either novel or are still not well understood. Predictions about the risks of these events to human health are thus riven with uncertainty. Certainly, they are not the type of certain, infallible advice that the public expects to receive from its public health leaders.

Against this backdrop of inflated expectation, the public health professional must embark on a process of health communication with members of the public. The aims of this communication are many, and include the need to provide accurate information to people, to achieve the compliance of the public with important health measures, and to allay public anxiety and avert widespread and disabling panic. An important question for public health workers is clearly one of how this can best be achieved. It is argued in this paper that in recent years, public health officials have increasingly employed a particular logico-linguistic strategy in their health communications with the public. This strategy involves the use of "no evidence" statements, often with a frequency and consistency that can appear overwhelming, at least to certain observers. These statements have logical and linguistic properties that warrant examination on their own terms. But additionally, "no evidence" statements have become an important part of the communication toolkit of public health officials and workers in their engagement with the public. This paper examines both aspects of these commonly used, but somewhat neglected, statements.

The discussion begins with an examination of different forms of these statements in spoken and written public health

communications that have occurred in the last 20 to 30 years. These communications span a range of public health problems including the BSE epidemic in the UK, concerns about the human health risks of new technologies such as the genetic modification of food, and possible cancer risks associated with prosthetic breast implants. The paper will then consider the functions of "no evidence" statements in public health contexts. These functions are intimately connected with the logical attributes of these statements, and specifically their role as premises in arguments from ignorance. Finally, to the extent that these statements are generally employed with the aim of discounting certain risks to human health, and thus allaying public anxiety, the discussion considers if members of the public are adept at assessing the logical conditions under which this is a reasonable use of these statements. To address this issue, this part of the discussion will draw on data from 879 subjects who participated in a study of public health reasoning.

2. "No evidence" statements in public health

Even a cursory examination of some of the communications issued by national and international health agencies reveals the widespread use of "no evidence" statements by public health officials. These communications originate in different geographical regions, concern a wide range of public health issues and relay health advice to the public through broadcast and print media. In illustration of these statements, several examples will be considered in this section in preparation for discussion of the main linguistic and logical features of these statements in the next section. The emergence of BSE in British cattle in November 1986 marked the beginning of a particularly protracted and difficult period in the public health of the UK (Cummings 2010a). Such extensive use was made of "no evidence" statements by health officials during the ensuing epidemic that they became the mantra of the BSE affair.[1] Responding to media coverage of a suspected case of BSE transmission to a 15-year-

[1] In the 16-volume report published following the public inquiry into BSE, Lord Phillips (chairman) and his team remarked: "On each occasion that public concerns were raised about BSE, they were met with the same refrains—'There is no evidence that BSE is transmissible to humans'; 'It is safe to eat beef'" (BSE Inquiry 2000: 133). The report added, "risk communication in relation to BSE was flawed" (133).

old girl, the Chief Medical Officer, Dr Kenneth Calman, released a statement on 26 January 1994 in which he remarked:

> (1) On the basis of the work done so far, there is *no evidence* whatever that BSE causes Creutzfeldt-Jakob disease (CJD) and, similarly, *not the slightest evidence* that eating beef or hamburgers causes CJD. (BSE Inquiry 2000: 143)

Two variants of the "no evidence" statement, involving claims of "no reason" and "no scientific justification", also repeatedly appeared in public health advice about BSE. For example, following the announcement to British Parliament in March 1996 that BSE had transmitted to humans, the Spongiform Encephalopathy Advisory Committee (SEAC) advised Mr Stephen Dorrell, Secretary of State for Health, that:

> (2) There is *no reason* to believe that children are particularly susceptible to BSE. (BSE Inquiry 2000: 164)

On 17 May 1990, at the request of the Chief Medical Officer, Sir Donald Acheson, SEAC held an emergency meeting to consider the implications of the discovery of a spongiform encephalopathy in a domestic cat. Following the meeting, SEAC sent a letter to the Chief Medical Officer in which it was stated:

> (3) In our [SEAC's] judgement any risk as a result of eating beef or beef products is minute. Thus we believe that there is *no scientific justification* for not eating British beef and that it can be eaten by everyone. (BSE Inquiry 2000: 131)

A more recent health problem, which has caused particular concern for women, is the safety of poly implant prostheses (PIP) breast implants. In January 2012, Sir Bruce Keogh, the Medical Director of the National Health Service in the UK, presented an interim report of an expert group that had been convened to consider the safety of PIP implants. The report stated:

> (4) The expert group consider that, on the available data, there is *no evidence* that PIP implants are associated with a higher risk of breast cancer than other silicone gel implants. (6)

Shortly afterwards in May 2012, a fact sheet on silicone gel filled breast implants was issued by the Chief Medical Officer of the Australian Department of Health and Ageing. It stated:

> (5) There is *no evidence* of increased risk of breast cancer or connective tissue disorders. (1)
> There is *no evidence* that the risk of anaplastic large cell lymphoma in the breast for PIP breast implants is greater than for all silicone gel filled breast implants. (1)

In the same month, a statement from Ireland's Chief Medical Officer was released. It contained advice from the Department of Health and the Irish Medicines Board on PIP breast implants. It read as follows:

> (6) There is *no evidence* of increased risk of cancer for women with this implant.

New technologies continue to raise public health concerns. A number of national and international health agencies have attempted to address these concerns. In May 2010, a report on the potential health impact of wind turbines by the Chief Medical Officer of Health of Ontario, Canada stated that:

> (7) Concerns have been raised about human exposure to "low frequency sound" and "infrasound" from wind turbines. There is *no scientific evidence*, however, to indicate that low frequency sound generated from wind turbines causes adverse health effects. (6)

In May 1999, the UK's Chief Medical Officer, Professor Liam Donaldson, co-authored a report with Sir Robert May on the health implications of genetically modified (GM) foods. The report concluded:

> (8) We have considered the processes used in genetic modification in relation to events occurring in nature and in conventional plant breeding and we conclude that there is *no current evidence* to suggest that the process of genetic modification is inherently harmful. (23)

In May 2006, the World Health Organization (WHO) published a fact sheet on electromagnetic fields and public health. Based on a review of scientific research in the area, WHO arrived at the following conclusion:

> (9) Considering the very low exposure levels and research results collected to date, there is *no convincing scientific evidence* that the weak radiofrequency signals from base stations and wireless networks cause adverse health effects.

This list could be extended to include "no evidence" statements from a range of other public health contexts. But little would be achieved by enumerating further examples. Our primary data is certainly sufficient at this point to permit an examination of the logical and linguistic features of these statements. It is to this examination that we now turn.

3. Logical and linguistic properties of "no evidence" statements

The nine examples presented in section 2 are representative of the different types of "no evidence" statements used in public health contexts. On the basis of these examples, a number of general observations can be made about the linguistic and logical properties of these statements. In terms of their lexical features, "no evidence" statements are introduced by nouns that either have probative force (e.g., evidence, proof) or display epistemic attributes (e.g., justification, knowledge). These nouns are typically preceded by negative terms such as 'no' or 'not'. Occasionally, phrases such as 'a lack of' and 'an absence of' are used in place of negative words. One or more pre-modifying adjectives are normally present and express a temporal restriction on the noun (e.g., *current* evidence), describe the disciplinary origin of the evidence in question (e.g., *scientific* evidence) or reflect a probative standard that evidence may be expected to attain (e.g., *convincing* evidence). Some pre-modifying adjectives are intended to emphasize that there is not even a hint or trace of evidence in support of a proposition. The use of a superlative adjective is particularly effective in this regard (e.g., not the *slightest* evidence). Similar linguistic emphasis is achieved through the use of postpositive adjectives (e.g., no evidence *whatever*).

These linguistic features of "no evidence" statements are not mere stylistic or rhetorical devices. Rather, their true significance lies in the contribution they make to the logical properties of "no evidence" statements. Those properties can be best characterized in terms of an informal fallacy that logicians have variously called the argument from ignorance or *argumentum ad ignorantiam*. "no evidence" statements of the type examined here function as premises in these arguments. Schedler (1980: 70) effectively makes this point when he states that "…a reader assumes that 'there is no reason to believe P' at least implies, or perhaps is another way of saying, 'there is reason to believe P is false'…". The logical function of these statements can be seen

in the argument below, where the premise is a paraphrase of the "no evidence" statement presented in (8) above:

> PREMISE: There is *no evidence* that genetic modification of food is harmful.
> CONCLUSION: Therefore, genetic modification of food is *not* harmful.

This argument has the logical structure of a classic argument from ignorance, in which an arguer reasons from a lack of knowledge (evidence or proof) that P is the case (where P stands in this instance for the proposition "genetic modification of food is harmful") to the conclusion that P is *not* the case (i.e., genetic modification of food is *not* harmful). Similarly, an arguer may reason from a lack of knowledge (evidence or proof) that P is *not* the case to the conclusion that P *is* the case. Regardless of the (positive or negative) logical form of the argument used, all arguments from ignorance involve an (illicit) shifting of the negation operator (~). This is indicated by the following notation in which 'K*P*' stands for "proposition *P* is known to be true":

> *Positive logical form of argument from ignorance:*
> ~K*P* therefore ~*P*
> *Negative logical form of argument from ignorance:*
> ~K~*P* therefore *P*

Until some relatively recent developments in logic,[2] the standard view of this argument had been that it is fallacious on the grounds that the absence of evidence or knowledge that a proposition is true does not constitute proof that a proposition is false. It is not difficult to bring forward examples where the characterization of the argument as a fallacy is indeed warranted. At the outset of the BSE epidemic, "no evidence" statements such as the following were repeatedly used by health officials and politicians in an effort to alleviate public concerns about the disease:

> There is *no evidence* that BSE is transmissible to humans.

[2] The developments in question, which include the emergence of disciplines such as informal logic and argumentation theory, were largely ushered in by the publication of Charles Hamblin's book *Fallacies* in 1970. Hamblin's text railed against the so-called "standard treatment" of the fallacies. This landmark book is largely credited with transforming the study of fallacies from the "debased, worn-out and dogmatic" (12) treatments offered in logic textbooks to the more systematic analyses of these arguments that are now commonplace.

This "no evidence" statement was certainly factually correct—in 1986 and for several years thereafter, there was indeed no evidence that BSE was transmissible to humans. However, this statement went beyond merely informing a worried public about this new disease to raising a misleading implication in the minds of consumers. That implication took the form of a proposition to the effect that BSE was *not* transmissible to humans. Of course, public health officials could not reasonably make this latter claim at the outset of the BSE problem. The lengthy incubation period of spongiform encephalopathies, in some cases of several decades, meant that it would be many years before natural transmission of BSE to humans could be demonstrated. But such is the lure of this implication that health officials only needed to "trigger" it by using a "no evidence" statement and then leave the public to come to the conclusion that BSE is not transmissible to humans. The widespread public dismay at the announcement to British Parliament in March 1996 that BSE had transmitted to humans suggests that many people did indeed draw this particular conclusion.

However, alongside fallacious uses of "no evidence" statements, it is also possible to identify cases in which these statements have real probative value in a public health context. In a situation where a knowledge base in a particular domain is closed and has been exhaustively searched, and a proposition is found not to be contained within that base, it is then reasonable to conclude that the proposition in question is false. To demonstrate how conditions of *epistemic closure* and *exhaustive search* may be satisfied in a particular case, it is necessary to return to the BSE problem. The following argument from ignorance was used by Brown and colleagues in 1987, just months after the emergence of BSE in British cattle. The argument concluded a 15-year epidemiological study of CJD in France and a review of world literature on this disease by Brown et al. (1987):

> There is *no evidence* that scrapie in sheep is transmissible to humans.
> Therefore, scrapie in sheep is *not* transmissible to humans.

Certain features of Brown et al.'s investigation meant that the above argument from ignorance was able to satisfy conditions of epistemic closure and exhaustive search. Brown et al.'s epidemiological study of CJD had run over many years, during which time no transmission of scrapie to humans had been found to occur. This extended period of time was the basis upon which investigators were able to claim closure of the knowledge base on scrapie and its possible links to CJD. Brown et al.'s review of

the world literature further ensured that the knowledge base on scrapie and CJD had been exhaustively searched. Under these conditions, it was reasonable for Brown et al. to conclude, as in fact they did, that scrapie is not transmissible to humans. In this case, the absence of evidence in support of *P* did indeed constitute proof of *not-P*. This conclusion was to hold considerable significance for BSE investigators, as it was to become the basis of subsequent risk assessments of the disease.[3] But for our current purposes, this example demonstrates that "no evidence" statements, and the ignorance arguments that contain them, can be more or less rationally warranted in accordance with the satisfaction of logical and epistemic conditions such as epistemic closure and exhaustive search.

The discussion of the logical properties of "no evidence" statements is still not complete, however. For some mention must be made of the contribution to these properties of the linguistic features that were described at the outset of this section. Features such as pre-modifying superlative adjectives (e.g., not the *slightest* evidence) and postpositive adjectives (e.g., no evidence *whatever*) emphasize that the search of a knowledge base in a certain domain has been particularly exhaustive. The use of temporal adjectives (e.g., no *current* evidence) indicates that while a knowledge base may be closed at a certain point in time, it may need to be opened in the future as new evidence is forthcoming. Expressions such as "no *convincing* evidence" and "no *scientific* evidence" stipulate the type of evidence that can legitimately be included in a knowledge base. The evidence in this base must attain a certain minimum probative standard (i.e., it should be *convincing*). It must also originate from a rational inquiry such as science rather than from divine, spiritual or mystical sources (or a host of other irrational enterprises). It is in this sense that the linguistic features of "no evidence" statements are not superficial stylistic or rhetorical devices. Rather, these features are contributing to the logical function of "no evidence"

[3] The conclusion that "scrapie is not transmissible to humans" formed the minor premise in the following frequently employed analogical argument during the BSE crisis. This argument became the mainstay of scientific risk assessments of BSE:

> MAJOR PREMISE: Scrapie and BSE are similar in certain respects.
> MINOR PREMISE: Scrapie is not transmissible to humans.
> CONCLUSION: Therefore, BSE will not be transmissible to humans.

statements through their stipulation of the type of knowledge base that can stand in a particular domain.

4. The psychology of "no evidence" statements

The discussion so far has focussed on the logico-linguistic properties of "no evidence" statements. On the basis of these properties, it was shown that some uses of these statements in arguments from ignorance in a public health context are rationally warranted while other uses fall short of an acceptable rational standard and are, accordingly, judged to be fallacious. However, an issue of some interest concerns the psychology of these statements. This is because these statements are used in public health communication not only with an informative purpose, but also with the purpose of *persuading* members of the public to adopt certain beliefs or pursue particular courses of action. And this latter purpose is decidedly psychological in nature. The issue of the psychological attributes of "no evidence" statements naturally resolves into two parts. Firstly, we want to consider the psychological character of these statements from the point of view of the public health official or other professional who uses these statements in communication with the public. The public health communicator is motivated by a wide-ranging set of goals, which is often at odds with logical ideals relating to the use of valid, or at least rationally warranted, arguments. Secondly, we also need to consider the psychological character of "no evidence" statements from the point of view of the members of the public to whom these statements are directed. Through reasons of indifference or cognitive limitations, the public may adopt a very different response to "no evidence" statements from the one intended by public health officials. This aspect of the issue can be usefully addressed by examining data from a recent study of public health reasoning by 879 members of the public.

Although "no evidence" statements can assume a number of forms in public health contexts, one almost consistent feature of these statements are the factors that motivate their use. These factors invariably involve a concern on the part of public health communicators to allay public anxiety and avert widespread panic even in cases where anxiety and panic are not altogether unwarranted. How can the agents of public health communication best achieve this reduction in anxiety? For the most part, it seems that this question has been answered by ensuring that public health communication is used to minimize, or in some

cases even trivialize, the human health risks associated with a particular action, state or event. Thus, communications of the form "There is *no evidence* that X causes adverse health effects" are routinely released through the print and broadcast media in the certain knowledge that a guileless public will subconsciously conclude that "X does *not* cause adverse health effects". These statements are certainly not without their merits from the point of view of the person who employs them in public health communication. They are "safe" statements in that the speaker who produces them knows he is uttering a factually correct statement—on many occasions there is indeed no evidence that a particular X (food additive, immunization, etc.) causes adverse health effects. Legal repercussions are thus minimized and scientific standards of truth and objectivity are upheld as the speaker is not heard to utter a falsehood. These statements are also logically seductive in that the speaker who uses them knows that an inference to the effect that X does *not* cause adverse health effects is almost automatic on the part of the hearer. So, the public health official secures his desired communicative aim—a belief on the part of the hearer that X does *not* cause adverse health effects—without incurring negative consequences, which include a loss of scientific standing and possible legal redress.

Of course, it may be argued that this is merely one interpretation of the psychological propensities of the speaker who uses "no evidence" statements in a public health context. Moreover, it may also be claimed that this interpretation is somewhat unfair on the question of what motivates such a speaker to produce these statements. However, if we return to the actual use of these statements in public health contexts, it can be seen that this interpretation is not without support. Only occasionally do public health communicators include additional information that serves to qualify "no evidence" statements. This information may be seen to describe conditions that preclude the closure of a knowledge base in a particular area or limit the extent to which this base can be exhaustively searched. In the absence of the fulfilment of these logical and epistemic conditions, a hearer is much less inclined to conclude from a *lack* of evidence that X causes adverse health effects that X does *not* cause adverse health effects. A rare example of the use of this additional information during the BSE epidemic occurred in a press release in October 1995 by the then Chief Medical Officer, Dr Kenneth Calman. Dr Calman's statement marked the publication of the fourth annual report of the CJD surveillance unit. He remarked:

> I continue to be satisfied that there is currently no scientific evidence of a link between meat eating and development of CJD and that beef and other meats are safe to eat. However, in view of the long incubation period of CJD, it is important that the Unit continues its surveillance of CJD for some years to come. (BSE Inquiry 2000: 149)

If we compare this statement with Dr Calman's statement in (1) above, we can see that the Chief Medical Officer is displaying greater caution on this occasion. During this press release, there are at least two ways Dr Calman signals that the knowledge base on CJD cannot be closed. His use of the adverb 'currently' indicates that our knowledge base on CJD may have to be revised at a later point in time if new evidence emerges. Also, Dr Calman describes a condition that precludes the closure of the base—the lengthy incubation period of CJD.

The BSE epidemic found public health officials acting under the dual pressures of containing an escalating animal and human health problem and managing a growing sense of public disquiet. This wider context inevitably influenced the frequency and nature of public health communication during the BSE affair. However, not all public health communication takes place in a context of crisis management of the kind that Dr Calman and his colleagues confronted. Some of the "no evidence" statements examined in section 2 were produced by expert advisory groups convened to consider the health risks of certain activities (e.g., the use of wind turbines). These groups met under very different conditions from those that characterized the work of public health officials during the BSE crisis. These expert groups were able to engage in an altogether slower process of deliberation in which all the scientific evidence relating to a particular public health concern was fully considered. Also, there was no public clamour for urgent measures to be taken to address a rapidly escalating public health problem. In this very different context, "no evidence" statements were not used by public health officials to achieve public reassurance by dismissing health risks. Rather, these statements were intended by those who used them to reflect a robust assessment of risk based on a rational, deliberative process of inquiry. The psychological disposition of the public health communicator in this latter scenario was not to allay public anxiety at all costs—even at the costs of misguiding the public—but to provide a balanced risk assessment based on scientific evidence. The use of "no evidence" statements in this type of scenario was thus less a tool of public pacification and more an instrument of rational appraisal.

Thus far, we have considered the psychology of "no evidence" statements from the point of view of the speaker who uses them. This speaker was characterized as operating with quite different priorities in different public health contexts. If the speaker's intention in communicating was primarily to allay public anxiety by dismissing or trivializing health risks, "no evidence" statements were often pressed into use in order to achieve this goal. These statements were a largely effective, but ultimately deceptive, means of pacifying a public worried about health risks. In the case of BSE, unsuspecting members of the public were not aware that these statements were being used in fallacious arguments from ignorance, preferring instead to acquiesce in the reassuring conclusion of "no health risk" that these arguments appeared to suggest. In other public health contexts, these same arguments marked the conclusion of a robust process of risk assessment in which there was full consideration of all the scientific evidence relating to a particular health concern. Under conditions in which there is an exhaustive search of a closed knowledge base by an expert advisory group, for example, claims of "no health risk" were often rationally warranted. The psychological dispositions of speakers are thus intimately connected to both rational and fallacious uses of "no evidence" statements in arguments from ignorance. These dispositions can transform the use of "no evidence" statements from a rational strategy of risk assessment on one occasion to a deceptive strategy whose purpose is to deflect public anxiety on another occasion. To the extent that psychological attributes influence how speakers use "no evidence" statements, it is interesting to ask if the recipients of these statements, namely members of the public, have certain psychological capacities that guide their response to these statements. It is to this issue that we now turn.

5. Testing public understanding of "no evidence" statements

"No evidence" statements in public health are assessed for their logical or other merits by members of the public. It is, therefore, relevant to ask if people have the type of rational psychological capacity that equips them to undertake this assessment. This was the question addressed by a recent study of public health reasoning in 879 subjects (see Cummings (2014a, 2014b, 2014c, 2014d, 2014e, 2015) for full details and discussion). Among other issues, this study examined the logical and epistemic conditions under which subjects accepted or rejected "no evidence" statements used in arguments from ignorance. Participating sub-

jects, who were aged between 18 and 65 years and were drawn from diverse educational, socioeconomic and ethnic backgrounds, were required to assess eight public health scenarios. These scenarios were presented to subjects in the form of a written questionnaire, which was completed anonymously. The scenarios, which are briefly described in Table 1, were followed by four questions. Two of these four questions were designed to check if the respondent had understood explicit information contained in the passage. These questions created the impression for respondents that they were engaging in a reading comprehension task rather than participating in a reasoning experiment.[4] A third question was intended to establish if the respondent had drawn a particular inference from an ignorance argument. A fourth question invited an open-ended response in which the respondent was encouraged to expand on his or her reasons for judging "no evidence" claims in a certain way. Passages were devised so as to vary the two logical conditions (*epistemic closure* and *exhaustive search*) under which arguments from ignorance are assessed to be more or less rationally warranted (see Table 1). Because prior beliefs about an issue or topic have been found to influence reasoning, an equal number of actual and non-actual (but plausible) public health scenarios were employed.[5] An example of one of the public health scenarios used in the study is presented below. This scenario was used to represent the logical condition <full closure, exhaustive search>:

> A new asthma drug is about to be released onto the market. As with all new drugs, it has undergone extensive clinical trials. These trials have been conducted in several

[4] There is considerable evidence of contextual effects on human reasoning. For example, the type of instructions given to subjects can affect their performance on reasoning tasks (Valentine 1985). With this in mind, it was considered important not to make subjects aware that the purpose of the study was to examine respondents' ability to draw inferences about public health problems. Such an instruction may have disinclined subjects to derive inferences from information in the passages when these same inferences may have been readily generated under other circumstances.

[5] It is expected that background knowledge and beliefs will affect the information that subjects attend to in the passages and the significance that subjects attach to this information. As Klahr (2000: 30) remarks: "When people are reasoning about real world contexts, their prior knowledge imposes strong theoretical biases…These biases influence not only the initial strength with which hypotheses are held—and hence the amount of disconfirming evidence necessary to refute them—but also the features in the evidence that will be attended to and encoded".

medical facilities in North America, the UK and Europe. The drug has been tested by the pharmaceutical manufacturer on a range of human subjects, including children and adults of different ages and both sexes. In total, several thousand subjects participated in the trials. The manufacturer wants an independent review of the findings of these studies to be conducted by experts on drug safety. To this end, a committee of pharmacologists, statisticians and physicians in respiratory medicine is assembled to assess the efficacy and safety of the drug in question. After extensive consideration of all the available evidence, the committee concludes that there is no evidence that the asthma drug is unsafe.

(a) Is the new drug to be used in the treatment of arthritis?
(b) Is the new drug safe for use in human subjects?
Yes No Don't know
(c) Name two types of experts on the committee.
(d) Please explain your response to (b).

1	***Full closure; exhaustive search; actual scenario:*** Risk assessment of the transmissibility of scrapie to humans
2	***Full closure; exhaustive search; non-actual scenario:*** Assessment of findings from clinical trials of a new asthma drug
3	***Incomplete closure; limited search; actual scenario:*** Risk assessment of the transmissibility of BSE to humans
4	***Incomplete closure; limited search; non-actual scenario:*** Health risks associated with chemicals in effluent from a pharmaceutical plant
5	***Full closure; limited search; actual scenario:*** Assessment of the safety of genetically modified foods
6	***Full closure; limited search; non-actual scenario:*** Assessment of the safety of a food additive in dairy products
7	***Incomplete closure; exhaustive search; actual scenario:*** Safety of swine flu immunization
8	***Incomplete closure; exhaustive search; non-actual scenario:*** Location of the source of an outbreak of severe food poisoning

Table 1. Description of public health scenario

The results from this study provide general support for the claim that members of the public exercise a rational psychological capacity when required to assess "no evidence" statements in a public health context. Moreover, this capacity largely reflects the logical and epistemic distinctions that were characterized

above in terms of the epistemic closure and exhaustive search of a knowledge base. Subjects accepted more inferences under conditions of <full closure, exhaustive search> than under any other condition, and rejected more inferences under conditions of <incomplete closure, limited search> than under any other condition. The following diagram shows that these acceptance and rejection rates accord with the logical and epistemic conditions which, it was argued above, confer the greatest and the least rational warrant, respectively, on "no evidence" statements in arguments from ignorance:

MAXIMUM

Rational Warrant

(1) Full closure, exhaustive search: 68.4% accept; 31.6% reject
(2) Full closure, limited search: 33% accept; 67% reject
(3) Incomplete closure, exhaustive search: 16.6% accept; 83.4% reject
(4) Incomplete closure, limited search: 10.3% accept; 89.7% reject

MINIMUM

Moreover, a number of significant Pearson chi-square values indicated that differences in acceptance and rejection rates could not be explained by chance. For example, the distinction between the full and incomplete closure of a knowledge base (scenarios 3 and 6) and an exhaustive and limited search of that base (scenarios 8 and 4) both resulted in significant chi-square values of 0.029 and 0.022 ($p < 0.05$), respectively. Findings of this type suggested that these logical and epistemic conditions had some psychological reality in whatever rational capacity subjects were using to make judgements about the public health scenarios contained in the passages. Responses to the open-ended questions after each passage confirmed these quantitative findings and supported the idea that these conditions held true logical sway for the subjects in this study. In response to the above passage concerning a new asthma drug, many respondents made comments which suggested that they were satisfied that the drug's manufacturer had made every reasonable effort to ensure that the knowledge base was closed (evidence had been gathered from "extensive clinical trials" involving "several thousand subjects"), and that this base had been exhaustively searched (a committee of experts considered "all the available evidence").

This was a sufficient basis for these subjects to conclude that if there was no evidence that the asthma drug was unsafe then it was not unsafe (i.e., it was safe). In this way, a 25-year-old, white British, university educated man responded:

> If after considering the evidence from several thousand tests on people of various ages and both genders did not produce any evidence that the drug is unsafe then it must be safe for human use.

The verbal expressions used by a number of respondents indicated that they were making direct use of logical features of the argument from ignorance in guiding their judgements. A 39-year-old, white British, university educated woman stated that "double negative indicates a positive", which is a reference to the use of two negative terms in the statement "there is *no* evidence that the drug is unsafe (*not* safe)". The word 'positive' in this woman's response refers to the movement of the first of these negative terms in front of the adjective 'unsafe' to result in the 'positive' adjective 'safe'. Similarly, respondents were often quite forthright in expressing when they believed that logical and epistemic conditions had not been adequately fulfilled by "no evidence" statements and the arguments that contained them. For example, many subjects recognized that the lengthy incubation period of transmissible spongiform encephalopathies meant that it would be many years before investigators could reasonably claim a closed knowledge base on BSE. Certainly, the relatively short period between the emergence of BSE in 1986 and public health pronouncements "in the late 1980s" suggesting that there was no evidence of the disease's transmission to humans was judged by many subjects to be an inadequate timescale for this closure to take place. One subject, a 50-year-old, white British, secondary level educated man, used an analogy with asbestosis to indicate that health risks often only become apparent many years after the point of exposure to a noxious substance or agent. For this respondent, insufficient time had elapsed by the late 1980s for the absence of BSE transmission to humans to have any real probative value in this case:

> The lack of evidence could be attributable to the long incubation period. For instance, asbestosis can occur 30 years after exposure to asbestos. BSE only emerged in 1986; without long historical data how can we tell how long the incubation period of a human version of BSE would be?

Similarly, subjects were also able to discern when some, but not all, of the logical and epistemic properties of arguments from ignorance were satisfied in a public health scenario. For example, in passage 5, the issue of the safety of genetically modified foods was examined. In their consideration of this passage, some subjects could be seen to weigh up a number of different factors. Some of these factors suggested the knowledge base on GM foods was likely to be closed (full closure), while other factors indicated that an exhaustive search of the base had not taken place (limited search) and, therefore, that any conclusion based upon this search was likely to have limited rational warrant. Negative factors tended to "win out" in a scenario of this type, with only 17.6% of respondents accepting, and 82.4% rejecting, the conclusion suggested by the "no evidence" statement in this case. The respondent who produced the following comment, a 37-year-old, white British, university educated man, identified that the search of the knowledge base was compromised on this occasion:

> There has been extensive testing of GM foods and a large amount of evidence is available but since the scientist has not studied the evidence he cannot make a valid argument and we cannot make a balanced decision.

This same respondent also consciously weighed up competing factors in passage 6, which examined the use of a food additive in dairy products. Once again, the negative epistemic property of this passage (limited search) tended to outweigh the positive epistemic property (full closure), with only 33% of respondents accepting, and 67% rejecting, the conclusion suggested by the "no evidence" statement:

> We don't know if the additive is safe for human consumption even though there is available extensive literature on the additive in question as the scientist who appeared on the TV programme had not read much of the information therefore he cannot justify this statement and we cannot make a judgement.

In general, respondents' judgements were more heavily influenced by negative epistemic considerations than by positive epistemic considerations. This was suggested by three findings. Firstly, even when respondents attempted to weigh up negative and positive epistemic properties, as the above respondent did, it was more often than not the negative epistemic attribute that emerged as decisive in judgement-making. Secondly, in many cases no attempt was made to balance negative and positive ep-

istemic attributes. Rather, respondents settled on the negative attribute *limited search* as the basis of their decision-making:

> [T]he scientist stating GM foods are safe has not studied the details in depth therefore his opinion is unreliable evidence. (64-year-old, white British, secondary level educated woman)

> [T]he scientist claiming that there is no evidence that the food additive is unsafe is aware of but not read the extensive literature available on this subject, therefore it is his personal theory that it is safe. (40-year-old, Pakistani Asian, secondary level educated woman)

Thirdly, the tendency to give priority to negative epistemic factors over positive factors also manifested itself in an upward shift in the logical standard applied to a case. There was evidence that when a negative epistemic attribute such as *limited search* existed alongside a positive epistemic attribute such as *full closure*, the logical bar on the latter property was raised. That is, subjects appeared to operate with a higher standard on what was allowed to constitute the full closure of a knowledge base. This was suggested by the finding that for many respondents, key statements in passages 5 and 6, such as "extensively field-tested and laboratory-tested over many years", "widely used for 40 years" and "the subject of numerous studies", did not lead them to conclude that the knowledge bases on GM foods and the dairy food additive were adequately closed. This was despite the fact that similar expressions in other scenarios appeared to give respondents confidence that the knowledge bases in these cases were closed:

> Scientists have studied impact of GM foods on human health, and there is no evidence that it is unsafe. However, this does not mean that there will not be long term effects or as yet undetected adverse effects of GM foods. (50-year-old, white British, university educated woman)

> The additive has been widely used for 40 years and during that time numerous tests have been undertaken. That suggests safety, but doesn't constitute proof of it. (62-year-old, white British, university educated man)

The presence of a negative epistemic attribute appeared to heighten subjects' logical acuity, with the result that they went on to impose a higher standard on what constituted the full closure of a knowledge base in a particular domain. This tendency

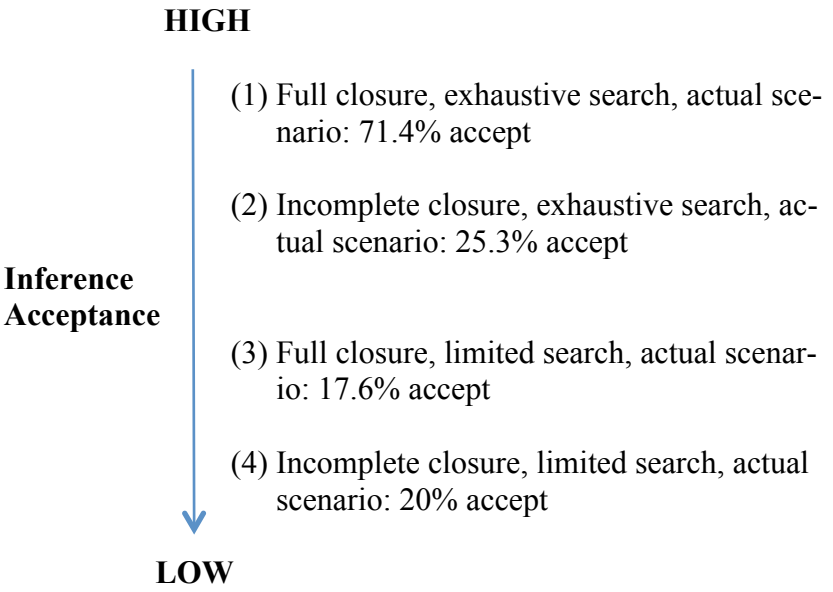
was confirmed in passages that examined the epistemic conditions *incomplete closure* and *exhaustive search*. The negative epistemic attribute *incomplete closure* raised the logical bar on what constituted the exhaustive search of a knowledge base. Accordingly, in the passage that examined the safety of swine flu immunization (passage 7), some subjects commented that they were not fully satisfied with the scientific review that had been conducted of the evidence. This was despite the fact that the passage stated that the results of trials "were reviewed at length by drug regulatory agencies around the world (e.g., the Food and Drug Administration in the United States)":

> Although no evidence that it was unsafe was found it doesn't mean that in ***a larger scale review*** or longer term study wouldn't find evidence. (36-year-old, white British, university educated man)

Similarly, in the food poisoning scenario described in passage 8, respondents were informed that environmental health services had investigated all food processing outlets mentioned in the case histories of people who had developed gastrointestinal symptoms. This information was intended to satisfy a condition of exhaustive search. But once again, subjects often failed to attribute any probative weight to this statement. This statement clearly fell short of what respondents were prepared to accept as constituting an exhaustive search on this occasion. Accordingly, when asked to assess the claim by the Director of Public Health that "there was no evidence that the abattoir was the source of the outbreak", it appeared to some subjects as if there was no basis for this statement whatsoever:

> Although the Director of Public Health stated that there was no evidence that an abattoir was the source of the outbreak of food poisoning, ***it is not clear what he based this statement on***; for example, it is not clear if public health officials had investigated abattoirs in the locality. (43-year-old, white British, university educated woman)

The negative lens through which positive epistemic attributes came to be viewed might explain the marked decrease that occurred in inference acceptance rates between the conditions <full closure, exhaustive search> on the one hand, and the conditions <incomplete closure, exhaustive search> and <full closure, limited search> on the other hand. This decrease is indicated in the scale below as the difference between (1) and (2), and (1) and (3), respectively:



An explanation of this negative tendency, I argue, is to be found in a logical bias in conditional reasoning known as the negative conclusion bias (Evans 2005). At the heart of the argument from ignorance is a modus tollens inference (Cummings 2010a). This is shown below in schematic form (left) and as applied to an argument from ignorance (right):

If *P* then *Q*	If X causes cancer, then X would be in our cancer knowledge base.
Not-*Q*	But X is *not* in our cancer knowledge base.
Therefore, not-*P*	Therefore, X does *not* cause cancer.

When in the form of an affirmative conditional statement (as above), the modus tollens inference is solved about 75% of the time (Evans 2005). This rate decreases to around 40% to 50% of the time when a negative is introduced into the first part of the conditional and the conclusion is in the affirmative, as is shown below:

If not-*P* then *Q*
Not-*Q*
Therefore, *P*

This large and reliable decrease has been demonstrated across many studies and is explained by a double negative effect (Evans 2005). For the conclusion of the second modus tollens

inference above is effectively "not not-*P*", that is, *P*. The marked decrease in inference acceptance by the subjects in this study can also be explained in terms of a double negative effect. If we return to the passage on the safety of swine flu immunization—one of the scenarios where this marked decrease was observed to occur—we can see how this pattern of response can be explained in terms of a negative conclusion bias. The modus tollens inference, which is the basis of the argument from ignorance in this passage, can be characterized as follows:

> If swine flu immunization were *not* safe (i.e., unsafe), then a scientific review of the evidence would reveal this to be the case.
> But a scientific review of the evidence did *not* reveal this to be the case.
> Therefore, swine flu immunization is *not* unsafe (i.e., is safe).

Whatever ultimately stands as an explanation of the logical performance of the subjects in this study, one thing is certainly clear: members of the public are reasonably adept at recognising the logical and epistemic conditions under which "no evidence" statements in arguments from ignorance are more or less rationally warranted. This finding raises an interesting question of what logical or other purpose might be served by this particular rational capacity. It is to this question that we now turn.

6. Arguments from ignorance as cognitive heuristics

This study has revealed a rational competence on the part of subjects that has been all but completely overlooked by the types of reasoning experiments that have been conducted by psychologists over many years. The focus of these experiments has typically been on deductive and inductive forms of reasoning, with some of the most prominent experimental work including the mental models theory of deduction of Philip Johnson-Laird (Johnson-Laird and Byrne 1991) and the probabilistic reasoning investigations of Amos Tversky and Daniel Kahneman (Tversky and Kahneman 1974, 2004). No one could reasonably deny that these studies have produced a wealth of knowledge about human reasoning. For example, we know the syllogisms that subjects can readily judge to be valid or invalid and the syllogisms that lie beyond the logical capacities of most people (e.g., Copeland and Radvansky 2004). We know the biases and errors that afflict human reasoning and the different factors

make these flaws more or less likely to occur (e.g., Klauer et al. 2000). We also know the developmental stages that children pass through on their way to acquiring logical competence (e.g., Bara et al. 1995) and how this competence may be disrupted or impaired in adults with a range of pathological conditions (e.g., Mirian et al. 2011). Notwithstanding an impressive display of experimental findings, this knowledge of human reasoning has been achieved at quite a substantial cost. That cost has been the misrepresentation of some of our most important rational resources.

For all the insights about reasoning that this important body of work has provided, the approach of these studies has been limited in several respects. (The reader is referred to Cummings (2015) for a fuller discussion of these respects.) Firstly, there has been a preoccupation with deductive and inductive forms of reasoning to the exclusion of other types of reasoning (e.g., presumptive, defeasible reasoning). This continues to be the case in psychological studies even though our daily reasoning practice suggests that deduction and induction are not the only, or even the dominant, modes of reasoning that people use in their daily affairs. (Woods (2013) has recently characterized these other modes of reasoning as "third way reasoning", and has pursued a program of naturalized logic within which the current view of fallacies finds an agreeable home.) Secondly, studies have operated with a pre-determined notion of the normative standard that reasoning must be expected to attain in order to qualify as good (valid, sound, etc.) reasoning. This standard is typically infused with rules and criteria taken from deductive logic (less often, inductive logic). Woods (2013) has remarked that "[i]mposing those standards on all of reasoning is a momentous interference" (10). The belief that deductive validity is the only or "best" standard of rational inference (so-called "deductivism") continues to have a powerful grip on studies of logic, including experimental studies. (The reader is referred to chapters 2 and 5 in Cummings (2015) where deductivism and inductivism in logic are challenged.) Thirdly, any deviation from a deductive or inductive standard is treated as a flaw or error of reasoning, which is to be avoided as it reveals the perpetual tendency of human beings to slip into irrational, illogical thinking. Fourthly, reasoning has largely been examined apart from the wider contexts in which it occurs. Experimental tasks typically present subjects with one or two premises from which they are expected to confirm or derive a conclusion. The current study opposes all four of these features of the psychological

studies of reasoning that have been conducted to date. The rest of this section will be devoted to explaining how and why.

In section 3, it was described how the argument from ignorance is one of a group of arguments known as the informal fallacies. As their name suggests, these arguments have been viewed by logicians as examples of weak or shoddy reasoning with the particular defect in each case evading characterization in terms of formal or deductive logic (hence, the use of the term 'informal'). This group of arguments, which includes other well-known names such as question-begging argument, straw man and the argument from authority, have more recently been characterized as instances of presumptive reasoning (Walton 1996). Presumptive reasoning has been largely overshadowed by deduction and induction in psychological and philosophical discussions of reasoning. The reasons for this neglect are clear enough. Presumption is a low-grade epistemic category that is defeasible and, hence, readily overturned and rejected (Rescher 2006). It cannot claim the type of epistemic absoluteness associated with the certain, known premises of deduction. But the perceived weakness of presumptive reasoning from the deductivist's viewpoint constitutes an epistemic virtue in a range of other contexts. In Cummings (2010a), one such context—the scientific inquiry into BSE—was explored at length. In that book and related publications (Cummings 2002, 2009, 2011), it was described how the tentative nature of presumptions rendered this concept ideally suited to the epistemic context that confronted scientists when BSE first emerged in British cattle. That context was one of pervasive uncertainty, with public health officials having to make risk assessments and institute protective health measures often on the basis of little evidence or knowledge. Against this epistemic backdrop, the presumptive character of the argument from ignorance and other informal fallacies was shown to be directly facilitative of inquiry.

So, presumptive reasoning has epistemic and logical merits when viewed within certain contexts of use. Later, we will say more about these merits. For the moment, it is important to emphasize that these contexts are lost to most (or all) psychological studies of reasoning. This is because these studies abstract human reasoning from the contexts that are its true home. By locating the investigation of reasoning within the context of public health deliberations, the current study aims to reconnect reasoning with the wider epistemic notions that are its very essence. Concepts such as beliefs are not confounding variables that need to be controlled in a psychological experiment. Rather,

they form the wider context of purposes, goals and intentions for which reasoning is undertaken. It is directly relevant to the evaluation of reasoning during a public health problem, for example, to know the purpose for which a risk assessment is undertaken. Is the purpose to protect human health, to avert severe economic consequences for a particular industry, or to restore confidence in a public immunization program? It is also relevant to an appraisal of public health reasoning to know the physical constraints that confront investigators. These constraints often involve temporal as well as technical limitations, in that decisions may need to be made within very short timescales and are often restricted by the experiments that are technically possible in a particular case. Further contextual considerations that are integral to an evaluation of public health reasoning include the consequences of inaction or any delay in action. Such consequences may range from death or serious illness of a large number of people to minor physical ailments that have little or no long-term implications for human health. It is simply not possible to abstract reasoning from these types of considerations in a public health context (or, indeed, in any other context).

Once one admits contextual considerations within an evaluation of reasoning, it is no longer possible to apply a predetermined normative (generally deductive) standard to that reasoning. This is because what constitutes "good" or "valid" reasoning in a particular case—similarly, "bad" or "invalid" reasoning—must emerge from the context at hand and cannot be represented by context-invariant ideals of deductive validity and soundness. The type of reasoning that facilitates the wider goals and aims of public health is likely to be an anathema to the deductivist. This reasoning can, and does, include jumping to conclusions, arguing in circles and from a lack of knowledge, and using quick "rules of thumb" which exploit similarities between situations and the opinions of trusted authorities. Not only do these non-deductive practices work well in public health and other contexts, but many (or all) of them are the reasoning strategies we have identified as the informal fallacies. Alongside the argument from ignorance, several of these non-deductive practices have now been examined in a public health context. This includes fear appeal argument, analogical argument, circular argument and the appeal to authority (Cummings 2004, 2010a, 2012a, 2012b, 2012c, 2013a, 2013b). Of course, each of these practices would be found wanting if they were assessed by a deductive logical standard. In fact, the original characterization of these practices as fallacies was more often than not for the rea-

son that they fell short of a deductive standard in reasoning.[6] But once one concedes that deduction is not the only, or even the most appropriate, normative standard to apply to the evaluation of reasoning, these various non-deductive practices can be viewed in an altogether more positive logical light. Certainly, this has been the rationale for recent pragmatic and presumptive frameworks for the evaluation of the informal fallacies (see Cummings (2010b) for discussion of one such framework).

So, there is nothing inherent in human reasoning that means it must be assessed by a normative standard based on deductive logic. And even more conclusively, there is nothing inherent in human reasoning that means that any deviation from this standard represents an aberration of our rational capacity or is an instance of fallacious reasoning. Certainly, there are numerous non-deductive ways to commit fallacious reasoning in public health and other contexts (see Cummings (2005) for discussion of some of these ways). Even as deductive logic is eschewed as a normative standard for reasoning in a range of contexts, we are not thereby losing sight of the rational in public health reasoning or anywhere else for that matter. Rationality and reason are still the baseline from which we proceed in reasoning and against which all of our deliberative practices must be judged. It is simply that this rationality is no longer constrained by deduction and is seen to have many non-deductive facets. As the current study demonstrated, subjects were at no loss to adduce reasons for their dissatisfaction with the reasoning of particular public health scenarios. In fact, even when such reasons were not part of the explicit information of the passages, subjects were seen to exercise their rational competence in numerous other ways, such as drawing on background knowledge of public health issues or forging connections with earlier, similar cases. Subjects may well not have been exercising a deductive logical competence in their assessment of these scenarios. In fact, they were almost certainly not exercising such a competence. But they were nonetheless exercising *some* rational competence in their judgement of these scenarios. The rejection of deduction was, therefore, not a more thoroughgoing rejection of rationality itself.

The elements are now in place for the view of arguments from ignorance as cognitive heuristics that will be presented in

[6] An exception is question-begging argument—also known as *petitio principii* or circular argument—which is a deductively valid, but fallacious, argument. The reader is referred to Cummings (2000) for discussion of non-fallacious variants of this argument.

the rest of this section. Those elements are that reasoning in public health is presumptive in nature, is sensitive to features of context, is warranted by pragmatic criteria and is inherently rational, notwithstanding the presence of errors or fallacies on occasion. The argument from ignorance is able to function so effectively in a public health context exactly because it exhibits each of these attributes. To demonstrate this, it is instructive to return to the BSE epidemic. Throughout this epidemic, but particularly during the early phase of the crisis, "no evidence" statements were used extensively by public health officials. It was described above that some of these uses were problematic because they sought quick and easy reassurance of the public at the expense of providing an accurate risk assessment of BSE. However, other uses were genuinely facilitative of the scientific inquiry that was conducted into this disease. For example, the argument from ignorance generated presumptive conclusion that investigators were able to use to inch forward in inquiry on a tentative basis until such times as further evidence was forthcoming. In the presence of contrary evidence, the defeasible nature of these presumptive conclusions meant that they were readily overturned. But their eventual demise did not negate their heuristic value in progressing an inquiry that might otherwise have stalled in the face of uncertainty created by a lack of evidence. In this context, the argument from ignorance served to transform a lack of evidence (there is *no evidence* that P) into a positive (and facilitative) epistemic resource (P is *not* the case). An example of this heuristic function is in order.

In the early months of the BSE crisis, public health officials needed to establish priorities for research, institute measures to protect human health, and devise regulations for practices in the beef industry. In each of these areas, action needed to be taken with considerable urgency against an epistemic backdrop in which little was known about this new disease. In this context, the argument from ignorance came to prominence as a means of managing uncertainty by allowing investigators to draw some conclusions, albeit presumptive conclusions, which were then used as the basis of a range of actions. If we consider an early BSE transmission study undertaken at the Central Veterinary Laboratory (CVL) in Weybridge, Surrey, the heuristic function of the argument from ignorance can be seen most clearly. The decision to attempt experimental transmission of BSE to some species, but not to others, was directly premised on what was already known about the host range of scrapie. It was known, for example, that scrapie had successfully transmitted to Cheviot sheep, mink and hamsters under experi-

mental conditions. Experimental transmission of BSE was, accordingly, attempted in all three species. However, there had been *no evidence* of the transmission of scrapie to exotic ungulates (e.g., gemsbok) or carnivores (e.g., domestic cat) in the 250 years in which scrapie had been endemic in the British sheep flock. It was reasonably concluded that scrapie had not transmitted to exotic ungulates or carnivores in this time and was, thus, *not* transmissible to these species. The decision not to include these species in BSE transmission studies at the CVL was directly premised on this knowledge of scrapie. Moreover, this decision was not without rational warrant, notwithstanding the later natural transmission of BSE to both groups of species.[7]

BSE transmission studies were not only hugely expensive investigations to undertake, but also took many months and even years to complete. There was, thus, a strong practical imperative to limit these studies to only those species that were most likely to be susceptible to BSE. Under these conditions, the argument from ignorance had considerable heuristic value for scientists. This presumptive argument became the basis upon which scientists were able to exclude certain species from further consideration, with the result that limited resources could be focussed on a small number of potentially susceptible species. The argument from ignorance effectively guided scientists through a myriad of research possibilities to realise only those possibilities that had the greatest likelihood of providing informative answers. This heuristic function of the argument can be characterized in cognitive terms as a means of allocating finite cognitive resources such as attention, memory and planning to those problems that have the best prospect of issuing in a solution. The argument from ignorance is thus one type of evolutionary adaptation of our rational resources to the problem of managing information and choice. When these choices are large in number, as they were for scientists who were trying to decide which species to include in BSE transmission studies, the argument functioned to bring this choice within cognitively manageable limits. When information is lacking, as it was in the case of scrapie's transmissibility to a range of exotic ungulates and carnivores, the argument served to transform this lack of knowledge into a positive resource for use in further deliberations.

[7] The first case of BSE in a gemsbok occurred in 1987. In 1990, the veterinary school at Bristol University identified the first case of BSE in a domestic cat. Neither species had previously been susceptible to scrapie, and their susceptibility to BSE suggested a different host range for this new disease.

This view of the argument from ignorance and, indeed, other informal fallacies as cognitive heuristics is only beginning to emerge in the literature on the nature and function of heuristics. (The reader is referred to Walton (2010) for another significant contribution to this literature.) Within recent additions to this body of work, heuristics have been described in terms that are largely congruent with the characterization of the argument from ignorance that has been given in this paper. In this way, Gigerenzer and Brighton (2009: 107) describe heuristics as "efficient cognitive processes that ignore information". Smithson (2008: 210) states that "at least some heuristics earn their keep by being not only fast and frugal, but also sufficiently accurate to be effective or adaptive". The combination of increased cognitive efficiency and sufficient accuracy is in stark contrast to the view of heuristics that had taken shape by the end of the 20th century, a view in which the use of heuristics had become associated with "shoddy mental software" (Gigerenzer and Brighton 2009: 109). But as cognitive researchers from a range of disciplinary backgrounds including psychology and computing have converged on the study of heuristics, it has become increasingly clear that heuristics are not in any way "second-best". Moreover, their avoidance of resource-intensive processing does not reduce their accuracy and can actually improve it (see Gigerenzer and Brighton (2009) for further discussion). Certainly, in a public health context heuristics have considerable value through their direct facilitation of the cognitive inquiries of this domain. The key role of informal fallacies within the heuristics of this domain finds informal logic standing alongside disciplines like psychology and computing for the first time in providing an explanation of this important rational resource.

7. Summary

This article has examined the widespread use of "no evidence" statements in public health. The logical and linguistic features of these statements were considered, with the logical focus on the use of these statements as premises in arguments from ignorance. These arguments were shown to be rationally warranted under certain conditions, which included the epistemic closure of a knowledge base in a particular domain and the exhaustive search of that base. The psychology of "no evidence" statements in public health was discussed, both from the point of view of the speaker (generally, a public health official) who uses these statements, and the hearer (typically, members of the public)

who receives these statements. The results of an experimental study of public health reasoning in 879 subjects confirmed that lay people are generally adept at identifying the logical and epistemic conditions under which "no evidence" statements in arguments from ignorance are more and less rationally warranted in a public health context. The article concluded with the characterization of arguments from ignorance as cognitive heuristics that have a facilitative function in public health reasoning.

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