

Chapter 5

Argument from Analogy

5.1 Introduction

There is no more universal feature of human thinking than the tendency to draw similarities or likenesses between people, objects and events in the world. Not all these similarities play a role in reasoning – many analogies that we employ in thinking and language have stylistic or figurative uses or fulfil a descriptive or explanatory function.¹ But for the substantial number of analogies that play a logical role in our thinking about public health problems,² it will be argued in this chapter that that role is a largely facilitative one. Indeed, it will be contended that even so-called false arguments from analogy can confer significant gains on our thinking when adverse epistemic conditions obtain in a particular context or scenario. These conditions are frequently encountered in a public health context where both expert scientists and lay people must come to judgement on problems in the absence of complete knowledge. This view of analogical argument requires a new approach to the study of this argument. Within this approach analogical reasoning is not viewed through a deductive or an inductive lens with all the pejorative evaluations that this has historically entailed. Rather, analogical argument must be seen as a rational adaptation of one's cognitive resources to the problem of uncertainty in practical reasoning. It is within this context that analogical argument, construed as a presumptively valid argument, can be seen to facilitate inquiry or deliberation by bridging gaps in the knowledge of a cognitive agent. This analysis of analogical argument has been initiated elsewhere (Cummings 2002, 2004, 2010, 2014d, e). However, it will be developed at length in the present chapter.

The discussion will unfold along what are by now familiar lines. In Sect. 5.2, the logical structure of analogical argument will be considered along with historical and more recent characterizations of this argument. It will be argued that a latent deductivism in logic is responsible for the largely negative accounts of this argument that have appeared in logical treatises and even some modern textbooks. Analogical argument is used extensively in public health, both in risk assessments and in

communications with the public. Yet, there has been relatively little examination of the use of this argument in a public health context. Several examples of the use of analogies in public health reasoning will be considered in Sect. 5.3. It is as a presumptive argument that analogies may be seen to function as a rational adaptation to the problem of uncertainty during practical reasoning. But when an analogy is strong or rationally warranted, analogical argument may also be used to shift a proponent's burden of proof onto an opponent in argument. These different uses of the argument are at all possible because presumptive arguments exhibit both dialectical and epistemic features. Dialectical and epistemic variants of analogical argument are examined in Sect. 5.4. The critical questions that attend the use of the dialectical variant of this argument can only be successfully transacted within a slow, deliberative process of reasoning (systematic reasoning). The identification of markers of strong and weak analogies requires a less deliberative form of reasoning that embodies cognitive efficiencies (heuristic reasoning). Both forms of reasoning are addressed at length in Sect. 5.5. Finally, the extent to which subjects make use of these two forms of analogical argument during reasoning about public health problems is addressed in Sect. 5.6.

5.2 Arguing from Analogy

In any argument from analogy one argues from the similarity of two or more entities in one or more respects to the similarity of those same entities in some further respect. The argument typically has two premises, the first of which states that entities P, Q and R have attributes or features w, x and y. The second premise states that one or more of these entities – let us say P and Q – also has attribute z. From these premises it is concluded that R must also have attribute z. The argument has the following form:

P, Q and R have attributes w, x and y
 P and Q have attribute z
 Therefore, R has attribute z

To the extent that there is a causal or systematic relation between attributes w, x and y and attribute z, the argument from analogy may be said to be strong or rationally warranted. If there is no such relation or only a tenuous relation between these attributes, then the argument from analogy is weak or has only minimal rational warrant. However, even a strong or rationally warranted analogical argument can go awry, as we will see in Sect. 5.3.

It is a sign of the stranglehold of deduction on logic that almost all historical thinkers have taken a dim view of analogical argument (see Sect. 2.3.2 for discussion of deductivism in logic). In his text *Fallacies*, Alfred Sidgwick leaves the reader in little doubt about his disregard for the argument from analogy. The argument is not even a pretender to deduction, according to Sidgwick: 'the more definite the

Principle the more the inference possesses the deductive character, the less definite the nearer it approaches to loose Analogy' (Chap. VI, Part II, p. 215). Analogical argument does not constitute a form of proof in Sidgwick's view:

The argument from analogy is, properly speaking, not so much a mode of attempting proof, as a mode of attempting to dispense with the serious labour of proving. It lies at the end of the scale of cogency which is furthest from Demonstration. (Chap. VI, Part II, p. 232)

Setting aside deduction, Sidgwick does not consider the argument from analogy to be a serious form of inductive argument either. His characterization of the argument as the 'lowest form' of inductive proof concludes his derogation of this form of reasoning:

We must distinguish then, as far as possible, between that kind of Proof which rests openly and distinctly upon already generalised knowledge – Deductive Proof, – and that which rests upon what may be loosely described as 'isolated facts', or 'perception of resemblance and difference', or 'observation and experiment', or 'circumstantial evidence', or however the phrase may run, – that which is commonly known in its highest form as Inductive Proof, and in its lowest form as the Argument from Analogy (Chap. VI, Part II, p. 214).

If a not so latent deductivism is the basis of Sidgwick's negative characterization of the argument from analogy, one might expect a more sympathetic view of this argument to be taken by the great defender of induction, John Stuart Mill. But what we find is an equally forthright dismissal of certain analogies – the so-called false analogies – for their failure to 'even simulate a complete and conclusive induction':

The last of the modes of erroneous generalization to which I shall advert, is that to which we may give the name of False Analogies. This Fallacy stands distinguished from those already treated of by the peculiarity that it does not even simulate a complete and conclusive induction, but consists in the misapplication of an argument which is at best only admissible as an inconclusive presumption, where real proof is unattainable. (Book V, Chapter V, Sect. 6)

There is a pattern in Sidgwick's and Mill's views of analogical argument. In the same way that Sidgwick's deductivism leads him to reject the argument from analogy, Mill's inductivism leads him to dismiss false analogies. But there is an error in these thinkers' views and it is the same error in both cases – the argument from analogy is evaluated and subsequently rejected on the basis of an inappropriate normative standard.³ Mill describes false analogies as an 'inconclusive presumption'. However, the presumptive status of the argument from analogy should not be grounds, or at least not the only grounds, for rejection of the argument, as Mill would appear to urge. Indeed, it will be argued in Sect. 5.4 that it is as a presumptive argument that the argument from analogy makes a significant contribution to a theory of public health reasoning.

If historical thinkers have negatively characterized the argument from analogy on account of a latent deductivism or inductivism, then it is clear that modern logic textbooks and other sources fare little better in this regard. A reader cannot fail to apprehend the deductivist disappointment of Copi and Cohen (2009) when they discuss this argument. They state that '[a]rguments by analogy are not to be classified as either valid or invalid; probability is all that is claimed for them'

(484; italics added). Gensler (2010) reveals his deductivism through his characterization of the argument from analogy as an analogy syllogism. Moreover, of one particular analogical argument about other minds, he remarks that ‘it at most makes it only somewhat probable that there are other conscious beings’ (99; italics added). Authoritative online sources perpetuate the same deductivism. For example, at the outset of his entry on analogy and analogical reasoning in the Stanford Encyclopedia of Philosophy, Bartha (2013) remarks ‘such arguments belong in the category of inductive reasoning, since their conclusions do not follow with certainty but are only supported with varying degrees of strength’ (italics added). Yet again, the reader cannot escape the conclusion that the argument from analogy is defective or inferior simply by virtue of the fact that it is not deduction.

Notwithstanding the deductivism of many historical treatments of the argument from analogy, these treatments still have relevance to the present-day evaluation of this argument. In his *Elements of Logic*, Richard Whately describes two ways in which analogies can give rise to errors in our thinking:

There are two kinds of error, each very common – which lead to confusion of thought in our use of analogical words:

i. The error of supposing the *things themselves* to be similar, from their having *similar relations* to other things.

ii. The still commoner error of supposing the *Analogy to extend further* than it does; [or, to be more *complete* than it really is;] from not considering *in what* the Analogy in each case consists. (Book III, Sect. 10, p. 206; italics in original)

Both these errors are exemplified by an analogy that was employed extensively during the BSE epidemic in the UK. Investigators committed the error of supposing that BSE in cattle and scrapie in sheep were the same diseases – BSE was bovine scrapie, it was claimed – from the fact that they shared certain features or ‘relations’ (e.g. histopathological features). When scientists concluded that BSE would not transmit to humans in the same way that scrapie had not transmitted to humans, they also made the second of Whately’s errors – they supposed the analogy between these diseases to be more complete than it really was. This particular analogy is examined further in the next section alongside several other analogical arguments that have been used in a public health context.

5.3 Arguments from Analogy in Public Health

Arguments from analogy are frequently employed in the public health domain. Yet, there has been little direct examination of those arguments either within public health or elsewhere. To begin an examination of these arguments, we return to the analogical argument that was introduced at the end of Sect. 5.2. This argument draws upon an analogy between BSE and scrapie, a transmissible spongiform encephalopathy (TSE) in sheep. This analogy was used extensively by scientists in risk assessments of BSE. It was also the basis of repeated public health communications that were intended to reassure the public that BSE would

not transmit to humans. The form of the argument that is shown in (1) below is one of several variants which were used extensively during the BSE epidemic (see Cummings (2010) for further discussion):

(1)

Scrapie in sheep and BSE in cattle are similar in respect of histopathology and epidemiology.

Scrapie has not transmitted to humans.

Therefore, BSE will not transmit to humans.

Of course, BSE did transmit to humans. So the conclusion of this analogical argument was eventually shown to be erroneous. Yet, the analogy upon which this argument was based did have some degree of rational warrant, particularly in the early stage of the BSE epidemic. Early investigations of the epidemiology of BSE conducted by Mr John Wilesmith of the Central Veterinary Laboratory in Weybridge, Surrey revealed, among other things, that the distribution of BSE cases was consistent with the distribution of meat and bone meal (MBM) which was made from recycled sheep tissues (Wilesmith et al. 1988). All BSE cases had also been fed commercial concentrates which contained MBM (Wilesmith et al. 1988). Aside from epidemiological similarities, there was also evidence that BSE had similar histopathological features to scrapie. Like scrapie, vacuolation was present in the neurones of grey matter in BSE cases. Also, fibrils that were morphologically similar to scrapie associated fibrils were found in BSE cases (Wells et al. 1987). Such were the early similarities between BSE and scrapie that it appeared to investigators that BSE was none other than bovine scrapie. So it was that early in the course of the BSE epidemic many scientists had already come to the view that scrapie had transmitted to cattle to cause BSE.

Having established certain similarities between BSE and scrapie, investigators then had to be satisfied that there was some causal or systematic relation between these similarities and the further attribute of transmissibility to humans. Investigators had to address the question: To what extent, if any, can features such as the histopathology and epidemiology of disease be said to be causally or systematically related to the transmissibility of disease? Here again, investigators appeared to view this relation as having some degree of rational warrant. However, the presumptive nature of this warrant meant that this relation could be overturned by the later emergence of evidence. In fact, this is exactly what happened when the results of strain-typing studies became available to BSE investigators. These studies were not technically possible when BSE first emerged in British cattle in 1986. When these studies were eventually conducted, they showed that BSE was not related to scrapie but was in fact a novel TSE in cattle. What these studies had effectively demonstrated was that two diseases could be similar in respect of features such as histopathology and epidemiology and yet still be essentially unrelated diseases. As distinct diseases, no conclusion could be drawn about the transmissibility of BSE to humans from the fact that scrapie had not transmitted to humans.

This analogical argument held considerable sway for scientists and the public during the BSE affair. Its widespread use and reassuring conclusion go some way

to explaining the public outcry that greeted the announcement to British Parliament in March 1996 that BSE had transmitted to a number of young people. But this argument is only one of many analogical arguments that have been used in the public health domain. When HIV/AIDS first emerged in the 1980s, early public health advice issued by the Centers for Disease Control and Prevention (CDC) in the United States was based upon an analogy between AIDS and another infectious disease, that of hepatitis B (see Cummings (2004) for discussion). Similarities in the epidemiology of these diseases led investigators to conclude that the pathogen responsible for AIDS must be transmitted sexually and parenterally in exactly the same way that hepatitis B is transmitted sexually and parenterally.⁴ The argument from analogy which was the basis of the CDC advice took the form shown in (2):

(2)

AIDS and hepatitis B have similar epidemiological features.

Hepatitis B is transmitted sexually and parenterally.

Therefore, AIDS will be transmitted sexually and parenterally.

The first (major) premise of this analogical argument was based on what was known at the time about the epidemiology of AIDS and hepatitis B. This knowledge included the greater prevalence of these diseases among certain population groups such as homosexual males, intravenous drug users and recipients of blood transfusions and blood-derived products (e.g. factor VIII for the treatment of haemophilia). The second (minor) premise of this argument described the well-known transmission routes of hepatitis B – hepatitis B is both a sexually transmitted infection and can be contracted through the use of tainted blood products and contaminated needles. The conclusion of this analogical argument – that the pathogen responsible for AIDS would have sexual transmission and parenteral transmission – was the basis upon which the CDC issued advice to the public to use protection during sex (i.e. condoms) and to avoid sharing needles during intravenous drug use: ‘With hepatitis B as a guide it was possible to devise, very early in the epidemic, effective guidelines for prevention of HIV infection. The recommendation to avoid sharing ‘bodily fluids’ came directly out of hepatitis B research’ (Muraskin 1993: 109).

Arguments from analogy are used extensively in the public health management of influenza epidemics. Plant (2008) describes how analogical reasoning shaped early actions in the management of severe acute respiratory syndrome (SARS): ‘we considered that the SARS organism was most likely a virus and spread predominantly via the respiratory route. Hence we acted as though that was true, meaning that infection control, patient management, patient isolation and so on were all treated as though the (assumed) virus causing SARS was similar to other viruses’ (49). The reconstructed analogical argument to which Plant refers takes the form shown in (3):

(3)

SARS is similar to other viruses.

Other viruses are spread predominantly via the respiratory route.

Therefore, SARS will be spread predominantly via the respiratory route.

The conclusion of this argument provided support for the early infection control measures (patient isolation, etc.) which Plant describes above. In the absence of analogical reasoning, the institution of these measures would have had to await direct evidence to the effect that SARS is transmitted via the respiratory route. A further analogy between SARS and the influenza pandemic of 1918–1919 (Spanish flu) was repeatedly employed by the World Health Organization and other agencies during the SARS outbreak of 2003 (see Zylberman (2010) for discussion of this analogy and other historical analogies involving influenza epidemics).

The BSE epidemic has had a largely negative legacy for all manner of food safety issues in the UK. One such issue is the safety of genetically modified (GM) food. Hunt and Frewer (2001) found that subjects in the UK identified BSE as an analogue for GM food. GM food was overwhelmingly identified by these subjects as a health risk in the same way that BSE poses a health risk to humans. The argument from analogy in this case takes the form shown in (4):

(4)

BSE and GM technology provoke public concern about the safety of food.
 BSE poses a risk to human health.
 Therefore, GM technology will pose a risk to human health.

The only attribute in respect of which BSE and GM technology may be said to be similar is that they both provoke public concern about the safety of food. That shared attribute is expressed in the major premise of the above argument. But public concern has at best a tenuous relation to the attribute expressed in the minor premise of this argument (viz., ‘poses a risk to human health’). Moreover, BSE and GM technology are dissimilar in essential respects. BSE is a zoonosis – a disease which transmits from lower vertebrates to humans – while GM technology is a scientific innovation that is aimed at increasing crop yields and resistance to disease. Notwithstanding these fundamental differences between BSE and GM technology, this argument from analogy continues to be influential in the widespread public opposition that exists to GM crops in the UK.

Other new technologies also raise safety concerns for public health. One such technology is the rapid expansion in the use of mobile phone transmission masts. These masts are believed by some members of the public and scientists to be linked to childhood cancers and other diseases. The concern revolves around the safety of the non-ionising radiation which is emitted by these installations. The argument in (5) rests upon an analogy between these transmission masts and a further type of electrical installation that has been in use for many years, namely, electricity pylons:

(5)

Mobile phone transmission masts and electricity pylons emit non-ionising radiation.
 Non-ionising radiation from electricity pylons has been linked to childhood cancer.
 Therefore, non-ionising radiation from mobile phone transmission masts will be linked to childhood cancer.

This argument has been used extensively by individuals and pressure groups who are opposed to the continued erection of mobile phone transmission masts,

particularly in the vicinity of schools and childcare centres. Yet, the argument is at best weakly warranted. This is because there are significant dissimilarities in the emissions from transmission masts and those from electricity pylons (i.e. the major premise is problematic). Wood (2006) states that ‘the characteristics of the electric and magnetic fields associated with high voltage power lines are quite different from the radiofrequency emissions from mobile telephony systems’ (361). Also, evidence in support of a link between non-ionising radiation from electricity pylons and childhood cancer is tentative to say the least (i.e. the minor premise is problematic). In this way, Wood (2006) also remarks that ‘[t]aken individually, some, but by no means all [. . .] studies show evidence of raised cancer risk and B-field exposure’ (364). (The B-field is one of two types of field associated with electrical power systems.) Notwithstanding these weaknesses, the above argument from analogy continues to command considerable public support.

As a final example of the use of the argument from analogy in public health, we turn to a drug safety issue. The issue in question concerns the teratogenic effects of taking sodium valproate (Epilim) during pregnancy. From newspaper reports to blogs and parental narratives, public discourses on this issue have increasingly involved an analogy with Thalidomide, a drug that was widely used in the 1960s to control morning sickness during pregnancy. In at least some of these discourses, this has been used to support the view that Epilim is responsible for a range of birth and developmental anomalies in babies and children who were pre-natally exposed to this drug. This logical analogy was made by Paul Flynn, for example, who is the Labour Member of Parliament for Newport West in Wales. In his blog of 11 March 2013, Flynn remarked of Epilim that ‘[i]t could be worse than Thalidomide for the same reasons’. This italicised expression attests to the well-established causal link between the ingestion of Thalidomide during pregnancy and the development of birth defects, a link which Flynn is clearly implying holds true of Epilim also. The argument from analogy which is implicit in Flynn’s view is shown in (6) below:

(6)

Epilim and Thalidomide are prescribed medicines sometimes taken during pregnancy.

Thalidomide has teratogenic effects on a developing foetus.

Therefore, Epilim will have teratogenic effects on a developing foetus.

Notwithstanding the analogy between these drugs that is suggested in many commentaries, there is little to recommend the use of this particular logical analogy. The only similarity which appears to link Epilim and Thalidomide is that both drugs have been ingested by women during pregnancy (major premise). However, these drugs are dissimilar in other, significant respects. First, they are used to treat different conditions. Epilim is used to manage a serious, neurological disorder (i.e. epilepsy), while Thalidomide was used to treat an unpleasant, but not life-threatening, symptom of pregnancy. Second, these drugs do not contain the same active ingredients. The chemical ingredients which gave rise to serious birth defects in the case of Thalidomide are not present in Epilim. A causal link may

eventually be demonstrated between the ingestion of Epilim during pregnancy and the development of conditions such as autism spectrum disorders in children. But in the meantime, no such link can be reasonably drawn on the basis of this weak analogy to Thalidomide.

This completes the present examination of some of the uses of arguments from analogy in public health. The arguments in (1) to (6) above concern a wide range of public health issues including food and drug safety, infectious diseases and new technologies. Some of these arguments were employed by public health agencies such as the CDC, while others were a feature of how the public conceives of threats to its health. A number of analogies stood up well to scrutiny. They revealed genuine similarities between human diseases (e.g. AIDS/hepatitis B) and animal diseases (e.g. BSE/scrapie), for example, that could be used in support of conclusions about the transmission routes and host ranges of pathogens. Other analogies traded on similarities that were weak or superficial in nature (e.g. Epilim/Thalidomide). These analogies were shown to provide little or no rational warrant for the conclusions of several of the arguments in (1) to (6) above. Having examined the varied uses of the argument from analogy in a public health context, it remains for us to consider how these uses may be best analysed within logical frameworks. These frameworks contain dialectical and epistemic criteria that were used to evaluate each of the analogical arguments in this section. In order to contribute to a theory of public health reasoning, argument from analogy must first be analysed from within these frameworks. It is to this analysis that we now turn.

5.4 Analysing the Argument from Analogy

Even the strongest analogies in Sect. 5.3 will begin to unravel if evidence emerges which shows that two or more entities are not similar in respect of the attributes claimed. An analogy which persists in the face of contrary evidence betrays its presumptive and defeasible roots. Just such a scenario arose during the BSE epidemic when a series of events (e.g. the appearance of a TSE in a domestic cat) revealed that scientists could no longer presume that BSE was bovine scrapie. Against this backdrop, scientists and others continued to uphold the analogy with scrapie, a conviction that was eventually to have disastrous consequences for human health. Notwithstanding the later corruption of this analogy, it did in fact serve scientists well in the early stage of the BSE epidemic when little was known about this new TSE in cattle. A question of some interest is how this was the case when the analogy between BSE and scrapie eventually came to have such negative repercussions for risk assessments of BSE. To answer this question, we must address the conditions under which arguments from analogy are first brought forward in an inquiry or other cognitive deliberation. These conditions usually involve some combination of uncertainty in the form of a lack of knowledge or evidence, and a requirement for – if not urgent, then prompt – practical action. Exactly these

conditions were present at the outset of the inquiry into BSE. They are also a feature of the many other public health scenarios where the argument from analogy may be seen to operate.

Let us examine these conditions further. When confronted with a novel TSE in cattle in 1986, scientists could have decided to do one of three things. They could have decided to ignore this new disease in the hope that it would have few, if any, implications for human health. This decision would have amounted to inaction in the face of uncertainty about this new disease, a cognitive policy which would leave all but the most hopeful of us with a strong sense of unease. Or scientists could have decided to mount a thoroughgoing investigation of every possible aspect of the new disease in the absence of any prior attempt to constrain those aspects. This decision would have placed considerable demands on the cognitive and technical resources of scientists and would have left them with only partially investigated questions when those resources became exhausted. Alternatively, scientists could have tried to find some way of allocating their limited resources to those questions and lines of inquiry that would have the best prospect of revealing the nature of this new disease. This decision would have required scientists to find some means of constraining the aspects of the problem that should be directly investigated. This is where a strong analogy comes to the fore – it provides scientists with a template upon which to mount an investigation into a new disease or other novel phenomenon. An analogical template guides scientists to consider *x* and disregard *y* and *z*, thus avoiding costly expenditure of resources on aspects of a problem that are likely to prove unrevealing. In the event, this latter course of action was the one chosen by scientists who confronted BSE for the first time in 1986.

In choosing to use an analogy to guide their early inquiries into BSE, scientists were exercising an effective adaptation of their rational procedures to the problem of uncertainty in the practical sphere. The question then arises of how they might maximize their success in this cognitive endeavour by selecting the strongest possible analogy to guide their inquiries. Evaluative criteria are needed in order to distinguish analogies that are strong and effective from those that are weak and likely to lead to error. These criteria are dialectical and epistemic in nature. Dialectical criteria relate to the use of critical questions. An analogy that can withstand critical questioning may be used to discharge a proponent's burden of proof in argument. These questions can be used to interrogate the nature and extent of similarities between entities which are the basis of the similarity premise. They may also be used to establish if there is a causal or systematic relation between the similarities expressed in this premise and the attribute that is the basis of the conclusion of an analogical argument. However, the exercise of subjecting an analogy to critical questioning is not undertaken quickly or effortlessly. This exercise demands time in which proponents and opponents are able to develop, raise and respond to one or more critical questions. The use of critical questions also requires the expenditure of a large range of cognitive resources in order to attend to evidence and retrieve information from memory. When time and resources are not in abundant supply, cognitive agents must employ a different (non-dialectical) set of evaluative criteria for distinguishing strong from weak analogies. These alternative

criteria consist in simple, epistemic markers of similarity. In the sections to follow, we examine the quite different analyses of the argument from analogy that are possible from within dialectical and epistemic frameworks.

5.4.1 *Dialectical Analyses*

As we have seen in previous chapters, the thrust of a dialectical analysis of argument is on the use of critical questions in a dialogical exchange between a proponent and an opponent. This is no less the case in analogical argument, where what may appear to be a robust analogy on initial examination can be found to be wanting under the close interrogation of an opponent in argument. Walton (2013) makes this point as follows:

When an argument from analogy is initially put forward, it is possible that there is a strong or even striking similarity between the case at issue and the analogous case. As the dialogue proceeds, however, questions may arise as to whether the two cases are similar in certain specific respects or dissimilar in other respects. It is a sequence of argument moves during a particular stage of a dialogue that determines how strong the argument from analogy should be taken to be, from a logical point of view. It is this dialogue sequence that should provide the basis for evaluating the strength of the argument from analogy. (142)

Walton's analysis of the argument from analogy proceeds from argumentation schemes to which are attached a number of critical questions. In Walton (2012), the basic scheme of the argument is presented as follows:

Similarity Premise: Generally, case C1 is similar to case C2.

Base Premise: A is true (false) in case C1.

Conclusion: A is true (false) in case C2.

This basic scheme invites the following critical questions:

CQ1: Are there respects in which C1 and C2 are different that would tend to undermine the force of the similarity cited?

CQ2: Is A the right conclusion to be drawn in C1?

CQ3: Is there some other case C3 that is also similar to C1, but in which some conclusion other than A should be drawn?

A long-standing issue for argumentation theorists has been how to analyse the notion of similarity that is the basis of the similarity premise interrogated by the first of these critical questions. According to Walton (2012), this is best achieved through the use of scripts of the type formulated by Schank and Abelson (1977) in early work in artificial intelligence: 'Story schemes allow us to answer the critical questions for the analogy scheme in more detail than any other evaluation has so far done' (217). A script or scheme is a body of knowledge of events and actions and how they typically unfold and interrelate based on our experience of the world. So, for example, I may have a restaurant script that includes information to the effect that a customer enters a restaurant, requests a menu, orders one or more dishes,

is served by a waiter, receives a bill, makes the required payment and then leaves the restaurant. Among the interrelations between actions in a script are those which are causal or temporal in nature. For example, a customer pays a bill because he ate a meal, and the meal is served after an order has been placed with the waiter. The motivations and intentions of the characters in an event can also be represented in a script. In demonstration of how scripts may be used to model the notion of similarity that is the basis of the similarity premise in the basic scheme of the argument from analogy, we return to the analogical argument in (2) above. That argument is repeated below for convenience:

AIDS and hepatitis B have similar epidemiological features.
Hepatitis B is transmitted sexually and parenterally.
Therefore, AIDS will be transmitted sexually and parenterally.

According to Walton (2012), the first step in using scripts or story schemes to analyze the similarity relation between the source case (hepatitis B) and the target case (AIDS) in this analogical argument is to identify a story in the source case. This story is presented as an ordered sequence of statements such as the following:

- (1) Public health scientists undertake epidemiological studies of hepatitis B.
- (2) These studies reveal that hepatitis B is more prevalent in certain demographic groups than in the rest of the population.
- (3) The groups with a higher prevalence of hepatitis B are homosexual males, intravenous drug users and recipients of blood and blood products (e.g. factor VIII).
- (4) Scientists use these epidemiological findings to determine the route(s) of transmission of the pathogen that causes hepatitis B.
- (5) The susceptibility of these groups to infection suggests that the pathogen responsible for hepatitis B is transmitted through sexual activity and the inadvertent infection of the body through a blood transfusion or other medical procedure.
- (6) The Centers for Disease Control and Prevention (CDC) construct public health advice based on what are believed to be the routes of transmission of the pathogen responsible for hepatitis B.
- (7) The CDC advises that at risk individuals should take sexual precautions and that blood and blood products should be screened for the presence of the pathogen responsible for hepatitis B.

No conclusion can yet be drawn as all we have done is generate a coherent story based on what we know (or imagine) to be the work of public health scientists who are involved in infectious disease control. The next step in this method of analysis is to identify a comparable story in the target case. Unsurprisingly, this story involves a similar series of actions:

- (1) Public health scientists undertake epidemiological studies of AIDS.
- (2) These studies reveal that AIDS is more prevalent in certain demographic groups than in the rest of the population.

- (3) The groups with a higher prevalence of AIDS are homosexual males, intravenous drug users and recipients of blood and blood products (e.g. factor VIII).
- (4) Scientists use these epidemiological findings to determine the route(s) of transmission of the pathogen that causes AIDS.
- (5) The susceptibility of these groups to infection suggests that the pathogen responsible for AIDS is transmitted through sexual activity and the inadvertent infection of the body through a blood transfusion or other medical procedure.
- (6) The Centers for Disease Control and Prevention (CDC) construct public health advice based on what are believed to be the routes of transmission of the pathogen responsible for AIDS.
- (7) The CDC advises that at risk individuals should take sexual precautions and that blood and blood products should be screened for the presence of the pathogen responsible for AIDS.

Having constructed a story in the target case, we then proceed to a higher level of abstraction where the story scheme that is common to both these stories is generated. Because a story scheme is abstract, it contains variables (x , y , etc.) which are distinct from the actual entities and persons of the corresponding stories. A story scheme for the above stories might appear as follows:

x and y are the focus of epidemiological studies
 these studies reveal x and y to be more prevalent in certain demographic groups
 these groups are homosexual males, intravenous drug users and recipients of blood and blood products
 epidemiological findings used to determine the routes of transmission of x and y
 x and y exhibit sexual and parenteral routes of transmission
 CDC issues public health advice based on routes of transmission of x and y
 CDC advises individuals at risk of x and y to take sexual precautions and urges screening of blood and blood products

Walton argues that this same story scheme may be represented by a linear structure shown in Fig. 5.1. In this structure, the statement functions in the boxes are abstractions of the statements in the corresponding stories, while the arrows represent a range of causal, temporal or other relations. For example, the CDC issued public health advice after their investigations established that the prevalence of AIDS cases was similar to that of hepatitis B (i.e. a temporal relation).

Having identified the story scheme that is common to the AIDS and hepatitis B stories, we can begin an evaluation of this analogical argument. This particular argument is strong for the following three reasons identified by Walton. Firstly, it fits the scheme for the argument from analogy. Secondly, the story scheme ties together in an orderly sequence a set of common elements in both stories. Thirdly, the fact that both stories can be fitted into the story scheme provides support for the first (similarity) premise of the argumentation scheme for the argument from analogy.

Walton (2012) proposes a hybrid theory in which argumentation schemes are combined with story schemes in the reconstruction and evaluation of analogical

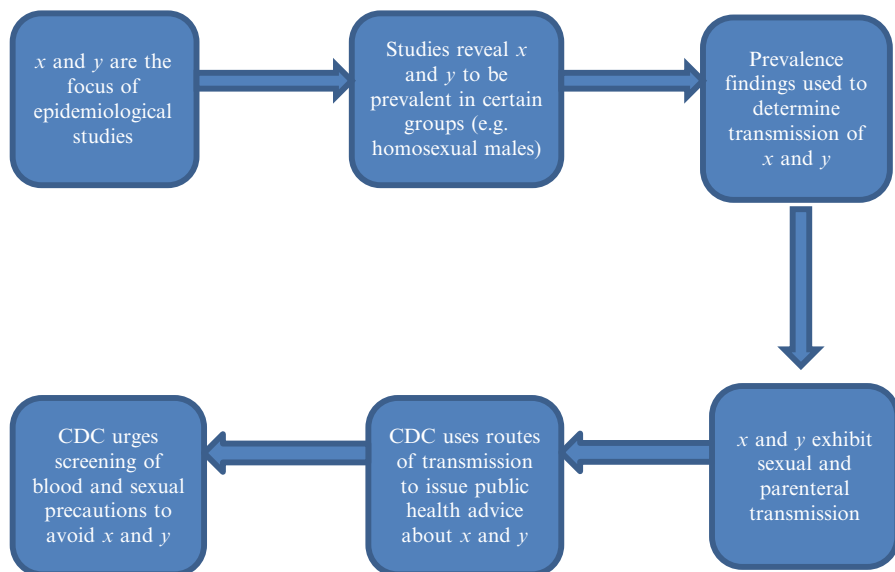


Fig. 5.1 Linear tree structure à la Walton of the story scheme in AIDS-Hepatitis B

argument. He also demonstrates the utility of this model in analysing a number of increasingly complex cases. This model may not be equally applicable to all cases. However, it does represent the most systematic attempt which has been undertaken to date to analyse the notion of similarity that is at the heart of the argumentation scheme for analogical argument and its corresponding critical questions.

5.4.2 *Epistemic Analyses*

If the argument from analogy is not to be analysed using an argumentation scheme and critical questions, then it is relevant to ask in what other way it may be analysed. To this end, Walton (2013) usefully distinguishes three different levels of analysis that may be applied to the notion of similarity in argument from analogy. He states:

These observations suggest that there are three stages to using argument from analogy. At the first stage, two cases may look similar, and this apparent match may suggest a rough analogy that could be used to support an argument from analogy. At the second stage, a closer look at the similarity premise can be given, to see whether the similarity is merely visually apparent, as an instance of pattern recognition, or whether there is a logical similarity [. . .] The third stage is the evaluation of the argument from analogy, by citing and comparing the respects in which the one case is similar to (or dissimilar from) the other. (135–6)

Walton's hybrid theory of argumentation schemes and story schemes represents the third and final stage in this tiered approach to the analysis and evaluation of

analogical argument. But equally interesting is the pattern recognition kind of similarity that is the basis of the first stage in Walton's tiered approach. This is a superficial type of similarity that might take the form of visual similarities between two cases. However, pattern recognition in humans is not limited to sensory-based observations and can include recognition of complex patterns that cannot be apprehended by visual or other senses.⁵ This latter type of pattern recognition need not require significant cognitive expenditure in humans or necessitate computational complexity in artificial systems if a pattern recognition device is sensitive to simple markers of similarity between two cases. These markers may include the identification of existing knowledge on the part of scientists or of multiple similarities between two cases. They may also include the identification of certain features of the context in which an argument from analogy is advanced. All three markers of similarity can be illustrated by returning to the AIDS-hepatitis B analogy. This analogy exhibits the marker existing knowledge as scientists at the CDC had extensive knowledge and experience of hepatitis B when early cases of AIDS emerged. This case also exhibits the marker multiple similarities as both AIDS and hepatitis B were identified to occur predominantly in homosexual males, intravenous drug users and recipients of blood and blood products rather than just one of these groups. The AIDS-hepatitis B analogy also displays an important context marker in that the analogy was pressed into use at the outset of the AIDS epidemic when little was known about this newly emerging disease.

The more of these markers that are identified by a pattern recognition device, the stronger the analogy between two cases. The AIDS-hepatitis B analogy exhibits all three markers and is a particularly strong analogy in consequence. The detection of these markers represents a form of pattern recognition that is little more complex than the identification of visual similarities between two cases. To appreciate this, it will help to conceive of these markers as entries within a checklist that a pattern recognition device can use to establish if certain features are present or absent in a particular analogy. For example, no extensive deliberation is required to decide in a particular scenario if scientists have existing knowledge of an infectious disease. Also, we do not have to deliberate long and hard to decide if two cases exhibit just a single similarity or multiple similarities. It can also be easily established if an analogy is advanced at the outset of an inquiry into an infectious disease or if it is used when considerable knowledge of this disease has already been amassed (a context marker). These judgements can be arrived at relatively quickly and easily. They are quite unlike the more elaborate judgements that are needed to decide whether a purported similarity between two cases is a true similarity between these cases. Judgements of this type do demand extensive deliberation as the similarity at issue in a particular case is subjected to critical questioning in a framework such as Walton's hybrid theory of argumentation schemes and story schemes. A pattern recognition device that is equipped to detect simple markers of similarity is not designed to obviate the need for an extended analysis of similarity of the type proposed by Walton. Rather, this device serves instead as an effective mechanism for distinguishing strong from weak analogies when a more extended analysis of similarity is not feasible or practicable in a particular case.

An epistemic analysis of the argument from analogy, at least of the type proposed above, has no precedent in informal logic or argumentation theory. But the pattern recognition mechanism that is posited to lie at the heart of this analysis does receive empirical support from work in other disciplines. In psychology, the presence of a similarity or ‘representativeness’ heuristic in human thinking was identified by Tversky and Kahneman (1974) in their landmark study of probabilistic reasoning.⁶ Although Tversky and Kahneman took a rather dim view of this heuristic – it led subjects, for example, to neglect prior probabilities in their probability evaluations – its presence nonetheless attests to the role of a simple similarity heuristic in human reasoning. Similarity or resemblance heuristics are known to play a role in face recognition (Kleider and Goldinger 2006).⁷ These same heuristics are impaired in individuals with autism. Behrmann et al. (2006) found that adults with autism are slower than neurotypical controls at face processing, especially as the level of categorization and perceptual similarity becomes more fine-grained. Attitude similarity has been found to function as a heuristic cue that signals kinship (Park and Schaller 2005). In this way, we are more inclined to have kinship cognitions about people with whom we share attitudes than about those whose attitudes are dissimilar from our own. In each of these cases, a simple pattern recognition type of similarity is presumed to underlie perceptions and judgements of similarity. A similar pattern recognition type of similarity is also posited for the epistemic variant of analogical argument.

5.5 Analogy as a Cognitive Heuristic

In the empirical studies mentioned above, it is clear that similarity assumes the role of a heuristic in perception and reasoning for investigators. A similar heuristic function is envisaged for analogy during public health reasoning. To state of any procedure that it has a heuristic function implies certain things. The procedure – in this case, an analogy – must embody cognitive and other efficiencies. Specifically, an analogical heuristic may be expected to achieve maximal return for whatever cognitive resources (memory, attention, etc.) are expended in its implementation. This economy in cognitive resources is matched by a further, significant economy. By bypassing extended deliberation, an analogical heuristic is not just a resource-efficient but a time-efficient cognitive instrumentality. It will be argued below that this instrumentality is an important adaptation of our rational resources to the problem of uncertainty in the practical sphere. Of course, an analogical heuristic only really makes sense to the extent that analogy can also function as a type of systematic reasoning. As the discussion in Sect. 5.4.1 demonstrated, the notion of similarity in an analogical argument can be extensively interrogated through the use of critical questions. Whether that interrogation is played out through story schemes or some other construct, the general principle is the same – there is an expansion of the rational grounds of a presumed similarity between two cases as a proponent

and an opponent in argument pose and respond to critical questions. This expansion is time-intensive and incurs substantial cognitive costs, both features which have implications for the type of context in which this reasoning occurs. The contextual features and other attributes of the use of analogy during systematic and heuristic reasoning will be examined further below.

5.5.1 Analogy in Systematic Reasoning

In some cognitive deliberations, reasoning is not constrained by limited evidence or exigencies of the practical sphere such as the need to take urgent action. When evidence is available and there is time in which to assess its implications for a particular question-at-issue, cognitive agents typically engage in systematic reasoning. Analogies contribute in a myriad of ways to systematic reasoning. They are the means by which connections are forged between previously unrelated entities, events and states of affairs. These connections are the source of insights into new and puzzling phenomena about which little is known. In a public health context, these insights may include a better understanding of the origin, pathogenesis and transmission routes of an emerging disease. For example, investigators used an analogy between BSE in cattle and scrapie in sheep to make assessments of the infectivity of bovine tissues, while scientists charged with responding to the emergence of AIDS used an analogy with hepatitis B to determine the routes of transmission of this new disease. In both cases, an analogy with a pre-existing disease became a productive source of theses about a newly emerging disease. The productivity of analogy can be demonstrated in specific ways in the context of systematic reasoning. Analogies are first and foremost the basis of similarity premises in analogical arguments of the following form:

Argument from analogy:

BSE and scrapie are similar in certain respects (similarity premise).

In scrapie, the thymus is less infective than other tissues in the lymphoreticular system.⁸

In BSE, the thymus will be less infective than other tissues in the lymphoreticular system.

However, the productivity of analogy does not end with the similarity premise of this argument. For having drawn the conclusion of this analogical argument, scientists then went on to use this conclusion as a premise in the following modus ponens inference:

Modus ponens inference:

If the thymus is less infective than other tissues in the lymphoreticular system, then the thymus should be excluded from the specified bovine offal ban.

The thymus is less infective than other tissues in the lymphoreticular system.

The thymus should be excluded from the specified bovine offal ban.

The similarity premise in the argument from analogy and the minor premise in this modus ponens inference owe their existence to an analogy between BSE and scrapie. The productivity of analogy is thus a significant source of the premises that are used in systematic reasoning. But analogies serve a second, important role in systematic reasoning. As well as generating new theses or claims for reasoning, analogies also steer investigators in the direction of potentially beneficial lines of inquiry. A strong analogy comes with an implicit recommendation. It tells scientists to investigate *x* over *y*, as the former is more likely to succeed in addressing the question-at-issue. In directing scientists towards some lines of inquiry and away from others, analogies can help scientists direct their cognitive and technical resources in ways that are likely to have a successful outcome. For example, an analogy between HIV/AIDS and another infectious disease, hepatitis B, had a reasonable prospect of helping scientists to understand the transmission routes of HIV/AIDS. However, the same could not be said of an analogy between HIV/AIDS and a chronic condition such as diabetes or even another infectious disease like tuberculosis. These weaker analogies (for analogies they are) were unlikely to address the question of the transmission routes of HIV/AIDS. As such, they would have represented a poor investment of the resources of scientists.

It emerges that analogies can contribute both to the content of systematic reasoning in the form of premises, and to the regulation of systematic reasoning through their capacity to steer investigators towards certain lines of inquiry and away from others. However, neither of these functions would be possible were it not for the fact that analogical argument also embodies certain other features of systematic reasoning. These features include slow, deliberative evaluation of all the evidence that relates to a purported similarity between two cases. This evaluation is only possible to the extent that evidence is available to investigators. This condition restricts the contexts in which analogical argument can be employed as a type of systematic reasoning. Furthermore, this evaluation is conducted through the use of critical questions whereby the rational basis of a presumed similarity is progressively laid bare through successive dialectical exchanges between a proponent and opponent in argument. The context for this critical questioning may be a story scheme of the type proposed by Walton or some other dialectical framework. Regardless of how similarity is analysed, it is clear that the use of analogy in systematic reasoning has time and resource implications for cognitive agents. For any degree of critical questioning of a purported similarity between two cases requires time and involves the expenditure of substantial cognitive resources. What makes this expenditure worthwhile for agents is the maximization of the truth of their mental representations of the world that it makes possible. This latter feature of systematic reasoning attests to its role in improving the cognitive fit of an organism with its environment. We conclude this section by examining the contribution of analogy to these further features of systematic reasoning.

Analogy can only contribute to systematic reasoning in contexts where evidence is readily available to investigators. In the absence of evidence, investigators cannot address the critical questions that are used to interrogate the rational basis of an analogy. These questions demand recourse to well-established theses or claims

which can be adduced as grounds in support of a purported similarity between two cases. These claims have their provenance in long-established scientific and other inquiries. For example, the substantial evidence base that had already been accrued in relation to hepatitis B when the first cases of HIV/AIDS emerged reflected a sustained program of research into this infectious disease over many years. This evidence base enabled investigators to test the strength of an analogy between HIV/AIDS and hepatitis B through the use of critical questions.

To demonstrate this, we need only consider how critical questions may be used to interrogate the strength of the relation between the demographic groups at risk of hepatitis B (property 1) and the routes of transmission of this viral infection (property 2). Because these properties were central to the analogy between HIV/AIDS and hepatitis B, investigators needed to be confident that there was a robust causal or systematic relation between them in the case of hepatitis B. That such a relation existed was established through the use of the following critical questions: What evidence is there of a causal or systematic relation between the demographic groups at risk of hepatitis B and the routes of transmission of this infectious disease? This question was effectively addressed by appealing to the substantial body of research that existed on the epidemiology of hepatitis B. This research consistently demonstrated a higher prevalence of hepatitis B infection among homosexual males and recipients of blood and blood products, among a number of other demographic groups. The increased prevalence of infection in these groups could only be explained if individuals were exposed to the causal pathogen in hepatitis B, a blood-borne virus, through sexual activity and epidermal injection (i.e. sexual and parenteral routes of transmission). So, a clear causal or systematic relation could be demonstrated between those individuals who were susceptible to hepatitis B and the routes of transmission of this infectious disease. However, this demonstration would not have been possible, were it not for the presence of a well-established evidence base on the epidemiology of hepatitis B.

The exchange of critical questions whereby the rational grounds of a purported similarity are progressively laid bare has time and resource implications for cognitive agents. At the outset of critical questioning it is not possible to determine the extent to which a similarity may need to be interrogated in order for rational actors to be satisfied of the strength of a purported similarity. Critical questioning may uncover the essence of a similarity between two cases after a short dialectical exchange between a proponent and an opponent. Alternatively, an extended process of critical questioning may be required to reveal the properties of an analogy and assess their rational merits. Even in a short dialectical exchange, a substantial investment of time is required in order for critical questions to be developed, raised and addressed. Critical questioning of a purported similarity between two cases also demands the expenditure of cognitive resources such as attention and memory. Proponents and opponents must attend to the claims that each party advances in support of an analogy. As the dialectical expansion of the grounds of an analogy continues, the number of these claims increases. All of these claims must be retained in short-term memory at least until such times as the dialectical exchange is concluded, and a purported similarity is judged to be strong or weak in nature.

In the case of an extended dialectical exchange, the finite storage capacity of short-term memory may be quickly reached. Furthermore, the claims that are advanced in support of an analogy may have to be retrieved from long-term memory. A search of this memory is also costly in terms of the expenditure of cognitive resources. In short, any amount of critical questioning of an analogy is not resource neutral and involves a substantial investment of time and cognitive resources.

What makes the time and cognitive skills that are needed to evaluate an analogy an investment as opposed to a costly use of resources that may be more productively deployed elsewhere? In order to answer this question, we must address the purpose that is served by our rational procedures. That purpose is to enhance an organism's survival by improving its cognitive fit with the environment. A cognitive agent whose mental representation of the world accurately reflects features of reality is best placed to respond to threats and other challenges from the environment. Such a mental representation can only be achieved if an agent prioritizes the maximization of truth over the satisfaction of other cognitive and epistemic goals. With its thoroughgoing testing of the rational grounds of a thesis, systematic reasoning is a truth-maximizing rational procedure. To the extent that analogical argument contributes to this reasoning, it also has a part to play in the maximization of the truth of a cognitive agent's mental representation of the world. Within a simple cost-benefit analysis, the investment of time and expenditure of resources that are needed to interrogate the rational basis of an analogy are outweighed by the improvements in an agent's cognitive fit with the environment that this expenditure makes possible. It emerges that analogical argument makes its most significant contribution of all as a survival-oriented, truth-maximizing rational procedure.

5.5.2 Analogy in Heuristic Reasoning

It is a sign of the versatility of analogy that it can also contribute to a very different type of reasoning. This reasoning does not prioritize the maximization of truth, although it is in no way averse to the achievement of this epistemic goal. Rather, its overriding aim is to provide cognitive agents with quick and effective solutions to problems in the practical sphere. In a public health context, these problems and their solutions can take many forms. They include decisions about how to contain the spread of an infectious disease through the use of vaccination programs and quarantine measures. They also include public health actions such as the banning of noxious substances in food production and the withdrawal of prescribed drugs and medical devices where these have been found to cause harm. These decisions and actions prioritize the protection of human health and are particularly pressing for this reason. A rational procedure such as systematic reasoning that attends to all evidence and weighs up its implications for the truth of a thesis is not always (or maybe ever) well suited to the resolution of problems in the practical sphere. In fact, such a procedure may be potentially harmful to cognitive agents who postpone the taking of urgent action in order to await the outcome of deliberation. What is needed

in these circumstances – and what heuristic reasoning can provide – is a quick and effective mental shortcut through deliberation. It will be argued in this section that within the context of heuristic reasoning analogy is just such a shortcut.

Central to the heuristic function of analogy is the idea that the identification of at least some similarities in the environment of a cognitive agent is a type of simple pattern recognition. Although this recognition has a basis in perception, it is not constrained by perception, as is demonstrated by the fact that cognitive agents are able to recognize all sorts of similarities which lack clear perceptual attributes. However, what cognitive agents do perceive during heuristic reasoning based on analogy are simple markers of similarity. These markers, which include the identification of multiple similarities between two cases and existing knowledge on the part of investigators, require no extensive deliberation to determine their presence or absence in a particular scenario. In much the same way that cognitive agents can readily perceive all sorts of features of their environment, the proposal here is that these agents are also able to rapidly discern if two cases are related by a single property or more than one property. Moreover, they are able to use this rapid recognition to come to a quick judgement about the strength of an analogy. In this way, two cases which exhibit multiple similarities constitute an altogether stronger analogy than cases which are related by only a single property or feature. And while it is certainly possible to undertake a more thoroughgoing evaluation of the nature and extent of these similarities by means of critical questions during systematic reasoning, this critical questioning is not necessary or even possible in those contexts where analogy is employed as a heuristic. To appreciate why this is the case, we need to examine the type of epistemic conditions under which analogy is used in heuristic reasoning.

Heuristic reasoning based on analogy is inextricably connected to the practical sphere. It was described above how this sphere makes demands of a cognitive agent's rational procedures, at least in the context of public health. These demands take the form of practical exigencies such as the need to take urgent action to mitigate threats to human health or even to avert them altogether. Action of this type is only possible to the extent that agents are guided by heuristics in their decision-making and other rational procedures. Analogy is one such heuristic. Through the identification of simple markers of similarity, an analogical heuristic bypasses the more extensive deliberative process of systematic reasoning. By doing so, it can confer significant cognitive and practical gains upon agents. These gains include an ability to respond promptly to environmental challenges as agents can avoid the time-intensive process of critical questioning. The detection of simple markers of similarity also has few resource implications for agents. Resources such as attention and memory, which are used extensively during critical questioning, can be conserved or redirected to other tasks when analogy is employed as a heuristic. An analogical heuristic can be seen to satisfy the two most important challenges to any physically situated cognitive agent: the need to take action in the practical sphere and the need to make parsimonious use of valuable cognitive resources. It thus serves as an effective adaptation of the rational resources of agents to an environment which does not always indulge protracted and costly cognitive deliberations.

There are certain epistemic contexts where the practical orientation and economic nature of an analogical heuristic have particular relevance to investigators. These contexts include the outset of an inquiry where there is a need to take some action often in the absence of knowledge. Goldstone and Son (2005) state that '[e]ven when we do not have specific knowledge of a domain, we can use similarity as a default method to reason about it' (14). It is in contexts where knowledge is lacking or limited that the epistemic benefits of an analogical heuristic come to the fore. When BSE first emerged in British cattle, little was known about the origin, host range and transmission routes of this new disease. However, with an escalating number of infected cattle and the risk that the disease may transmit to humans, public health officials and scientists could not afford to take no action. Yet, the question of how best to direct that action in the absence of evidence from experimental studies posed a considerable challenge to investigators. An analogy between BSE and a brain disease in sheep known as scrapie stepped into this evidential gap. When BSE was first identified in 1986, there was insufficient knowledge of this new disease to subject this analogy to any degree of critical questioning during systematic reasoning. However, analogy was to serve an altogether more useful function as a cognitive heuristic under these epistemic conditions.

Unable to undergo a systematic evaluation of its properties, the analogy between BSE and scrapie did at least satisfy certain markers of similarity. There was existing knowledge of scrapie, a transmissible spongiform encephalopathy which had been extensively studied by scientists for several decades prior to the emergence of BSE. BSE and scrapie also exhibited multiple similarities in terms of their epidemiology, histopathology and molecular properties. In the absence of a more thoroughgoing analysis of the similarity between these diseases, an analogical heuristic licenced a range of actions in the practical sphere. One such action was the introduction of the human Specified Bovine Offal ban in November 1989b, a landmark event in the protection of human health during the BSE epidemic. This vital public health action would not have been so readily implemented if the analogy which had motivated it had been subject to systematic reasoning. But as a heuristic, analogical argument was able to play a key role in the expedition of this important ban. The use of analogy during systematic and heuristic reasoning is illustrated in Fig. 5.2.

5.6 Study of Public Health Reasoning

This chapter has argued that analogy can function systematically and as a heuristic during public health reasoning. However, in order to validate this claim, it is necessary to look beyond the largely conceptual considerations that have been addressed thus far and obtain empirical support for this view in the reasoning of subjects. That support has been forthcoming in a recent study of public health reasoning in 879 members of the public. The results of this study have been discussed at length elsewhere (Cummings 2013b, 2014a, b, c, d, e). In this section, the main findings are reported such as they relate to the use of analogical argument

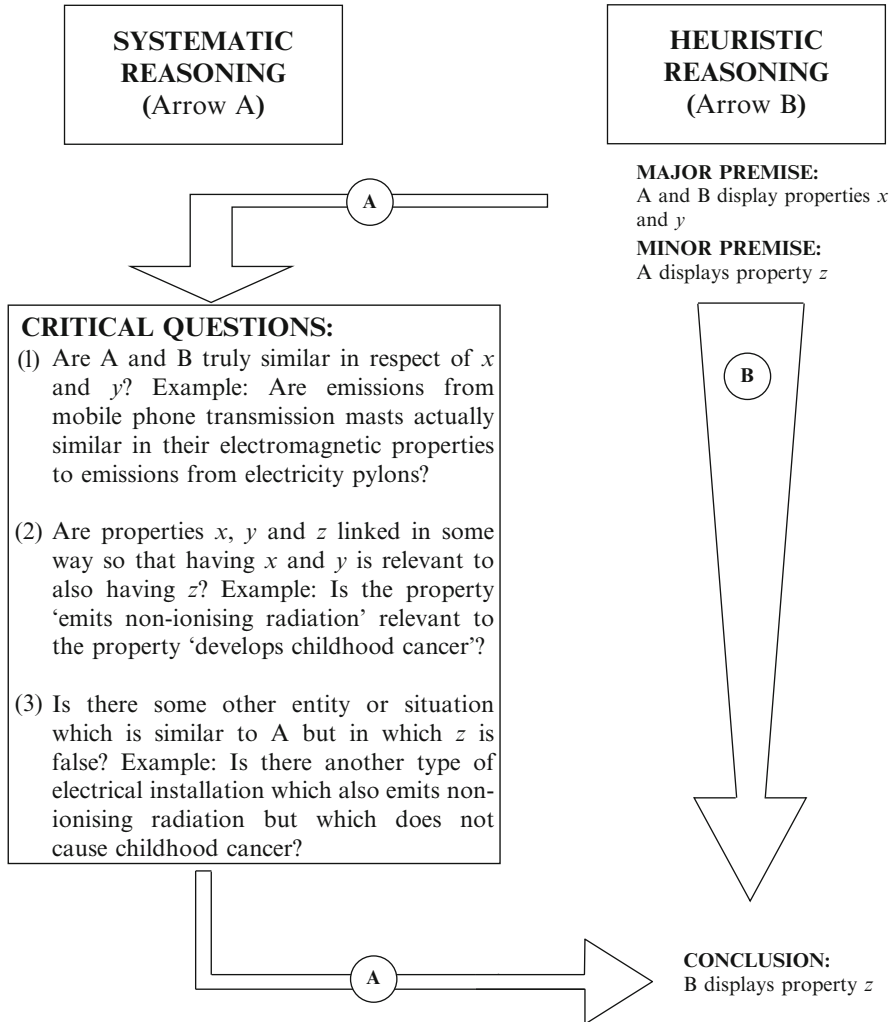


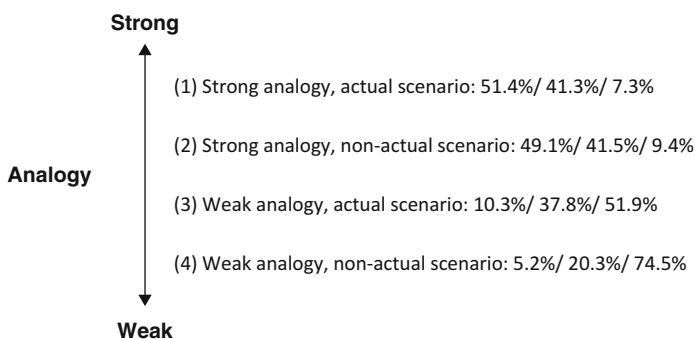
Fig. 5.2 Analogical argument as systematic and heuristic reasoning

only. Three other arguments investigated in the same study – argument from ignorance, argument from authority and circular argument – are discussed in Chaps. 3, 4, and 6, respectively.

Full details of the subjects who participated in the study and how they were recruited are reported in Appendix 1. The following public health scenarios were used to assess analogical argument: (1) the use of hepatitis B by the Centers for Disease Control and Prevention in the USA as a model for HIV/AIDS health advice; (2) an investigation by environmental epidemiologists of illness that is possibly related to the presence of chemicals in drinking water; (3) the use of scrapie by

British scientists to assess the risk of BSE to human health; and (4) a study by pharmacoepidemiologists of the health effects of a new arthritis drug. The first and third scenarios described actual public health problems, while the second and fourth scenarios described plausible, but non-actual events. Two scenarios presented strong analogies and two contained weak analogies. All scenarios were presented in the form of a written questionnaire which was completed anonymously by subjects in their own time. Each scenario was followed by four questions. Two questions asked about information that was explicitly presented in the passage which described the scenario. These questions were intended to create the impression amongst subjects that they were engaging in a reading comprehension task. A third question asked subjects to rate the analogy in the passage as valid, moderately valid or not valid at all. A fourth question encouraged subjects to expand upon the grounds for their validity rating in an effort to determine the logical and epistemic factors which were decisive in forming their judgement. The passages and questions that were used in each scenario can be found in Appendix 4a.

The responses of subjects to these passages revealed a consistent and robust set of judgements regarding the use of analogy in public health reasoning. Across all four scenarios, strong analogies were consistently rated as either valid or moderately valid: 51.4 and 41.3 % (actual scenario), and 49.1 and 41.5 % (non-actual scenario). Analogies which were weakly warranted or flawed in some respect were judged by most subjects to be not valid at all: 51.9 % (actual scenario) and 74.5 % (non-actual scenario). As might be expected, the reverse pattern of validity judgements also obtained. Only 7.3 % (actual scenario) and 9.4 % (non-actual scenario) of subjects judged strong analogies to be not valid at all, while 10.3 % (actual scenario) and 5.2 % (non-actual scenario) judged weak analogies to be valid. The clear trends in judgements of validity are evident in the following diagram. From left to right, the percentage figures represent the response categories of valid, moderately valid and not valid at all:



Although these quantitative findings suggest that subjects can reliably judge the logical merits of analogies across a range of public health scenarios, they are only part of the picture. For what is equally or even more revealing are the criteria that subjects appealed to in order to support their validity judgements. These criteria

attest to the role of a type of dialectical rationality based on critical questions in subjects' judgements of the validity of analogies in the passages. Through the use of these questions, subjects were seen to interrogate the rational basis of different analogies. However, only some of the questions took the form of explicit (grammatical) questions as in (1) and (2) below. Many others were posed through the use of statements as in (3) below:

Critical question (1):

'[H]ow do we know that scrapie may not have transmitted to humans in 250 years as technology has not been advanced over the 250 years and people died of unknown conditions?' (37-year-old, secondary school educated, white British woman)

Critical question (2):

'Was the patient on any other drugs that may have caused these problems. Other genetic/underlying problems, etc.?' (31-year-old, university educated, Indian woman)

Critical question (3):

'[I]t doesn't seem to me a safe assumption that because two diseases are 'related' they will necessarily act in the same way as far as transmission to humans is concerned' (62-year-old, university educated, white British man)

In the first of these critical questions, the respondent is interrogating the claim that scrapie has not transmitted to humans. This claim forms the second premise in the analogical argument in (1) that was presented at the beginning of the chapter. In the second critical question, the respondent is challenging the conclusion of the following analogical argument:

Drugs A and B have properties x and y.
Drug A has property z.
Drug B has property z.

Property z is the feature causes side effects such as cardiac and kidney problems. In asking if these side effects could not have been caused by some drug other than drug B, the respondent who poses this critical question is challenging the conclusion of this analogical argument. In the third critical question, the respondent is challenging the extent to which certain similarities between BSE and scrapie can be used as a basis for arguing that these diseases will act similarly in terms of their transmission properties. In effect, the subject is querying the extent to which there is a causal or systematic relation between shared properties in the histopathology and epidemiology of BSE and scrapie and the transmission properties of these two diseases.

Dialectical criteria were not alone in influencing the validity judgements of respondents. A number of epistemic markers of strong and weak analogies also played a decisive role in the logical judgements of subjects. These markers included the presence of existing knowledge about one of two cases used in an analogy, the existence of multiple similarities between these cases and the particular context in which analogies were employed. It was clear from subjects' comments that when these markers were detected in a particular public health scenario, they were associated with the use of a strong, 'logical' or valid analogy:

Strong analogy:

Epistemic marker: existing knowledge

'It seems logical to use existing knowledge about another similar chemical to investigate whether the second chemical was the source of the health problems in the area' (29-year-old, university educated, white British woman).

Epistemic marker: multiple similarities

'The advice was 'moderately valid' as AIDS appeared in the same groups as hepatitis B another blood-borne virus' (63-year-old, university educated, white Irish man).

Epistemic marker: context

'This was a valid initial start to the investigation, until the actual cause could be isolated' (48-year-old, university educated, white British woman).

Each of these subjects attends to a particular epistemic marker in his or her assessment of the validity of an analogy. The first respondent describes as 'logical' the use of existing knowledge of one of the chemicals used in the analogy as a basis for conclusions about the effects on health of the second chemical. The second respondent assessed the CDC's advice to be 'moderately valid' given the presence of AIDS and hepatitis B in several population groups as opposed to just a single group. The third respondent attached logical weight to the particular context or stage of an investigation – the start of an investigation – in her assessment of the analogy as valid. This same analogy may have been assessed somewhat differently in the context of a well-developed inquiry in which substantial evidence had already been accrued and investigators did not need to resort to the use of analogy.

There was also evidence that respondents were guided by epistemic markers in their judgements of analogies as weak or invalid. Markers of dissimilarity or dubious similarity varied with each analogical argument. Subjects readily detected markers of dissimilarity in the passages. In the chemical compound analogy, subjects characterized these markers in terms of expressions such as 'no common denominator' or 'very different chemical compositions'. By stating that these different chemical compounds should not be 'tarred with the same brush', the first respondent below is indicating that no conclusions can be drawn about the properties of one compound from the properties of the other (dissimilar) compound.

Weak analogy:

Epistemic marker: dissimilarity

'The drugs had very different chemical compositions and so should not have been tarred with the same brush' (30-year-old, university educated, white British woman).

'The drugs involved were of "different chemical composition" and so had no "common denominator"' (59-year-old, secondary school educated, white British man).

Epistemic marker: dubious similarity

'At this time it was not conclusive that BSE and scrapie were related diseases – it was only a suggestion, therefore the reasoning behind the suggestion that BSE would not transmit to humans was flawed' (32-year-old, university educated, white British woman).

Respondents were also attentive to markers of dubious similarity. The third respondent above is referring to the fact that in 1988 ('at this time') the tests that would definitively establish if BSE and scrapie were related diseases (so-called

strain-typing studies) were not available to scientists. In their absence, the claim that these diseases were related was at best weakly warranted (a mere 'suggestion') and was not a valid basis for the conclusion that BSE would not transmit to humans.

Other markers of strong and weak analogies as well as further critical questions that played a role in the analogical reasoning of subjects can be found in Appendix 4b.

5.7 Summary

This chapter has examined a further type of argument which plays a key role in public health reasoning. In analogical argument, an analogy or similarity is drawn between two cases A and B in respect of certain properties or features. This analogy is then used to argue that if case A has property x then case B must also have property x. Analogical arguments can be more or less rationally warranted depending on the nature and extent of the purported similarity between two cases, and the degree to which there exists a causal or systematic relation between the known properties of these cases and the unknown property that is described in the conclusion. Several historical accounts of analogical argument were examined. These accounts were somewhat dismissive of the logical merits of this argument, a fact that was explained in terms of a pervasive deductivism in logic. The widespread use of analogical arguments in a range of public health problems was illustrated with the use of examples. Dialectical and epistemic analyses of this argument were then examined. These analyses emphasized the use of critical questions to interrogate the rational basis of a purported similarity between two cases (dialectical analysis) and the identification of simple markers of similarity (epistemic analysis). They corresponded to a now familiar distinction, that between the use of analogy in systematic and heuristic reasoning. Finally, the results of a study of public health reasoning were reported. These results tended to confirm a role for analogical argument in the reasoning of members of the public both as a cognitive heuristic and during systematic deliberation.

Notes

1. Even within public health, analogies can have a figurative, ethical or descriptive function. Examples include an analogy between infectious diseases and war (De Grandis 2011), between dose-response in toxicology and public health areas such as diet, alcohol and physical activity (Whitelaw 2012), and the use of normative analogies in establishing ways in which new and emerging technologies such as umbilical cord blood biobanking should be used (Hofmann et al. 2006). These analogies do not have an argumentative or logical function, although they may perform other, equally important roles: 'Figurative analogies do not argue,

though they may elucidate' (Waller 2001: 200). Health analogies may also be imported into other fields such as the analogy between viral dynamics in humans and in computers (Eubank et al. 2008). For an extensive list of references on the use of analogy across different domains and disciplines, the reader is referred to Guarini et al. (2009). The reader cannot do better than Holyoak (2005) for an overview of analogy.

2. Ness (2012) proposes the use of analogies as one of eleven tools for developing innovative thinking in epidemiology.
3. Walton (1989b) makes this same point as follows: 'Many arguments from analogy that could be reasonable arguments unfortunately have to be evaluated as weak, questionable, or even fallacious if treated as inductive arguments. Why is this so? It is so because many powerful arguments from analogy are plausible arguments rather than inductive arguments' (258).
4. Parenteral transmission is defined as that which occurs outside of the alimentary tract, such as in subcutaneous, intravenous, intramuscular and intrasternal injections (Berkley 1991).
5. Duin and Pękalska (2007) make this same point as follows: 'we are able to deal with much more complex patterns that may not directly be based on sensorial observations. For example, we can observe the underlying theme in a discussion or subtle patterns in human relations. The latter may become apparent, e.g. only by listening to somebody's complaints about his personal problems at work that again occur in a completely new job. Without a direct participation in the events, we are able to see both analogy and similarity in examples as complex as social interaction between people' (221–222).
6. Although Tversky and Kahneman (1974) use the expression 'representativeness heuristic', it is clear from their description of this heuristic that they have similarity in mind: 'Many of the probabilistic questions with which people are concerned belong to one of the following types: What is the probability that object A belongs to class B? What is the probability that event A originates from process B? What is the probability that process B will generate event A? In answering such questions, people typically rely on the representativeness heuristic, in which probabilities are evaluated by the degree to which A is representative of B, that is, by the degree to which A resembles B. For example, when A is highly representative of B, the probability that A originates from B is judged to be high. On the other hand, if A is not similar to B, the probability that A originates from B is judged to be low' (1124; italics added).
7. Like the representativeness heuristic of Tversky and Kahneman, it is clear that Kleider and Goldinger (2006) view their resemblance heuristic as having a biasing effect on face recognition: 'resemblance refers to a heuristic strategy wherein recognition decisions are biased by a test item's thematic similarity to other studied items' (261). Kleider and Goldinger argue that this biasing effect can have serious implications for eyewitness memory.
8. The thymus gland is one of several tissues that make up the lymphoreticular system. Other tissues include bone marrow, tonsils, spleen and lymph nodes. Additionally, in ruminants, there is primary lymphoid tissue in the gut called the ileal Peyer's patch.