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PETER RABBIT IS A BADGER IN DISGUISE: DECONSTRUCTING THE BELIEF SYSTEM OF THE INSTITUTE FOR CLINICAL AND ECONOMIC REVIEW IN HEALTH TECHNOLOGY ASSESSMENT**Abstract**

The Institute for Clinical and Economic Review (ICER), a Boston-based consulting group, has seen itself as the lead organization in the US for evaluating pharmaceuticals and, at product launch, making recommendations for pricing and access. Previous commentaries in Innovations in Pharmacy have made the case that the ICER analytical framework is nonsensical. It abandons the standards of normal science in favor of inventing evidence through unsupported assertions and lifetime assumption driven simulations. It has been labeled pseudoscience. Yet ICER persists in its belief that it can disregard these standards, notably in respect of the axioms of fundamental evidence, and continue its technology assessment activities. Challenging a belief system is not undertaken lightly, although in the case of ICER the belief system is built on such shaky foundations that the effort seems almost superfluous. Nevertheless, it is important because it brings into relief the wider belief system of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) who share the same mythical certainties. A key issue is one of cultural relativity: can we accept with equanimity the parallel existence of two belief systems in health technology assessment when one is clearly nonsense? The answer proposed here is clearly no; although unfortunately the blowback for ICER and ISPOR will ensure the survival at least in the near term of this unfortunate meme.

INTRODUCTION

Challenging strongly held belief systems with their mythical uncertainties is not a task lightly undertaken. The penalties for disagreeing can be severe, as Michael Servetus (1511-1553) found to his cost when he stayed overnight in Geneva in 1553, coming inadvertently into the clutches of a vicious and unforgiving John Calvin (1509-1564) ¹. A belief system or meme is an intractable position. It does not have to make practical or even logical sense. It can be replete with mysteries; the more they are obviously nonsensical only makes the belief even stronger. An attempt to leave this citadel of belief has significant downsides: ostracism, rejection of published papers, failed marriages and denial of promotion and tenure. Not quite matching the threat of the inquisition and subsequent stage managed *auto da fé* events with green wood to extend the agony, yet the penalties can be severe.

For our purpose a key question is why this dominant meme in health technology assessment, characterized as the rejection of hypothesis testing in favor of the invention of approximate information came into being. While not quite a Damascene conversion, the epiphany, if that is

the right word, came from a concern with the evidence base to support cost-effectiveness claims. In the early 1990s the thought leaders or illuminati in the nascent subject area of health technology assessment raised the issue of the implications of limited evidence at product launch. They decided that hypothesis testing would be put to one side in favor of inventing approximate information to support formulary decision making through lifetime simulation modelling ².

But that was only the start. To ensure survival you need to develop a creed to support this nascent meme; to ensure transmission fidelity and attract converts. This was accomplished through the development of techniques, with a supporting language; to ensure adherents did not stray too far from the core activities. At the same time, care was taken to minimize apostasy. Certain questions were off limits: notably discussions of the applications of the scientific method, including the question of limitations imposed by the axioms of fundamental measurement. Quality adjusted life years (QALYs) became the holy grail of modelling. Measurement theory was never discussed.

For the Institute for Clinical and Economic Review (ICER) the badger belief assertion that ordinal scales have only ordinal not hidden ratio properties is a non-starter for any disputation. The ingrained belief that the ordinal utility or preference scale has hidden yet a critical ratio property simply rejects the question out of hand. Peter Rabbit is, without question, a badger in disguise. It admits of no empirical evaluation; it is asserted. Generations of children might object and in tears disagree, but ICER will stand firm in its badger belief. This would apply to the author, Beatrix Potter, who might challenge this rewriting, as well as her publishers.

We might even rephrase this in terms of the Bertrand Russell (1872-1970) and Ludwig Wittgenstein (1889-1951) Cambridge encounter in 1911 where instead of a rhinoceros or an elephant in the lecture room we have Peter Rabbit as a badger, where Russell might raise the question “there is not a badger disguised as Peter Rabbit in the lecture room”. For interest, it might be noted that the Tale of Mr Tod was published within a few months of this encounter ³.

THE ICER/ISPOR TRUTH IS CONSENSUS

Judged by the series of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) good practice guidelines, the invention of evidence through simulation modelling was seen as the only practical approach; evidence for cost-effectiveness claims and an analytical framework to deliver the imaginary goods had to be invented. At no stage over the past 20 years has ISPOR even produced: (i) a practice guideline that focused on the evidentiary standards for credible, empirically and replicable claims; or (ii) a practice guideline that focused on the evaluation of patient reported outcome (PRO) claims in terms of the axioms of fundamental measurement. This latter point is important because of the neglect of PRO instruments that allow a meaningful response to therapy ⁴. That is, PROs that met the required

standards of fundamental measurement and emulate the measurement protocols of the physical sciences. Absent these standards and claims from PROs are just disregarded.

The ISPOR truth by consensus meme puts to one side the standards of normal science and any consideration of the limitations of fundamental measurement; a statement or assertion is true simply because people generally agree with them. An ISPOR team will decide on the merits of any debate in these imaginary scenarios. We have the commitment to imaginary simulated claims which cannot and never were intended to be empirically evaluated (let alone expressed in credible empirically evaluable terms). Imaginary claims, with the security blanket of sensitivity analysis, are in badger belief both necessary and sufficient for formulary decisions.

BARRIERS OF LANGUAGE

The language of a belief system or a meme can act as a barrier to criticism; even mutual incomprehension. This can raise a can of worms when we consider language and its application in the 20th century. The chief protagonist here is Wittgenstein in his belief that certain, otherwise simple empirical questions, can be considered out of bounds: the question has no meaning.

If we accept Wittgenstein's proposition that 'the limits of my language is the limits of my world' then language, notably the introduction of technical terms to support a meme and its application become important. Although often sharing a common language, the relativists and realists in health technology assessment have a number of barriers in place to repeal unwanted ideas and concepts. To the extent that the language determined beliefs and the limits of enquiry, it can also reinforce belief. We will consider the Karl Popper (1902-1994) and the Wittgenstein Cambridge encounter of 1947.

THE QALY AS HOLY GRAIL

It is difficult not to understate the hold that the quality adjusted life year (QALY) has on the ISPOR and ICER meme for technology assessment. Incremental cost-per-QALY imaginary simulations are the lodestone of technology assessment. This is easy to understand: take away the unconstrained badger belief in the QALY and the edifice of health technology modelled assessments collapses. Samson can demolish the Temple. It is sad to think that generations of eager health technology enthusiasts who have embraced the QALY without recognizing it is a mathematically impossible construct – unless you believe that ordinal utility scales have hidden ratio properties. This represents the singular failure in the ISPOR/ICER meme; a failure to face simple logic and the impact of levels of measurement. Belief trumps logic.

Without being overly tedious, the argument is simple: utilities are on an ordinal scale, they are ordinal scores ⁵. Nothing has been put forward to dispute this position. As such, you cannot

multiply a ratio measure (time) by an ordinal score. It is mathematically impossible. Of course you can as these are just numbers, but it is meaningless. If you want to combine a measure with another measure, then both have to have ratio properties. We have known this from Thurstone's contributions of the early 19th century and Stevens' contributions of the 1940s^{6 7}.

One interpretation of this disaster is simple leadership and illuminati ignorance. Those developing multiattribute instruments and proselytizing in favor the time trade off (TTO) and standard gamble (SG) techniques, had no idea that they should be aiming for a measure with interval and, hopefully, ratio properties; a measure that could support the QALY holy grail. Otherwise they could just sell tickets for an ordinal score raffle, which could present negative values and a cooked chicken.

THE ICER MEASUREMENT CREED

To protect its use of the QALY, ICER has a measurement creed; a set of unsupported assertions that guide, indeed dictate, ICER's aims. As stated:

As we have expressed before we (and most health economists) are confident that changes in the EQ-5D (and other multiattribute utility instruments) do have ratio properties. The EQ-5D value sets are based on time trade-off assessments (which are interval level), with preference weights assigned to different attributes. We fail to see why this should be considered an ordinal (ranked) scale. The dead state represents a natural zero point on a health related quality of life. Negative utility values on the EQ-5D scale represent states worse than dead. We do not find this lacks face validity⁸.

This creed has a confused deconstructive message:

- The creed is in terms of belief based on a failure to understand the standards of normal science, including fundamental measurement
- The EQ-5D-3L/5L and other multiattribute instruments are believed to have hidden ratio properties although they are ordinal scales (a badger in disguise);
- The time trade off (TTO) scores are believed to have interval properties (another badger);
- These interval properties mysteriously transmuted to a ratio scale;
- Ordinal scales are believed to have ratio properties;
- It is believed to be perfectly acceptable to add up scores for different attributes to create a single score;
- Utility or preference scales such as the EQ-5D-3L/5L can generate negative utilities;
- The 0 = death point on an ordinal scale ensures it has ratio properties consistent with negative values;
- Negative values on a ratio scale have face validity;

- The EQ-5D-3L/5L multiattribute scales were designed to have face validity while allowing negative utilities or states worse than death.

As detailed below, these are nothing more than a series of assertions with no attempt to consider them as empirical propositions. This is a weak defense of an indefensible position.

CULTURAL RELATIVITY

One perspective on why ICER (and ISPOR) continue to deny the relevance of hypothesis testing with their advocacy of imaginary simulations, together with the denial of the axioms of fundamental evidence, is to consider belief in terms of cultural relativity or, in the vernacular, anything goes. Under what is described as the 'strong program'; as Wootton describes it, the position taken is that the values and aspiration of scientists answer to a sociological explanation⁹. This rests on the notion of symmetry between beliefs. If beliefs differ then they should be evaluated in their own terms, not by reference to standards held by other belief systems. Badger belief systems should not be evaluated by the standards of non-badger belief systems. Put simply: rationality is always culturally relative. The strong program, which goes further, *denying that scientific claims are ever adopted because they fit the evidence better than the alternatives* (Wootton p. 580). This postmodernist view, in common with most postmodernist views, is nonsense. If the view that all beliefs are equivalent is accepted then we must accept ICER's position that the ratio scale can accommodate a non-true zero. This may violate, even in simple logic, the axioms of fundamental measurement but in this parallel badger belief system it makes perfect sense. But, as Wittgenstein is reported to have pointed out the logic of mathematics may not be relevant; in this lecture room $2 + 2 = 4$; in the next lecture room the belief is that $2 + 2 = 5$. As Wootton continues: *To insist that the issue of validity must be separated from the issue of credibility is to insist that well-founded beliefs be treated as if they are unfounded beliefs* (p. 582). The belief, held by generations of children that Peter Rabbit is not a badger in disguise (the issue was never raised by Beatrix Potter) should be treated as on a par with the assertion that Peter Rabbit is a badger in disguise (absent any evidence to support this proposition). The beliefs are equivalent and entirely rational.

If ICER supporters are to be labelled 'relativists', in the badger camp, the question then arises: is this a relativism of convenience to support a misguided analytical framework while supporting a successful business model with attendant accolades or are they all true badger-believers? Should ICER/ISPOR be viewed as a cete of badgers? A cete of true believers that judge their analytical approach (the term is used loosely) only within their own belief system. Questions that are raised by reference to a non-badger belief system (e.g., claims with empirical credibility) are not only irrelevant but make no sense in their terms. It is an article of faith, interpreted in sociological terms, that the creed holds: there is a ratio scale with a true zero (death = 0) yet, perhaps in contradiction, also utility states worse than death. This is not uncommon in belief

systems (or memes) to hold mutually contradictory beliefs; indeed such mysteries, rife in religions, may engender even stronger belief.

What ICER holds as a central tenet of their analytical framework is clearly relativist: evidence is never discovered, only constructed within a particular social community that joins in subscribing to a common belief system. This wider community is, of course, the ISPOR and supplicant community of those who believe in creating approximate information as opposed to hypothesis testing. No one body of evidence is superior to another; approximate information is equivalent to hypothesis testing if we are to 'inform' decision makers. Success, in these terms is judged on the ability to garner support. The EQ-5D-3L/5L may be failed constructs, but belief in these scales remains, supported by an effective outreach program of believers or missionaries, in some cases by those with a financial interest (and those refusing, for one reason or another, to abandon their belief). Within this community 'truth is consensus'; a position held by ICER in its assertions regarding measurement theory and the confidence of badger believers. For the relativist a belief system cannot be overturned by new evidence; the badger belief system is nothing more than rhetoric, persuasion and authority. The search for new knowledge is irrelevant; laurels can be rested on the creation of assumption driven imaginary simulations.

To the non-badger belief system, with its commitment to evidence, hypothesis testing and the discovery of new facts, stretching back to the 17th century, the badger cete is logically and linguistically indefensible; indeed, an object of scorn. Care has to be taken; one might object to Wittgenstein's view of language, but yet agree with him on the importance of evidence and the scientific method. As detailed in the *Tractatus* and (posthumously) in *On Certainty* Wittgenstein was no relativist (e.g., his rejection of logical positivism) and, even though taken as a inspiration by them, would not only have rejected relativism out of hand but also claims built on imaginary or existential simulations ^{10 11}.

We should not, as Wootton notes, confuse the symmetry principle where good and bad science can be explained in the same way with impartiality, where failed science should be studied as carefully as successful science. This is a major theme of this commentary. Focusing on a sociological defense of a failed science, and the ICER framework is clearly an analytical dead end, should not excuse us not assessing the reasons for failure as impartially as we can. Perhaps only an impartial resolution will keep the genie in the bottle (or the badgers in their cete). After all, for the majority of ICER's audience, the analytical framework is still a black box.

HIPPOPOTAMUS IN THE LECTURE ROOM

The issue of linguistic convention still remains. This is illustrated, in the context of evidence, in the confrontation in 1911 in Cambridge between Bertrand Russell (1872 - 1970) and Wittgenstein as to whether there was a rhinoceros (or elephant) in the room, with Wittgenstein refusing to admit there was not. It hinges on the nature of evidence and whether belief or a

belief system can ever be overturned by an appeal to evidence. To paraphrase Russell's recollection:

Wittgenstein maintained that all existential propositions are meaningless. As this was a lecture room I invited him to consider the proposition that 'There is no hippopotamus in the room at present'. When he refused to believe this, I looked under all the desks without finding one, but he remained unconvinced'⁹.

The encounter, was commented on by Russell "My German engineer, I think, is a fool. He thinks nothing empirical is knowable. I asked to admit there was not a elephant in the room, but he wouldn't"¹² [note: it is unclear from Russell's recollection whether there was not a elephant or not a hippopotamus]. From the ICER badger perspective, would Wittgenstein have refused a response if Russell has said 'There is not a badger in the room'? While we can agree that the badger is an existential entity, the reasons for Wittgenstein's response (or lack of) is not clear.

One explanation is that Wittgenstein thought the statement made no sense and hence saw no reason to answer. Consider the distinction between a proposition and an assertion. A proposition is a statement that it makes sense to ask whether it is true or false; an assertion is a statement that one claims is true (hence the ICER creed). Assertions are more restrictive than propositions (example: "It's snowing" is a proposition not an assertion) but if I open the door and say 'it's snowing' I am asserting the proposition is true; hence it is an assertion. Everything that is a proposition can also be an assertion while all assertions are not necessarily propositions; i.e., a claim that may be true or false. While the distinction is contextual, it is clear that the ICER belief system in measurement is a series of assertions with no intention of opening them up to refutation. For Wittgenstein there are meaningful and non-meaningful assertions, which leads to the question of a background to the proposition. What Russell thought was a proposition was not, for Wittgenstein, in fact a proposition or assertion. Hence the term used by Wittgenstein 'asserted proposition', as an everyday statement that can be true or false as compared to one that is nonsense.

AN UNCOMMON GROUND

Whether one agrees with Wittgenstein regarding the concept of a form of representation, for our purposes it is the distinction between a proposition and an assertion that is critical. If a belief system rests on assertions, by assertion truth is consensus, then there is little common ground for arguing for propositions. Importantly, it is not just a belief system built on assertions that is a barrier, but the structure of the belief system and its language. To believers in the non-badger belief system an analytical framework that rests on core assumptions that are clearly false and develops techniques such as probabilistic sensitivity analysis (PSA), is nonsensical; techniques that do nothing other than act as a cover for assertions and false assumptions.

Amongst a global community that believes in the scientific method and the role of measurement in instrumentation to support hypothesis testing, we have a nested global community of non-believers. Relativists in health technology assessment who have accepted an entirely different reference framework; one that predates the scientific revolution in constructing imaginary worlds with a complete disregard for empirically evaluable claims or propositions in favor of assertions. Whether understood by the leaders and illuminati in health technology assessment, their decision to abandon hypothesis testing in favor of inventing approximate imaginary information to support formulary decisions is a denial of the scientific method; a major reversal of any commitment to the scientific method. Indeed, an implicit acceptance of verification, as a central analytic of logical positivism, with the consequence that all mathematical proofs and logical inferences are tautologies. As such, they give us no information about the real world, they are devoid of substance and are only about the internal relationships of the proof. This seems apt when deconstructing the ICER badger belief system, taken with the standard paragraph in ICER evidence reports that verification is either in terms of the internal structure of their model or its comparison to other models in the same disease area. Claims are made, but none meet the required standards in normal science of credibility, empirical evaluation and replication. The thought that verification has been long been rejected in terms of falsification and probabilistic confirmationism seems not to have occurred to them.

To a realist, the badger technology assessment belief system is truly Orwellian; O'Brien would clearly approve. You might hold up 3 fingers but if you are told there are really four you will assert (and actually see) there are four. There is no evidence from an external reality that would shake that belief; it is disallowed¹³. More to the point, the relativist position is an embarrassment. For the first time in 400 years since the invention of science in the 17th century, we have a commitment to imaginary claims in decision making by analysts that share a common language, endorsed by leading academic groups and applied by government agencies such as the National Institute for Health and Care Excellence (NICE) in the UK. This makes the intractability of the meme, the embrace of facile ideals, psychologically fascinating. This is not just the belief that direct and indirect utility scales have, not just hidden interval, but hidden ratio properties, but that ordinal preferences are an integral part of the creation of imaginary claims for cost-effectiveness. This, again, is clearly in the tradition of denying the relevance of external evidence; the relevance of accepting propositions. We are now dealing with a bloat of assertive hippos (hippopotami) [or a crash of rhinoceroses] in the belief, commitment and publication of imaginary claims.

To argue for cultural relativity, ignores how the language for what we now call science has evolved⁹. The notion of science, in the 17th century, was a process of a growing vocabulary; science was invented. Observations were made for which there was no nomenclature; cloud classification, planets and moons and so forth. So the language evolved to accommodate these and establish a common vocabulary (at first in Latin), and continues to do so. The downside is that a language and vocabulary can also emerge that supports a relativist rather than a realist

belief system. If a language does not evolve then events such as the scientific revolution or the rapid acceptance of Einstein's theories will not occur ¹⁴. Certainly, a static language cannot support a commitment to a dynamic social science; the need for an evolving vocabulary to capture new observations and techniques. Communication and rational thought are only possible between people when there is an agreed and comprehensible common ground.

A POKER EVENING

If we fast forward some 36 years later to the evening of 25 October 1946 at a meeting of the Moral Sciences Club in Cambridge, we come to the famous (or infamous) poker confrontation where, in a heated argument with Popper, Wittgenstein is believed to have waved a poker at Popper, shouting 'you are wrong'; Russell took the poker and Wittgenstein stormed out of the room slamming the door. Wittgenstein had invited Popper, possibly at the suggestion of Russell, to discuss 'philosophical problems'. The details of the actual debate are elusive but have been characterized by one reviewer as a row over the role of philosophy in addressing real problems (Popper) as opposed to linguistic puzzles (Wittgenstein) ¹⁵. The debate over the debate continues with no end, at least from the Wittgenstein perspective, where advocates maintain that Wittgenstein is too complex a philosopher to categorize neatly (or understand) the complexities of language in communication. In contrast, the overwhelming majority of practical scientists and those in the philosophy of science mainstream, see Popper's focus on real problems, the growth of knowledge, and their evaluation as winning. From our perspective, in technology assessment, the case should be closed. The question is whether in rejecting Popper and taking a relativist position on the invention of simulated evidence, ISPOR/ICER have inadvertently rekindled this debate. If the issue is about language and grammar, a relativistic position that holds truth is consensus and that no one belief system, or language including internal contradictions, is as good as another, then we have just descended into solipsism where ICER presents an assertive linguistic defense of the indefensible. This may appeal to those who want to support the ISPOR/ICER imaginary belief system (whatever their motives), it certainly does not appeal to those who take science seriously, agreeing with Popper, and point to the failure of ISPOR/ICER to advance beyond pseudoscience ¹⁶. As Lakatos (Imre Lakatos 1922-1974) points out:

For centuries knowledge meant proven knowledge – proven either by the power of the intellect or by the evidence of the senses. Wisdom and intellectual integrity demanded that one must desist from unproven utterances and minimize, even in thought, the gap between speculation and established knowledge ¹⁷.

What actually transpired at the meeting is hazy and subject to mixed recollections, including even the accusation that Popper 'embellished' his recollections, even to the extent of lying ¹⁸. The evening started with Popper presenting a paper 'Are there philosophical problems?' or, as a subtext, are their problems as opposed to what he saw as Wittgenstein's position that there

were only linguistic puzzles. According to the account by Edmonds and Eldinow, Wittgenstein's preoccupation was with how we use words, how language functions, how to give words meaning to avoid the systematic misuse of language; are there statements which defy the logic of our language¹⁹. Other so-called philosophical problems could be dismissed as questions of logic and mathematics, not philosophy. One question raised by Popper was how we obtained our knowledge, not only about the external world but about ourselves, about the nature of reality. This was surely not by induction? Logical positivism and verification, the so-called Vienna School, had long been abandoned, with Popper and Wittgenstein prime architects. Apparently, the discussion came to a head when Wittgenstein asked for an example of a moral problem that philosophers could address; Popper replied 'Not to threaten visiting lecturers with a poker'; hence Wittgenstein's response. However, while Wittgenstein is believed, an important impetus in the relativist emergence in the 1960s, arguments from the *Tractatus* and, more recently, *On Certainty* would not only suggest otherwise but also point to the convergence between Wittgenstein's and Popper's views on induction and hypothesis testing as early as the 1920s.

Popper was correct in raising the question of the reach of philosophical problems. Certainly the use and abuse of language is critical, contexts where meanings are poorly articulated, as in the badger belief ICER response that we are 'confident' and we do not find this 'lacks face validity' and, most concerning, the view that ordinal scales have ratio properties. These can be dismissed out hand as logical nonsense, pointing to a cavalier misuse of language, to the extent of being deliberately misleading; the lack of coherence by the author or just mischievous. Given this, Popper is also correct in pointing to a range of philosophical problems. In particular, and central to our thesis, the question of progress and the growth of knowledge. We cannot address this issue in terms of the misuse of language, falling back to a counter-productive relativistic philosophy, but through a commitment to the discovery of new facts; not old assertions recycled by ICER through imaginary constructs which fail Popper's demarcation test.

So, one way of viewing what transpired is agreeing that science and philosophy can tell us new things about the world, but only by putting to one side relativism, pseudoscience, mythical mysteries and linguistic games. Perhaps the most important contribution is to focus on demarcation: what criteria distinguish pseudoscience (bunk) from science?¹⁸. The distinction may not be hard and fast, but it certainly relegates the ISPOR/ICER activities and beliefs to the Dover Courtroom to join and defend intelligent design. Or, in the ISPOR/ICER case; unintelligent design.

Wittgenstein in the history of science is important because while he would not have described himself as relativist (if that term had any meaning for him), in his influence his assumed relativism is taken for granted⁹. This gives relativism an uncalled for credibility. Wittgenstein clearly believed that we can separate good science from bad science, where one of the defining criteria is the support for progress and, in Kuhnian terms (Thomas Kuhn, 1922-1992), evidence driven paradigm shifts²⁰. The unfortunate aspect is of course is that Wittgenstein's arguments

are often puzzling, contradictory and often allow more than one interpretation; hence the interpretations that surround the hippopotamus/rhinoceros event.

PROTECTING SIMULATED ASSERTIONS

The invention of evidence through assertions and assumption driven lifetime simulations, supported by the varied applications of deterministic and PSA is designed, not to produce evaluable claims which admit of an appeal to external evidence, but to smother them in a blanket of plausibility ²¹. This is made clear by ensuring that the claims are impossible to 'validate' in ICER terminology, other than within the model itself. Discounted lifetime incremental cost-per-QALY claims are magical constructs which defy any form of external assessment, unless in some bizarre universe one is prepared to create a 30 to 40 year data set to challenge them. Certainly, model assumptions may change with 'new facts' from clinical trials and new publications, but these are just subsumed within a selective analytical framework that uses these to create more imaginary claims on the future. Applying these assumptions still defies elementary logic. It is one thing to deny the role of an appeal to evidence to support propositions; it is another to ensure that such an appeal can never take place. In other words; we make sure there is no hippopotamus (or disguised badger) in the lecture room to start with. We are left with a discipline focused on creating non-evaluable assertions with a probabilistic tag; assertions which can never be considered propositions.

The fact that alone amongst the social sciences, technology assessment embraces an assertion driven relativistic belief system is, as noted, an embarrassment. For 30 years the leaders or illuminati of this relativistic and quixotic world have denied the role of hypothesis testing in favor of creating non-evaluable assertions, approximate imaginary information, the parallels with quasi-religious belief systems are too close which is why the term meme is more than apt. With organizations such as ISPOR the support for this belief system is well entrenched as evidenced by the publication of practice guidelines for the young model builder to replicate imaginary claims. Transmission fidelity is high, supported by the existence of mysteries such as the impossible or I-QALY which merely serves to reinforce belief because they are, to any intelligent observer, ridiculous. It might be noted, that there is no ISPOR publication on measurement theory and the limitations imposed by the axioms of fundamental measurement; perhaps that cat is best left in the bag. It is only recently, after an earlier attempt to submit a paper on fundamental measurement to *Value in Health* (the ISPOR house journal) was rejected without peer review, that a shortened version appeared as a letter to the Editor ²². The message was quite clear: 30 wasted years in technology assessment and a willingness to reject the axioms of fundamental measurement. The letter asked, possibly over optimistically, that *Value in Health* might inform its readership.

The relativist position is anti-science yet the ICER/ ISPOR belief persists; it fails to recognize (or refuses to recognize; or doesn't want to recognize) that the purpose of science, the progress of

science, is to seek provisional new knowledge through, as Karl Popper in his early work would describe it, a process of conjecture and refutation²³. A dynamism that admits of paradigm shifts when belief systems are challenged and a crisis sets the stage for a new consensus. Dynamism, the possible emergence of a new consensus, is absent from the static and unchangeable analytical framework of the relativistic meme; a virus of the mind^{13 14}. Consider the use by ICER in their creed of the word 'confident'. In the belief systems prior to William Gilbert (1544? - 1603) we find confidence in beliefs aplenty, but no widespread commitment to experimentation or even the advance of ideas (beliefs) in a form suitable for experimentation. Indeed, if we consider the language of science and its evolution through the 17th century, the concept of experimentation was resisted. As Wotton makes clear. for mediaeval philosophers such as William Grossteste (c.1175 – 1253):

Experience and experimentation were thus invoked only to fill gaps in a fundamentally deductive system of knowledge, never to question the reliability of deductive logic itself; and these gaps were always of limited significance within a curriculum centered upon Aristotle's texts⁹.

For ICER/ISPOR shared mythical certainties resist intellectual speculation.

DECONSTRUCTING THE ICER CREED

In order to illustrate the lack of any redeeming features in the ICER assertive creed, consider the following four fundamental errors in logic and measurement:

- assumptions to support lifetime modelled simulations
- ignorance of attributes and the axioms of fundamental measurement
- failing to recognize that time trade off can only create ordinal scales
- failing to recognize that the QALY is an impossible mathematical construct

ASSUMPTIONS: WHAT WHITE SWANS?

It is a fact of elementary logic that what has happened in the past cannot lay claim to what might happen in the future. Presumably to those in ISPOR/ICER, the issue of induction (Hume's problem; David Hume 1711-1776) was not an objection standing in the way of developing simulations of imaginary therapeutic futures, driven by past assumption, populated by I-QALY claims, to produce pricing and access assertions that had no empirically evaluable content. Put simply: the ISPOR and ICER models are derailed by their ignorance of induction and the demise of logical positivism by the mid 20th century. It is not as though this is a recent proposition; Hume proposed in the 18th century and Wittgenstein went to lengths to demolish it in his *Tractatus*, followed by Popper and his focus on conjecture and refutation. These are, apparently,

concepts that are entirely foreign to ISPOR/ICER. While we might consider modifications to Popper and the rise of confirmationism, where scientific theories are defined by the accumulating probabilities of experimental success²⁴, the fact remains that the commitment to assertions and an assumption driven future imaginary world is logically indefensible and an analytical dead end. We cannot confirm non-evaluable assertions. There can be no experimentation. There is no progress. If you assert, on past observations in the UK, that all swans are white, consider a vacation in Western Australia where they are black; unless of course you retreat and insist on defining a swan as a bird with white feathers. It is assumed the black swans are unconcerned. The badger belief system should collapse on these terms alone.

ATTRIBUTES AND THE AXIOMS OF FUNDAMENTAL MEASUREMENT

In the absence of ISPOR practice guidelines on the application and misapplication of the axioms of fundamental measurement, a primer is in order. As ICER in its assertions appears confused on the agreed levels of measurement, as recognized in the physical sciences and the more mature social sciences, the confusion should be addressed even at this late stage. Following the formalization by Stevens and others in the 1930s and 1940s, measurement scales used in statistical analyses are classified as nominal, ordinal, interval or ratio⁷. Each scale has one or more of the following properties: (i) identity where each value has a unique meaning (nominal scale); (ii) magnitude where ordered values on the scale have an ordered relationship with each other but the distance between each is unknown (ordinal scale); (iii) invariance of comparison where scale units are equal in an ordered relationship (interval scale) and (iv) a true zero where no value on the scale can take negative scores (ratio scale). The implications for the ability to utilize a scale to support use of arithmetic operations (and parametric statistical analysis) are clear. Nominal and ordinal scales do not support any mathematical operations; only nonparametric statistics. Interval scales can support addition and subtraction while ratio scales support the additional operations of multiplication and division as they have a true zero. These attributes are, it appears, totally foreign to the badger discipline. Indeed, the suspicion is that there is no perception of a pressing need to open this measurement window. Defenestration is long overdue.

Importantly, in fundamental measurement ordinal scales together with interval and ratio measures refer to single attributes; not to scales which attempt, as in the case of multiattribute instruments such as the EQ-5D-3L, to create an aggregate score that combines individual scores for each attribute. What was ignored (or overlooked) in the instrument development was that each attribute measure (e.g., pain, mobility) must have dimensional homogeneity, unidimensionality and construct validity. This has to be demonstrated in the development of measurement scales with intended interval or ratio properties. Assertion (or unfounded belief) is not proof; it may be an article of faith among some (but certainly not the majority of) health economists, let alone mainstream economists, but that leads us nowhere (apart from wars of religion). If an instrument is to have a given property this has to be built into its design and

development. In this respect it is important to distinguish the term 'score' from 'measure': a measure refers to a scale that meets interval or ratio properties while score refers to a scale with nominal or ordinal properties. In both instances the interval or ratio scale must be for a single attribute, physical or latent, to meet the standards of fundamental measurement. The attribute must have coherence, relating to key concepts (e.g., need-fulfillment quality of life ²⁵) and an assessment of measurement options (e.g., Rasch measurement theory ²⁶).

These properties have been accepted for decades yet have been ignored, by design or otherwise in the development of direct and indirect preference scales for health technology assessment. The first step promised disaster: attempt to take a health state description comprising a cluster of attributes and assuming, incorrectly, that this could be valued either as a single description (TTO) or by a fixed set of attributes (EQ-5D-3L). The ready acceptance of these preference measures, without recognizing their failure to meet fundamental measurement standards has had, in retrospect, a disastrous impact on health technology assessment. A situation where an organization such as ICER, following faithfully as a disciple of ISPOR, is promoting a relativistic solution for formulary pricing and access decisions. If there is a major failing, among many others, it is the mistaken impression that ordinal scales are magically transformed to interval scales if you place the scores on a number line with equal intervals, and then a metamorphosis into a ratio scale. You could equally well put the scores on a number line with unequal intervals. A ratio scale, in the absence of a natural true zero, is a more complex undertaking, in particular with latent constructs. This negates decades of experience in the physical, medical device and more mature social sciences. ISPOR appears prepared to endorse this charade with ICER lapping it up.

This level of ignorance is all too obvious in the creation of multiattribute preference or utility scales. Multiattribute utilities are ordinal scores; the scale has no pretense to meet either interval or the required ratio properties. The reason is blindingly obvious: the algorithms creating these scores (EQ-5D-3L/5L; HUI Mk2/Mk3) can take negative values. There are states worse than death. The 0 = death anchor is not a true zero, just a convenience. The developers might attempt to 'rescale' to eliminate these states or just ignore them but the fact remains: there are states worse than death. To this would be added the mistake of creating a scoring algorithm in the first place. As noted, measurement refers only to single attributes. If a combination of attributes is proposed then each attribute must be on a ratio scale. This is not the case with the multiattribute instruments as there is no evidence that the developers thought about this as witnessed by the EQ-5D-3L where the five symptoms or attributes are all on 3-response level ordinal scales and reflect merely clinician preferences for summary descriptions of general health. Moving to a 5-level has proved to be disastrous as the scores are different with ridiculous attempts to map between them ^{27 28}. An activity that is doomed as the scales are ordinal. You can only 'map' between ratio scales and, in certain circumstances, between interval and ratio scales. A point that ISPOR, in presenting practice guideless, has overlooked ²⁹. Multiattribute scales fail the axioms of fundamental measurement.

Once the criteria of fundamental measurement are applied, not only to multiattribute generic instruments but to the menagerie of published PRO instruments specific to disease areas or target patient populations, it becomes readily apparent that the overwhelming majority of PRO instruments fail to meet required measurement standards. The reason is obvious: no one thought that fundamental measurement was relevant. All that had to be done was to add up scores from the various scales (usually Likert) that composed the instrument and present an aggregate score to assess response to therapy. No one thought of emulating the instrument development standards of the physical or more mature social sciences where the focus is on measuring specific attributes. Multiattribute instruments are by name and design unacceptable; they produce only ordinal scores. The multitude of disease specific PROs follow in their wake. Deconstructing (and demolishing) PROs is a major challenge for health technology assessment. We are left with only a handful of PRO instruments that can provide a coherent and response to therapy metric. We have few measures but an abundance of ordinal scores.

ORDINAL TIME TRADE OFF SCALES

Time trade-off (TTO) creates ordinal scales. While some would like to think it has interval and even ratio properties it fails on two counts: (i) the TTO can produce states worse than death so that it fails to have a true zero or any pretense to a ratio scale; and (ii) as the TTO is applied to a health state description, this description is multiattribute and not a single attribute. This means it is impossible to capture the description as a 'single value' the multiattribute description is dimensionally heterogeneous, lacking unidimensionality and construct validity. Even minimal descriptive changes can result in different scores. To this we should add that respondents find the TTO valuation exercise cognitively challenging with responses clumping towards the presumed end points and the middle of the hypothetical range. We cannot assume that it produces an interval scale; a conclusion that is reinforced by the lack of concordance by patients with the behavioral assumptions for respondents that underpin the scale. The current view is that any claim that the TTO has interval properties is by assertion and unsupported belief³⁰.

THE IMPOSSIBLE QALY

The centerpiece of the badger belief system is the I-QALY; a construct, as noted, that is impossible (hence I-QALY) as it requires multiplying a ratio measure (time) by an ordinal score (utility); typically a multiattribute score which lacks dimensional homogeneity⁵. While this impossibility, given an appreciation of measurement theory, is more than obvious any attempt to recognize it would destroy the centerpiece of badger belief: the incremental cost-per-QALY and the application of cost-per-QALY thresholds. Simulation models are designed, in their commitment to generic scales, to generate non-evaluable QALY claims. If the QALY is cast aside, in a truly biblical sense, then, to mix metaphors, the emperor is stark naked. A methods framework such as that carefully detailed in the leading textbook, with its assertions and

techniques, is redundant ²³. A major element of the relativistic belief system does not collapse through external evidence (which it ignores), but from its internal contradictions. Marx and post-modernist disciples such as Foucault, were they alive, would be pleased.

THE ROAD NOT TAKEN

A reasonable question is why the leaders and illuminati in health technology assessment rejected the scientific method in favor of inventing evidence, convincing thousands that this was the way forward. The excuse provided the leaders was that we needed to construct imaginary simulations and invent evidence because, at product launch, current and good quality evidence is insufficient ²³. We can even attempt to resolve uncertainty with value of information analysis applied to constructed imaginary scenarios. A more practical approach is to balance uncertain early benefits against longer term more evidence rich, real world evidence; not to create imaginary cost-effectiveness claims, but for formulary committees to require manufacturers to underwrite protocols submitted for prospective claims assessment. This was proposed almost 20 years ago and has been maintained in the latest version 3 of the Minnesota proposed formulary guidelines ³¹. Pricing and access requirements would be provisional, subject to claims assessments being reported to the committee. This would establish required measurement standards in the process of discovery with, if required, providing support for value contracting.

The mistake made by the leaders or illuminati was that attempts to support, even provisionally, cost-effectiveness claims through simulation modelling collapses because those advocates of modeling overlooked the question of the limitations of fundamental measurement. Together with the advisability of moving from a mediaeval or pre-scientific analysis to one that actually proposed credible, evaluable and replicable assertions. Just as the venerable I-QALY was the catalyst for reference case simulation modeling, so recognition that the I-QALY as an impossible mathematical construct has destroyed it.

Unfortunately, convincing agencies such as NICE to endorse reference case invention of approximate imaginary information has proved counter-productive. It is all too easy to construct a model; engineer the model to support the manufacturer's preferred price and convince a committee that this is the last word in technology assessment. This stifles any further need to discover new facts; non-evaluable assertions will suffice. The product is on formulary and the manufacturer only has to consider its ongoing marketing and sales position *vis á vis* competing products and new entrants. This may involve further modelling, but the incentive is not necessarily there; ICER does not revisit regularly its previous modelled claims to accommodate new evidence from the literature and revised assumptions. A case can, of course, be made that it is not in ICER's interest even with its new cloud based platform, ICERAnalytics where the ICER model structure and its assumption can be changed to create entirely new assertions regarding pricing and access. For those interested to do so and with time on their hands on a wet Sunday

afternoon, the opportunity is there to create a multitude of competing models and non-evaluable claims; an assertive paradise of competing non-evaluable claims ³².

PROBABILISTIC SENSITIVITY ANALYSIS

To those in the badger belief system, the ultimate model outcome is PSA. This technique, proposed in the late 1990s, was to generate simulated likelihood assertions for comparative cost-effectiveness from invented evidence. A comparison of products, with the application of cost-per-QALY thresholds, produced a series of assertions, associated with contrived probabilities that various products at different price levels were cost-effective. Formulary committees were asked to embrace these assertions in their formulary assessment deliberations. This, from a realist perspective, is complete nonsense. There is no basis and never would be for these likelihood claims (and attendant probabilities) ever to be empirically evaluated. Different assumptions and assertions could produce (and in some cases were designed to produce) alternative probabilistic claims. A multitude of models could produce a multitude of non-evaluable PSA claims. As more data to support changing assumptions became accessible a new deluge of likelihood claims could be envisaged. These would be, it should be noted, for decades into the future, a veritable Disneyland of claims or, to be precise, assumption driven assertions for those prepared to put the standards of normal science to one side.

Not surprisingly, within the badger system, belief in the imaginary PSA information content as a driver of formulary decisions is widely held; truth, again, is consensus. ICER is a devoted advocate. The logical position that the simulations driving PSA are built on assumptions and assertions that, for a realist, lack any credibility, is not part of the discussion. This apparently is approximate imaginary information (or assertions) that are equivalent to that created by randomized clinical trials where the protocol is designed to capture comparative cost-effectiveness. Formulary committees are in a dilemma: do they accept non-evaluable probabilistic or likelihood assertions of cost-effectiveness at different pricing levels as valid decision inputs or should they be thrown out. To the realist the answer is obvious. The gap between speculation and established knowledge, in Lakatos' terms, is wide. Admittedly, the PSA diagrams are pretty as candidate for a relativist wallpaper collection; the problem is that they are meaningless.

REPUTATIONAL CHALLENGES

There is always satisfaction for the non-believer in deconstructing a belief system and relegating it to the nearest metaphysical dumpster. In technology assessment this is straightforward and long overdue. Indeed, there is the feeling that the need to protect the belief system against charges that were not even considered in its infancy is not a reasoned defense but an *ex post facto* contrived defense; a defense to protect reputations and the inordinate amount of money spent to construct imaginary worlds. The importance of the network of believers should not be

underestimated: these include academic and research centers, PSA missionaries as well as the multitude of believers presently employed by pharmaceutical manufacturers. All have a lot to lose. After all, admitting to generations of graduate students that the emperor has no clothes is an unanticipated recantation, with obvious religious analogies with worthless indulgencies and relics.

There are two options to consider in this commitment to an approximate imaginary information meme: first, that advocates of hidden ratio properties actually do believe that the EQ-5D-3L and other multiattribute scales are ratio scales in disguise or, second, that the belief system may be open to ridicule but that the sunk costs and subsequent 'egg on the face' admission of 30 years of nonsense are not worth the embarrassment.

If, in the first case, the true believer, an unreformed relativist, holds firm then the debate ends there. No logic or evidence will ever convince the believer that he/she may be wrong. They will drink the cool aid. Their belief system, even if an observer thinks it's weird, is immune to any criticism. The only salvation, if that is the correct word, is for third parties, such as agencies evaluating pharmaceuticals, to reject submissions that treat ordinal utilities as though they were ratio scales, rejecting constructs such as the impossible or I-QALY, this allowing the badger belief system to wither away to an empty cete.

In the second case, there will be a continued re-statement to defend both reputations and a successful business model. Over the last 30 years, millions of dollars have been spent, by both public and private sectors, on constructing imaginary simulations to support marketing claims for products. Tens of thousands of papers have been published in leading journals (*Value in Health, Pharmacoeconomics, Journal of Medical Economics*). ISPOR and ICER have been in the forefront of these endeavors. By and large, these investments in imaginary claims have paid off. Who would not invest in a product that can never be shown to be wrong in the claims made? To the cynic: we can always prove a product is cost-effective (without having to reduce price!). Paradoxically, manufacturers may continue to support the ISPOR/ICER meme on these grounds. The outcomes from a contribution to a church collection are far less certain; in this badger case the outcomes are predetermined. John Calvin would no doubt approve.

CONCLUSIONS: THE MADNESS OF CROWDS

Can a belief system have a use by date? Even the anticipation of a Parousia. The feature that stands out in terms of both ISPOR and ICER is their denial (or refusal to even consider) the limitations imposed by the axioms of fundamental measurement. Certainly, the belief system has proved to be inordinately popular and incredibly lucrative, but the end is uncertain. This is not from the many reminders of the limits of measurement, which have been a constant over 30 years, but the willingness of third parties to support the ISPOR and ICER packaged responses. Put simply, if the I-QALY fails so does the belief system. This is no small matter; it is more than

an academic ripple in a decaf coffee cup or a Senior Common Room spat. It is a failure that impacts one of the major sectors of the US economy.

To a degree, the continued popularity of the relativistic imaginary simulation has been the result of national agencies such as NICE buying into this relativistic belief system. The NICE reference case has been emulated globally, in many cases with a NICE police force equivalent of academics, like an inquisition, giving manufacturer's submissions the good housekeeping seal of imaginary approval. If it makes life easy, although nonsensical, then manufacturers will fall into line. Hiring a consultant to create an imaginary simulation on reference case standards is an easy and low cost option. A *danse macabre*: where both parties want a quick and low cost resolution in pricing and access recommendations. Neither party is willing to expose the underbelly of the badger and the failure to meet measurement standards; both seek a comfortable relationship that hits the checkboxes and gains formulary approval. The claims are never revisited; a rite of passage has been observed and pricing negotiations, including rebates, can begin. Welcome to the real world.

It is not the intention here to force believers to abandon a commitment to imaginary simulations and the rejection of fundamental measurement. That would be the moral equivalent of convincing a class of 5-year olds in mid-December that Father Christmas is a myth. Why shatter such innocent belief? Yet, while innocent it may be in its rejection of normal science and fundamental measurement, the fact is that it is fatally flawed. If those promoting approximate imaginary information to support formulary decisions are to maintain a steadfast belief, then (as with the Salvation Army) they need to be prepared to stand behind those beliefs; tambourines and those irritating Christmas bells. Just asserting belief, a deeply held faith in the technology assessment meme, taking refuge in relativism, is unlikely to convince realist critics.

In an important sense, ISPOR and ICER are between a rock and a hard place. On the one hand they embrace relativism, maintaining that truth is consensus, and defend in their practice monographs the construction of approximate imaginary information and the denial of the standards of normal science. On the other hand, their ongoing neglect (or refusal to consider) the limitations imposed by the axioms of fundamental measurement undercuts their belief system; all scores are ordinal and the I-QALY is an impossible construct; let alone their embrace of logical positivism. As noted, at no time has ISPOR considered a practice guideline for measurement. It lurks in the background; no effort to suppress these criticisms will succeed. This implies that the end of shelf life will be at least entertaining. Will rhetoric, persuasion and authority trump the realism of the scientific method? Will common sense prevail? Will third parties reject ICER and the QALY? Or will we have a post-Reformation parallel belief world? Absent wars of religion, we may have two groups of advocates of health technology assessment: dogmatic followers of the relativist badger ISPOR/ICER meme and

more practical realists looking to confront claims with real world evidence and the discovery of provisional new facts for therapy impact. Hopefully, pokers will not be involved.

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