

Objections to Radical Constructivism

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> Context • A number of objections that are frequently raised in the literature against radical constructivism, including: the charge of solipsism, allegations of self-refutation, social and moral reservations, and the accusation that RC cannot explain the success of science. **> Problem** • These four objections are sought to be refuted. **> Results** • 1. Solipsism is only troublesome against the background of a realist ontological perspective. 2. The truth-value of any proposition is only defined relative to some ontological context; hence self-refutation, as constituting a logical problem, does not arise. 3. Any ethical argumentation derives from one's own personal views on ethical matters: their construction being a personal responsibility such that no one else can tell a person how to construct the "right ethics." 4. In the relativist ontology of radical constructivism, a scientific theory is regarded as a model imposed on natural phenomena; its success is due to the capabilities of its constructor (the scientists). **> Implications** • It is found that the objections to radical constructivism are based on an (overt or tacit) adoption of the antithetical viewpoint of scientific realism. In other words, radical constructivism is being criticised for not promoting a realist ontology. **> Key words** • Ethics, ontology, realism, relativism, science, self-refutation, solipsism.

Introduction

In the literature, one encounters a large number of different theories, often in mutual disagreement, that all label themselves as being some variety of "constructivism" (see, e.g., Geelan 1997). The present paper will be concerned exclusively with the epistemic and ontological theory known as *radical constructivism* (RC). This theory has been defined by Ernst von Glasersfeld (1993, 1995, 2000, 2007) in the form of two basic propositions:

- 1 | Knowledge is not passively received, but actively¹ built up by the cognising subject.
- 2 | The function of cognition is adaptive, and serves the organisation of the experiential world, not the discovery of ontological reality.

Note that both these propositions make explicit reference to the notion of *cognition*. The various implications of this will be discussed in some detail below.

RC has occasioned a lot of controversy, as is well known. An extensive discussion of many implications of this theory has been undertaken in Quale (2008). In this paper, I shall address a number of *objections* that are frequently raised in the literature against

1| The term *active* here means that it is the knower who (consciously or unconsciously) does the construction; she is not a *passive* receiver of preformed knowledge.

RC, in the context of *natural science*: that is to say, the discussion will focus on the experiential world of natural phenomena, such as are described by means of scientific theories.²

The objections to be considered here may be conveniently classified into four categories, denoted and described thus:

- 1 | *existential* – the charge of solipsism;
- 2 | *logical* – allegations of self-refutation;
- 3 | *social/moral* – the claim that RC supports reactionary social and political structures;
- 4 | *ontological* – the "miraculous match" that is sometimes claimed to be manifest between science and the experiential world.

However, before engaging in a detailed discussion of these categories, let me remark briefly on some quite general features of RC.

First, in this theory is implicit the premise that the notions of *learning* and *knowledge* are mutually defining: learning is the process through which we gain knowledge; and knowledge is the product, or result, of the learning process.³ Thus any individual person will, throughout her life,

2| The interested reader is also referred to a similar discussion earlier in this journal, conducted in a wider context in the target article of Gernot Saalmann (2007) and various open peer commentaries.

3| In fact, the originator of RC, von Glasersfeld, prefers to speak of it as a *theory of learn-*

ing and knowing" (and simultaneously) playing two roles: that of a *learner* (who continually receives and reflects on experienced input of information), and of a *knower* (who is in actual possession of whatever knowledge has resulted from this process of learning).

This does not, however, mean that the knowledge is constructed by an individual in isolation. On the contrary, RC accepts the conception of learning (i.e., knowledge construction) as an active social process, where knowledge is constructed by individuals communicating in networks. However, the *knowledge* constructed in this social process is in RC regarded as residing in the mind of each individual knower – the person who "does the knowing," so to speak. In this sense, then, RC is an individualist epistemic theory, despite its acknowledgement of the shared aspects of the learning process.⁴

Second, RC is a theory of epistemic and ontological relativism. For the purposes of the present discussion, one may describe as follows the mutually antagonistic positions of realism and relativism with regard to the notion of *truth*:⁵

ing and knowing – cf. the book title (Glasersfeld 1995).

4| I am grateful to an anonymous reviewer for pointing out the need to clarify this point.

5| Some qualifications are in order here. First, the meanings of the terms "realism" and "relativism" both vary in the literature with the context in which they are used. The specific meanings

- *Realism* is based on the assumption that objective truth can (in principle, at least) be defined and identified. In other words: there exist objectively true propositions that describe the natural world, and it is the goal of science to find and investigate them – or, at least, to establish propositions that come arbitrarily close to this ideal of objective truth. Indeed, this lies at the basis of the widely held view that science is *progressing over time* towards a better (i.e., more true, more correct) description and understanding of the world.
- *Relativism*, on the other hand, does not recognise such a conception of objectively true propositions. The notions of truth and falsity, as descriptors of any proposition, are taken to be defined only relative to some given *context*; and (very importantly) it is then up to the individual knower whether she will accept this context and adopt it as an ontological premise for herself in her continual quest for knowledge. In particular, the notion that science is making progress over time, and that it is, through this progression, “approaching the truth” in some objective sense is taken to be devoid of cognitive meaning: there simply is no way we can observe and demonstrate how close we are to this purported state of scientific truth, or even whether we are in fact “getting closer” to it in the course of time.

The position of relativism, as it is described here, is fundamental to the theory of RC. As a consequence of this position, RC asserts that there can be only one meaningful definition of the notion of “reality” for any individual knower at any moment of time: namely, *her own experiential world* – the totality of all that this knower has experienced in her life up to this moment. As will be demonstrated below, it is precisely this basic dichotomy, or antithesis, of realism vs. relativism (see e.g., Bickhard 1997) that lies

that are adopted here, as described above, are often termed “scientific realism” and “truth-relativism,” respectively – see, e.g., Mautner (2000: 472, 480, 574). Also, there are different theories addressing the notion of “truth”. In the present context I shall discuss the “correspondence theory” and “coherence theory,” to be described later on.

at the bottom of most of the objections to be discussed below. In the present paper, I will restrict myself to discussing some aspects that relate specifically to the theory of RC and its ontological implications for natural science.

1. The existential objection: The charge of solipsism

The relativism that is inherent in RC raises important epistemic issues about the nature of scientific knowledge. It rejects the idea that the purpose and goal of any science must be to seek “objectively true knowledge” about the phenomena that it investigates. Indeed, it is sometimes asserted that RC must necessarily lead to the extreme philosophical position known as *solipsism*: i.e., the assumption that every individual is free to construct her own world, in whatever way she fancies. This is often expressed as the charge that RC “denies reality”! Thus, critics of RC such as McCarthy & Schwandt (2000: 41–85) have raised questions such as the following: If all knowledge is constructed by the individual learner, and resides in her own mind, how can she know that there is anyone else out there in the world with whom she can communicate and share her knowledge? Indeed, how can she even be sure that there *is* a world outside her – can she exclude the possibility that she is entirely alone, locked up inside her own mind and hallucinating all her experiences?

The answer to this last question, as offered by RC, is that: (i) no, she cannot exclude this possibility, but (ii) this is quite irrelevant for her! In other words: for any individual learner, such a solipsist stance may well be *logically irrefutable* – i.e., she can never have a 100% watertight guarantee that the world she perceives around her is not just a hallucination in her own mind. However, this stance will also be *existentially irrelevant* for her – i.e., she will choose to disregard this possibility in the way she conducts her life! It is inherent in our nature as human beings to assume that the external world that each of us experiences is in fact there for us to experience. In other words: it is natural for us to assume that we all inhabit and share the same experiential world, and that this world is accessible for us, to act

on and interact with each other in. This reflects a fundamental ontological premise of RC: that the world is indeed there, not as a territory to be discovered and mapped, but as a *shared resource* for individual learners/ knowers to experience and construct their knowledge of. Indeed, to reject this premise would generally be considered a sign of mental aberration. So, we can reject the “solipsist fallacy.”

Let me elaborate a little further on this point. The bottom line is that RC, as a theory of epistemology, is strictly *agnostic* with respect to ontological questions: it states unequivocally that objective knowledge of “the real world” (better: of our experiential world) is in principle not obtainable. However, it is argued here that we need to adopt, as a basic assumption, the proposition that there is a *shared experiential world* that we can discuss; otherwise any personal communication and interaction become meaningless. In other words, it is assumed that “the world is there,” serving as a common arena of intercourse between knowers, even though we can have no objective knowledge of its properties. One might say that the necessity to talk about this “ontological prerequisite” is not logical but rather *psychological*. The author is grateful to an anonymous reviewer for suggesting the need to clarify this point.

However, it is important to note that the *experiences* (through sensory perception and/or mental reflection) that individual persons can have of this world are *not shared!* Any particular such experience will be realised (i.e., sensed, observed, felt, and so on) by some individual learner, and used by this learner to construct her knowledge of the world. Moreover, there is no objective (i.e., person-independent) way of deciding whether two individual learners do in fact experience some given aspect of the world “in the same way” and thus can construct the same *knowledge* of this aspect. In other words, the knowledge that one can gain of the world is not automatically shared between knowers: any particular item of knowledge will reside *in the knower* (i.e., in the mind of the individual who “does the knowing,” so to speak), and there is no way that one knower can inspect the mind of another to check whether the two are both in possession of “the same” knowledge! Note

that this applies not only to knowledge of the natural world but even to knowledge involving social interactions and communications. In other words, the conception of “society” is also to be considered an individual construct rather than an ontological given, as has been emphasised by von Glasersfeld:

“I argue that ‘others,’ too, can be explained as an individual’s creation; a creation, however, that is just as constrained by the condition of viability as are the physical objects with which we furnish our world. Consequently, ‘society,’ too, can be considered an individual construct, rather than as an ontological given.” (Glasersfeld 2008: 59)

It should be noted that there are several different meanings of the term “solipsism” found in the literature (see, e.g., Mautner 2000). Above I have argued that RC does not imply *ontological* solipsism, defined as the view that *nothing exists* outside one’s own self and the contents of one’s own mind. On the other hand, RC does imply (or at least is compatible with) the position of *epistemological* solipsism, which holds that *nothing can be known* except one’s own self and mind.

This of course raises the question: How can individual knowledge (of any kind) be meaningfully *shared* between knowers – say, by the act of teaching – if one cannot check whether it is really shared? The position taken by RC on this issue has been extensively discussed elsewhere (Quale 2008: 103–114). Here, let me just state the conclusion: Knowledge may be considered to be shared between two persons only in so far as *they can agree that they share it*, i.e., to the extent that their actions with respect to this knowledge “are at best compatible. Which is to say, in a given situation, neither reacts in a way that the other could not expect” (Glasersfeld 1993: 177). That is to say, they share it until (perhaps) something happens in the interaction between them that leads them to discover that they do not. Loosely speaking, then: we share to the extent that we think we do! Quite generally, a sharing of individually constructed knowledge between knowers is (and must be) achieved by *personal interaction* between them, carried out within the framework of a common language. Thus, with respect to (say) scientific knowledge, there is no need to get entangled in futile

speculations concerning issues such as “Do I and my colleagues *really* share our knowledge of this or that physical phenomenon?” The answer is: Yes, we do, to the extent that we can engage in productive interaction and cooperation that involves this knowledge.

2. The logical objection: Self-refutation

Now, let us take a look at two specific charges raised against RC that are sometimes encountered in the literature.

First: this theory has been accused of being logically inconsistent. The inconsistency derives (it is claimed) from one version of the classical paradoxes associated with *self-refutation*. In a simplified formulation, it may be expressed something like this: “There is no such thing as true knowledge.” If this statement is true, then it by definition expresses an item of true knowledge, which contradicts the content of the statement; hence it must be false. Or, in the present context: The basic claim of RC – that there is no true knowledge – reflects back on and undermines the theory itself, since it denies that this theory can be right...! This will be recognised as one version of the well-known Liar’s paradox – a troublesome feature of logical reasoning that has been discussed by a number of philosophers and logicians, notably Russell & Whitehead (1927). The problem with statements expressing this type of paradox is that there is no way to logically assign to them a consistent *binary truth value*: if they are true, it follows that they are false, and vice versa.

However, this criticism of paradoxical self-refutation misses one essential point – namely, that RC does not claim to represent “truth,” neither in a logical nor an ontological sense. In other words: the theory of RC is *not* regarded as a set of logical propositions, each having a binary truth value (i.e., *true XOR false*) to be deduced from an axiomatic base; and (more importantly) this theory does *not* pretend to give an objectively true representation of “the way the world is”! Recall that RC is committed to the view of *truth relativism*: the truth-value of any proposition can be defined only relative to a given context, as emphasised above. In the case of RC itself, we can take the context to be

that of truth relativism itself, considered as an epistemic position. And in this context, *no* proposition of RC can claim to be either true or false, in an objective sense – i.e., the binary *true/false* dichotomy simply does not apply here.

So, RC is not a theory that claims to present a true epistemology and ontology, to be applied within its own world view. It would be more appropriate to say that it *recommends itself* to the individual learner as a possible epistemic approach that she may find to be useful in her quest for knowledge. However, the actual adoption of such a position is then up to the knower: she may choose to do so, if she feels that it resonates well with her own thinking. This freedom of the individual knower to choose her own epistemic position according to personal preference is fundamental to the relativism that lies at the heart of RC.

Second: It is sometimes asserted that the position of truth relativism is *epistemically self-refuting*. It leads to the conclusion (claimed to be absurd) that if *A* knows a proposition *p* to be true, while *B* knows *p* to be false, we should have a paradox: namely, two items of true knowledge that are mutually incompatible! However, this argument rests on the acceptance of an epistemic position of *realism*, with the associated *correspondence theory of truth* (i.e., truth as giving a correct description of the real world), and a notion of knowledge as *justified true belief*. Thus, if one wishes to adopt the viewpoint of *realism*, where it is meaningful to speak of *p* as being either true or false in some objective sense, then clearly truth-relativism must be rejected. (In the present case, it would then follow that at least one of the two knowers *A* or *B* cannot be justified in her knowledge about the truth value of *p*.) But, once again, RC is a *relativist* theory – indeed embodying the position of *truth-in-context*: it rejects the notion of truth-by-correspondence, and takes the position that propositions can only be regarded as true or false relative to a given context. In the literature this is often termed “the *coherence theory of truth*”. So, there is no self-refutation here: indeed, if *A* and *B* should disagree in their convictions as to the truth-value of the proposition *p*, this would only indicate that they base their knowledge of *p* on different (and mutually incompatible) contexts.

In fact, numerous examples of this may be found in mathematics and the sciences. Consider, for instance, the proposition: The interior angles in any triangle will always add up to 180° . This is true in *Euclidean geometry*, i.e., in the context of the Euclidean geometrical axioms, but false in (say) *hyperbolic geometry*, which has a different axiomatic base. We recall that for some two millennia after its inception (ca. third century BC), Euclidean geometry was thought of as being *uniquely logically true* – indeed, it was believed that no other geometrical theory could be logically possible. Moreover, it was assumed to give the correct physical description of space – not very surprising, after all, since it was the only geometry around...! But then, starting ca. 1850 AD, various alternative *non-Euclidean* geometries were formulated (see, e.g., Somerville 1958); and these were shown to be equally as logically sound as is the Euclidean theory, but with different geometrical properties. For instance, in *hyperbolic geometry* the internal angle sum of a triangle will always be *less* than 180° , and *decrease* when the size of the triangle increases. For this reason, the idea of a true and logically unique geometry, which in turn can provide a true and unique geometrical description of physical space, is no longer held to be tenable.

Another example: The universe may be assumed to be many billions of years old (as seems to be agreed by most scientists today), or only some six thousand years old (as at least some creationists appear to believe). Note that both these protagonists, the scientists and the creationists, would presumably want to claim that they *know* their position to be the correct one – or, at least, to be more correct than that of the other side. The point is, from the viewpoint of RC, that the truth-values of the two positions are defined relative to different contexts: scientists base their conclusions on the laws of science (here, physics); while creationists base theirs on a belief in divine intervention in the world, as described in the Bible. Hence their truth values are *not comparable*: in fact, each protagonist may only claim her position to be “true for her,” i.e., true relative to the ontological context that she has adopted. Note that this does *not* mean that the scientific and creationist

accounts are “equally valid” in some universal and intersubjective sense! It means that each of the two is *valid by its own standard of viability*; thus it is every knower’s personal responsibility to decide by herself which account she elects to accept, based on her own ontological preferences. And in this enterprise she is essentially on her own: in a relativist theory such as RC there is no way to demonstrate by cognitive arguments which is the objectively “correct” ontology, as noted above!

3. The social/moral objection: A support of reactionary/unethical positions?

The theory of RC is not infrequently accused of encouraging (or even implying) support for reactionary social and political views, and of leading to ethical corruption. Thus, for instance, it has been claimed that for radical constructivists “there can be no commitment to democratic values [... and that this theory] seems far more at home with non-democratic forms of educational and governmental practices” (McCarty & Schwandt 2000: 77–78). Another example: it has been alleged (Nanda 2003) that RC is lending support to the attempts by ruling orthodoxies in India to promote the world-view of the ancient Vedic Scriptures as constituting a viable alternative to the theories offered by (Western) natural science. In general, it is the inherent *relativism* of RC that is the villain here: “Relativisms are poisonous with respect to issues of morality and ethics, and can be psychotic with respect to issues of science and mathematics” (Bickhard 1997: 31). Now, these are grave charges indeed; and they need to be addressed.

To start with, we recall that RC is a theory of knowledge – or better, in von Glasersfeld’s words, *a theory of learning and knowing*. It addresses the issue of how learners construct their knowledge of the experiential world in a process of learning based on individual perception and reflection; and it discusses in detail the epistemic and ontological status of this knowledge. It does *not* offer an explicit endorsement or

recommendation of any specific political or ideological stance, whether reactionary or otherwise. Furthermore, it does *not* advocate any specific ethical position or commitment.

It is important to recognise that the theory of RC, as originally formulated by von Glasersfeld (cf. the defining propositions at the beginning of this paper), primarily addresses *cognitive* knowledge, i.e., knowledge that is generated by an act of *cognition*. This may be thought of as a particular kind of mental activity, carried out by the individual learner, which is based on rational thinking using logical reasoning, and which does not involve the learner’s personal feelings, preferences or beliefs. Scientific propositions clearly fall within this category of cognitive knowledge. But propositions of political preference, religious belief, or ethical values do not! It is a fundamental assertion of RC that it is not possible to establish cognitively supported knowledge in matters of politics, or religion, or ethics. This does not, of course, mean that a radical constructivist cannot have political views, or religious convictions, or ethical commitments – on the contrary, these will enter into the knowledge that she is continually constructing for herself all the time. But it does mean that she cannot support such views/convictions/commitments by cognitive arguments – in fact, they constitute part of what might be called her own *non-cognitive knowledge base*: i.e., her store of personal feelings, chosen values, preferences, beliefs, sympathies, dislikes, etc. Together, all these contribute to form her personal *ontological position*: i.e., her perception of how her experiential world *is* for her.

The crucial point here is that non-cognitive knowledge, such as exemplified above, cannot be demonstrated and shared through cognitive argumentation. For concreteness, let us consider the case of *ethics*. This term is generally taken to address issues of right and wrong, in a broad sense – with the underlying goal of establishing standards of good and bad with regard to human character and conduct. Thus, it deals with *interpersonal relationships*, addressing the issue of what is “the right way” to behave towards other people. RC maintains that it is not possible to base ethical argumentation on *cognitive knowledge* – or,

equivalently, to establish a cognitive underpinning for arguments of morality; this point is discussed in detail in Quale (2008: 175–183). In other words: any ethical argument (for some concrete action to be morally right or wrong), as proposed by an individual person, must ultimately be based on some non-cognitive knowledge (featuring preferences, beliefs, values, etc.) on her part. In a social context, this implies that RC must be *cognitively neutral* with respect to ethical issues: this theory cannot be used to endorse any particular social or political code of moral behaviour, as derived from cognitive learning.

We remark that it is the *relativism* of RC that underlies this conclusion. RC asserts that our ethical convictions and actions are rooted in our ontological perception of ourselves, which in turn will be strongly influenced by our past history of interaction with other people. And this means that the individual learner is elevated, by the theory of RC, into a position of *personal responsibility* with respect to ethical issues. It is solely up to her to construct her own ethical position; no one else can do this for her, or tell her how to do it. However, this assignment of responsibility does not carry with it any specification of *how* it is to be discharged! In other words, there is no conception in RC of an objectively given “right” (or “correct,” or “good”) code of ethics that the individual learner should strive to construct for herself – in this process of construction, she is on her own! Moreover, it is her responsibility to recognise that the ethical knowledge that she thus constructs for herself will inevitably have a (small or large) effect on the ethics that is constructed by other individuals. Thus, it is up to her to reflect on her own ethical values: how she wants her actions to affect other people; how she wants these others to feel towards her; whether she wants to share her own ethical commitments with them; etc.

Summing up: RC rejects the idea that there exists a true code of ethics lying somewhere out there for us to discover. For any individual knower, her ethical knowledge must be constructed by herself; how that is to be done is left entirely up to her! One might describe this as a position of *ethical and political/ideological agnosticism*. It is precisely this agnostic attitude of RC that has

provoked such strong criticism from many quarters. It goes against the millennia-old goal of philosophers of implementing the idea (or hope) that “good rational thinking can lead to good ethics.” In fact, RC recognises that every one of us is all the time continually constructing and developing our own ethical commitments; unfortunately, it offers no objectively valid guidelines that can tell us what are the “right” ethical values to adopt in this process of construction.

However, this does *not* mean that the individual knower has to acknowledge all ethical positions as being “equally valid” or “equally good”! On the contrary, the knower will naturally consider her own position, gained through personal construction as described above, to be superior to that of another person on ethical issues where the two of them disagree. A concrete (and somewhat personalised) example: According to my own ethical convictions (such as they have been constructed by me), discrimination between people based on their sex, race or creed is wrong, and should be fought against. When I encounter another person X who has a different position on this issue, I am certainly *not* obliged, out of some misguided conception of “fairness,” to grant the views of X an equal status with mine! On the contrary, I shall probably try, by whatever means at my disposal, to oppose and speak up against these views. However, and very importantly, in a situation of dialogue between us, RC asserts that there is no way I can demonstrate to X by *cognitive argumentation* that her ethical position is wrong. This is because the ethical convictions of any knower are a part of her own *non-cognitive knowledge base*, as was remarked above, and are therefore not vulnerable to cognitive reasoning. So, if I want to persuade X that my ethical position is superior to hers, I must do so by non-cognitive arguments: i.e., try to convert her to my point of view by appealing to her feelings, beliefs, sympathies, values, etc.!

As noted, the assertion in RC of cognitive ethical neutrality has provoked strong criticism from many quarters, and one may well ask: Why is this so? At least one reason may be suggested: it is a fact that the word “ethics” carries a strong *affective charge* in common parlance – not surprisingly, since after all it does purport to tell us what is

“good and bad,” or “right and wrong”! However, RC is an epistemic theory that (it is alleged by the critics) declares itself to be unconcerned about ethics, and thus “turns its back” on ethical considerations, so to speak. This may indeed be perceived by some as being disturbing: there seems to be a feeling that such a theory *should*, or *ought to*, take a stand on ethical issues – in fact, not to do so may well appear to be “unethical”...! However, it should be recognised that this allegation of ethical indifference is quite unfounded: RC does *not* imply that all ethical positions are “equally valid” or “equally good,” as has been argued at length above.

4. The ontological objection: Science as a miracle?

The formidable success of modern science as a strategy for explaining (and controlling) processes in the physical world is well known and documented. And this success has led many people to assume that science must be (actually or potentially) *true*, in some sense. Thus, for instance, the philosopher Hilary Putnam (1975) has defended the viewpoint of *scientific realism*: that well-developed theories of science do in fact refer to *real* (i.e., objectively existing) entities and processes in the physical world.⁶ Putnam criticised the alternative viewpoint of *relativism*⁷, arguing famously that unless one assumes the truth of realism, the success of science would indeed be a *miracle*...!⁸

In other words, realism is claimed to provide the best (or, arguably, the only credible) explanation for the success of scientific theories. And contrariwise: from a relativist point of view it must surely be quite mysterious, or even miraculous, that the physical world should behave according to accepted

6| Thus, the success of classical electromagnetic theory in describing the electric and magnetic phenomena observed in nature would imply that the electric and magnetic field vectors actually *exist* as real objects residing out there in physical space.

7| In the literature, variously termed “conventionalism” or “instrumentalism”

8| However, it should be mentioned that in later years Putnam revised his viewpoint on this issue.



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scientific theory if that theory did not in fact furnish a *true description* of the world. This would appear to be a particularly strong argument against the relativism of RC, where scientific knowledge is taken to be *constructed* by the individual knower: it is hard to imagine that this constructing knower could “get it so right” only by a fluke!

So, let us examine this argument. Granting that scientific knowledge, like all other kinds of knowledge, is in fact constructed by its practitioners (the scientists), as is asserted by RC, is the success of this construction then really such a miracle? In order to address this question, we need to take a closer look at how the theory of RC views the strategy of scientific activity.

The radical-constructivist position on this issue may be briefly summarised as follows:

- 1 | Nature is *not* assumed to possess any pre-existing identifiable *intrinsic structure* that is person-independent.
- 2 | A scientific theory is a *model* of some domain of natural phenomena, constructed by scientists and *imposed* on the phenomena. This construction can be done in many ways, depending on which questions the constructors (scientists) want to address; it is not possible to identify one such model as giving “the objectively correct” description.
- 3 | It (i.e., the model) should be formulated in *mathematical* terms.
- 4 | It should yield *predictions* that agree with observation.
- 5 | It should fit with the *ontological preferences* of its practitioners (the scientists).

These five points may serve to outline the *relativist* approach to scientific epistemology and ontology that is inherent in RC. For comparison, we note that a proponent

of *realism* would not accept #1 and #2: in a realist worldview, Nature is definitely assumed to have an inherent structure – in fact, it is the primary objective of science to study this structure. Scientists are *not* free to construct models and impose them on Nature; on the contrary, it is the task of science to “listen to nature” – i.e., to *discover the laws* that govern natural phenomena, through scientific investigation! On the other hand, #3 and #4 should be acceptable to both realists and relativists: these two points express what is generally agreed among scientists to be sound policies of scientific practice.

It remains to take a look at #5. We may define the *personal ontology* of any individual knower to be: the sum of her own sensed attitudes, volitions, emotions, beliefs, preferences, etc. – in short, the totality of her own perception of “what the world is like for her” at any one time.⁹ According to RC, this ontology has been constructed by her, as a result of her own past experiences; and it may be expected to change and evolve over the passage of time. In the present context, we focus specifically on the knower’s conception of, and attitude to, *natural science*: how does she experience the *being* of it? Does she like it, or dislike it, or maybe feel neutral about it; does she find it interesting, or maybe feel indifferent to it; is it relevant or irrelevant in her life; does she hold views on what it is, or should be; etc.? All this together constitutes what might be called her own *personal ontological perception* of science.

⁹ In the context of the present paper, the term “personal ontology” may be identified with “non-cognitive knowledge base,” as defined above.

In this sense, then, every individual knower does have an ontological perception of science, irrespectively of whether or not she has a personal interest in it. Of course, quite a number of people feel some disinterest, or even hostility, towards science – as has been documented in various studies of students’ attitudes: see, e.g., Sjøberg (2000). However, let us now consider the individual knower who is positive toward natural science, whether as an interested member of the general public or as a practising scientist within some particular scientific discipline. The ontological perception of science, as constructed by this person, would then depend on whether she is an adherent of epistemic realism or relativism.

For the *realist*, “the truth is out there,” waiting to be found. This includes, in particular, the scientific theories describing various natural phenomena; it is assumed that there exist (in principle, at least) objectively true theories of science, exhibiting the correct way to describe the natural world, and that it is the task of the scientists to discover them. To this knower, then, the “miracle argument” may well have some force: modern science could not be such a huge success if it were not closely attuned to “the way the world truly is”...!

For the *relativist*, on the other hand, there is (in the context of science) no such objective truth to be discovered; the miracle argument consequently falls to the ground. In RC, a scientific theory is considered to be a *model*, or a *tool*, devised by its constructors (scientists) to describe and investigate a certain domain of natural phenomena, as was noted above. As it turns out, these models have been very successful: in other words, the tools have proved to be well-designed for the job they were designed to

do! And this, of course, is very gratifying – perhaps even cause for self-congratulation – but it hardly calls for an explanation as a miracle. To put it another way: a tool (say, a hammer, or a screwdriver) is *constructed*, more or less ingeniously, to handle some particular task; it is not *discovered*, serendipitously, as a uniquely existing “true way” to handle this task.

Following up on this argument: RC holds that scientific theories (models) are constructed with a particular *purpose* in mind: namely, to answer certain questions that the constructors (scientists) want to ask about some class of natural phenomena. These questions emerge from the ontological preferences adopted by the questioners, and they will *evolve* in the course of human history with cultural changes, technological advances, etc. This evolution of ontology, determining the scientific questions that are at any time considered relevant to ask, is taken by RC to be one of the major agents driving the development of science.¹⁰

Conclusion

We have discussed several objections, often encountered in the literature, against the theory of RC. It is notable that all these objections possess a common feature: namely, a philosophical stance (taken by the objector) against the ontological *relativism* that is inherent in RC. Specifically, the objections are based on an (overt or tacit) adoption of the antithetical viewpoint of scientific *realism* – in effect, RC is being criticised for not promoting a realist ontology! This has been discussed in some detail in the present paper. Let me now briefly sum up this discussion with reference to the four categories of objections listed at the beginning:

Existential – The charge of solipsism is a little troublesome from a realist ontological perspective: here the question of whether the world “really exists” outside the individual knower is legitimate to ask. From a relativist perspective, on the other hand, this charge causes no problem: the knower is

10| This viewpoint, concerning the “driving force” behind scientific endeavour, has also been forcefully argued by Thomas Kuhn (1970).

free to adopt, as a fundamental ontological premise, the proposition that the external world is there for us as a shared resource – and it is manifest that virtually every knower (whether an adherent of RC or not) does in fact choose this option.

Logical – The allegations of self-refutation are based on the conception of truth that is featured in realism: a proposition is true iff it describes a true fact about the real world. In the relativist ontology of RC, on the other hand, the notion of truth is differently conceived: the truth-value of any proposition is only defined relative to some ontological context, which the knower is free to adopt or reject. Hence the issue of self-refutation, as constituting a logical problem, simply does not arise.

Social/moral – The claim that RC supports reactionary social and political viewpoints seems to derive from an assumption that it must be possible to establish valid cognitive arguments supporting “good ethics” – and some feeling of indignation that RC appears to be rejecting this praiseworthy enterprise. Again, the relativism of RC is the villain here: the theory asserts that the ethical position adopted by an individual knower belongs to her *non-cognitive knowledge base*, and hence any ethical argumentation that she engages in must ultimately derive from her own personal views on ethical matters, as they have been constructed by her. Furthermore, this construction is her own personal responsibility: no one else can tell her how to construct the “right ethics.”

Ontological – The alleged “miraculous match” between science and the experiential world is essentially an argument based on the adoption of epistemic and ontological realism. The claim is that if we are indeed free to construct scientific theory at will, it is highly unlikely that we should, by pure chance, hit on such an amazingly successful description of nature; hence the theory must be (at least close to) an *objectively true* description of nature! However, in the relativist ontology of RC a scientific theory is regarded as a *model*, constructed to address certain questions that we want to ask, and then imposed on natural phenomena. If the model is successful, fine – but this is then better seen as due to the capabilities of the constructors (scientists).

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