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What is an Immature Science?

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Abstract

Cognitive and social sciences such as psychology and sociology are often described as immature sciences. But what is immaturity? According to the received view, immaturity is disunity, where disunity can usefully be cashed out in terms of having a plurality of disunified *frameworks* in play, where these frameworks consist of concepts, theories, goals, practices, methods, criteria for what counts as a good explanation etc. However, there are some reasons to think that the cognitive and social sciences *should* be disunified in this sense. If that is right, either these sciences should remain immature, or we need a new account of immaturity. The former option is unappealing. I therefore provide an alternative account of immaturity, based on Dudley Shapere's work on the internal/external distinction. I then go on to use this account to argue against the imposition of unification on the cognitive and social sciences. Acceptance of disunity may be the route to maturity, rather than a sign of immaturity.

1. Introduction

This paper concerns the cognitive and social sciences in the broad sense of sciences concerned with mind, brain, and social and individual behaviour, including but not limited to psychology, neuroscience, sociology and anthropology. These are the sciences most often labelled as “immature”, typically being contrasted with physics as the prime example of a

mature science. Here I will focus in particular on psychology because it is the most discussed example in the literature, and cognitive neuroscience from which I will draw a useful illustrative example. However, the account is meant to be one of immature science in general.

I will take the claim that the cognitive and social sciences are immature as a starting point and ask what sense can be made of it. It is not a claim that everyone agrees with; for example when cognitivism first became dominant, a literature emerged taking it as the basis for mature scientific investigation (e.g. Palermo, 1971), and there has since been some discussion of what should replace cognitivism in this role (e.g. Harré and Gillett, 1994; O'Neill, 2002). This paper is not addressed to these literatures, but to those that *do* consider the cognitive and social sciences to be immature.

Why do we need an account of immaturity? It seems that there is something that physics is doing better than psychology, and it is desirable to capture this intuition such that immaturity claims are more than just excuses for some perceived failings in psychology. Better yet, we would like to say something about immaturity that provides a recommendation for how psychologists and other cognitive and social scientists should proceed, and how philosophers of science can contribute to their work. The main aim of this paper is to develop a new account of what it is for a science to be immature that meets these desiderata.

The paper will begin by outlining the received view, according to which immaturity is disunity. A major problem for the received view is a significant and growing pluralist literature in philosophy suggesting that science *should be* disunified. If this literature is on the right track, we need a new account of immaturity. I will develop such an account, using the work of Dudley Shapere, in particular his (1986a) paper "External and Internal Factors in the Development of Science". This account says that an immature science is one that does not yet have a well-developed internal/external distinction. According to this view, the idea that a science should be unified to be deemed mature is something that has been imposed on the

cognitive and social sciences from the physical sciences. The prevalence of the received view of immaturity thus will be explained by the new view.

2. The Received View

Whatever immaturity is, it doesn't seem that it can just be a matter of time, given that mind and behaviour have been studied since the ancient Greeks if not before. Talk about immaturity usually cites Thomas Kuhn, in particular the *Structure of Scientific Revolutions* ([1970] 1996). According to Kuhn's account, immature sciences are *pre-paradigmatic*: 'Acquisition of a paradigm is a sign of maturity in the development of any given scientific field' (Kuhn, 1996, 11).¹ Much of the literature follows Kuhn in using psychology as the main example of an immature science.

Psychology is seen as being pre-paradigmatic in the sense that its research is still largely based around the accumulation of data and observations without any overarching program to unify and guide this research. As Kevin Rand and Stephen Ilardi say here:

From its inception as a distinct discipline, psychology has been characterized by conceptual disarray (Henriques, 2004) and relatively slow scientific progress (Meehl, 1978). This is not to suggest any shortage of psychological research, as the field generates a massive empirical literature each year. Rather, we note that psychology's myriad and diverse programs of research are, as a rule, neither coherently connected to one another nor meaningfully linked to relevant lines of investigation in related scientific disciplines (Staats, 1999). The field has instead witnessed the relentless accumulation of assorted facts, findings, and theories that typically fail to find integration across rival research enclaves and theoretical factions (Ilardi & Feldman, 2001a; see also Miller, 1992; Staats, 1983). In short, psychology functions as an immature science (Kuhn, 1970). (Rand and Ilardi, 2005, 7)

As this quotation reveals, it is “*conceptual disarray*” and the failure to integrate “*programs of research...facts, findings, and theories*” that are at issue. Psychology lacks a unifying paradigm to give shape to the research it generates.

Unification is something that the cognitive and social sciences should strive towards, according to this account of immaturity. Arthur Staats puts this quite explicitly:

[M]y own philosophy of science states as a fundamental principle that all sciences begin in disunity and only advance toward unification by dint of hard and lengthy scientific achievement...Psychology is very much a science, but it is a science early in its career. Psychology is what I call a modern disunified science, with a plethora of diverse and unrelated scientific products but with little investment in unifying those products. The resulting disorganization of knowledge leads people such as Toulmin (1972) to consider psychology a “would-be science.” (Staats, 2004, 273)

According to the received view then, unification is the route to maturity.

While accepting that this disunity is present, I don't think it can be the basis for an adequate account of immaturity, for reasons I will explain in the next section. To describe the disunity without tying myself to a particular version of the received view, I will say that psychology and the other cognitive and social sciences have a plurality of disunified *frameworks* in play, where these frameworks consist of concepts, theories, goals, practices, methods, criteria for what counts as a good explanation etc. I am thus using “framework” as a broad and relatively neutral term, capturing many of the same elements as a Kuhnian paradigm (Kuhn, [1970] 1996), a research program for Lakatos (1968), a research tradition for Laudan (1977), or a research framework for Von Eckardt (1993), while remaining neutral between the details of the disagreements between them, and the implications of the rest of their respective analyses.²

The language of frameworks can be used at different levels of organization in the sciences. There are frameworks for subdisciplines, but also coarser-grained frameworks for broader disciplinary groups, and finer-grained frameworks for particular research groups. The disunity that is at the root of the received view of immaturity is found at various levels, although the claim is usually made in terms of disunity for a discipline, e.g. psychology as a whole. I will now illustrate the relevant kinds of disunity with an example.

Although the literature focusses on psychology, and my discussion here has so far largely followed it in this respect, the received view is intended as an account applicable to immature sciences in general. The example I want to make use of here is from cognitive neuroscience: the Cognitive Atlas Project (see Poldrack et al., 2011). Although Russell Poldrack and his collaborators do not talk in terms of immaturity, they begin their paper about the Cognitive Atlas project with a quote from Rutherford B. Rogers saying that ‘We’re drowning in information and starving for knowledge’, expressing the same concern for the plurality of disunified frameworks as that just outlined.

2.1 An Example: The Cognitive Atlas Project

This example will illustrate the plurality of disunified frameworks, and an attempt by scientists to deal with the situation. The Cognitive Atlas project is an open collaborative project to map the current ontology of cognitive neuroscience, where an ontology is ‘an “explicit specification of a conceptualization”, (Gruber, 1993) or a structured knowledge base meant to support the sharing of knowledge as well as automated reasoning about that knowledge’ (Poldrack et al., 2011, 2).

The Atlas is divided into *concepts* and *tasks* and collections of these. For the Atlas’s creators:

A mental concept is a latent unobservable construct postulated by a psychological theory... Some potential kinds of mental concepts include (but are not limited to) mental representations and mental processes...A mental task is a prescribed activity meant to engage or manipulate mental function in an effort to gain insight into the underlying mental processes. (Poldrack et al., 2011, 3)

Various relations between these terms (e.g. is-a, part-of, measured-by) are also included. A page for each concept gives a definition of the concept, its relations to other concepts, tasks used to measure the concept, links to databases containing any associated fMRI images (e.g. NeuroSynth, see Yarkoni et al., 2011), a section for discussion, and a bibliography of relevant papers.

Using an example allows me to now be more explicit about the kinds and sources of disunity involved. Firstly, the fMRI data from neuroscience often does not match the mental concepts that have traditionally been used in cognitive psychology. This is part of the problem that the project was set up to address, and can be seen as stemming from the differing frameworks in use in neuroscience and in cognitive psychology. The coming together of subdisciplines whose frameworks developed somewhat separately in order to form interdisciplinary hybrids like cognitive neuroscience is therefore one source of disunified frameworks.

Secondly, there is disagreement over the mental concepts themselves. For example Poldrack et al. give three different definitions of working memory, all of which are found within cognitive neuroscience (Poldrack et al., 2011, 1). These definitions apply to distinct processes that occupy different roles in investigation, or places in the frameworks of different research groups within the same subdiscipline.

Thirdly, there is a problem of equating tasks with mental constructs. Poldrack et al. detail several problems this causes, one of which being the assumption that each task

measures a specific construct. They give the example of the “Sternberg item recognition task”, which they say ‘is often referred to as the “Sternberg working memory task”, which implies that it measures a specific mental construct (“working memory”)’. Not only is there ambiguity in what “working memory” means, but also

any link between tasks and constructs reflects a particular theory about how the task is performed; thus, equating tasks with constructs makes theoretical assumptions that may not be shared throughout the community (and further, those community assumptions may be incorrect). (Poldrack et al., 2011, 2)

In the terms I have been using here, the task and mental construct are part of different frameworks for different members or groups of members in the community. Task and construct are related to one another and to other aspects of theory and practice in different ways in these different frameworks.

The Cognitive Atlas project attempts to work towards a solution to these kinds of disunity by mapping the disagreements. Its collaborative nature is an essential part of this.

When the project began,

[a]n initial vocabulary of more than 800 terms was identified manually through analysis of a broad set of publications on cognitive psychology and cognitive neuroscience and curated by three of the authors (Russell A. Poldrack, Robert M. Bilder, Fred W. Sabb). (Poldrack et al., 2011, 3)

Subsequently, anyone approved by the authors as a contributor can make changes and additions. Discussion of these changes is encouraged first, and there is space incorporated for these discussions. If there is sufficient disagreement a concept will fork, i.e. be split into several different definitions with a disambiguation page (Poldrack et al., 2011, 7–8). In this

way, the project is aiming for an ontology that everyone can agree on, i.e. attempting a kind of unification of the diverse frameworks in play. As the authors say:

Our approach to this issue is inspired by the success of social collaborative knowledge building projects such as Wikipedia, which allow discussion and the expression of divergent views *in service of developing a broader consensus*, and one that can be modified flexibly over time as new knowledge emerges (Poldrack et al., 2011, 3, my emphasis).

The project also has the potential to result in unification between fMRI data and mental concepts, and there are also plans to extend it further by linking databases of other things such as psychiatric syndromes, genes and signalling pathways (Poldrack et al., 2011, 9). The ambitious goal of such plans is unification with frameworks from even more subdisciplines. Nothing is presupposed in the project about how that unification may come about; for example it may be reductive, or non-reductive.

On the received view discussed in this section, we can see the Cognitive Atlas project as an attempt to move toward unification, and therefore as part of an effort to achieve maturity for cognitive neuroscience. In what follows, I will suggest that this is the wrong view, and in fact may inhibit the process of maturation.

3. Pluralism in the Cognitive and Social Sciences

This section will make use of recent pluralist literature to suggest that disunity is no bad thing for the cognitive and social sciences. The material will only be suggestive, but the rest of the paper will illustrate the benefits of taking up this suggestion and developing a new account of immaturity.

Stephen Kellert, Helen Longino and C. Kenneth Waters (2006) distinguish usefully between plurality and pluralism, and I will make use of their distinction here. Plurality is a

descriptive term, while pluralism is normative; it is a program one would advocate. The current situation in the cognitive and social sciences is one of plurality; in this section I am looking at literature that advocates pluralism. This literature suggests that the current situation is no bad thing and the cognitive and social sciences *should*, for one reason or another, be plural in nature.

Pluralism is becoming an increasingly popular outlook in the philosophy of cognitive science (e.g. Dale, 2008), with several journal special issues being devoted to the topic (e.g. Staats, 1991 and comments on his article in *American Psychologist* [McNally, 1992, Kukla, 1992, Schneider, 1992, Green, 1992, Kunkel, 1992]; a special issue of *New Ideas in Psychology*, volume 28, issue 2, 2010). Rick Dale talks about diversity of theories, ‘explanatory schemes’, and ‘theoretical frameworks’ (Dale, 2008, 156–157). Looking at a selection of authors from the *New Ideas in Psychology* special issue on pluralism, Jason Goertzen mentions conceptual frameworks (Goertzen, 2010, 202), Tsuneo Watanabe talks about paradigms (Watanabe, 2010, 254), and William Smythe and Stephanie McKenzie about diversity of methodologies and theoretical orientations (Smythe and McKenzie, 2010, 227).

It is clear from these papers that many interconnected aspects of scientific endeavour are under scrutiny when we talk about pluralism. In the terms I have introduced, these are the elements of what I have called “frameworks”, so pluralism here is about advocating maintaining a range of disunified frameworks.

Although I do not have space to provide a detailed argument for pluralism about the cognitive and social sciences here, there are a variety of perspectives taking this line in the literature, and I will briefly outline some of them. According to some, pluralism is appropriate for science in general, and this is an increasingly popular position. It comes in more metaphysical (e.g. Cartwright, 1999) or more pragmatic (e.g. Chang, 2012) flavours. Alternatively there might be something particular about the subject matters handled by the

cognitive and social sciences. One possible feature that may set these sciences apart from the physical sciences is causal complexity; the cognitive and social sciences study so many causal chains with such complex interconnections (what William Wimsatt [1994] refers to as “causal thickets”) that there can be no unified “theory of everything” in their domains. Another alternative is that we should adopt pluralist theorizing for its beneficial implications. For example, there is an argument in the feminist philosophy of science that theories and models are partial and goal-directed according to the interests of particular groups. The pluralist says that many of these theories and models should be pursued, thus allowing traditionally marginalised voices to be heard (Longino, 1996, 275–277).

There are also a variety of types of pluralism. For example it may turn out to be fruitful to work out the relationships between frameworks and have them interact with one another. As Dale says ‘[i]t [the pluralist approach] may also recommend integrating these competing theories in meta-theoretical frameworks that would sustain their co-existence’ (Dale, 2008, 156). Much of the literature on pluralism discusses potential ways of doing this (e.g. Sandra Mitchell’s Integrative Pluralism [Mitchell, 2002, 2003]; from the *New Ideas in Psychology* special issue mentioned above, Goertzen’s Dialectical Pluralism, and Smythe and McKenzie’s Dialogical Pluralism are attempts at a similar thing).

We do not know what a successful pluralist picture would look like—what degree of integration between frameworks there should be etc. But for my purposes here it is enough to establish that the cognitive and social sciences currently exhibit plurality, and there are plausible reasons to think they ought to stay that way.

On the received view, the observed plurality is a sign of immaturity in a science, and maturation consists in moving away from it and toward unification. If authors such as Dale are correct to advocate pluralism, either they are advocating remaining an immature science, or we need a new account of immaturity. The former option strips the notion of immaturity of

its usefulness because it leaves sciences like psychology without a clear route to improve their theory and practice. This is what we wanted a notion of immaturity for, so it would render the notion redundant. Therefore if the pluralists are right, we need a new account of immaturity. Providing such an account will open up a new potential route to maturity, as well as explaining the prevalence of the received view.

4. A New Account of Immaturity

4.1. Introducing Shapere's Internal/External Distinction

My account of what it is for a science to be immature stems from ideas developed by Shapere, particularly in his (1986a) paper "External and Internal Factors in the Development of Science." In this sub-section, I will outline Shapere's distinction.

On Shapere's view, theories, methods, the goals of a science, what counts as an observation etc. (in other words all the aspects of what I have been calling frameworks) can be shaped both by considerations internal to the science, and by external considerations. There is no distinction between the internal and external that can be laid down from a meta-scientific perspective, for example by philosophy. The distinction must emerge over time from the practice of the science itself; 'it is a distinction which has been forged in the very process of investigation of nature, not laid down in some edict from heaven or philosophy which determines what counts as scientific and what does not' (Shapere, 1986a, 6). It is therefore not the crude distinction between the scientific and the social that some other versions of the internal/external distinction reduced to (see Shapin [1992] for a relatively sympathetic discussion of various versions). Which considerations are internal and which are external is subject to gradual change over time as the science develops. In Shapere's words,

[c]larification with regard to these four aspects of inquiry—what to study, what was relevant to the study, the appropriate methods for that study, and the character of an explanatory

conclusion to the study—required *learning how to learn* about nature. (Shapere, 1986a, 3, emphasis in original)

To say that considerations are “internalized” means that they become part of the background that the science can rely on. This builds on Shapere’s (1984) work on objectivity and rationality of reasons in science. Here, Shapere says that ‘...the problem is to show how the employment of some “background beliefs” (rather than others) can be described convincingly as the use of *background information*, serving as *reasons*’ (Shapere, 1984, 640). Beliefs which have proved themselves become internalized – become part of the background information – and this background information is the basis of what science counts as reasons in its deliberations (Shapere, 1984, 645).³ External considerations don’t count as reasons (Shapere, 1984, 648). In fact, this is not just a question of accumulating background beliefs, but of *rationality*. A science is rational to the extent that it has internalized the considerations on which it relies (Shapere, 1984, 654).

What does it mean for beliefs to “prove themselves”? Something will come to be taken for granted as background if reliance on it results in success. As Shapere puts it in his 1986 paper, ‘[t]hose considerations become internal, scientific, which have been found, as a matter of contingent fact, to be doubt-free (successful and coherent) and relevant to the domain under investigation. All other considerations become external, non-scientific’ (Shapere, 1986a, 6–7). It is through this process that the internal/external distinction emerges from the investigation of nature, i.e. from the practice of science. This account gives a notion of progress for a science, in terms of the increasing sufficiency of internal factors to guide science as the distinction emerges (Shapere, 1986a, 2).

A few points about Shapere’s account are important by way of clarification.

Firstly, what is meant by “success” here is something like providing accurate predictions, good explanations, and useful practical applications. It is impossible to be more

precise than this while talking in abstract terms, because the criteria something must meet in order to be accurate, good, or useful must emerge from the practice of the science itself.

When we have multiple frameworks in play, as we do in the cognitive and social sciences, this may sound like a species of relativism. The standards for success vary between frameworks, and it seems that any framework is acceptable as long as it is internally coherent. This is not right, however. Shapere's position, and my application of it to the cognitive and social sciences, are realist⁴ in the sense that there is a mind-independent world that constrains which theories and practices will produce successful explanations, predictions and applications. This is why the internal/external distinction must emerge from practice over time; it cannot just be laid down in advance. Although what it means to be successful is relative to a framework, we do not have unrestricted proliferation of theories and practices, or proliferation restricted only by social and political whims.⁵

Secondly, it is important to emphasise that relying more on internal considerations and less on external ones does not mean that science should become increasingly isolated. Part of the motivation for tackling a particular research question rather than another will still often come from outside the science; there will still be wars, epidemics, technological fashions and so on, and they will still bring with them a demand for certain types of research to be prioritised over others. Part of what it is to be successful is to provide the kinds of predictions, explanations and practical applications that are useful at the time. There is nothing irrational about this context-embeddedness of science. It does not amount to dependence on external considerations in Shapere's sense unless it provides criteria which a science relies on as reasons that determine its theories and practices in a way that does not lead to success (religious considerations today are one example of this, see below).

Thirdly, one might wonder what is distinctive about Shapere's account. Most philosophers of science would recommend retaining successful theories and practices. What

more does Shapere give us? Most philosophers of science would recommend retaining successful theories because they are likely to be the theories that accurately describe the world. Shapere's account gives us more because it respects the fact that *what would count* as accurately describing the world is variable. It tells us that by looking at the history of a scientific framework, we can see what standards for success have been internalized, and thus get concrete recommendations for how the science should proceed—by aiming to meet these standards. This ability to precisely specify what counts as success in particular cases is of more use to both scientists and philosophers than a general instruction to keep successful theories because they are likely to be accurate. Section 5 of this paper will demonstrate one kind of concrete recommendation that can be made.

A fourth important point is the contingency of what is internalized. In other words, we cannot predict or decide in advance of doing the scientific research which features will be internalized as it progresses. This is part of a more general thesis of Shapere's which he calls the *Principle of Rejections of Anticipations of Nature*, according to which '[t]he results of scientific investigation could not have been anticipated by common sense, by the suggestions of everyday experience, or by pure reason' (Shapere, 1987, 1). This is also an important part of his rejection of a meta-scientific perspective from which science can be judged.

Finally, it is important to note that it is not the case that once internalized, methods, concepts, theories etc. are no longer open to question (Shapere, 1986b, 22–23). This is a familiar picture of what it means to accept something in science; it becomes part of the background that is relied upon for further research, but it is still possible to overturn even the most entrenched parts of the science under the right circumstances.

I will now discuss a couple of Shapere's more concrete examples – namely religious considerations and unification – in order to flesh out this theoretical skeleton. Religious considerations used to be an important part of the background according to which scientific

theories, results etc. were judged. Newtonian theory needed God to intervene every so often in the motions of the planets, and this was not a dependence on something external to science at the time, while it would be today (Shapere, 1986a, 4–5). Shapere argues that religious considerations came to be external because enough other purely internal considerations were accumulated that they were sufficient. In his words, ‘such considerations were external to science precisely because the laws of science had been shown (even if as yet imperfectly and incompletely) to be sufficient to account for certain phenomena which had previously seemed to require divine intervention’ (Shapere, 1986a, 5). Religious considerations did not establish the track record of success required for internalization into science, so it would now be considered irrational to treat them as reasons.

The other example of Shapere’s that I will give here, unification, is of particular relevance for this paper. Unification between different domains was not always seen as important. However, the unification of electricity and magnetism and other similar cases were successful, so the criterion of compatibility with theories in other domains was internalized. Such compatibility is now a reason for adopting a particular scientific theory or practice. As Shapere puts it,

[i]n addition to doubts based on its failures to account for its domain of responsibility, a theory can also be doubted on the ground that it fails to conform to a type of theory with which we believe it ought to conform—for example, because that type of theory has been successful in several other domains. (Shapere, 1986a, 6)

Compatibility with other domains has become a standard for successful science, where it was not before.

I will now go on use this distinction between internal and external factors to construct a new account of what it means to be an immature science.

4.2. Making Use of the Distinction

Although Shapere does not use the phrase “immature science,” he does talk about the internal/external distinction with respect to sciences at an early point in their history. He says that at first, a science has internalized very little, or more precisely it does not have a firm idea of an internal/external distinction. This amounts to the same thing, because the distinction only emerges via the internalization of considerations over time. An immature science therefore does not have much that it can rely on as reasons, because very little so far has established a track record of success. The science is therefore forced to try out the unproven, or what Shapere in the following quotation calls “hypotheses”:

In all these respects, what are naturally called “hypotheses” played a role; and there was, in earlier phases of science, little to go on in selecting these hypotheses. Or more exactly, the motivating considerations in selecting explanatory approaches might come from just about anywhere. Antagonism to Aristotelian forms, natures, and final causes, rather than the dictates of nature, entered into adoption of the mechanistic and atomistic approaches of the middle and late seventeenth century; Newton developed his theories of motion (and thus of space and time) at least partly in the light of theological considerations, objecting to Cartesian physics on such grounds just as his own views were deemed atheistic by Leibniz and his followers. And in general, the large gap between scientific ambition and scientific conclusion had to be filled, under such circumstances, by considerations which we today would consider non-scientific, external, though at the time there was little or no ground to so distinguish them. Indeed, even the ambitions of science at such stages were dictated, at least partly and perhaps largely, by considerations which would today be called external. For the distinction between the external and the internal to science was at best only rudimentary and in many cases did not exist at all. (Shapere, 1986a, 4)

Things are different for a mature science like modern physics, and this gives a useful sense in which physics is more mature than psychology: It has established a firmer internal/external distinction, and has a body of internal considerations that it can rely on as background. Psychology and the other cognitive and social sciences on the other hand still have relatively little of such reliable background. The issue is not just a lack of internalized theory, but also of all the other aspects of a framework, such as clearly delineated goals, criteria for what counts as an observation, standards for what constitutes a good explanation etc. For many of these things, the cognitive and social sciences are relying on hypotheses, rather than considerations which have been internalized.

For example, with reference to the Cognitive Atlas project discussed earlier, sufficient criteria for a good explanation have not yet been internalized, so that it is not clear whether a good explanation in cognitive neuroscience should respect our folk mental categories, their refinements in use in cognitive psychology, the categories suggested by the fMRI data, or whether it must find some way to integrate these different categorizations. In general, where there are different frameworks in the cognitive and social sciences, it is not yet clear whether we should be aiming for reduction of higher level frameworks to lower level frameworks, establishing some non-reductionist relationship, or whether the different frameworks concern sufficiently different subject matter that the relationship between them does not need to be (and perhaps cannot be) established.

On my account, the maturation of a science is a rational process because a more mature science has more that it can rationally treat as reasons, and therefore has less need to rely on hypotheses or external factors. In Shapere's words, '...it is a measure of the degree of sophistication of an area of science that its body of background beliefs autonomously suggest or imply certain hypotheses, problems, methods, and so forth...' (Shapere, 1986b, 21), and

‘...with the increasing scope and power of internal considerations, scientific conclusions have come to be obtainable, more and more, independently of external ones’ (Shapere, 1986b, 22).

Does the account developed here therefore suggest that the cognitive and social sciences are irrational? For the purposes of this account, rationality, like maturity, is not something that a science either possesses or does not. Psychology is less rational than physics, but neither of them is rational or irrational *simpliciter*. This is not a derogatory description of psychology on this view. Inevitably a less mature science will have a less well-developed internal/external distinction, so there is less of a body of internal considerations to rationally use as reasons.

On this account, maturity does not necessarily correlate with age, because some sciences may continue to work with little or no internal/external distinction for a long time, while others may have early success, internalize criteria, and develop this distinction more rapidly. Here, I hope to point out one criterion that the cognitive and social sciences are currently relying on as though it has been internalized, when in fact it has not gone through this process, and is being imposed from outside the science. By moving beyond doing this, a new route to maturing further is opened up. This illustrates the benefit of the new view, and also explains why the received view of immaturity has been so prevalent. The criterion in question is unification.

5. The New Account in Practice

I claim that unification has not been internalized in the cognitive and social sciences, although it was internalized in physics and chemistry.⁶ Defence of the success of unification leans heavily on examples from the physical sciences, chiefly the unification of the theories of electricity and magnetism, but also of terrestrial and celestial mechanics, electricity and chemical events, electricity and light, and spectra, atomic structure and chemical valency

(Shapere, 1986a, 5; 1977, 519–521; see Staats [1991, 900] for some discussion). This track record of success in one group of disciplines (the physical sciences) is only a motivation to internalize the criterion into those disciplines. There is no reason to assume that what works in one area of science should work in another, so there is no reason to assume that this strategy's success in the physical sciences indicates that it will be successful in the cognitive and social sciences.

Shapere himself seems to believe, based on his examples from physics and chemistry, that unification has proved itself in general so, although we could not have predicted in advance that this would happen, science as a whole will approach unification over time. This is something I am denying here; his mistake is to see unification as having been internalized at a higher level of organization (the level of science as whole) than it actually was.

I am not denying that cognitive and social scientists use unification between domains as a criterion for shaping their theories and practices, but when they do so, it is as an external criterion. It is imposed from outside—from the physical sciences. It has not undergone the process of internalization into the relevant disciplines by proving a track record of success in their domains. In fact it has been in use for some considerable time in the cognitive and social sciences without proving such a track record, indicating that it might be time it was abandoned.

The use of unification as a criterion is the reason the received view of immaturity has been so prevalent; it has provided a standard that the cognitive and social sciences have been expected to live up to. Consideration of the pluralist literature in the philosophy of science discussed in section 3 suggests that these sciences might be unable to live up to this standard. Trying to do so thus constitutes a barrier preventing them from maturing further. Dismissing this standard as an external criterion removes the barrier by giving them the freedom to

internalize pluralism instead, if doing so results in success. Accepting the disunity that seemed characteristic of immature science may be the route to maturity for these disciplines.

What about instances where use of unification has proved successful? One might think that, for example, unifying psychology with neuroscience is proving successful. It has allowed the development of various types of brain scanning techniques, and mental states can be “read off” these brain scans with some degree of accuracy, resulting in the possibility of various practical applications (e.g. see Shirer et al., 2012). This seems to be fruitful science in that it allows some degree of prediction and explanation, and has practical uses. The use of the computer metaphor for the mind is another example. Computationalism has been very fruitful, and it unifies much of the work in the cognitive sciences around a particular picture, for example uniting work in Artificial Intelligence with psychology and neuroscience.

I acknowledge that there has been some degree of success using unification, but continued anxiety about disunity shows that many scientists do not themselves believe it is enough. The lack of neat unification with neuroscience is something that many psychologists find troubling (e.g. see Uttal, 2001). It is not only lack of unification with other subdisciplines that is an issue; within psychology, there is a high level of anxiety about the fragmentation of the discipline, and this anxiety is often coupled to immaturity talk (on the received view of immaturity). For example the Journal of Clinical Psychology article “Psychology Defined” asks:

What is psychology? Is it a single, coherent scientific discipline awaiting transformation from the current preparadigmatic state into a more mature unified one? Or, is it a heterogeneous federation of subdisciplines that will ultimately fragment into a multitude of smaller, more specialized fields? This is, in essence, the “to be or not to be” question of the field. (Henriques, 2004, 1207)

Recall that it is to this more pessimistic literature that I am addressing my paper. Those who think we have made great strides towards unity already (for example those who think cognitivism is a unifying paradigm for a mature science, see above) are not those who accept my starting assumption that the cognitive and social sciences are immature. In fact, the very observations of disunity that led to the cognitive and social sciences being characterised as immature on the received view can now be seen to count against the internalization of unification. Any degree of success that has been obtained through unification does not seem to be enough by the scientists' own standards, so it certainly doesn't seem enough to constitute the proven track record required for internalization. Not only is the evidence from the physical sciences not appropriate to recommend the internalization of unification into the cognitive and social sciences, there is evidence from those disciplines themselves that it is something that should be external, because it is failing to establish a track record of success.

We can now be clearer about the error made by believers in the received view of immaturity: They are privileging unification as the criterion for maturity, when really it is only one consideration which could be internalized, and as we have now seen, one for which there is not good evidence in the cognitive and social sciences. Even if unification were to eventually be internalized by all the sciences, there is no reason to privilege it as a criterion of maturity.

A criticism that might be raised against my view is that philosophy is external, so as a philosopher I am trying to impose a pluralist agenda on the cognitive and social sciences from outside. However, to worry about this is to misunderstand my conclusion. I am not arguing on philosophical grounds that the cognitive and social sciences should be pluralist. My discussion of pluralism was designed only to prompt the intuition that pluralism is a live possibility; if pluralism is to be internalized, it will have to result in a track record of success in the relevant sciences over time. It may be that unification will prove itself in the cognitive

and social sciences and come to be internalized, and perhaps the successes of the method so far are the beginnings of this process. However they are insufficient at this stage, and the case for them does not look promising.

We can now see that this account of immaturity meets the desiderata set out above. Not only does it give us a sense of what physics is doing better than psychology, it also suggests what cognitive and social scientists should do next (stop imposing unification as a criterion), and gives philosophers of science a useful role (in recommending trying out the pluralist approach and smoothing the path towards it). Returning to the example I have been using throughout will illustrate these points.

5.1 The Cognitive Atlas Project Revisited

Reconsideration of the Cognitive Atlas project shows us one way that pluralism might be tested in practice to see whether it should be internalized. Currently, disagreements over concepts are built in to the project with space for discussion of disagreements over definitions. Recall that if there is sufficient disagreement a concept may fork, i.e. be split into several different definitions with a disambiguation page (Poldrack et al., 2011, 7–8). This may be seen as a way to approach unification, as discussed in section 2 of this paper, and I take it that this is Poldrack et al.'s aim. But alternatively, it could be a way to capture pluralism. If the disagreements remain built in to the project and this is successful, the science has internalized a means of coping with pluralism. It could function as a database for tracking the other frameworks available in the discipline to aid communication and collaboration. This could help, for example, with translating results and conclusions between the language of one framework and another, or with selecting the most appropriate framework for embarking on a new research project. As mentioned above (Dale, 2008; Mitchell, 2002, 2003; Goertzen, 2010; Smythe and McKenzie, 2010), many pluralists think

that interaction between the different frameworks would have to be an essential part of a successful pluralist science, and projects like the Cognitive Atlas could facilitate that.

This is speculative, and only trying the idea out in practice can determine whether it will work. At this stage the project has not proved successful or unsuccessful, so it is too early to say whether permanently building disagreement into big data approaches as a means of coping with pluralism could be internalized; this is just one possibility. It is not yet clear where the internal/external distinction should fall.

6. Conclusion

According to the received view, the cognitive and social sciences are immature because they are disunified, in the sense of having a plurality of disunified frameworks in play. I have used the Cognitive Atlas project as a way to illustrate this disunity, and scientists' attempts to move beyond it and achieve maturity.

However, there are reasons to think that the cognitive and social sciences should be disunified, and if this is correct, immaturity cannot be disunity. I have therefore given a new account of what it is to be an immature science, based on Shapere's distinction between internal and external considerations. According to this account, an immature science is one which is at an early stage in the process of internalizing factors to rely on to shape its theories and practices, and which therefore does not yet have a clearly delineated internal/external distinction. The cognitive and social sciences are less mature than the physical sciences in this sense. In Shapere's words, they have not yet 'learned how to learn' (Shapere, 1986a, 7).

Applying the new account, we have seen that unification is one criterion which has not proved itself successful enough to be internalized into the cognitive and social sciences. Where unification with a neighbouring domain is applied as a criterion in these disciplines, it is as an external consideration, based on its success in the physical sciences. The inability of

the cognitive and social sciences to live up to this criterion explains the prevalence of the received view of immaturity. Ceasing to rely on this external consideration by being open to the possibility of pluralism may accelerate the process of maturation for the cognitive and social sciences.

I returned to the Cognitive Atlas project as an illustration of one way that pluralism might be tried out and internalized if it is successful. Acceptance of disunity and plurality may be the route to maturity, rather than a sign of immaturity.

One role for philosophers is in clarifying the status projects like the Cognitive Atlas project could have—the scientists involved do not talk in terms of immature science or internalization, and it could benefit them to do so. Relatedly, philosophers could make recommendations about scientific education and institutional organization to facilitate pluralist practice. (The suggestions in Robert Sternberg and Elena Grigorenko's [2001] provide a useful starting point).

A further implication of this work for philosophers of science is a recommendation to look more closely at Shapere's distinction between internal and external criteria. It has not received much attention, perhaps due to the fall from grace of cruder versions of the internal/external distinction. This paper has suggested a modification of Shapere's distinction so that it is applied at different levels of organization; internalization by one discipline is not internalization by science as a whole. As a further complication, the boundaries between disciplines are not static. As Shapere says, 'the claim that a certain body of alleged information constitutes a domain is a hypothesis, subject to rejection in the light of new discoveries' (Shapere, 1984, 642). The possibility of changes to domains adds a further layer of complication to the picture that has not been considered here. Further work on this will prepare philosophers to fully play our role in the maturation of the cognitive and social sciences.

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¹ Kuhn’s position may not be this simple (see Von Eckhardt, 1993, 353–354) but this is how his view is usually construed in discussions of immaturity.

² Note that this is not “framework” in the sense meant by those distinguishing framework from content (in the tradition of Carnap, 1950). In my sense of the term, frameworks include some aspects of theoretical content as well as more structural aspects.

³ This notion of reasons is a little restrictive. Shapere does say that ideas, methods etc. which have not yet been fully accepted as background information, but were constructed based on such background, and function in the same ways, can be called “reasons” in a derivative sense (Shapere, 1984, 648).

⁴ While I would describe this position as a species of realism, if its claims are too minimal to constitute realism in the eyes of some readers, they may refer to the position as anti-realist or relativist. It is certainly not compatible with *certain forms* of realism. The important thing is to be clear about the position itself, not whether it is tagged with a label that has currently fallen out of favour.

⁵ I take it that this notion of success can also rule out pseudosciences because they do not respond properly to failures to establish a track record of success. It is not the case that anything can be allowed to be a criterion for success, only that multiple different things can count as such. Thanks to an anonymous reviewer for raising this point.

⁶ It might be significant that some very modern physical science shows increasing specialisation and disunity. This could suggest that the run of success had by unification in physics and chemistry is coming to an end. If this is right, and the change is rational, it is compatible with Shapere's view that even the most entrenched parts of a science can be overturned. If those who advocate pluralism across the board are correct, it may be that unification should become an external consideration in the modern physical sciences too. I take no view on this here, as doing so would involve detailed examination of cases in the physical sciences. With thanks to two anonymous reviewers for pressing this point.