

## **Humanities' new methods: a reconnaissance mission**

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### **1. Introduction**

In comparison to the natural and social sciences, the humanities have received comparatively little attention from analytic philosophy of science. This discipline has been concerned primarily with the sciences narrowly construed. In particular confirmation theory, the systematic study of theory evaluation, shows remarkable lacunas when it comes to the methodology of the humanities. But developments in the humanities and in confirmation theory invite us to reconsider this situation. First, due to the fast uptake of empirical and computational methods in several humanities disciplines, the humanities are presently very much in flux, and much more amenable for methodological elucidation. Second, confirmation theory has over the past decade significantly broadened its scope, and made contact with developments in mathematics and computer science. It is in a good position to take on new challenges.

The main idea of this paper is that confirmation theory can help to elucidate the introduction of new methods in humanities scholarship. In the context of this paper, it will not be possible to work out the confirmation-theoretic models in any level of detail. Instead I will discuss an example of the kind of challenges that arise where humanities scholarship is confronted with empirical and computational methods. After some general considerations on the case study itself, I will sketch how we might engage with these challenges by means of confirmation theory. One goal with this is to expand the reach of confirmation theory, thereby contributing to the philosophy of science. But more importantly, I think there is a need within the humanities for a theory about the status and impact of empirical and computational results. I hope this paper can illustrate this need and suggest a possible direction for exploring the issues.

### **2. New methods and missing methodology**

The last two decades have seen the fast growth of a number of new branches in humanities scholarship, centered on the application of empirical and computational methods. We find these new methods in a wide array of humanities' disciplines. They range from linguistics and cognitive musicology, in which researchers simulate language production and musical hearing on a computer, to archaeology, museology, philosophy and the study of religion, in which empirical studies from psychology, ethnography, and sociology are brought to bear on more traditional ways of theorizing. These developments present us with new challenges and opportunities, and invite us to rethink the humanities as a discipline. How do the new methods relate to traditional humanities scholarship? What is the epistemic status of the empirical and computational findings and how do they bear on the theories and models that scholars in the humanities are entertaining? And where should we position the humanities in relation to the social and natural sciences?

The working hypothesis of this paper is that some answers to these questions can be found in the philosophy of science. A quick glance at history suggests that methodological analysis plays an important role in the definition and formation of scientific disciplines. Bacon's *Novum Organon* set the stage for an experimental science of nature. Popper's *Logik der Forschung* and Fisher's *Statistical Methods for Research Workers* have provided the social sciences with a backbone, and even with a criterion of demarcation. For a research area that is undergoing fast changes, like the humanities, a philosophical theory on evidence and the evaluation of theories is likely to be of great value. More specifically, an improved understanding of how the humanities interact with empirical and computational methods will help the humanities to incorporate those methods on their own terms and integrate them with more traditional interpretative approaches.

In view of the pressures on academic research, humanities scholars may well be tempted to resort to methods from sciences whose societal or economic value is more easily established. The loss of scholarly approaches presents a real possibility, and potentially a risk. Moreover, it is not exactly clear what the humanities are supposed to hold on to if they resist this temptation. The disciplines that make up the humanities involve a wide array of methods, approaches and intellectual sources. While these disciplines recognizably belong to the humanities, it is hard to say exactly what links them. They seem much less unified and homogeneous than the social or the natural sciences (cf. Kagan 2009). In an attempt to remedy this, Bod (2011) calls for renewed historical and philosophical attention for the humanities, which he terms the "forgotten sciences". He proposes to counteract the disunity by conceptualizing the humanities as concerned with pattern recognition: patterns in music, in discourse, in language, in art, and in history. On itself, this is a very welcome attempt to push the agenda of the humanities. However, for the purposes and concerns of this paper, the proposal of Bod is less attractive. Insofar as Bod gives a correct description of the humanities, empirical and computational methods can be integrated relatively easily. The introduction of empirical and computational methods is more likely to lead to tensions where humanities research does not fall under the header of pattern recognition. This paper is focused explicitly on cases in which tensions do arise, and addresses the question of why they arise and how they can be resolved.

Unfortunately, in current analytic philosophy of science attention for humanities methodology is scarce. As said, this may be partly due to the orientation of analytic methodologists on the sciences.<sup>1</sup> In contrast, much of the research in the humanities is carried out by means of scholarly methods: the close reading of texts, the analysis of concepts, and the interpretation of practices. In analytic philosophy of science, insofar as it is concerned with research methods and the justification they lend to scientific theories, these scholarly methods have hardly been targeted. For another part, the absence of an analytic and empiricist methodology for the humanities derives from the eclectic nature of humanities research. The empirical, computational and other methods used in the humanities are often not home-grown. Rather, they have been taken over from neighbouring fields of research, and hence accommodated to the specifics of their domain of application on a case-by-case basis.

More specifically, insofar as researchers from humanities disciplines employ quantitative empirical methods, they mostly rely on the methodology of the social sciences. The study of religion, for example, is routinely informed by psychological and ethnographic research. But the statistical and experimental tools employed for such interdisciplinary work derive by and large from the social sciences. This means that some presuppositions of the methods will be taken over into humanities research, for lack of an alternative methodological backbone. And this may have adverse consequences. For instance, in the social sciences there is little room for the exploratory nature of theorizing – hypotheses are fixed in advance and tested against the collected data – while in the humanities theory formation is deliberately done in tandem with data collection. In the same vein, available methods from the social science do not accommodate the possible

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<sup>1</sup> In Dutch the term for the humanities is "geesteswetenschappen", literally "mental sciences". This term is on a par with terms like "natuurwetenschappen" (natural sciences) and "sociale wetenschappen" (social science). In English the humanities and the sciences are unfortunately set apart from each other.

incompatibility of theoretical concepts with the empiricist conception of measurement and fact. In short, the presuppositions of empirical research methods borrowed from the social sciences sit badly with particular aspects of humanities scholarship.

Of course the present paper cannot fill these lacunas. The aim is rather to illustrate some methodological challenges with a particular case study, and to offer a perspective on a resolution. The case study concerns the confrontation of empirical methods with more traditional scholarly methods from archaeology and museology. More precisely, it features a project of the Drents museum, where visitor data is currently being collected and analyzed, with the aim of improving the match between visitor and collection and the management of the museum's collection.

### **3. Case study: the Drents Museum**

The Drents Museum has recently obtained an infrastructure to trace visitors in real-time, using so-called RFID technology and an annotated database of its collection. The movements and interests of visitors can be recorded using a simple chip embedded in the museum ticket.<sup>2</sup> The museum now faces the challenge to provide the conceptual and statistical tools to fully employ this infrastructure, and to bring the resulting information system to bear on the traditional conceptions of collection and visitor. The eventual aim is twofold: to enhance the visitor experience by real time feedback based on revealed interests, and to improve the management of collection and exhibitions.

In its traditional form, a museum displays objects from a heritage collection so that visitors can learn about them. But in the past century this idea had to be modified extensively. Rather than exhibiting things, museums engaged in an “economy of experience” (Pine and Gilmore 1999) and underwent so-called “McDonaldization” (Ritzer 2008). Accordingly, museums saw the need to cater to visitors who vary strongly in their intentions, motivations, and attitudes when interacting with heritage collections. Moreover, where the old mode of information transfer is linear and unidirectional—think of a book—the internet introduces an entirely new mode of operation for visitors. The roles of museum and visitor converge (cf. Jenkins 2006): rather than following a given story line, visitors are predisposed to browse over a network of links, constructing their own narrative as they go along.

These shifts in the conceptions of museum and visitor present major challenges to museum management, which have only partially been met. Curators have learned to develop exhibitions with dramatic timing, latching onto people's interests and natural attention span. Moreover, museums attempt to accommodate the diversity in the interests, motivations, and attitudes of their audience by audio guides and other technological means. However, the information provided in that way is hardly adapted to the nature of the museum visitor, as revealed by her behaviour during the visit. Moreover, personalized interaction with the collection typically remains confined to the touchscreen of a PDA, focusing visitors' attention to a hand-held device rather than the physical environment. And lastly, in all of this the curator remains the sole source for the available story lines.

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<sup>2</sup> More abstractly, the infrastructure assists owners of a collection of artifacts and information items (museums, zoos, town centres, but also shops) in offering these items to the general public. As such, the infrastructure can also be employed for active forms of control in the personal sphere, e.g. attempts by retailers to manipulate consumer behaviour. Research in this direction is already well underway and, rather worryingly, mostly not available for the general public. We believe it better to put both research and technical development in the hands of non-profit organisations that work in Open Source, and that are committed to the common good rather than private interests. To this aim the University of Groningen and the Drents Museum have set up a foundation which ensures that the expertise developed in the project is accessible for everyone, while commercial parties pay for licensed use. The added benefit is that proceeds reaped from the application of the expertise will flow back to the general public, through the funding of research and museums.

Ideally, technology and heritage studies can work together to translate the experience of browsing the web to the individual's physical interaction with cultural heritage, leading to an entirely new conception of viewing and managing heritage collections. The eventual aim is an adaptive information system that presents visitors with selections of derivatives (short texts, films, photos) in conjunction to the objects that hold their attention, and that provides personalised suggestions on how to continue the museum visit. Suggestions and selections can be made in real-time, determined by earlier on-screen choices among objects and derivatives, as well as by measurements of the physical movements of visitors. As an example, when seeing an excavated pot, the visitor who has previously looked at stone tools may be pointed to a film on prehistoric cooking and receive a suggestion to see weaponry next, while a visitor who just looked at stone figurines is offered a text on the ornamental styles of pots and be invited to view jewellery from the same period.

Importantly, this is not just a technological challenge. It requires substantive theoretical input from museology and heritage studies. The system yields a wealth of data on visitor behaviour. Correctly analysed and interpreted, these data provide invaluable information to the museum management, e.g., the time visitors spent at different items in the exhibition, the type of additional information that they take interest in, the overall timing of the museum visits, and so on. With this information, the museum can inform key decisions on exhibition management. Moreover, by recording the patterns of choices and interests of the visitors, the information system can enrich the annotated database with semantic structure: robust patterns in visitor behaviour will suggest new perspectives on objects in the collection. For instance, if many people whose revealed interest is paintings also look at certain prehistoric items, this may lead to a reconceptualisation of these items in aesthetic terms, and their inclusion in a suggested itinerary for art-lovers.

In terms of the case study, we can now revisit the challenge outlined in the foregoing. How can we integrate the computational and empirical results with an understanding of the collection based on museology and heritage studies? In the Drents Museum project, the risk is that the information system will be developed independently of the scholarly study of the collection. As an illustration of the larger aims referred to in Section 2, the following will zoom in on the task of determining how empirical findings on visitor behaviour might square with theoretical ideas about heritage management.

#### **4. Exploring the relation between visitor data and heritage studies**

Below we consider the relation between visitor data and museological theory from the point of view of confirmation theory. Of course this relation is many-sided, and in fact impossible to capture in a single confirmation-theoretic model. In this section I first explore a number of perspectives on the relation between visitor data and heritage studies in the Drents Museum project. The main goal with this is to convey the many-sidedness of this relation, and thereby to enrich our understanding of the analysis provided further down.

Let us say that the museum establishes some kind of information or knowledge transfer from collection to visitor. Then three influential philosophical viewpoints on knowledge then come to mind: it is interactive, embodied, and dynamic. More precisely, knowledge is a *construction* emerging from the interaction of a subject or a group with its environment, rather than a neutral representation of that environment (Collins 1993). Second, the nature of knowledge is essentially connected to the physical nature of the interaction between knowing subject and object, or in short, cognition is *embodied* (Clark 1997). And third, knowledge is characterised by *dynamic*, and not by static qualities. The nature of knowledge is given not by fixed foundations, but by rules about revision in the light of evidence. All these ideas about the nature of knowledge provide a particular perspective on the relation between visitors and cultural heritage, which reflects back on the relation between visitor data and heritage studies.

If those ideas about knowledge seem a bit far-fetched, notice that the infrastructure at the Drents Museum establishes an embodied and dynamic interaction between the museum's collection and the visitors. Consider the interactive museum guide. The traditional structure of knowledge is hierarchical and linear, leading to a conception of knowledge transfer that is unidirectional from source to receiver. But at the Drents Museum the visitor will eventually be able to construct her own stories from the collection, by physically browsing it. In the interactive museum guide we can therefore identify the contours of both constructivism and embodied cognition. The former emphasizes the role of the receiver in the constitution of knowledge, while the latter views knowledge as the result of physical interactions with an environment, as opposed to passive recordings thereof. Finally, the idea that knowledge is essentially dynamic is also made concrete. The fact that patterns of visitor may suggest new perspectives on items in the collection makes concrete that the nature of knowledge depends on its dynamics, in this case its interactions with museum visitors, rather than its static foundations in archaeological findings and source material.

Among these perspectives, I believe that the constructivist aspects merit special attention. One reason for this is that the constructive nature of the knowledge contained in a heritage collection connects naturally to methodological ideas that stem from community-based archaeology. Although not universally embraced, many archaeologists and historians have started to involve the wider community in their research agenda (cf. Greer 2002). Interaction with the people that have cultural ties to the research topics may in fact help to shape research questions, identify preconceptions, and improve the interpretation of results (Wylie 2002, 2007). In the context of museums, involvement of local communities in archaeological research comes down to giving museum visitors, as receivers of archaeological research results, a say in the design of exhibitions and in the information they obtain. Indeed, the project at the Drents Museum may stimulate an approach to heritage management that directly involves the general public.<sup>3</sup>

As a second reason to focus on constructivist ideas, the information system currently installed at the Drents Museum presents unparalleled research opportunities in the area of social epistemology. Within social epistemology the use of computational techniques has seen a sharp increase in the last decade (cf. Hegselmann and Krause 2002, Zollman 2007). But the application of these trends in social epistemology to themes from social constructivism has not been properly undertaken. The museum presents a wonderful opportunity to see the process of "knowledge construction", happening when visitors collectively interact with the collection in the museum, at work. The information system at the museum allows us to follow this process of knowledge construction experimentally, and thereby provides a quantitative, empirical and computational perspective on philosophical ideas of constructivism (e.g., the actor-network theory of Latour 1987). The Drents Museum offers a rich experimental environment for it.

This constructivist perspective presents interesting avenues for further research. However, in what follows we will first and foremost investigate certain confirmation-theoretic aspects of the relation between data and theory in the museum project or, more precisely, the evidential bearing of visitor data on the scholarly study of the museum collection. To keep matters simple, we will by and large ignore the idea that knowledge about the collection is partly constructed by the interaction of visitors with the collection. This will only feature briefly at the end of the next section.

## 5. Fuzzy evidence and incompatible conceptual schemes

We focus on two aspects of the relation between visitor data and museological theory: the phenomenon of *incompatible conceptual schemes* and the phenomenon that empirical data may hold *fuzzy evidential*

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<sup>3</sup> Unfortunately the public voice does not always carry universal approval. A poll organized by the public broadcasting company KRO nominated the populist politician Pim Fortuyn (1948-2002) as the "greatest Dutchman of all times". Commentators and historians considered this an embarrassing choice.

*relations* to theory. Before providing a sketch on how confirmation theory might accommodate those aspects, it will be insightful to show their broad relevance to humanities methodology and make them more concrete in the case study. At the end of this section I will briefly return to how these aspects relate to a focus on constructivist ideas.

The phenomenon of incompatible schemes can be encountered in any humanities discipline that harbours multiple vocabularies. Consider, for example, the difficult relation between archeological findings as physical objects and as artefacts that served a purpose in prehistoric society and culture (cf. Descola 2005 and 2008). Establishing this relation requires us to confront the empirical archeological facts, written in a modern and empiricist vocabulary, with ideas from anthropology and cultural theory, written in a language determined by the culture under investigation. Similar confrontations of theoretical frameworks can also be found in the study of religion. Findings from the psychology and the sociology of religion are typically cast in the empirical vocabulary that matches the ontology of quantitative social science, while the content of those findings pertains to experiences and events that are normally recorded in a wholly different vocabulary, e.g., of magic or religion (Taves 2009, Kripal 2010).

With respect to fuzzy evidence, the key observation is that in the humanities there is often only a weak confirmatory relation between empirical findings and theory. Partly this is because the empirical facts are still amenable to a variety of interpretations, each associated with their own confirmatory value for the empirical facts at issue, and partly this is because the theories may themselves be subject to fuzziness in content, owing to the fact that the theories have not been spelled out in full detail or operate with incompatible conceptual schemes. To date, there is no comprehensive understanding of empirical confirmation in settings where evidence is fuzzy in these ways.

The claim here is not that the themes of incompatible concepts and fuzzy evidence exhaust the problem domain of a confirmation theory for the humanities. However, these themes address genuine theoretical problems that apply widely across the meeting ground of new methods and humanities scholarship. Moreover, they seem particularly relevant for disciplines in the humanities. The confirmatory practice of the natural and social sciences is comparatively straightforward, often consisting of data collection and hypothesis testing against a fixed background of theory and terminology. The humanities, by contrast, employ a wider variety of confirmatory relations, which are often set against an imprecise and contested theoretical background. Conceptual change is more frequent in the humanities than in other disciplines. It is high time that these characteristics of the humanities are brought to the attention of analytic philosophy of science.

With this more general motivation in place, consider how fuzzy evidence and incompatible schemes show up in the afore-mentioned museum project, in which we match a museum inventory to empirical facts on typical visitor profiles. The theme of incompatible concepts is immediately recognizable. A direct challenge for museums is to link patterns in visitor data, for instance expressed in the time spent in the vicinity of objects belonging to various categories like paintings, documentation, and archaeological findings, to an understanding of the collection, which is typically structured according to different terms: historical periods, cultural significance, origin, owner, and so on. The introduction of new labels and terms in the analysis of visitor data is highly problematic: how do we adapt the analyses in response to, effectively, refinements and alterations of the possible visitor patterns? This concrete problem touches on technical issues (Romeijn 2005), but also on deep conceptual issues with a wide appeal in epistemology and philosophy of science, concerning language-relativity and theoretical continuity under revisions of conceptual frameworks.

Finally, consider the phenomenon of fuzzy evidence in the museum project. Formal epistemology is already acquainted with the idea that empirical fact does not always relate neatly to the theories that may be supported or falsified by it. A large body of literature researches epistemic update rules in which the empirical facts cannot be described in the straightforward observational terms, e.g., as in Jeffrey updating. In

such update rules, the empirical facts are instead described by specific probabilistic constraints that do allow expression in the terms associated with the theory. But the museum project seems to give rise to fuzziness of a different nature. While the visitor data is itself perfectly clear, its impact on theory is not. Often the theories, which might concern particular cultural or aesthetic relations among items in the collection, will only have a vague empirical content. How do we bring evidence from visitors, whose behaviour strings items in the collection together, to bear on these theories? Extant confirmation theory is quiet on this point.

Recall that I deemed the constructivist perspective particularly salient in the project of the Drents Museum. We can now return, albeit only briefly, to constructivism and relate it to the two aspects just outlined. It will be clear that a constructivist mindset means that we cannot preselect a vocabulary as primitive or preferred when it comes to, e.g., an item from a heritage collection. This vocabulary genuinely depends on the person observing the item, in this case the visitor. To integrate all the different visitor experiences in a single data structure and analysis, we will need to make the vocabularies of different visitor types and curators meet. And this is what confirmation-theoretic models of incompatible schemes may help to achieve. Similarly, we might use visitor data for evaluating a claim about the collection. Simultaneously the visitors impact on the way in which the collection is being conceived. And this might in turn affect the content of theoretical claims about it. To accommodate such looping effects (cf. Hacking 1999), the confirmatory relations between visitor data and theory has to allow for some degree of fuzziness.

## **6. Some first steps in confirmation theory**

Confirmation theory, a sub-discipline of the philosophy of science, concerns the support that empirical and other evidence provides for scientific hypotheses. The focus lies on logical and mathematical models of scientific inference. Generally speaking, the inferences start in empirical fact and result in general statements, or else predictions on future observations. In other words, the inferences run from data to some form of theory, or else from data to observations that are still to come. Confirmation-theoretic systems of inference have been the subject of academic study for almost a century now, with seminal contributions from Carnap, Reichenbach, Hintikka, Levi, Jeffrey, Skyrms, and numerous more recent authors.

In the last two decades, philosophers of science have become increasingly aware of the fact that scientists use all sorts of non-empirical considerations when choosing between theories: causal structure, simplicity, coherence, novelty, and so on. In response, they have developed a large array of primarily probabilistic models to explicate and clarify the role of non-empirical, or theoretical, considerations. Present-day confirmation theory consists of some lively debates on how to model coherence (e.g. Bovens and Hartmann 2003), variety of evidence (e.g., Howson and Urbach 2006), explanatory force (Lipton 2004, Okasha 2000), on how to detect and exploit causal structure (e.g., Pearl 2000, Williamson 2005, Romeijn and Williamson 201X) or analogy (e.g., Romeijn 2006), on how to weigh simplicity against predictive performance when comparing models (e.g., Forster & Sober 1994, Kiesepä 2001), and so on.

One of the messages of this paper is that we can break new and fertile ground for these developments in confirmation by focusing on new methods in humanities scholarship. Applications to humanities scholarship will involve major changes in confirmation theory, requiring us to rethink some of the hard-wired assumptions of current confirmation-theoretic systems. But the potential benefit and impact of improving confirmation theory is enormous. The systematic approach of confirmation theory will help to clarify the intricate relations that obtain between empirical studies and theories, as they appear in humanities disciplines. This will make humanities scholars aware of the dangers and opportunities associated with involving empirical studies in their research. And eventually the research will also inform scientists who hope to involve insights from the humanities in their science, for instance in the medical humanities.

The general plan is to enrich confirmation theory with ideas from statistical model selection and probabilistic logic. But it will be clear that a full-scale development of new confirmation-theoretic models is not undertaken in this paper. The more modest goal is that fuzzy evidence and incompatible schemes will be related to some promising current developments in confirmation theory. The central development is a change in the conception of theory, and an associated change in the conception of epistemic attitudes towards theory. The point of departure for this change is Bayesian confirmation theory (Howson and Urbach 2006). This type of confirmation theory expresses our epistemic attitudes with regard to theory by degrees of belief, or probability functions, over a language or algebra. Scientific and scholarly theories are supposed to be captured by sharp probability functions over empirical data, expressing that theories make probabilistic, yet fully specific predictions. The key point is that humanities theories are often represented more adequately by *structured sets of probability functions* over empirical data (cf. Romeijn and van de Schoot 2008, Henderson *et al* 2010, Haenni *et al* 2010). Relative to empirical data and various theoretical criteria, we do not merely choose the best fitting probability function as our best theory. Rather we choose between several sets of such functions, or in statistical parlance, we choose between models. The major advantage of representing the nature and evaluation of theories from the humanities in this way is that it provides more room for accommodating confirmation-theoretic phenomena like incompatible concepts and fuzzy evidence.

Now it might require some explanation that the central ideas here are apparently gleaned from a statistical context. After all, in the humanities, evidence and theory are often not quantitative, let alone statistical in nature. Indeed, I readily concede that some humanities disciplines are primarily informed by methods of interpretation or hermeneutics (Gadamer 1989), which seem to resist a formal and confirmation-theoretic representation.<sup>4</sup> Moreover, the rigidity and uniformity of statistical methods seems to be in stark contrast to the plurality of methods that we find in humanities disciplines. And finally, humanities research is often concerned with the unique and specific, and not, as are statistical methods, with the repeatable and generic. However, the goal of involving confirmation theory is certainly not to cover all theory evaluation in the humanities. The proposal is to employ confirmation theory for an assessment of particular approaches within the humanities, namely computational and empirical ones. It is undeniable that some humanities disciplines have recently seen the introduction of such empirical and computational methods. Our challenge is to integrate those new methods with an open eye for the specifics of existing humanities scholarship. And for this task, formal philosophical methods are certainly not far-fetched.

All of this is of course a far cry from designing a confirmation theory that fits the specific requirements of the museum project. This is not the place to lay out the probabilistic models in detail, but rather to sketch a development in confirmation theory, and the philosophical and methodological setting in which this development takes shape. The take-home message is simply that confirmation theory can be made applicable to pressing methodological problems in the humanities, and that this breaks new ground for confirmation theory itself.

## 7. Conclusion

It will be clear from the foregoing that we are only seeing the start of the development of a confirmation theory that can accommodate humanities scholarship as well as methods from the social sciences that have been imported into the humanities. However, at this point it deserves emphasis that such a project is timely, even urgent. It addresses developments that are presently transforming the humanities, and has the potential to be a key contribution to its methodology: it integrates an analytic and empirical mindset into a field formed by traditional scholarly methods, and it establishes a much smoother connection of the humanities

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<sup>4</sup> Some theorists (e.g., Foucault 1970) even argue that the humanities have passed the stage of tabulation and representation. This seems a rather one-sided view of humanities scholarship.

with the natural and social sciences. Finally, it will bring an entirely new perspective to the lively philosophical debate on scientific confirmation.

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