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INFERENCE IN SOCIAL SCIENCE RESEARCH: INTRODUCING ABDUCTION

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ABSTRACT

Abduction is a very promising mode of inference, particularly when researchers aim to simultaneously build and test theoretical propositions. Yet the application of abduction in social science research is marginal in comparison with induction and deduction. It is likely that this is due so to limited understanding of what abduction does and how it works in practice. In this working paper I introduce abductive inference first by looking at its principles of logical conduct, then by making it an integral aspect of the social science research design. It is demonstrated that abduction is an invaluable attribute to critical realism and case study research, especially when researchers want to proffer explanations of social reality in the face of uncertainty. My research on the controversy surrounding high-speed rail in the United Kingdom (UK) makes insightful the merit of using abduction for improving the plausibility of theoretical propositions. The working paper suggests that inductivists and deductivists could learn considerably from abduction by accepting that the search for 'ultimate truth' hinders rather than advances progress in social science research.

KEY WORDS

abduction, induction, deduction, inference, social science research

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1. INTRODUCTION

In this working paper I will introduce abduction and argue why it is a viable – and, I believe, supreme – alternative to deduction and induction. Most academics wanting to link the general to the specific think they have to choose between the latter two and, with that, between their research as either theory-building or theory-testing (as is often posited this way, cf. De Vaus, 2011). I think such a choice is to throw away the baby with the bathwater. Abduction, in contrast, is a mode of inference in active pursuit of both testing and building theory and as such dispenses with the stated dichotomy. The core aim of the paper is to demonstrate what abduction is and how it works in practice. I will first expose the theoretical tenets of abduction mainly by giving reference to the work conducted by Charles S. Peirce (1839-1914). Peirce is generally known for his philosophical pragmatism to make scientific inquiry yield to practical outcomes, but he was also one of the greatest logicians of his time. I will then proceed by linking abduction to critical realism, a philosophical tradition which sits amidst the positivism and constructivism. This is followed by a brief exploration of abduction in relation to case study research. Next I will draw upon an example from my own research to illustrate how abduction works in practice. The working paper ends by providing some recommendations to inductivists and deductivists for inferring social reality.

It is not at all apparent why deduction and induction have become the established modes of inference. As to infer is to explain the unknown, inference could be described as the logic of deriving conclusions from a research premise (e.g. King *et al.*, 1994). Such a description can be debated, of course, particularly as it is uncertain whether research premises are 'true'. In *Against Method* (1993), Feyerabend fulminated against the oppressive characters of any inference that is predetermined conduct and knows an established set of rules. He claimed that deduction thwarts falsification because a priori theoretical propositions inadvertently and invariably produce facts that support them. This is because of the tunnel vision inherent in deductive inference. Conversely, the Viennese logical positivists propagated induction precisely to get rid of such tunnel vision; they wanted to free inference from subjectivity. For this they reinforced the strict separation between the logic of discovery and the logic of justification and proposed to infer through the verification of research outcomes. Here it was anticipated that verification would support claims of causality. Perhaps ironically, as this is what logical positivists wanted to exorcise, Feyerabend accused them of being metaphysicians (a view shared by Bergmann, 1954). He asserted that induction would only be used to corroborate preconceptions.

I concur with Feyerabend that deduction and induction may suffer from the same disease: in some instances they merely serve to confirm what scientists would like them to confirm. These instances of 'synthetic' inference are prone to ignore results that are hostile towards deeply rooted preconceptions. Consequently, the difference between research which either builds or tests theory falls away completely. Theory-building or theory-testing are reversed patterns yet represent similar conducts in speaking truth to intuition. Yet the testing or building of theoretical propositions continues to be propagated as the prevailing norm in research design, as they are presented as the only alternatives available to social scientists for linking the general to the specific. There seems to be no middle ground.

Yet at the same time I disagree with Feyerabend that it is wrong to have a set of rules for conducting inference. Quite the contrary, I think abductive inference presents an adequate solution to the dangers of preconception by making theoretical development generative, while also accepting that uncertainty and genuine doubt are intrinsic to scientific inquiry (Locke *et al.*, 2008). Abduction, then, does not only combine the most promising elements of induction and deduction but it is also inherently reserved as to what extent inference is able to make truth claims. I claim and aim to show that this is a vital requirement for social science research, if not the natural sciences. The forthcoming discussion in this working paper will illuminate how abduction relates to induction and deduction, and not least how this ties in which pertinent ontological and epistemological questions. The treatise on inferential conduct and the juxtapositions between the three modes (induction, deduction and abduction) help give insight into what social reality may look like and how we may know what we think we know.

2. WHAT IS ABDUCTION?

"Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; for induction does nothing but determine a value, and deduction merely evolves the necessary consequences of a pure hypothesis" (Peirce, cited in Burks, 1946: 303)

In the words of Harman (1965: 88), abduction is *"the inference to the best explanation"*. This statement could en passant be read as a critique against deduction and induction, for apparently they do not seek the best explanation. McKeown (1999) argues that adherents of logical deductive inference are de facto 'Folk Bayesians' who deploy the so-called likelihood function – as a statistical measure of probability. An admission of the likelihood of occurrence in deduction is then able to internalize *intuition* into the truth claim of the research premise. In inductive case study research, McKeown (1999: 180) claims that *"[t]he selection of cases for investigation is guided by the researcher's prior probabilities of a given explanation being correct in a certain kind of setting, coupled with that researcher's assessment of the costs of being wrong in that assessment"*. If cases are used for inference, then their selection matters a great deal for the research premise to be returned positively by the research outcomes. This also problematizes induction for the same reason, as there is *"no knowledge without foreknowledge"* (Diesing, 1991: 108).

As will be shown, abduction puts centre-stage the discovery of theoretical propositions as logical derivation from the inference. Yet this goes hand in hand with the perceptive and imaginative virtues endowed to humans (Magnani, 2014), as well as the pivotal role of uncertainty in theoretical development. Perhaps these attributes make abduction look more 'honest' than induction and deduction in that prior or tacit knowledge is embedded as an intrinsic part into the research premise. Besides this, abduction spurs on the researcher's imagination, which arguably is stifled by norms inherent in the other two modes of inference. Or as Weick (2007: 433) has put it, *"[n]orms of rationality and uncertainty reduction suppress an important vehicle for imagination,* [which is] *abductive reasoning"*.

King *et al.* (1994) ascribe logic to deductive inference preferably through the statistical testing of theoretical propositions. Conversely, inductive inference is considered logical in that the research results are assessed against a set of verification criteria. Respectively, these logics corroborate/falsify or build a theoretical proposition. Abduction is different from both: it is inference without giving pre-eminence to the general over the specific, or to the specific over the general (Danermark *et al.*, 2002). The sequence of theoretical proposition and result is also logical in abduction, but certainly not in the way that one automatically leads to the other. Central to abduction is that uncertainty is embraced not feared or shoved under the carpet. That is, uncertainty is intrinsic to understanding the relationship between theory and facts.

I will now draw upon an example to illustrate the difference between the three modes of inference. This example is borrowed from Peirce (1932; cited in Danermark *et al.*, 2002: 90), who could be described as the founding father of abduction. In the example 'theoretical proposition' is replaced by 'rule'; this term foregrounds the assumed regularity and universality of theory. The example deals with a sack, beans, whether or not these beans are white and whether or not these beans are from the sack. For the example to work it is important to accept either that the number of beans in the sack is infinite or that the researcher does not have time to investigate all the beans in the sack.

Deduction	Induction	Abduction
Rule: All beans from this sack are white	Case: These beans are from this sack	Rule: All beans from this sack are white
Case: These beans are from this sack	Result: These beans are white	Result: These beans are white
Result: These beans are white	Rule: All beans from this sack are white	Case: These beans are from this sack

Table 1: The logic of three modes of inference (based on Peirce, 1932)

In deductive inference the result confirms the rule. Such confirmation occurs when it is ascertained that the beans under investigation are from the sack (case) and that they are white (result). Thus, the result follows strictly from the rule when proved correct (Danermark *et al.*, 2002). However, Popper (2002) admitted that theoretical propositions can never be proved but only corroborated. Corroboration ascribes regularity to the rule only for the time being; a bean that is not white would falsify it immediately. For induction to become logical it is vital for the probability of occurrences to become transposed into the inference (Hacking, 1975; McKeown, 1999). In the example an indefinite number of beans from the sack are randomly selected and are considered to represent all the remaining beans. If all selected beans are white, then this is sufficient for an inductivist to infer that all beans remaining in the sack are also white.

In both deduction and induction the result logically follows the case. The difference in each mode of inference stems from the logical relation of case and result to the rule. From Table 1 it is therefore safe to conclude that *"inductive and deductive logics are mirrors of one another"* (Eisenhardt and Graeber, 2007: 25), as both of them confirm (or corroborate) the rule. In contrast, an abductivist does not subscribe to a sequence where the result follows the case. According to Danermark *et al.* (2002: 90), in abductive inference *"the case presents a plausible but not logically necessary*

conclusion". The conclusion in abduction revolves around whether the case proves the plausibility of a theoretical proposition. It stimulates further inquiry into the truth claim of the proposition or whether the case leads to valuable insight.

When returning to the example of the sack and the colour of the beans, in abduction it could be concluded that the beans are indeed from the sack. It sounds plausible given the fact that all the beans under investigation are white. However, an abductivist does not rule out the possibility that the beans are from a different sack that also contains white beans. From the conclusion it could very well be inferred that all the beans in the sack are white. But, again, this plausibility claim cannot be promoted to fact. We do not know how representative the selected beans are for the beans still remaining in the sack, or whether there are other beans taken out of the sack that have not been considered for empirical investigation.

What abduction does here is try to revalidate the theoretical proposition that all the beans in the sack are white. For this it uses the logic of change. Collins (1985) has argued that *"[i]n Peirce's view abduction, too, is a mode of inference - of logic in the largest sense – by which one moves from one set of ideas to their conclusions in another set of ideas"*. If in the example provided in Table 1 the beans under investigation turned out not to be white, then it could be concluded that the beans are not from the sack. Yet in abduction it is equally plausible to conclude that the beans are indeed from the sack, provided the theoretical proposition is changed. The conclusion will therefore enable a new rule to be at the centre of inductive inference. By moving to such another set of ideas, abduction is apt to recontextualize the research premise (Danermark *et al.*, 2002).

If the beans were brown not white but they are indeed considered to come from the sack, then the new theoretical proposition could be that all beans in the sack are brown, or alternatively that some beans in the sack are white. Such recontextualization enables the discovery of new theoretical propositions to contribute to our understanding of social reality by providing new and mind-altering plausible explanations. In abduction this comes particularly well to the fore in the attempt to reconcile the explanatory character of a proposition with its discovery. Peirce wanted to build a system where a theoretical proposition as 'explaining hypothesis' is seamlessly connected to the logic through which new hypotheses are discovered (in Burks, 1946). This requires methodological guidance on how the hypothesis and its discovery should be connected, for instance by advocating that these two steps occur simultaneously (Paavola, 2004). Also seamlessly connected are the repeated attempts to discover explaining hypotheses. This goes on perpetually.

The core aim to look for the best explanation for what happens around us is intrinsic to the ontological agenda of abduction. To fully explain reality is a fruitless exercise since theoretical propositions remain plausible at best – something which Rodrigues (2011) associated with 'epistemological fallibilism'. Yet if the proposition is to be regarded as an explanation for what happens around us, then abductive inference will aim to increase its explanatory strength. Strength may in this context be expressed as a percentage of truth (Rodrigues, 2011). Indeed, as Peircean logic has suggested in Table 1, abductivists do believe that there is truth independent from our observation (i.e. the beans are from the sack or they are not). Although the whole truth cannot be grasped, this does not distort the goal of abductivists to approach it best as they can.

This ontological quest brings the logic of discovery back into the game (e.g. Paavola, 2004; Reichertz, 2007), thereby consciously breaking with the artificial divide made between the discovery and justification of theory. Popper (2002: 7), a well-known deductivist, asserted that *"[t]he question how it happens that a new idea occurs to a man (...) may be of great interest to empirical psychology; but it is irrelevant to the logical analysis of scientific knowledge"*. Deductive inference relegates any knowledge obtained from the conception of a theoretical proposition to the realm of pseudo-science. Inductivists would add that such a proposition is merely the conclusion of its methodological justification (see Fann, 1970). In contrast, Peirce argued that the discovery of a theoretical proposition warrants investigation. He advocated that scientists should reason *from* the proposition instead of *towards* (in Fann, 1970, original italics), precisely because it is the proposition upon which inference is based.

Perhaps to some it is a sad thought that abductive researchers will never know the colours of the beans in the sack. Or to put it in legal terms, abductivists' infatuation with plausibility will never be able to make its conclusions go beyond reasonable doubt. Yet the inherent uncertainty in abduction is seen as central to its logic. Similarly, interpretation is central to dealing with uncertainty and 'forces' the abductivist to side with a particular hypothesis. By bringing up a metaphor between abduction and research on lightning, Reichertz (2007: 221) claimed that *"[a]ccording to Peirce, the presence of genuine doubt or uncertainty or fear or great pressure to act is a favorable 'weather station' for abductive lightning to strike"*. Peirce argued that uncertainty prompts the researcher to delve deeper into the study material at hand and find new and creative explanations for social phenomena. His first conception of abduction was one which equated inference to the act of 'guessing' (Fann, 1970), as a means to spur the progress of scientific inquiry.

The relationship with uncertainty is such that abductivists relax the extent to which they can generate conclusive scientific knowledge. Inferential conduct in this view would benefit when it is acknowledged that a theoretical proposition can be wrong. This acknowledgement supports the formulation of new and potentially better propositions that help shed new light on how the 'truth' of the matter best may be sought. Feyerabend (1993) would probably be sympathetic to the abductivist approach to knowledge and truth. He claimed that knowledge *"is not a gradual approach to the truth. It is rather an ever increasing ocean of mutually incompatible alternatives, each single theory, each fairy-tale, each myth that is part of the collection forcing the others into greater articulation and all of them contributing, via this process of competition, to the development of our consciousness"* (Feyerabend, 1993: 21). This latter point corresponds with Peirce's assertion that abduction is integral to the development of human perception and memory (in Fann, 1970).

3. ABDUCTION IN THE RESEARCH DESIGN: CRITICAL REALISM

How can abduction be embedded in the research design? In order to make abduction correspond to the general logic with which the general is linked to the specific, it is pertinent that it fits comfortably in the broader philosophical orientation of the research. I think that critical realism is particularly apt to give abduction its proper place in social science research, although moderate constructivism or post-positivism also accommodate abduction (Järvensivu and Törnroos, 2010). As will be shown in

this section, critical realism is similar to abduction in that it *"asserts the primacy of ontology"* (Mingers, 2004: 299), as a way to update what we know of an independent world out there. It is therefore primarily interested in ontological questions (Easton, 2010a). Yet critical realists also engage with epistemology, for instance when stating that our knowledge falls short of fully grasping the causal laws that make up social reality – hence Hunt's (1990) more cumbersome notion of 'fallibilistic realism'. What is also similar to abduction is that critical realism gives prominence to the logic of discovery (e.g. Archer *et al.*, 1998; Wuisman, 2005). In critical realism the conception of explaining hypotheses is not merely a psychological event; it rather exerts a definitive influence on the research logic.

As a general admission it can be argued – albeit rather simplistically I think – that critical realism consists of a positivist ontology and a constructivist epistemology. The combination of positivist and constructivist elements make critical realism sit amidst positivism and constructivism; it is the 'both-and' perspective (Danermark *et al.*, 2002). According to Järvensivu and Törnroos (2010), critical realism is therefore a viable alternative to these incumbent philosophies of science, thus avoiding the naiveté of positivism and the 'everything-is-relative' mantra of constructivism. The difference between the three of them is prominently manifested in its stance towards causality. Critical realism rejects the positivist stance that causal social laws can be uncovered and it rejects the constructivist stance that such causal laws simply do not exist. Causal analysis in critical realism instead revolves around *"the elucidation of the processes and mechanisms that generate the objects, events, and actions they are seeking to explain"* (Reed, 2009: 435).

The starting point of critical realism is that social reality is composed of myriad entities. They all relate to one another in different ways and it is precisely these relations that are of interest to the critical realist. To be more specific, critical realists are interested in the extant relational fields and liabilities between the mechanisms that assemble the entities, concepts, events and things in social reality (Reed, 2009; Easton, 2010a). Reed (2009) and others refer to 'generative mechanisms' to foreground that the relations between the components of social reality are generated in a particular way, by a configuration of mechanisms. Generative mechanisms are those mechanisms that make causality possible (X *always* leads to Y). Yet the critical realist does not know which mechanisms generate particular versions of social reality. As critical realists want to understand what causes what, they aim to theorize on varying and potentially rival causal relationships (Sayer, 2000). Thus, are there contrasting interplays conceivable between underlying generative mechanisms and surface-level social realities?

Generative mechanisms can be all kinds of things in social research: labour divisions, stereotypes, gender, corruption, community bonding, et cetera. (Reed, 2009). Research on generative mechanisms induces inquiry into the ontological make-up of social reality. Critical realist ontology is generally said to comprise three elements (e.g. Bhaskar, 1978; 1989; Archer, 1995; Archer *et al.*, 1998). First, it accepts that entities are intransitive. This means that the entities that make up social reality are independent from human observation and have a momentum and modus operandi of their own. Second, it argues that generative mechanisms are transfactual. Mechanisms endure in time and across space. Changes in social reality are incurred by a change in the composite arrangement of the mechanisms, but not by the mechanisms themselves. Again this reveals the

critical realist belief that causality is a theoretical truth. Third, it reasons that social reality is stratified. There is stratification between entities and the mechanisms that generate particular versions of social reality. To Archer (1995) this adds 'ontological depth' to the research design.

This latter point, on the stratification or verticality of social reality, takes up a leading role in the critical realist stance towards theory. I concur with Danermark *et al.* (2002) that representations of social reality in social science research based on critical realist principles are made the subject of continuous theoretical refinement. As time marches on, good and systematic scientific inquiry will become better apt at fitting social phenomena into an encompassing theoretical framework (the abductivist nods in agreement). Danermark *et al.* (2002: 10) have gone as far as to state that "*it is possible to gain knowledge of actually existing structures and generative mechanisms, albeit not in terms of a mirror image (...) but certainly in terms of theories, which are more or less truthlike"*. Although this possibility may well be the subject of debate within critical realist circles, the desire to capture social reality in 'theoretical truths' resonates across the scholarly community.

It is pertinent to stress that theory generates explaining hypotheses rather than explanations. This is a subtle yet vital difference, because critical realists believe that the stratification of social reality prohibits an investigation of causality between the intransitive entities and the generative mechanisms (e.g. Bhaskar, 1978; Mingers, 2004). Theory that aims to explain the lines of communication between these levels will hence prove unsatisfactorily. Rather, critical realism treats the formulation of theoretical propositions as a pragmatic effort to try and grasp how social reality has come about. This is comparable to Peirce's approach to abductive inference (Fann, 1970), where theoretical propositions – whether right or wrong – guide the scientific inquiry (Bertilsson, 2004). Quite similar to this point, critical realism wants to proffer theoretical possibilities. It wants to "*construe rather than construct"* (Easton, 2010a: 122).

In critical realism, a 'triadic theory of science' may be used to inquire into social reality (Harré, 1986). This theoretical approach helps perceiving social reality in a stratified way. It is to some extent consistent with the argument set forth by Mingers (2004) that critical realists should aim to make a 'double reduction' in linking theory to social reality: first from assumptions of causality to social events; and then from social events to the real-world experiences of people. Theoretical stratification supports the ontological depth of social science research (Archer, 1995), since it separates what is perceived to happen in the real world from how social events are generated. In the triadic of science, Harré (1986) distinguished between three types of theory:

- Type 1 theories involve manifestations of reality. They classify and explain things that are 'real';
- Type 2 theories reflect the representation of reality. They primarily deal with social events;
- Type 3 centres on entities: cognitive *"beings beyond all possible experience"* (Harré, 1986: 273).

Each of the three types of theory is a necessary stratum in critical realism. Type 1 theories are necessary for observing social reality. For instance, theories on social behaviour enable researchers to observe how people behave in traffic or at a crowded beach. Yet these theories cannot probe beyond what is immediately measurable. Type 2 theories help make sense of 'messy' concepts. Most theories are of this type, as they represent the actual state of the real. But they remain a facsimile, a

not-exact replica of social reality. Type 3 theories aim to canvass how entities and generative mechanisms relate to each other in social reality. They inform theory formation on the representation and observation of social reality, although their cognitive dimension is too elusive to provide compelling truths about social reality.

The triadic theory of science brings together theories on observation, representation and cognition. It shares strong resemblance between Bhaskar's (1989) claim that social reality consists of three domains: the empirical, the actual and the real. In this typology the empirical pertains to human experience, the actual to an amalgam of observable and unobservable experiences at social events, and the real to how these events and associated experiences are generated. The latter domain merits special interest, for it counters the assertion that what is real is also what is known. Although critical realists accept that the search for true knowledge is intrinsically fallible (Hunt, 1990), they hold on to the belief that there exists an independent world 'out there'. Bhaskar (1989: 13) therefore rejected the view that *"statements about being can always be analyzed in terms of statements about our knowledge (of being)"*. Critical realists are apt to remind positivists that we will never know all there is to 'being'. Yet by presenting social reality as something real, and therefore intransitive, they leave no doubt about what is their ontological position.

Many scholars agree with me that abductive inference can conveniently be integrated within a research design based on critical realist principles (e.g. Danermark *et al.*, 2002; Bertilsson, 2004; Easton, 2010a). Although core notions of plausibility (abduction) or fallibility (critical realism) may resort to a discussion on whether the cup is half full or half empty, they share a similar stance towards the pragmatist use of science. Both abductivists and critical realists understand that claims on what is true can only exist in a practical sense, and only when they are shared by all. Bertilsson (2004: 374) argued that, for Peirce, *"truth resides in the belief of a common interpretation"*, for want of conclusive truths on what happens in the real world. A common interpretation is necessary indeed, because *"[t]he universe is always much more than will ever be experienced by humans"* (Bertilsson, 2004: 375). This admission of fallibility shares strong resemblance with critical realism. For whilst critical realists believe that 'the real' can never be readily observed, *"we behave as if it was true, as if the world was real"* (Easton, 2010a: 119).

Another similarity between abduction and critical realism is the reification of the discovery of new theoretical propositions, subsequent to their mutual interest in efforts aimed at uncovering truth claims. This essentially draws back to a search for the best (Harman, 1965) or, perhaps more humble, a better explanation compared with what we knew previously (Easton, 2010a). And although the search for ultimate truth will always be in vain, they tear down the artificial wall built between theory-building and theory-testing. In consideration of both abduction and critical realism, Bertilsson (2004: 383) has argued that *"theory is not a phase of inquiry lying outside and beyond that of methodical inquiry, but an intrinsic methodological phase"*. Theory permeates all stages of research and is neither a starting point nor the end stage of scientific inquiry. This statement will be further elaborated in the forthcoming section, which shows that case study research is imperative to bringing the methodological strength of theory to its full potential.

4. ABDUCTION AND CASE STUDY RESEARCH

"What is the general? The single case. What is the specific? Millions of cases." (Goethe, cited in Easton, 2010b)

With abduction now firmly embedded in a critical realist research design, it is equally important to share some thoughts on methodology. Here I will explain why conducting case study research is particularly suitable when one aims to generate explaining hypotheses, which is consistent with Peirce's assertion of what should follow from inference (in Burks, 1946). Yet, perhaps contrary to what many large-N researchers think, case studies are also integral to both theory-building and theory testing (Flyvbjerg, 2006). Because cases are often very rich in detail, a study which from the outside may appear as theory-testing is likely to progress into a study where alternative hypotheses are built. Case studies do not discriminate between these two pivotal research activities and as such dispense with the – in my view – artificial divide that exists between them.

Besides a number of other virtues ascribed to case study research, Flyvbjerg (2006) has argued that case studies can generalize statements with universal validity. I reckon this is also what prompted Goethe to assert that research based on a single case represents the 'general' rather than the 'specific'. Various forms of generalization can be identified, for instance analytical generalization (Yin, 2009), contingent generalization or typological generalization (George and Bennett, 2005). Whilst there are certainly different points of view as to what knowledges can be accrued from studying cases, partially depending on the number and selection criteria of cases, adherents of this type of research share the supposition that the cases under investigation stand model to one or more aspects of social reality. Drawing on Dubois and Gadde (2002), Flyvbjerg (2006), Easton (2010b) as well as numerous others, I will implicitly focus on single-case study research. As will be shown with the example on high-speed rail in the next section, a single case is well able to accommodate abductive inference.

Abduction is a useful tool for making theoretical reflections of what happens in a case (e.g. Dubois and Gadde, 2002; Järvenpää, 2007; Locke *et al.*, 2008). Not least, it aims to understand why events in the case happened and in what order. In the literature abduction has often been linked to cases where some time has elapsed between the beginning and ending of events. Dubois and Gadde (2002) used the label of the 'evolving case' to foreground this aspect. The need to reflect on the chain of events is intrinsic to explaining why such a chain could be considered logical given a particular theoretical proposition. This latter point shares common ground with the methodology of process-tracing (Tilly, 1997; George and Bennett, 2005), which prescribes a close examination and reflection of the successive order of key events in a case for theory to make sense. Although process-tracing can be deployed in any mode of inference, the desirability of moving back and forth between theory and the case at hand fits particularly well in abduction.

As stated earlier, case studies provide an ideal research context for abduction because of their detailed description of the factors that could possibly impact on the chain of events. Yet similar to what is prescribed by process-tracing, abduction can only be of real value when researchers refrain from studying their cases in a linear fashion. Dubois and Gadde (2002: 555) have therefore argued

that case study research based on abduction *"requires an integrated approach, because the main difficulty of case studies is handling the interrelatedness of the various elements in the research work"*. This suggests that case studies which aim to inquire into the plausibility of a theoretical proposition should constantly go back and forth between the theoretical proposition and the case. In this way the case study is not circumscribed to either theory-building or theory-testing.

From what we know of abduction and also of critical realism (e.g. Andersen and Kragh, 2010; Easton, 2010a), theory plays a crucial role in case study research. Again this role becomes prominent in the building and testing of theory, not in their respective capacities but as an integrated endeavour. Eckstein (1975: 80), a political scientist, argued that case studies are *"most valuable at that stage of theory-building where least value is generally attached to them: the stage at which candidate theories are tested*". An abductivist is sympathetic to this statement, of course, but does not agree that theory-building and theory-testing should be ranked in order of value. This is because case-based testing will never be able to yield definitive proof that the theory is correct (i.e. there is no 'crucial' test, cf. Popper, 2002). Rather, its value is enclosed in the mere desire to search for such proof. What follows is that the case-based test proffers new theoretical explanations for what has happened in the case.

5. ABDUCTION IN THE REAL WORLD: HIGH-SPEED RAIL IN THE UK

I will now give an example of how abduction can be implemented in the real world. This is done by studying a case where logics of inquiry inform how actual research outcomes can tell something meaningful about the theoretical proposition. The case concerns the proposal for a nationwide high-speed rail network in the UK, called HS2 (Department for Transport, 2010; HS2 Ltd, 2012). HS2 is aimed at improving interconnectivity between the major British cities, principally through shortening journey times between London and the north of England. However, quite some communities adjacent to the prospective lines of route are firmly opposed against the proposed development. Opposition is especially strong in areas which are currently unaffected by large-scale infrastructures. In the case study I have focused on the anti-HS2 campaign in the Chilterns, located some 30 miles northwest of London. Since the Chilterns is an Area of Outstanding Natural Beauty (AONB), to be regarded as a 'sensitive area' in British planning regulation (Department for Communities and Local Government, 2011), it is safe to argue that there is a local interest in its preservation. The anti-HS2 campaign in the Chilterns stands model to similar campaigns along the prospective lines of route.

In my research it is assumed that those affected by adverse developments such as HS2 hold perceptions of what happens around them. This is captured by the concept of discourse, to be envisaged as a social narrative *"that is produced, reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities"* (Hajer, 1995: 44). The core objective is to see whether the discourses of civil society actors are mediated by political institutions and public attitudes towards democracy, the latter comprising democratic satisfaction and trust as the key indicators. It is reasoned that institutions regulate the political life of the citizenry, involving pertinent questions on representation and advocacy, and that different democratic institutional designs yield different levels of satisfaction and trust (cf. Lijphart, 2012; Banducci *et al.*, 1999).

To give a small example, the discourse of ecological modernization has often been linked to consensus politics (Mol *et al.*, 2010). Put simply, ecological modernization is the belief that sustainable development can be achieved within existing economic structures. Support within these structures is premised on the ability of (neo-corporatist) institutions to foster consensus on trajectories of green growth. Civil society actors engaging within these institutions are generally satisfied with the solution potential and trust the authorities, because their views brought to the negotiation table are taken at face value (e.g. De Vos and Tatenhove, 2011). This shows that institutions and the public attitudes associated with them matter a great deal for discourses. Hence, I hypothesize that discourses become mobilized as a consequence of these two external variables and that this mobilization process can be mapped through discourse analysis. This further suggests that the discursive positioning of civil society actors in the Chilterns and anywhere else in the HS2 project is contingent on political context.

By focusing on institutions and public attitudes, I offer one particular explanation for how discourses mobilize. Abduction is applied to see whether this explanation is plausible, or whether other explanations are more plausible. Prior to the inference, it is important to distinguish between different layers of theory. Figure 1 suggests that the theoretical make-up of discourse mobilization comprises three layers of theory, thus being consistent with Harré's (1986) triadic theory of science. The layers effectively mark the stratification of social reality, with the functions of observation (Type 1), representation (Type 2) and cognition (Type 3) complementing each other.

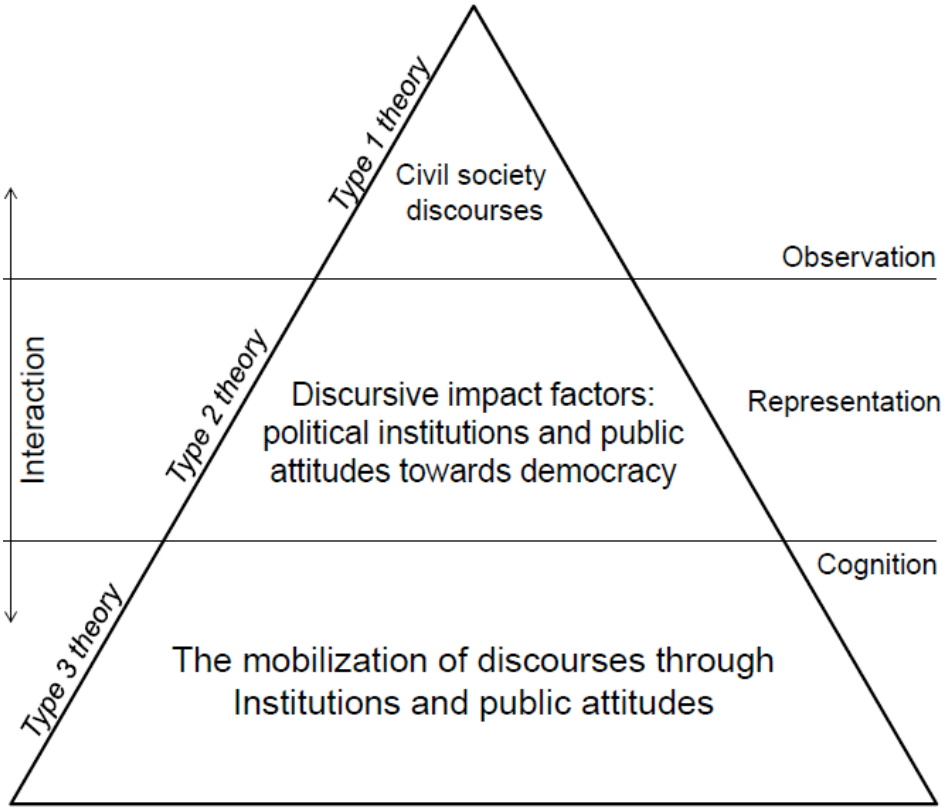

Figure 1: The triadic theory of discourse mobilization (based on Harré, 1986)

Civil society discourses are theoretical in that they are composed of the multiple ideas and beliefs of actors and, subsequently, how they are expressed in real terms. This can be observed, for instance by interviewing actors, through the canvassing of written sources (e.g. pamphlets, reports) or in ascribing value to protest or court action. It has been in my discretion to group the observed ideas and beliefs, which limit the deeper theoretical meaning of the relevant discourses. This is different from the meaning given to institutions and the public attitudes towards democracy, as their bedding in Type 2 theory is warranted by the theoretical assumptions I have condensed from the literature. For instance, I have assumed that the British majoritarian democratic system brings forth institutions that regulate the representation of citizens and possibly their engagement with real-world issues in a specific way (cf. Lijphart, 2012). I have further assumed this has consequences for citizens' satisfaction with their representation or enfranchisement and whether they trust politicians (or political authority more generally) (cf. Banducci *et al.*, 1999). These assumptions ultimately construct the idea that civil society discourses do not merely fall from the sky, but that they are mobilized by institutions and public attitudes.

Mirroring Peirce's (1932) analogy of the white beans and the sack, Table 2 presents three modes through which discourse mobilization in the HS2 case can be inferred by looking at institutions and public attitudes. Induction moves from the specific to the general by linking result (i.e. research outcomes) to rule (i.e. theoretical proposition), preceded by the selection of a case. Deduction links the general to the specific in quite the opposite way. In contrast to these two mirror images (Eisenhardt and Graeber, 2007), abduction aims to conclude whether the HS2 case offers a plausible explanation for discourse mobilization. In the abductive inference it is suggested that 'HS2' accommodates discourse mobilization through its exposure to institutions and public attitudes.

Deduction	**Induction**	**Abduction**
Rule: Institutions and public attitudes mobilize discourses	Case: HS2 accommodates 'institutional' and/or 'attitudinal' discourses	Rule: Institutions and public attitudes mobilize discourses
Case: HS2 accommodates 'institutional' and/or 'attitudinal' discourses	Result: Institutions and public attitudes mobilize discourses in HS2	Result: Institutions and public attitudes mobilize discourses in HS2
Result: Institutions and public attitudes mobilize discourses in HS2	Rule: Institutions and public attitudes mobilize discourses	Case: HS2 accommodates 'institutional' and/or 'attitudinal' discourses

Table 2: Induction, deduction and abduction in discourse mobilization

After having collected data in the Chilterns, principally through conducting face-to-face interviews and documentary analysis, I have identified three core discourses: (1) party politics, (2) conservation and (3) justification. The first discourse I have labelled 'party politics', for many of the stakeholders ascribed importance to HS2 as a vehicle for electoral success. They mainly referred to the role of HS2 in changing the electoral landscape of the UK, either to benefit the Labour Party or the Conservative Party (depending on who I was talking to). As one of the objectives of HS2 is to bring economic

prosperity to the North, which traditionally votes Labour, the Conservatives' support for the project was understood as part of their political campaign. Arguably, the association with party politics could be the result of elections based on the 'first past the post' principle, which make it necessary for a party to win parliamentary constituencies. Stakeholders furthermore argued that the essentially British two-party system is strongly adversarial and that some vital nuances in the debate on HS2 get easily lost in consequence.

HS2 is currently supported both by Labour and the Conservatives. Some of the stakeholders therefore felt disenfranchised, as they considered themselves unable to organize political dissent against the proposed infrastructure network. The party politics discourse seems apt to confirm the rule that institutions and public attitudes mobilize discourses.

Yet two other discourses shed a wholly different light on discourse mobilization. The second discourse relates to the conservation of the impact area, revolving around the unique natural characteristics of the impact area. Stakeholders referred to the Chilterns as a 'natural treasure', akin to the description of AONBs as advanced by the Department for Environment, Food and Rural Affairs (DEFRA, 2011). Many of the stakeholders I interviewed reasoned that the AONB status of the Chilterns should transcend any imperative for a railway line crossing the area, not least as various viable route alternatives at hand with much less ecological destruction may be conceived.

The most salient discourse, however, concerned the lack of justification for constructing additional rail infrastructure. Stakeholders stressed the flawed business case of the proposed scheme, for instance by referring to weak rail passenger demand forecasts and insubstantial journey time savings (for an overview of these arguments, see HS2 Action Alliance, 2013). They argued that cheaper alternatives for increasing rail capacity are available and that the relative short distances between the major urban conurbations do not necessitate high-speed rail. In expressing the perceived lack of justification, stakeholders prompted a heated debate on the scientific quality of the project proposal. It was argued that HS2 suffered from optimism bias, expressed through the methods that were used to calculate costs and benefits. This led stakeholders to comment that assumptions rather than facts associated with expected public demand for HS2 were considered intrinsic to the cost-benefit ratio of the project. Conversely, strategic alternatives to HS2 – such as an upgrade of the existing West Coast Main Line (WCML) – were systematically undervalued (the 'pessimism bias', see also Næss, 2011)

Table 2 suggested that institutions and public attitudes towards democratic conduct mobilize civil society discourses. The fieldwork results by and large do not confirm this rule. Whilst the mobilization of the discourse on party politics may be attributed to institutions and public attitudes, the discourses on conservation and (scientific) justification shift away from their influence spheres. For the sake of simplicity, then, let us state that institutions and public attitudes did not mobilize civil society discourses in HS2. This research outcome evidently needs to be followed up in each mode of inference. Following the structure of Table 2, Table 3 shows the research outcomes specified to induction, deduction and abduction.

Deduction	Induction	Abduction
Rule: Institutions and public attitudes mobilize discourses	Case: HS2 accommodate 'institutional' and/or 'attitudinal' discourses	Rule: Institutions and public attitudes mobilize discourses
Case: HS2 did not accommodate 'institutional' and/or 'attitudinal' discourses	Result: Institutions and political culture did not mobilize discourses in HS2	Result: Institutions and political culture did not mobilize discourses in HS2
Result: Institutions and political culture did not mobilize discourses in HS2	Rule: Institutions and political culture do not mobilize discourses	Case: HS2 did not accommodate 'institutional' and/or 'attitudinal' discourses

Table 3: Research outcomes on discourse mobilization in the case on HS2

Whilst the research outcomes (the 'result') are the same in all three modes of inference, namely that institutions and public attitudes did not mobilize discourses in the case under investigation, two very different conclusions can be reached. In induction and deduction the result signals the end of the scientific inquiry, unless of course a new inference is started up. Once the inductive researcher discerns that external variables other than institutions and public attitudes led actors in the Chilterns to form discourses on HS2, the conclusion that institutions and public attitudes do not mobilize discourses naturally follows. When an inductivist purposefully selects a case, as suggested by Table 3, then it will prove impossible to conclude otherwise. In a similar vein, the deductive researcher finds no way to reconcile the case with the rule. As the latter was premised on a preconception, deduction does not provide any leeway to express the results in anything other than negative terms (that is, incommensurate with what the rule dictates).

The abductive researcher can explain the result in quite a different way. In contrast to induction and deduction, it is able to do so upon concluding that HS2 did not accommodate discourses that were mobilized in consequence of incumbent institutions or extant public attitudes towards democracy. Yet as the abductivist is in search of plausibility rather than confirmation or corroboration, two viable options for further research may be pursued. These options principally manifest the 'both-and' perspective of abduction (Danermark *et al.*, 2002), as they propose either to change the rule or the locus of research. In the latter instance, another case can be selected where justification and pressing conservation issues do not play a significant role. Yet a pertinent consequence of 'both-and' is that a new explaining hypothesis could also be formulated.

Here we have it. The conclusion in the abductive mode of inference brings uncertainty to the fore, but offers promising research trajectories to break out from the impasse. I have benefited from strictly applying abduction to my case on HS2, as it has propelled me to keep on searching for a better explanation. Yet would all be lost when I opted to induce or deduce theoretical propositions? I think a 'good' inductivist will be able to learn from the result and find a more suitable empirical environment where institutions and public attitudes are at work in discourse mobilization, or to shift the focus to other variables. Similarly, a deductivist who wants to find a perfect match between rule and result will either change the former or to dispense with the case on HS2 and look for other cases instead. In both cases, I can make educated guesses of what goes on in my case and renew the

research premise. Perhaps ironically, this is exactly what abduction does. When Inductivists and deductivists do not take 'no' (or 'yes', for that matter) for an answer, they are abducing. Yet, they may not be aware of it.

6. RECOMMENDATIONS FOR SOCIAL SCIENCE RESEARCH

"All I know is that I don't know nothin'" (Operation Ivy)

In this working paper I have presented abduction as a very promising mode of inference. It promises to reconcile theory-building with theory-testing research through looking for the best explanation, under the condition of uncertainty. This means that the maximum result from abductive inference is to increase the plausibility of theoretical propositions. This is a realistic maxim, and therefore reciprocated by critical realism, because we are inherently unable to grasp the causal laws of social reality. Yet we abductivists are content with this inability, as it forces us to constantly alter the propositions upon we build theoretical claims. So instead of entering a minefield where preconceptions of what is true are likely to be rejected or falsified, we express theoretical propositions as an expression of truth. Until, of course, the real world provides us with new research directions and subsequent propositions.

All these aspects make abduction a viable means to infer social reality. It is humble in its approach to truth and knowledge. That is to say, it accepts that we can never know for sure, that any incumbent explanation is never perfect and that inference is an infinite process. I recommend that social scientists take this approach seriously. Whilst causal laws indeed govern social reality, at least from an abductivist's point of view, the irregularity and transitivity of what happens around us makes these laws impossible to grasp.

A treatise on abduction naturally has to deal with induction and deduction, for it is the sharp contrast between the former and the latter two that makes it worth studying. Yet notwithstanding my assertion that abduction is intrinsically virtuous and that it holds exclusive qualities, this does not mean that induction and deduction cannot improve. For both it is important to let go of the supposition that inference should lead to ultimate truth, because this is a fallacy. Scientific progress is incremental progress and therefore requires the constant tweaking and reconfiguring of the research premise. I guess this requires a change of research ethics and mentality, because I suspect that most researchers do not want to present outcomes that do not match with preconceived theoretical propositions. Yet 'negative' research outcomes are integral to the progress of science.

It will undoubtedly prove difficult to change practice where likelihood is promoted to truth or where anomalies ('black swans', cf. Popper, 2002) are overlooked or simply ignored, in induction and deduction respectively. If we are willing to change, however, then I hope 'old' debates will be reopened, new debates will be initiated, long-standing truth claims will be critically reconsidered and plausible theoretical propositions will be met by healthy investigative scepticism.

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