Information retrieval (IR) and the paradox of change: an analysis using the philosophy of Parmenides.

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Abstract

Purpose - To explore whether philosophical insights from Plato's dialogue 'Parmenides' on the complex and often paradoxical nature of change can illuminate the nature of information retrieval (IR). IR is modeled as a dialectic process involving mutually dependent yet conflicting forces between the subjective and the objective. These forces operate to produce change in the subjective experience of users (becoming informed) through facilitating a relationship with objective documents. Accurately modeling, predicting and enabling this process remains a persistent problem for IR and this paper examines the extent to which this is because of the nature of change.

Methodology/Approach - Conceptual analysis and literature review.

Findings - The problem of change (what it is, how it happens and how we can know it has happened) is essential to our understanding of information as information normally implies some kind of change in knowledge state. Any process of change, however, on examination of its qualities, appears to necessitate the combination of irreconcilable and conflicting forces. The apparent contradictions within the existence of change as discussed in 'Parmenides' also exist in IR on both a theoretical and a technical level.

Research Implications - Change is a central concept for information in general and IR in particular. A deeper understanding of the paradoxical nature of change can provide new insights into IR theory and practice.

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Originality/value of paper - Presents a new historical philosophical perspective on the nature of change and applies it to current IR problems.

Introduction

This paper looks at one question: how important is an understanding of the concept of change to understanding the nature of IR? It takes as its premise that information retrieval (IR) is a problematic and paradoxical field of enquiry which, despite considerable technical developments, has yet to create a coherent and agreed theoretical framework for its key questions. This lack of a clear theoretical structure within IR and the persistent intractability of IR as a problem has also discussed by, amongst others, Blair (1990, 2006), Warner (2008) , Hjorland (1997, 2000, 2002, 2009) and Thornley and Gibb (2009). In this paper IR is modelled as a dialectical process arising from the dependent yet mutually conflicting relationship between the subjective (the user/s) and the objective (the document/s) (Thornley, 2005; Thornley and Gibb, 2007). The way in which these forces work together to initiate change is central to our understanding of information and IR. This is because information normally implies some kind of change in knowledge state and thus to understand IR we need to understand change. Understanding change (what it is, how it happens and how we can know it has happened) is, however, very difficult. Change is a problematic and paradoxical concept and its complex nature had been discussed in philosophy over thousands of years. I argue that we can use some of this discussion, in particular some of the arguments discussed in the Platonic dialogue 'Parmenides', to help us to understand what change is and thereby help us to understand IR.

What exactly is problematic about change? It is problematic because of the philosophical questions is raises concerning the nature of existence (a question of being), the relationship between generals and particulars (a question of language); and the possibility of measurement (a question of knowledge). Firstly, it requires something becoming something out of something which it is not (the juxtaposition of non-being and being). Secondly, if change exists how can abstract concepts describe our changeable physical world? Finally, as change is a fluid process,

how can we accurately measure when it has happened or to what extent? The process of change involves a relationship between opposing and yet related forces and thus can be understood as dialectical in nature. This argument is explored using a discussion of the apparent contradictions brought about by accepting the existence of change as discussed in ancient philosophy and then proceeds to show that these contradictions are also an ongoing problem for IR on both a theoretical and technical level. It concludes that this is because an understanding of information must incorporate an understanding of change and thus the complexities and contradictions within change will manifest themselves in IR.

Structure of paper

Firstly, I introduce and define the central concepts used in the argument and describe the scope of the paper. This clarifies the nature of paradox i.e. the problem of conflicting ideas or concepts co-existing and I explain its relationship to change using the concept of the dialectic. I then discuss the ways in which I perceive IR to be a paradoxical problem i.e. is it actually the case that there is paradoxical problem in IR which is worthy of exploration? As part of this I outline my dialectical model of IR and discuss its relationship with change. Secondly, I examine the discussion on the existence and nature of change primarily from the Socratic dialogue 'Parmenides'. I draw out the particular areas where the contradictory and problematic aspects of the change process are seen to arise and make some initial connections with related contradictions in IR. Whilst clearly more recent work on these questions has been covered in philosophy I maintain that the contribution of the ancient tradition is enormously influential on modern thinking and worthy of examination for both philosophical as well as historical reasons. This view is supported by influential voices in philosophy such as Anscombe (1981) who did detailed work on the influence of Parmenides on Wittgenstein and also, perhaps the more well known thesis of Whitehead's (1929) that the history of western philosophy is a series of footnotes to Plato. I then address in more detail how each of the contradictions or problem areas as discussed in the dialogue are also current and ongoing issues in IR and show that an increased understanding of the role of change in these contradictions can improve our understanding of their nature. In conclusion, I review the contribution that an increased understanding of change

can make to the ongoing challenges of IR theory development, representing information and evaluating IR systems.

Paradox

A paradox is a statement that contains conflicting ideas or concepts. An example in philosophy is the Cretan liar paradox in which Epimenides (circa 600 BC) of Knossos in Crete claims all Cretan's are liars. If he is correct then he contradicts himself as then he cannot be lying (he has in fact asserted a true claim). This explanation, however, still leaves us with the question of what is a conflicting idea or concept, how can they both be contained in the same statement or indeed thing, and what happens when they are? One way of understanding this is the concept of the dialectic which models this process as a struggle between oppositions which then results in some kind of change (which in turn is unstable and tends to lead to an increase in tension and then more change). I will provide a brief overview of the concept of dialectic and then go onto discuss some examples in IR where these conflicts and paradoxes assert themselves.

Dialectic

The exact meaning of dialectic has developed over time. In earlier philosophy it was understood as a method of argumentation in which two opposing viewpoints would be discussed to eventually reach the truth. In more recent philosophy, most notably the work of Marx (1867) and Hegel (1807), it is used as a way of analysing how conflicting forces create social change. Both these definitions, however, share the central theme of opposition and conflict causing change or the creation of something new. The oppositions and resulting change and creation also tend to be unstable and forever changing as the opposing forces both require and repel each other. Magee (2000, p.43) argues that the central role of change in reality is the most important aspect of Hegel's contribution.

> "Hegel's fundamental insight, out of which most other aspects of his thought evolved, was that reality is not a state of affairs but a process: *it is something going on.*"

This view that reality is a process is very relevant to IR and also to information science (IS) in general in so far as information is both an object (for example a document) and a process (a user

becoming informed) in which the object 'causes' or has some impact on a change in knowledge state (Buckland, 1991a). In Hegel's philosophy the process of change is not random but the result of the interplay of forces that can be understood as a dialectic.

"He (Hegel) formalised his view of change in what he called the dialectic: any positive state of affairs (let us call our assertion or description of it our thesis) will, merely by coming into existence, call into being contrary and incompatible states of affairs (the statement of this fact will be the anti-thesis) which de-stabilise and cause it to change into something new, a new situation, partly new and partly the same, in which what were destabilising elements in the old become constituent structural features (we call this synthesis). But this new state of affairs, merely by coming into existence, calls into being…etc., etc." (Magee, 2000, p.43)

Thus the concept of the dialectic in this paper is taken to mean a relationship between two opposing but mutually dependent objects or concepts. The opposition in the relationship creates conflict and energy which often causes change of some sort to happen. As the opposing objects or concepts also require each other it is never ending process, both elements need to survive, as if one destroyed the other it would also destroy itself.

I have, so far, introduced the nature of paradox and its connection through the concept of dialectic to the nature of change. My own previous work on the role of the dialectic in IR (Thornley, 2005; Thornley and Gibb, 2007) examined the role of conflicting and yet mutually dependent oppositions, primarily between the subjective and the objective, in understanding the persistently intractable nature of IR and dialectical models have also recently been used in image retrieval (dos Santos *et al.*, 2008). This paper, in its discussion on the contradictions and conflicts in change, builds on this work and provides some new theoretical and historical context to the nature of these tensions. Before proceeding with a detailed discussion of change, however, I briefly review my model of IR which perceives it as essentially a dialectic process characterised by paradox and conflict with change as an important component.

A dialectical model of IR

IR is sub-set of information science which focuses on the specific problem of how to represent and organise documents (of any sort) in systems which then best facilitate the retrieval (i.e. finding and accessing) of relevant documents by users. Thus IR examines the optimal way of allowing effective communication or, at least a connection, between a document stored in a system and a user. The question of whether this is a process of communication or merely one of connection will be discussed in the next sub-section. IR then is concerned with the relationship between an objective document (in so far as it is a physical object) and a user's subjective experience of that document. What kind of relationship is this? I argue that it is a dialectical relationship involving conflict and dependencies in which there is rarely a clear and absolute solution. Any representation of a document must both be 'about' the document yet must also be simplified (or made less 'about' the document) so it may be found a by a user. It must also be 'relevant' enough to 'inform' but not so similar that it just replicates existing knowledge. An examination of themes discussed in a range of IR traditions over the decades (Neill, 1987; Ellis, 1996; Thornley, 2009; Bawden and Robinson, 2009) reveal a clear involvement with the problem of intractable and often paradoxical dilemmas. This approach to IR as a relationship between opposing forces or objectives is also discussed in the early work of van Rijsbergen (1979, p.30) who concludes that the relationship between representation and discrimination is one of 'optimal trade offs'. Cole (1997) and also van Rijsbergen (1993) illustrate the difficulty of articulating information needs in IR and of recognizing potentially relevant documents by using

Meno's paradox (Plato. Trans Syndenham, 1773). This paradox claims the impossibility of recognizing or knowing something that we do not already know i.e. how can we gain knowledge from the unknown? More recently Mai's (2011) examination of the problem of classification explores the tension between subjectivity and objectivity in how LIS describes and categorises documents.

I argue that one way of understanding these conflicts and tensions is as a dialectical process. The dialectic is between the subjective and objective in so far as it is concerned with providing access to an objective object (a document of some sort) for a person with a subjective experience of that document including a particular context in which it may or may not be perceived to be relevant. The objective document and the subjective experience of it are both very different and also, for IR to work at all, related in some ways. It is managing this relationship which is characterised by conflict (between the object and the subjective experience and also between various different subjective experiences of the same object) which is central to IR. In particular, it is managing this relationship in a way which best facilitates a change in knowledge and also helps ensure it will be a qualitatively useful change in knowledge. There has been considerable work within IR and IS on the relationships between documents and users but limited investigation, particularly from a philosophical perspective, into what this change process actually consists of.

I investigate the role of change in IR by exploring discussions on the nature and existence (or possible non-existence) of change in philosophy with a particular focus on the Platonic dialogues of 'Parmenides' and, to an extent, the 'Theaitetos'. I argue that these reveal a perennial philosophical problem with understanding the nature of change. In particular, when we try to articulate exactly how change exists and works in the world at both an abstract and a physical level we tend to find ourselves dealing in contradictions, paradox and dilemmas that we can't seem to completely resolve. I argue that in IR it is when we try to articulate exactly how information exists and works at an abstract and a physical level that we also tend to come across contradictions, paradox and dilemmas that we can't seem to completely resolve. Why is this? It is at least partly because when we talking about information we are also talking about change, hence if understanding the nature of change is problematic this will also follow for information.

I also argue that disagreement about the role of otherwise of change in our understanding of information and thus of IR is an important source of disagreement between different research traditions. Thus the answer to the question 'Is change part of how we should understand information?' can be used as one way to understand the divisions within the IR tradition. This can be illuminated by discussing it within the context of Parmenides' question 'Is change part of how we should understand the world?' which also is a central division between different philosophical world views. In the following two sub- sections I discuss firstly those in IR, and also in the broader field of IS, who argue that change is not part of information and secondly I discuss those who claim it to be of paramount importance. Finally I highlight shared themes in both perspectives in addressing the problem of defining information and thus IR.

Change is not part of IR

The more objective tradition within IR, as characterised by the early work of van Rijsbergen (1979), proposes that its purpose is to provide a user with details of documents about his or her request. The question of whether or not they do actually inform the user is outside IR's remit. Thus IR is about facilitating a connection in terms of providing access to a document rather than about communication which would include concern about the effects of the document. Van Risjbergen cites Lancaster (1968) in the first page of his introduction to 'Information Retrieval' (1979) as providing a 'perfectly straightforward definition' of IR

> "An IR system does not inform (i.e. change the knowledge of) the user on the subject of his enquiry. It merely informs of the existence of (or not) and whereabouts of documents relating to his request." (Lancaster, 1968, In Van Rijsbergen, 1979, p.5)

This long-standing perspective that IR is about the relationship between the content of a document and the content of a query without the requirement for any detailed analysis of the actual impact on the user is still very prevalent. It can be seen, for example, in the large-scale test collections such as the Test Retrieval Evaluation Conferences which is generally known within IR as TREC (http://trec.nist.gov/). The success of competing techniques are calculated based on their ability to retrieve documents with relevant content rather than on the experience of users.

Thus the assumption is that if the content analysis is good enough then there is no need to study the extent or the quality of the users' change in knowledge.

This assumption does appear to be valid in many cases as significant improvements in system design have not generally come from the user study led tradition. This has been observed by, for example Hjorland (1997, 2000), who criticises the *ad hoc* nature of user studies and Ellis (1992) who observes that the cognitive tradition's claims to model and understand the subjective experience of information have not translated into the improved performance of IR systems. More recent developments involving the user in searching, such as Google with PageRank's use of citation links (Brin and Page, 1998) and the use of 'popularity' scores for pages over and above content (White, Bilenko and Silviu , 2007*)* have transformed searching or certainly the experience of searching in many ways. There are, however, significant voices who challenge the extent of any real improvement in the retrieval of high quality and informative content (Tenopir, 2001; Bawden and Robinson, 2009). Involving users and thereby dynamically changing relevance is becoming increasingly possible but its value perhaps remains complex and unclear.

Change is part of IR

There is also a research tradition in IS and IR which emphasises the importance of change in its modelling of information. Brookes (1980) argued that the 'fundamental equation' of information science was the extent to which a knowledge structure is changed and becomes modified by information. This view remains influential and the juxtaposition of the term 'equation' implying a defined and predictable process with the actual thing to be observed (a change in knowledge structure) reveals much of the problematic nature of this perspective. There is also the complication that generally we would define becoming informed as not only a change in extent of knowledge state but also an improvement, for example a deeper understanding or a more comprehensive one, as change could also include deterioration, for example using a faulty research study which then changes medical practice.

Buckland's (1991, 1991a) theory of information defines it as a problem with three (at least) perspectives: information as thing; information as process; information as knowledge. This can be seen as one approach to combine the apparently competing qualities of information in a way

which can model change ('thing' initiates a 'process' which initiates 'knowledge') and I interpret his work as an attempt to model a complex process involving multiple factors. In his paper ' Information as thing' (1991) he sometimes call all these factors 'things' but in my view in this particular case his terminology can be a possible cause of confusion as they are not all 'things'. Information is not one unified concept but rather a complex collection of things, events and mental change which work together (or sometimes don't) to produce what we generally call information. He argues that rather than provide a unified definition of information that it is more useful to acknowledge that information has various qualities and we still call all of these information. This model can therefore include change as it explicitly discusses how 'entities' may initiate an intangible process (becoming informed) without insisting that only one of these counts as 'information'.

Ingwersen (1992) stresses the importance of the ways in which information should change understanding arguing that 'IR is pre-occupied with providing information, which may act as a supplement to a human conscious or unconscious mental condition in a given situation (Ingwersen, 1992, p. 25)'. The link with information with changes in cognition is also developed in later work (Ingwersen and Jarvelin, 2005). In this case information is not just about the content of the document (often referred to by Ingwersen as the meaning) but rather the actual effect it has on the user in their particular situation. How does it change their understanding and their ability to act differently?

Change and defining IR

A recurring theme in this discussion of change in IR is the nature of how information is defined and how this is related specifically to IR. In those that deny the importance of change they seem to acknowledge that perhaps change is part of the normal understanding of information but they explicitly state that IR is not concerned with that aspect. It deals with content not with the potential effects of that content. So the definition of information as it applies to IR is narrow and does not include change but there is an acknowledgement that different perspectives on information exist. In research traditions which do emphasise change the multiple factors within

information are acknowledged with the difference that these are seen as part of IR's remit. Some complex work is then required to try and explain how they might work together to facilitate change.

I argue that this shows that the only way we can deal with explaining change in information is to divide information. We can model its apparently competing qualities (for example as an inanimate object and as a mental process) if we say it all these things but in a very broad way. Then the decision is whether IR wants to include a consideration of the aspects of information that include change or just deal with the aspects that don't. If we exclude change we have a much simpler problem but we aren't able to explain or model the actual effects of IR systems. If we include change and attempt to model or explain it this becomes very difficult as we have to explain how these different aspects of information are related.

This is very closely related to the discussion in 'Parmenides' where he argues that to allow the existence of change is to allow diversity and difference (reality is many) which leaves us with the philosophical problem of how these different things and/or qualities relate to each other. Therefore he argues change doesn't exist and that reality is unified (reality is one) but, as his friends in the dialogue point out, this leaves us with the philosophical problem of how to explain the diversity and change that we appear to observe. In a similar way, the perspective within IR that claims change is outside the IR system allows the system to remain a unity without complex contradictions. This is reassuring in some ways but doesn't seem to adequately acknowledge the change and diversity that we observe in IR. Alternatively there is the IR perspective that acknowledges change but then there is clearly much progress to be made in explaining and predicting how it actually happens.

Change in philosophy

The purpose of this section is to show that change is a fundamentally paradoxical process. Change is something that appears to happen all the time. When we, however, start examining how it actually occurs, we very quickly seem to get involved in discussing apparently contradictory and conflicting statements. The evidence I will use is discussions on the nature of change in philosophy, primarily from the ancient tradition, which reveal the difficulty of understanding change. They also show that different philosophical views on change are central to

the differences between different philosophical world views. The purpose of this discussion is to reveal that current disagreements in IR about the nature of information can be connected to disputes about the nature of change. We can, therefore, use insights from this debate about change to extend our understanding of IR.

Support for the thesis that change is a difficult and hard to define process is prevalent throughout the history of philosophy. It is closely linked to three central questions. Firstly what is the nature of existence, secondly how we can describe what exists and thirdly, how we can know or measure what exists? In more recent times philosophy has continued to grapple with these questions and, for example, Wittgenstein's (1922, 1953) work on the nature of language is closely tied to his views on the nature of existence and knowledge. Insights from the ancient tradition remain, however, important and influential. These three questions are also central to IR as IR represents and describes information about what exists in such as way as to best facilitate people gaining knowledge about it.

The first question I examine is the philosophical discussion in ancient philosophy, primarily through the Socratic dialogue 'Parmenides', (Plato. Trans. Warrington, J. 1961) about whether existence is something that changes or not, or to put it another way, is change actually just an illusion or does the appearance of change, i.e. the fact that we perceive change happening, reflect reality (existence)? This is presented as a dichotomy between two theses, firstly reality is an unchanging unit (or the 'One') proposed by Zeno and Parmenides and the opposing thesis that reality is an ever changing plurality (the doctrine of perpetual flux or the 'Many'). These opposing views are pitted against each other in the style of the dialectic method of argument to see which viewpoint leads one into fewer contradictions than its opponent. The second question I discuss is how we can describe what exists and this can be understood as a problem of language. How can we group particular instances which appear to change under general descriptions which seem to be abstract and unchanging? This is also known as the problem of participation, for example, how does an individual dog 'participate' in our general descriptive term 'dog'. Finally I analyse the problem of measuring or gaining knowledge about what exists and its relationship to the existence or otherwise of change. If the world is constantly changing how can we gain reliable knowledge about the world? Within the Platonic tradition it was seen as imperative to

answer these three questions which can be summarised as the problems of existence, language and knowledge, and the debate here is about whether allowing change into our world view makes it easier or more difficult to provide a satisfactory (and non-contradictory) answer to these questions. In the rest of this section I tackle in turn the problems of change and existence, change and participation (or language) and finally change and measurement or knowledge within a philosophical context. In the next section on 'Change in IR' I then use these insights from philosophy to tackle the same problems in the context of IR.

Change and the problem of existence

Change was seen as a problematic issue in ancient philosophy because if one allowed its existence, it seemed to lead one into philosophical contradictions as it suggested that things could be (exist) and simultaneously not be (during change aspects would stop existing). It appears from looking at the world that lots of things exist and then stop existing and then come into being again. This is perplexing as it appears to imply that objects somehow contain their own negation which appears contradictory. So we can perceive change but it is problematic to fit this perception into a cohesive and non-contradictory philosophical world view. In order to understand the nature of this debate one needs to know that for the Ancient Greeks 'being' or 'existence' were seen almost as a 'thing' as Anscombe discusses in her work on Wittgenstein and Parmenides.

> "Parmenides does not treat *to be* as an object, but rather *being*, i.e. something being or some being thing. It is difficult to use the participle in English in the required way, and we might get closer to the sense by saying "what is"." (Anscombe, 1981, p.x)

Thus if change exists then 'being' must also contain 'non-being'. Parmenides and Zeno argue that change therefore cannot exist, it is all an illusion. Reality is a unity (or the One) in which no change occurs as we see in Socrates' summary of their arguments below. It is not the case that many different things exist (the many) and that they all change, rather reality is one unchanging unity.

"Soc: Ah! Since unlike cannot be like, or like unlike, it must also be impossible that reality should be many, because if it were it would have irreconcilable characters. Am I right then in saying that your arguments have no other purpose than to maintain, against all contrary assertions, that reality is not many? Do you believe that each of those arguments proves this one point, and that you yourself, accordingly, are offering as many proofs that reality is not many as you may have put forward arguments? [128] Is that what you mean or have I misunderstood you?

Zeno: No, you have a perfect grasp of my theory as a whole."
(Plato, Parmenides, [127-128], trans. Warrington. 1961)

The discussion continues with Zeno showing that his thesis that 'reality is not many' was written to support Parmenides' thesis that 'reality is one'. They both attempt to show that the allowance of plurality or the thesis 'reality is many' "when closely examined, involves yet greater absurdities than our assumption of the One" (Plato, Parmenides, [128] trans. Warrington. 1961) The alternative world view which they are attempting to overthrow in this dialogue is the one presented by Heraclitus in the Socratic dialogue 'Theaitetos'. Heraclitus claims that everything changes all the time which is also sometimes known as the doctrine of perpetual flux. This is characterized by the expression 'One can never step into the same river twice' and proposes that reality is an ever changing flow. The implications of this for knowledge are that 'man is the measure of all things' 'Theaitetos [152] and that there is no objective external reality that we can reliably know about.

What kind of absurdities or contradictions do Parmenides and Zeno marshal to show that reality is indeed one and not many and that continuous change, as proposed by Heraclitus in his theory, is an illusion? Their major objection to the existence of the many is that is seems to require that things both exist and don't exist simultaneously. In order to understand the debate here we need to see what is meant by 'things' in this context. Firstly it is necessary to distinguish between the abstract and the physical in this debate. Is it actual physical reality that must be a unified whole containing no change or contradiction or is it the abstract model of reality which must behave in this way? Plato's philosophy argues that there exists a number of abstract 'forms' (for example

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justice and beauty) in which reality (or things) as we perceive it partake and thus gain their qualities. Thus a 'just act' is 'just' in so far as it participates in the form of justice. In this dialogue Socrates' argues that if you accept this split between the abstract forms and the physical world then the apparent contradictions arising from the assertion that the 'one is many' disappear. Just because one observes that an individual object contains or partakes in apparently contradictory qualities this is not problematic as one is not concluding that the actual qualities themselves partake in their opposites, rather that they are both present in the one instance. He challenges Zeno to show that abstract qualities or 'forms' have to partake in their opposites if many of them (rather than a unity of one) are said to exist.

"We may therefore conclude that if a man sets out to demonstrate that that such things as stones, bits of stones, etc. are simultaneously many and one, we shall say that he proves that some *thing* is both many and one, not that unity is plurality or vice versa. We shall find nothing extraordinary in what he says which is, after all, mere commonplace. If, on the other hand having clearly demonstrated the Forms, to which I just referred-e.g. Likeness and Unlikeness, Plurality and Unity, Rest and Motion, etc.-he goes on to prove that these can alternatively merge into and separate from one another, then, Zeno, I shall be dumbfounded."(Plato, Parmenides, [129] trans. Warrington. 1961)

The rest of the dialogue is an extended attempt by Parmenides to demonstrate that, even at this abstract level of the forms, allowing the existence of the 'many' rather than the 'One' still forces one into contradictions as can be seen in the following discussion on the problem of how objects participate in abstract qualities.

Change and the problem of participation
There is still, for example, the problem of how one can demonstrate that the physical world partakes of these forms. How can the form of large be distributed to objects without being forced to partake also in its opposite the form of small? If we allow that change and diversity exist how can we manage to have a precise descriptive language that will not sometimes, or perhaps always, do an imperfect job of representing the exact nature of what it describes? In terms of IR we can see this in the problem of document representation which is always, by its very nature,

partial and incomplete (Buckland, 1991). In terms of Platonic philosophy do forms have to be divisible so they can be distributed amongst things in the world and does this mean they are no longer accurate or perfect representations?

> "Par: look now, suppose you split up Magnitude itself and say that every large thing is large by virtue of a *part* of Magnitude, which is less than magnitude itself; won't your statement appear rather silly?
>
> Soc: it will indeed."
>
> (Plato, Parmenides, [131] trans. Warrington. 1961)

The difficulty being examined here is what happens to abstract universals when they are used to describe or define or create a case in the particular. By getting involved in reality is their pure nature sullied to the extent that they no longer qualify as a satisfactory abstract universal? If we accept Socrates' suggestion that the forms are unified and unchanging and therefore contain no contradictions then how can we explain how the forms are actually used to give qualities to objects in the physical world? This process seems to suggest that they would have to be divided up in some way and thus be less than their whole and therefore no longer a perfect abstract model.

This debate is interesting and relevant to IR as it reflects issues on the use of classification schemes and taxonomies. How can a particular information item be definitively catalogued under a particular subject heading and at what point does a changing physical reality or a changing understanding of a physical reality, mean that we should change, radically or otherwise, an existing way of representing and organising knowledge? An interesting example of this problem is Hjorland's (2009, p. 1534, endnote 65) discussion of the controversial role of genetic knowledge in species classification.

So we can see that one problem with the nature of change discussed in Platonic philosophy is its relationship to unity and diversity in so far as, if change and therefore diversity exist, then individual objects must be able to participate in general qualities. The effect, however, that allowing the existence of change has on the nature of abstract universals is seen as problematic for the purity and accuracy of these universals. This is a problem of language and meaning as it

examines how we can describe and talk about the world accurately and also a problem of information in that it is concerned with how we can organise and group our descriptions.

Change and the problem of measurement/knowledge

The third argument used to show that a belief in the existence of change raises more contradictions than the opposing view of unified stability is the argument about how we can accurately perceive or measure change. Initially we may say that we perceive change around us all the time, yet, when we are pressed to say exactly when it happened we can find it hard to give a convincing answer. In the following section Parmenides argues that once one tries to pinpoint the moment of change one is forced to assert a contradiction (that something both does and does not exist at any given point in time) therefore change cannot in fact exist.

> "Par: Exactly when, then, does the change occur? It cannot do so when the subject is at rest, nor when it is in motion, not within any period of time.
>
> Arist: Clearly not.
>
> Par: Very good; there must really be that paradoxical something-or-other in which the subject must be at the actual moment of change.
>
> Arist. What 'something- or- other'?
>
> Par: Why, the instant. The word 'instant' would appear to signify that from which change takes place in either direction, or something of the sort. Change from the state of rest does not occur while the subject remains stationary, nor change from that of motion while the subject continues to move. No, between motion and rest there stands this paradoxical entity, the instant, which marks no period of time whatsoever. Into it and from it the moving or stationary object changes respectively towards rest or motion." (Plato, Parmenides, [156] trans. Warrington. 1961)

In the dialogue Zeno also supports the view that reality is an unchanging unity. He develops Parmenides' arguments through developing a series of paradoxes to logically demonstrate that change is an illusion. Motion, for example, is in fact an illusion and the reason is that accurately measuring a precise moment in motion is seen as impossible. In order to reach a destination one must first reach a half way point. When one reaches that half way point there is yet another one

to reach and this process is logically infinite. This means that, despite appearances, we can never actually get anywhere.

To the modern mind this may seem so far from how we experience reality as not to be of concern. In fact, however, concerns about the reliability of measurement are an important and current issue in quantum physics. In Schrödinger's discussion of the infamous cat both the problem of how measuring something alters it and also the problem of simultaneous 'being' and 'not-being' in terms of the cat being alive and dead simultaneously at one point are discussed. In terms of IR, accurately identifying and measuring the moment when a document changes a knowledge state is very difficult, sometimes even for the user, not even taking into account the other related problems of how we measure or evaluate this in IR system testing.

Conclusions on change in philosophy

In this dialogue the participants grapple with the problem of how to explain the existence of change without succumbing to contradictions. Change seems to imply some kind of process from not-being to being and this allows the existence of negation into being, seen in this dialogue as contradictory to the nature of existence. Can we solve this apparent contradiction by saying that existence is in a perfect unity, the 'One' as Parmenides argues and that therefore change doesn't exist? Can we solve this apparent contradiction by using Plato's arguments that only physical objects change but abstract entities, the forms, which are what actually exists, do not change and thus do not contain contradictions? Thus a particular object may change and contain negations of its qualities etc. but this is not a philosophical problem for existence *per se.* Parmenides attempts to show it is still a problem because of the mechanics of how abstract entities can be distributed amongst physical objects e.g. how could the 'large' be split up without each part of it being smaller than the 'large' and thus again we have contradictions. Zeno links this to the paradox of measuring movement. It appears that movement does exist but how can we possibly identify when and how it exactly happens without becoming mired in paradox? So in this dialogue it is the doctrine of unity without change which seems to be gaining precedence as incorporating change into our understanding of what exists (the problem of existence) , how we can describe what exists (the problem of language) and how we can measure what exists (the problem of knowledge) appear to pose serious problems. My purpose in discussing these

dialogues is not an attempt to show that change doesn't exist but rather to show that incorporating an understanding of change into a philosophical view of existence, language and knowledge will often involve one in apparent contradictions and philosophical difficulties.

In the next section, I proceed to show that discussion on the nature of change and its relationship to existence, language and the nature of knowledge presented in the format of paradoxes leading to complex contradictions is also an appropriate method for understandings its role in IR. This is because IR is concerned with the problem of how can we organise our knowledge (which is itself continually changing and improving) of what exists in a way which maximises the chances of this knowledge informing (or changing) the knowledge of users. I argue that teasing out the contradictions in this process at the most fundamental level provides insights into some of the conflicting requirements that we observe when trying to develop both theoretical models of IR and also design systems.

Change in IR

The contradictions in the concept of change that we see discussed in ancient philosophy are one of the reasons why IR remains such a theoretically and pragmatically intractable problem. As discussed earlier most theories of information and also of IR include some discussion on change. Views on the nature of this change vary depending on the different perspectives on the nature of information. Theories of information that emphasise the objective aspects of information understand change as an imperfection (noise) in the transmission of the same message from sender to receiver (Shannon and Weaver, 1949). The more subjective approach normally sees this change as a shift in the user's knowledge state Brookes (1980). So if change is an essential aspect of our understanding of information is it the aspect of information that makes it an elusive and contradictory phenomenon? Does the change requirement in information raise similar problems to the problems in change as discussed in ancient philosophy? In this section I show how the problem of change as discussed in 'Parmenides' in terms of the problems of existence, participation between generals and particulars, and knowledge and measurement is closely related to similar problem in IR.

Change and the problem of existence

In IR we are normally concerned with the problem of how documents (in the broadest sense) about things (or ideas) that do exist (or did at some point) can be stored and represented in such a way that they can potentially create a change in the knowledge state in a user. Documents and, to a greater or lesser extent all aspects of language, are a bridge or connection between the world and our understanding of the world. Thus we have existence, our immediate perception of it and also a record or description of that perception in documents. Thus IR systems are both a defence against change (the temporary and fragile nature of undocumented knowledge) and also their purpose is to facilitate change in users through access to that knowledge.

How is this related to our earlier discussion on the problem of existence and change? The incorporation of change or otherwise into our understanding of IR raises some interesting issues about the juxtaposition of non-being and being in terms of documents. Does a document exist when it is stored and represented but not read or used (even if it is retrieved) or do we say that is only really exists as information when it has changed the knowledge state of a user? A document can both exist in one sense (be stored in the IR system) and yet also not exist in at least two senses (it may not be found or it may be found but not read or understood). For an interesting discussion on why certain documents of great importance may get lost and neglected for long periods of time see Bawden's (2004) discussion of the failure to recognise the significance for genetics of Mendel's work on pea hybridisation. So in this way the view that our understanding of documents should somehow incorporate their potential to change their reader does bring in some of the contradictions regarding the nature of change and being and not-being. If we jettison this requirement and claim that IR systems simply let the user knows about the existence or otherwise of documents, then to some extent, this problem disappears. If we remain at the level of 'information as thing' i.e. if we don't try and model the change process, we have much less contradictory problem on our hands. Buckland (1991a) does use his model of the multi-faceted nature of information to model the way a document can be one sort of information (thing) but not another (process, knowledge). The intangible and hard to predict qualities of the document (its effects) are generally associated with its relationship with change. This complex relationship between a documents and its potential effects can be seen in the fundamental nature of IR in that IR systems contain objects (or 'information as thing' in Buckland's terminology) and IR users

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are undergoing a process or there is 'something going on' (to borrow Magee's (2000) phrase on Hegel), with the IR user's level of understanding and knowledge. In my view Buckland's (1991, 1991a) characterization of information in this way remains the most useful contribution to understanding the multi-faceted and complex nature of information. The question remains, however, as to how we can best model the relationship between these different aspects. I argue that this relationship is essentially a change process in which very different, yet related things, have to in some way interact to produce an 'informed' user. Buckland acknowledges that it is in the relationships between the different aspects of information systems that theoretical insights are likely to arise.

"Information systems (and their users) form a system of interacting parts. We should expect that the relationship among these parts will constitute a major part of any adequate description or theory of information systems." (Buckland, 1991, p.27)

Exploring the nature of change is an important part of understanding the nature of these relationships. The potential of a document to create change is something within the document that may or may not come into being. Aristotle, working after Plato, used the concepts of actuality and potentiality to show how something could both be and not be in an attempt to show that allowing the existence of change did not lead one into contradictions. Aristotle accepted that change did exist and did much work on analysing how it may actually happen.

"Every potentiality is at one and the same time a potentiality for its opposite; for, while that which is not capable of being present in a subject cannot be present, everything that is capable of being may possibly not be actual. That, then, which is capable of being may either be or not be; the same thing then is capable of being and not being." Chapter 8, [5-15] Aristotle. Metaphysics, book 1X, trans. Ross, 1924. In Ackrill, J.L. ed. (1987)

This is interesting for IR as it provides a model for understanding the ways in which a document can be potentially information and yet, in actuality, it may not be information. This problem of how we can talk about things that don't exist and how things can come to be out of something different from themselves and then perhaps, change again is, I argue, underlying many of the

ongoing dilemmas in IR. This can be seen as a problem of potentiality (the possibility of becoming information) and of actuality (the fact or existence of becoming information).

Change and the problem of participation

Is the problem of participation, or how do particulars 'partake' in their general descriptions, really as complex and contradictory as Plato seems to be claiming in 'Parmenides' and other dialogues? How does allowing the existence of change make this more difficult? In this section I examine what the problem of participation means to IR and how it is related to the problem of change.

In IR participation or allocating how particulars should be described under general/abstract concepts can be understood in at least three ways. Firstly how can we decide on what basis we should group or classify documents under a particular term. What is it about these different documents which is both significant and similar enough to justify grouping them together? Secondly the problem of participation can be understood as the extent to which different users will share similar interpretations (or on a simplified level similar search terms) when they are searching for documents 'about' a particular topic? How can we ensure that this index term will 'work' for the largest number of users who might find this document relevant? Thirdly, with the development of both individually personalised and also shared (through access to the tags of other users) tagging systems there is the problem of participation or continuation through time. How can I be sure that the term that I use to tag this photograph today will still make sense to me in five years time? There is a dilemma here in that a strictly controlled indexing system may not respond well to changing terminology making older documents harder to retrieve. A system, however, which allows unlimited change, may also result in the failure to retrieve documents as there is no external check on the terms that might have been used.

All of these can be interpreted as different approaches to the problem of change. The classification approach attempts to control and limit change by providing a fixed structure, the automated (or derived/post-coordinate) approach responds to changes in the document collection by changing the content and significance of index terms to reflect this. The social tagging approach allows change on a personal level and facilitates differences in individual interpretation. These are attempts, like all of IR, to somehow coordinate the system 'view' of the

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document with the user 'view' to facilitate retrieval of relevant documents. Change is central to this problem. This 'matching' of views both requires some way of limiting change and also of facilitating it. Limiting change , which is emphasised in classification schemes, leads to imperfect links between documents and their classification 'slots'. The alternative approach when the indexing scheme is a reflection of the documents (post-coordinate) allows changes in terminology over time to be reflected in the indexing terms. This can also result in failure to retrieve older documents indexed using discontinued terms and also a loss of an historical record of the previous terminology of a subject. The social tagging approach allows far more change in the representative process both at an individual level (I can choose to change my tags as I wish) and at a social level (the 'relevance' of a page will depend dynamically on how it is tagged by other users).

Blair (1990, 2006) argues that the central problem in IR is enabling the user to make a better judgement of the words an indexer (human or automated) might have used to represent a document which the user would find relevant. This is difficult, according to Blair, because unlike in an oral conversation the documents are removed from the context in which they were created and thus words, rather than features such a place, tone or task, become the only things that can convey the 'meaning' of the document. Is this mismatch between a user choice of word and an indexer choice of words fundamentally a problem of change? It is problem of change in so far as the words in the document are not going to change but an individual user's view of their information need is almost certainly going to change. The group of potential users in the future will also have different viewpoints. It is also a problem of difference (different descriptor words) and sameness (the same document would in fact be relevant but indexer and user are describing it differently). The passage of time would initially appear likely to increase the chances that the user and the indexer will use different terms to describe the same document. Buckland (1991, p.61) observes that within IR "delay and indirectness are liable to exacerbate difficulties caused by problems of definability".

Hjorland (2009, p.35) discusses as one possible solution to this problem the potential role of begriiffgeschicte (conceptual history) which create certain kinds of dictionaries which map how a given word has changed and developed its meaning over time. They thus map and record the

context in which concepts are given their meaning. Measuring this precisely, however, and accurately identifying when change occurred to the extent that this should be noted in descriptors would be challenging.

Thus I argue that the problem of change and participation between general and particulars as discussed in 'Parmenides' is strongly reflected in IR in terms of the problem of representing the meaning of a document. How do we deal with the dilemma that a document is normally a physical object yet its meaning or what it is 'about' it will be interpreted by a user as something that changes over time and also between different individuals? How can this be reflected in an IR system without creating more (or just the same amount but of a different nature) problems than it solves? There remains the problem that it is possible for a document to both be about x in one sense (it contains those terms) and to not be about x in another sense (it will not in fact be relevant to a user). This is generally because the document doesn't change but the user's understanding and situation does. Attempts to solve this, however, by allowing users the facilities to change or personalise their perspective on documents, can raise new dilemmas especially in terms of access to documents over time (Thornley, 2009).

Change and the problem of measurement/knowledge

In the discussion in 'Parmenides' we see the argument that change must be an illusion because, even if it appears to happen, it is impossible to pinpoint or accurately measure exactly when it happens. Is this also a problem for IR and does it raise any contradictions or fundamental conflicts? I argue that this problem of accurately measuring change is a difficulty for IR in terms of how we measure whether documents are relevant.

This is seen in the whole problem in IR of defining and measuring relevance. This is discussed, for example, by Borlund (2003) who argues that we are reaching consensus on these questions by incorporating multi-dimensional and dynamic aspects to our model of relevance. Taylor (2012), more recently, has studied how relevance judgment criteria are linked to cognitive changes during the search process. Thus, increasingly, models of relevance incorporate change (information is seen as a process not just a relationship between a document and query) and other multiple factors and variables. Using these models in the design of large scale design of IR systems may remain problematic but the incorporation of change is seen as an important goal.

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In terms of measuring relevance there is also the problem of whether recent IR developments using context give the appearance of producing relevant results for the user whilst often not retrieving information which is likely to dramatically change knowledge. One could argue that social web and recommender systems with their emphasis on document popularity and the activities of other users (over content) actually just facilitate and encourage 'more of the same'. In terms of an individual user focussing on past and previously popular searches also discourages divergence from established methods of searching. This can also been seen with the increasing use of bibliometric indictors in presenting and organising documents. Many academic journal webpages now alert the reader to the 'most cited' and 'most downloaded' documents. So here the measurement of citations or downloads is used to suggest relevance but is this is a good indicator of how much the document may change the user? Does this actually reduce the extent to which different perspectives are presented to the user in so far as the popular papers are only likely to become more popular as they are retrieved first? This may make for a less challenging, in every sense, IR experience but is it optimal for the growth i.e. change of knowledge?

IR systems, and IS in general, should offer users a selection of documents with competing ideas and/or theories to allow the user to make a choice for themselves. Early discussions on these themes include work by Mitroff (1972) using dialectical theory and also Swanson's (1986) work on developing methods of identifying unknown but useful links between disparate disciplines. Ford (1999) also examined the best way for IR to support original and creative thinking. Recent work on this approach, often known as literature based IR, and the best way to evaluate it has also been done by Cervino-Beresi, Baillie and Ruthven, (2008). These approaches are an almost explicit modelling of the tension between sameness and different within relevance in terms of actually creating and facilitating a change in knowledge. It does seem to be the case that dramatic shifts and changes in knowledge often appear to happen without the steady accumulation of related data that traditional IR systems are to an extent, predicated on, as Bawden (2006) observes in his observations on the scientific development of Einstein. Thus if IR is to optimally increase knowledge it must also examine how it can optimally facilitate change and this seems to require access to divergent and, often seemingly irrelevant, information. Finding ways to predict the ability of a document to change the knowledge of the user is clearly far more complex that just measuring the similarity of a document and query.

Conclusions

I have discussed how Plato's discussion in 'Parmenides' on the nature of change raises some very problematic questions about the nature of change in terms of existence, language and knowledge. I argue that change is central to IR as it is an important part of how we understand information. Thus, if change is problematic, information will be problematic and, if information is problematic then the problem of how we represent it and retrieve it, i.e. information retrieval, will also be problematic. In these conclusions I review how an analysis of change can help explain the intractable nature of some of IR's central problems and finish with some reflections on how insights from ancient philosophy can help IR.

Change and IR theory

Theoretical progress in IR, despite considerable input, has remained mainly fragmented and is not clearly linked to significant improvements in system design. We know that information is a complex and theoretically unclear concept (Buckland, 1991, 1991a; Raber and Budd, 2003). An analysis of how this may relate to change and thus to very difficult issues concerning the relationship between being and non-being can help explain why this maybe the case. Any area of enquiry which concerns itself with change has to articulate how things have the potential to become something that they are not. It would also appear that any problem which concerns itself with change has to somehow divide the problem into different parts. It then has to explain how different qualities and objects interact in ways which are often unclear. If we say change is not part of information we seem to exclude from our understanding of information things that we would normally call information. Alternatively, we can say change is part of information and then we are often struggling to explain how and when this change happens.

Change and information representation

We know that representing the meaning of documents so that they can be found by users who would find them relevant is a complex problem. Can an analysis of change contribute to why this might remain the case? I argue that it is the way in which our understanding of meaning changes that makes this such a difficult problem. Our interpretation of meaning changes over time as one individual and also, on a larger scale, over periods of time and between different

groups of people. IR presents us with documents and even during one IR session our understanding and interpretation of our information need can change. The problem of how to organise documents so that they can best facilitate knowledge change (i.e. new knowledge) also seems to depend on the ability to bring seemingly very different but also related documents together (Swanson, 1986; Cervino-Beresi *et al*, 2008). This is a challenge for IR as relevance normally implies similarity.

Change and IR evaluation

We know that evaluating IR systems in a meaningful and reliable way remains a complex problem (Robertson, 2008; Ellis, 1996) with diverging views in the field of the best approach to take. I argue that this is because we are, in one sense, trying to measure change, and this is what makes it so difficult. How can we pinpoint when someone becomes 'informed' and can we know when they are informed 'enough'? Should we concern ourselves with that or just concentrate on retrieving documents that may or may not inform them but that appear to be relevant? In this case are we trying to predict, in an imperfect manner, potential change?

In Plato's dialogue 'The Meno' (Trans. Syndenham, 1773) as discussed in relation to IR by Cole (1997) and Van Rijsbergen (1993) the problem of how gaining new knowledge seems to imply that we know and recognise what we do not know is discussed. In this dialogue, however, Plato regards this contradiction as so insoluble that he concludes that gaining knowledge through empirical experience, and thus by implication the existence of information, is impossible. Plato thought that knowledge could not change, and thus it cannot rely on the changing and temporal nature of the senses, and he argued that we are born knowing everything. Learning is not a question of gaining new knowledge but of remembering what we already do know. Thus the relationship between what we already know and how we can add to it is clearly difficult and the complex nature of relevance is perhaps a reflection of that.

What can we learn from ancient philosophy?

The existence of IR rests on the assumption that change, certainly in terms of the accumulation of knowledge does exist, and that information from the past is pertinent to the present and the future. Surely this cannot be a thesis that leads to the contradictions that Zeno insists arise when

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one allows that change happens? Change in terms of growth in knowledge does undisputedly seem to exist. At what exact point these changes occur and how is a fascinating and often non-linear process as characterized in Kuhn's seminal 1970 work on the nature of scientific revolutions. A revolution normally implies tensions and contradictions that suddenly become untenable in the face of new evidence forcing a radical shift in our understanding. The discussion we see in 'Parmenides' reflects how difficult it is to fully understand and model this kind of change process. We at least appear to observe it happening and, in IR, we often seem to retrieve relevant documents that we find useful but articulating it within a theoretical framework remains problematic. There is no clear resolution to this but I argue we can learn more about the persistent paradoxes and contradictions we see in IR by examining how these conflicts have been discussed in ancient philosophy. The technological and scientific framework is clearly completely different but the central philosophical problem of how we interact with the world through language and knowledge remains very similar. We can, therefore, usefully study philosophical work on the contradictions inherent in change as a way of increasing our understanding of the contradictions and tensions involved in storing, representing and retrieving information for the purpose of changing knowledge.

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