Leadership in everyday practice: 
Pair programming and computational objects

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Abstract
This paper explores leadership practices (LPs) as everyday material-discursive practice and in particular, their enactments through computational objects (COs). This anthropologically-grounded study explores this phenomenon through what some might consider an unlikely empirical setting: a dyad with no leaders. I argue however, that this provides an ideal location to critically interrogate the construct ‘leadership’, for the empirical evidence provides a compelling account of how leadership is enacted through material-discursive practice even when no formal ‘leader’ is present. The study has been conducted through a practice-based approach in the US and the UK. It also analytically mobilises interviews and site-specific electronic databases. Theoretically, the study builds on the work of Grint and Kempster et al. to develop a multidimensional framework of leadership through which the phenomenon can be recognised empirically. By combining this with Barad’s agential realism (AR) and in particular, its central concept of material-discursive practice, I demonstrate not only how LPs are materially enacted but also symbolically attributed processually and performatively by members. My principal argument is that the concept ‘leadership’ functions as a symbolic resource or repository for values. That is, it points to an underlying process of human categorisation of value and worth. In this fashion, I demonstrate that leadership shows up in the smallest possible groups and within the most mundane human interactions. Furthermore, I show that it is increasingly enacted through COs where the COs themselves can also act as leaders, with humans responding accordingly.

1 Introduction

Globalised organisations are characterised by interactions between people and computational technology that are foundational to their existence and outputs (Avolio, Sosik et al. 2014; Faulkner, Lawson and Runde 2010; Suarez-Villa 2012). With respect to these phenomena, my doctoral dissertation
addresses a critical gap in the leadership literature: the relationship between COs and LPs in organisations (Kahai 2012; Lowe and Gardner 2001; Zammuto et al. 2007). The research explores this gap in terms of the presence and deployment of COs, their projections, and enacted material-discursive practice understood as ‘leadership’.

This year’s ISLC call for papers asks scholars to undertake more qualitative and ethnographic studies and for empirical focus to be directed toward often overlooked organisational and cultural contexts. This paper directly addresses both of these points.

Regarding the first point, scholars have long argued that research be undertaken exploring leadership by engaging a qualitative approach (Avolio, Kahai and Dodge 2000, p. 661; Conger 1998; Gronn 2002, pp. 444-445). Here, Van Maanen observes, ethnographic ‘fieldwork is one answer — some say the best — to the question of how the understanding of others, close or distant, is achieved’ (1988, p. 2). Along these lines, Endrissat and von Arx have recently entered this territory and begun to map leadership in terms of enacted practice as observed in situ (2013).

Following from this work, I draw on practice theory (Nicolini 2012; Reckwitz 2002; Schatzki 2002), thereby taking practice as the central empirical focus of study. I also make use of Nicolini’s toolkit approach (2012, p. 213) to assemble methods based on the contextual requirements of the research. As part of this toolkit, the study made extensive use of shadowing and observation (Czarniawska 2007; Nicolini 2012) and is further supported by interviews (Alvesson 2011; Charmaz 2003). Analytically, I employ Barad’s material-discursive practice (2007, p. 178), a central concept that comes out of her work on agential realism (AR). AR is an ontology that holds both meaning and matter as inseparable and performative. AR thereby posits that observable phenomena, such as LPs, are productions arising out of the ‘intra-actions’ (ibid., pp. 139-140) of such material-discursive arrangements. It therefore points analysts to focus on particular phenomena arising out of specific material-discursive practices and holds that these phenomena are ontologically primary. Thus, in the case of intra-actions between material objects such as humans and COs, particular phenomena may arise that can be interpreted as LP.

With respect to the second point, directing the research focus toward often overlooked organisational and cultural contexts, the relationship between COs and LPs remains a largely unexplored territory (Kahai 2012; Zammuto et al. 2007). Lowe and Gardner, in their review of the leadership literature, assert that ‘we need to know more about the interaction of leadership and technology’ (2001, p. 501). However, in order to heed their call, I must also confront the essentially contested status (Gallie 1956) associated with leadership.

I have in this research adopted well-established human-computer interaction (HCI) and information systems (IS) perspectives asserting a co-constitutive relationship between technology and practice (Orlikowski 2000; Suchman 1987). I view such perspectives as being encompassed by AR. The objective in adopting this theoretical position is to produce a rich understanding of everyday LPs and the roles COs play in their enactments.

In this study, I employ the specialised term computational object to foreground the physical interfaces through which humans interact with broader computational systems and their manifestations. I employ this term, arguing that COs are phenomenologically distinctive; through them humans ex-

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1This is a position in many ways analogous to ethnomethodology where conversation is said to produce social order (Garfinkel 1986, pp. vi-vii). A difference is that AR includes a much broader set of material-discursive practice as constitutive of such orders, in addition to binding it with a materiality that both precedes and results from it. In this sense, ethnomethodology can be viewed as a subset of the thesis that AR puts forward.

2For reviews detailing the competing paradigms within the study of leadership, see Alvesson and Spicer 2011, 2012; Grint 2010, 2011; Ospina and Uhl-Bien 2012; Palmer and Hardy 2000, pp. 228-258; Van Seters and Field 1990.
perience and extend distributed computational platforms via material-discursive practice. As a site of material-discursive practice, they may be found in the form of a personal computer, a smart phone, tablet, or embedded within other objects.3

2 Pair programming

In this paper, I explore pair programming as a site for LP. At first glance, focusing on a material-discursive practice called pair programming (Beck 1999; Williams 2001; Williams and Kessler 2003) might seem a rather odd perspective from which to explore leadership, for within this human dyad there are no formal leaders. Yet it provides an ideal location to critically interrogate the construct ‘leadership’ (Alvesson and Spicer 2012), for as I will demonstrate, it provides a compelling account of how leadership is enacted through material-discursive practice even in cases where there is no official ‘leader’, a position that harkens back to Bion (1946) and the more recent emergence of the Tavistock school to which little attention has been given.

This empirical focus provides a rather illuminating perspective on leadership — leadership in a human dyad enacted through COs. While this may not be a traditional ‘place’ to locate leadership, it nonetheless builds the foundation for one of the principal arguments I wish to put forward in this work: the claim that leadership shows up in the smallest possible groups and within the most mundane human interactions and, furthermore, that leadership is increasingly enacted through COs. In this fashion, the empirical data serves to support the claim that once leadership is viewed through its relation to COs, what ‘leadership’ is changes dramatically. Indeed, as I will adduce, sometimes these pairs of humans who program together are not even physically in the same location, further reinforcing the role of the CO in constituting their material-discursive practice. Thus, studying pair programming will allow me to show leadership in material-discursive practice, distributed through both people and COs — and to then show how leadership is symbolically attributed post hoc by members.

3 Theoretical perspective: Leadership

In terms of a theoretical position on leadership, by building on the work of Grint (2005a, p. 18) and Kempster et al. (2011), I combine and extend their models of leadership.

Grint’s model addresses the contested terrain of leadership by contending that consensus on a definition is both ‘forlorn and unnecessary’ (2005a, p. 1). As such, he offers a fourfold typology as a starting point to capture different ways of identifying and understanding leadership. For Grint, this pluralistic device maps extant theories of leadership. Crucially, it also frames the questions researchers

3COs are distinctive from other forms of technology, such as airplanes or toasters, yet share a material and embodied aspect through which humans interact with them (Dourish 2001). They signal Turkle’s ‘evocative object’ as ‘a companion in life experience’ (2007, p. 5), acting as a critical site for human relationship (1984 / Turkle 2005). Nicolini et al. observe a similar quality in objects that ‘acquire a deep emotional holding power...[and an] intimate attachment that creates social bonds...and sense of belonging’ (2011, p. 614). The term is also derived from Hayles’ ‘computational universe’, which functions as a link to materiality in its ‘claim for computation as ontology...the means by which reality is continually produced and reproduced on atomic, molecular, and macro levels’ (2005, p. 3). The existence of such objects and the material-discursive practices humans undertake — with and through them — signals a critical transformation beyond the liberal human subject that has held sway since the enlightenment; what Hayles calls posthumanism (1999, pp. 283-291). In sum, the label ‘computational object’ is a trope that simultaneously signals my emphasis on materiality, relationality, and a posthuman perspective that moves away from human exceptionalism.
ask, positioning them in relation to a legitimate object of research which he asserts to be one or more of person, result, position, or process (2005a, p. 18).

In response to Grint’s proposed typology, Kempster et al. (2011) offer an additional dimension: purpose. According to them:

Purpose only appears to come to the fore in situations in which leaders have set goals that project their groups to either ethical and [sic] moral debates. The widely celebrated and vilified examples of Gandhi and Hitler spring most readily to mind. We argue that the lack of explicit orientation towards the manifestation of purpose is not an oversight. (ibid., p. 318)

Thus for Kempster et al., purpose not only carries an explicit ethical substrate; perhaps more importantly, they also claim that the dimension of purpose has been systematically ignored within the leadership literature.

![Figure 1](image.png)

**Figure 1:** An extended five-fold typology through which leadership can be identified and understood. (adapted from Grint 2005a, p. 18; Kempster, Jackson and Conroy 2011)

Together, what Grint and Kempster et al. suggest is that leadership can be recognised in these five ways: person, result, position, process, and purpose. This typology is rendered below as figure 1. I employ this theoretical typology as part of my analytical toolkit (Nicolini 2012, p. 213) to explore dimensions of leadership empirically observed in material-discursive practice.

My theoretical perspective also extends the work of Grint and Kempster et al. by taking leadership as an ex post facto attribution. I argue that leadership, rather than an observable phenomena per se, is instead a signifier ascribed both processually and performatively through material-discursive practice. For these reasons, this is a theoretical perspective that necessarily views leadership-as-practice (Carroll, Levy and Richmond 2008; Crevani, Lindgren and Packendorff 2010; Raelin 2011). In my extension to Grint and Kempster et al.’s work, the thesis I wish to take forward in this paper is that material-discursive practices are understood as leadership precisely because they are attributed as such. In this sense, building on Grint and Woolgar’s sceptical constructivism (1997, p. 143), what the study explores are possible versions of ‘leadership’, some of which are recognised by members and some
of which may go unrecognised. The question then, of why some material-discursive practices and not others are viewed as such is explored.

I argue that leadership, following Ailon and Kunda, acts as a ‘symbolic resource’ (2003) standing for particular values within the context of a community such as an organisation. Thus, I argue that leadership always stands for something else for which the word ‘leadership’ is a proxy or container. I insist that leadership points to an underlying process of categorisation (Bowker and Star 1999) of value and worth (Boltanski and Thévenot 2006). This underlying and hidden network of attribution is precisely what a practice-based approach helps to make visible (Nicolini 2012; Reckwitz 2002; Szymanski and Whalen 2011a).

4 Methods

This paper mobilises data from my doctoral study (Friedland forthcoming). The research was conducted as an anthropologically-informed work practice study (Szymanski and Whalen 2011b). The bulk of the empirical data was collected through observational fieldwork across a number of companies with offices in the US and UK over the period 2012-2013. Data collection was based to a large extent on the shadowing (Czarniawska 2007) of formal leaders in situ, an active situational focus (Alvesson 1996, pp. 201-206), and the Latourian tracing of networks of people and objects as ‘circulating reference’ (1999, p. 24).

This was accomplished in practice by first shadowing formal leaders and then shadowing the people they met/worked with, ensuring also to spend time with the informants at points where they worked with their COs. The research is further enriched by extensive interviews (Alvesson 2011; Silverman 2011) as well as a variety of virtual methods (Boellstorff et al. 2012) which help to reveal data not so readily available through traditional ethnographic approaches (Barley and Kunda 2001, p. 85). Thus, I have augmented the data through the collection of internal company databases, external social network activities, and a range of other electronic logs (Boellstorff et al. 2012, p. 36). These enable a diffractive understanding (Barad 2007, pp. 86-94; Nicolini and Roe 2014), that is, an understanding of differences that make a difference, between the observed interactions and discursive elements at play.

To identify sites, I first undertook a set of interviews aimed at developing sensitising concepts, providing a ‘general sense of reference and guidelines in approaching empirical instances’ (Blumer 1954, p. 7). I was able to identify and conduct a series of such sensitising interviews with senior executives, ranging from senior vice-presidents to C-level executives across a wide range of global organisations. A total of 33 of these sensitising interviews were conducted across 20 different companies. Some of these informants spontaneously expressed deeper interest in the research during this process.

4Latour uses this term to refer to the way in which objects and meanings are manipulated through what he calls transformations. Through such activities, actors construct meanings through chains of transformations. As transformations progress, what is local, particular, and material becomes compatible and standardised reference that can be more easily amplified. Latour’s example of this follows (among other things) a leaf in the Brazilian savannah that is ultimately transformed, through a multitude of activities into a data point in a report. This report can then be circulated by post, fax, or email. The report (which is itself a reference) and the references contained therein are thus said to be circulated. Circulating reference, according to Latour, is one of the ways knowledge is produced, and is a ‘trade-off between what is gained (amplification) and what is lost (reduction) at each information-producing step’ (1999, p. 71). By revealing the various stages that the leaf goes through to achieve this reified state, Latour exposes a hidden aspect of scientific practice whereby ‘successive stages link us to an aligned, transformed, constructed world’ (ibid., p. 79). My reading is that the transformations of objects and meanings Latour writes of and which underpin this perspective are compatible with Barad’s construct of material-discursive practice, the linchpin within AR where meanings and matter are perpetually reconfigured (2007, pp. 148-149).
Through this dynamic, site candidates self-selected. Access, then, was produced in part through a focus on developing productive relationships with others (Daniel-Echols 2004, pp. 106-109).

At this early stage, my thinking had been that given my background in computer science (CS) and with internet & technology companies, while I presumed such organisations would be potentially useful sites, I had been leaning toward observation in sites that were not in an area I already held familiarity. However, once I began reviewing and analysing the data from the sensitising interviews, a pattern emerged that changed my mind.

In particular, I found a consistent pattern in the narratives of the sensitising interviews around material differences in LPs between organisations describing high levels of technological engagement compared to organisations describing a more moderate level of technological engagement. This pattern split such that the leaders at internet & technology companies fell more into the ‘higher engagement’ camp while the non-technology companies more often fell into lower levels of engagement, or even actively resistant.

The companies with narratives of lower engagement and higher resistance often conveyed this in stories of (often compounded) errors in data leading to a mistrust of the computational systems (Interview 1002, 23 Jan 2013; Interview 1005, 26 Mar 2012) or the position that ‘our systems don’t talk to each other’ (Interview 1002, 23 Jan 2013).

In contrast, many of the technology companies conveyed quite a different set of narratives, about technology being positively ‘embedded’ in their daily experience (Interview 1012, 17 May 2012), about a willingness to try new things with computational systems (Interview 1009, 06 Apr 2012) and perhaps, most importantly, an ability to competently enact evolutionary changes to computational systems as learning occurred (Interview 1004, 28 Mar 2012). Based on this pattern, I took the decision to focus observations more toward the internet & technology companies as a likely location for the innovation of novel LPs enacted through COs. I suggest here that such an approach represents an extension to Alvesson’s situational focus (1996, pp. 201-206) by selecting such focus prior to formal fieldwork.

Observations generally carried on for a full working day and repeated as long as the person being shadowed was open to it and I was available in that location. Writing up the field notes for a one-day observation normally took me about two days, so one observation generally took a total of three days. I could in this fashion conduct about two observations per week. I was subsequently granted observational access to three internet & technology companies, all of which had locations in the US and in the UK. In total, I undertook 39 observations at these three companies in three different cities over a two year period.

The empirical data generated from the fieldwork was analysed to highlight the relationships between LPs and observed outcomes, noting also where and how COs played significant roles. The aim in such an approach is to delineate a territory not well understood (Kahai 2012, p. 102; Eisenhardt 1989, p. 532).

The methodology employed for coding empirical material was Miles and Huberman’s pattern-coding, an approach that ‘pull[s] together a lot of material into more meaningful and parsimonious units of analysis’ (1994, p. 69). Further, drawing on their contact summary form (ibid., p. 54), interviews were also tagged with pertinent metadata in order to further facilitate selective analysis downstream.

Analysis proceeded informed by Alvesson and Kärreman’s writings on creative theory develop-

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5 This self-selection also represents a limitation of the study, as organisations that did not open themselves to this research were not explored.
ment which they contend goes beyond mere critical questioning — by establishing a platform from which to offer solutions that contribute to knowledge (2011, p. 1278). Specifically, they posit that ‘empirical material may be mobilized as a critical dialogue partner — not a judge or a mirror — that problematizes a significant form of understanding, thus encouraging problematization and theoretical insights’ (ibid., p. 1266). This is the approach I have tried to take in my own analysis of the empirical material.

As a means to establish greater validity (Sanjek 1990; Silverman 2011, pp. 367-383; Peräkylä 2004) to the interpretations I made, I closely followed the principle of respondent validation (Silverman 2011, pp. 371-372), regularly sending copies of written up field notes to informants for their review and feedback. Further, I presented draft papers to the informants to ask them for their feedback on what I had written as a final research product and presented findings to the companies that allowed me access. This ongoing conversation with the informants has proven to be a valuable source of additional insight to the interpretations I present here.

Finally, as an ethnography, the study carries the responsibilities and limitations of employing the researcher as an instrument (Atkinson and Hammersley 2007, p. 17) who, like all humans, can only ‘see the world through the forms we construct to grasp it’ (Taylor 1989, p. 472).

4.1 About ‘Eta’

Eta is the pseudonym for a global provider of agile software development and software infrastructure. The company maintains offices in both the US and UK. They hold an esteemed market position based on a number of successful engagements with high-profile technology companies. All of these engagements feature as a central practice, pair programming, said to result in rapid, high-quality, sustainable, iterative software development capabilities.

My research with Eta commenced in May 2012. My first phase of observations were at its UK office from November 2012–January 2013. I returned for a second round July–September 2013. I observed in US office locations from March–June 2013. A second round of observation was conducted in the US from October–December 2013. Thus, the total duration for study with Eta extended over a 1½ year period.

5 Findings: Pair programming at Eta

At Eta, I observed pair programming at three physical locations within their organisation. While there were certain similarities in structure at each location around how pair programming was constituted, a key distinction observed was that in some cases the pairs were physically proximal while in others they were remote. The latter remote pair programming contexts also involved additional COs to enable the material-discursive practice.

I present below two episodes that explicate how LPs are enacted within pair programming. The first concerns ways in which various aspects of leadership are visible in the material-discursive practice of the pair and the COs through which they interact. The second depicts a more radical case where LP is initiated by a CO, which serves to support my claim that COs are both integral to modern day LP, but in a literal and material sense, often constitutive of it.

5.1 Episode one: ‘Driving’ and other forms of leadership

I begin with an (approximate) 45 minute time slice of the remote pair Walt and Robert:
At 10:28AM, Robert asks ‘where did we leave it yesterday? There was stuff in the user interface (UI) we wanted to clean up.’ Walt is looking at code and suggests they start breaking down, or refactoring⁶ the existing code.

Robert [the remote pair] is just watching the screen in front of him and not looking at the camera at all, not saying a word. He is especially quiet and withheld compared to the way I saw him last time. Meanwhile, as Walt types, he is talking about the code and what he thinks. This goes on for some time and finally Walt asks Robert what he thinks. Robert responds, but it’s almost inaudible and sounds like mumbling.

Walt now realises he is not sharing his screen, an omission that, surprisingly, Robert has said nothing about. Walt asks for a short break and goes to get some coffee and Robert goes to get water while their build/test tool kicks off a local build and test of the code base. The build/test tool passes 15 tests with 0 failures.

Walt looks at the difference between the previous block of code that was committed to the source control system and the current working copy. Robert is cradling his chin in his palm looking intently at the screen in front of him. Walt says he wants to commit the code to the source control system. Robert is visibly unresponsive. Walt types in a comment for the pending check-in and checks the code in.

They move on to the next task and Walt offers Robert keyboard control. Robert accepts this silently. As Robert types, Walt offers commentary about limitations of the approach Robert is taking but suggests that they continue and see if it ‘feels right’.

Robert runs the build/test tool and a number of errors show up. There are now a total of 17 tests and 7 test failures. Walt suggests a logical modification: he tells Robert that an expression can be condensed from several lines into one. In response, Robert says ‘yeah, that would be good’.

At 10:51, the build/test tool reports 18 tests runs and 8 failures. Robert is writing a class.⁷ Walt suggests to Robert that he adds stubs, or boilerplate code so that the tests will pass. Robert seems a little more interested now.

At 11:07AM they are writing the unit tests first and watching them fail, and then Robert is iteratively writing the (stub) code to enable these to pass (field diary (FD) 1030 26 March 2013).

5.2 Analysis: Episode one

I’d like to first call attention to the materiality of Walt’s impressive arrangement of COs that both enabled and constituted remote pair programming, where a number of important features are discernible. These are depicted in figure 2 on page 9.

Figure 2 depicts a plethora of COs that have been assembled by and in in relation to Walt specifically to facilitate remote pair programming. These are enumerated in table 1 on page 10 and document

⁶Refactoring is a software engineering practice to satisfy the dual constraints required by production software to satisfy increasing requirements concurrent with the need for reusability (Gamma et al. 1995, p. 391). These constraints provoke a tension that can result in code that is difficult to read or poorly organised, sometimes called ‘spaghetti code’ (Boehm 2006, p. 13). Refactoring is thus a means whereby the goals that each of these constraints impose are achieved by restructuring the code so that it is considered more readable whilst simultaneously maintaining its behaviour (Opdyke 1992, p. iii).

⁷Within object-oriented languages, classes are the templates/recipes for ‘objects’ that will be instantiated into memory when the code is executed. See Goldberg and Robson 1983, p. 40 for further discussion.
Based on his statements to me and various blog posts he pointed me to which he authored, Walt seemed to take great pride in his work on the development of this sociotechnical frontier. It is through this arrangement of what Latour refers to as the ‘assemblage of human and non-human elements’ (1999, p. 159) or what Barad calls ‘material-discursive practice’ (2007, p. 178) that the phenomenon of remote pair programming — and any attendant leadership that might be observable in it — is actually produced.

Within the episode, evidence of LP is present in a variety of forms throughout the interaction between Walt and Robert. It begins with Walt offering direction (Van Velsor and O’Connor 2007, p. 32; Uhl-Bien et al. 2014, p. 90), suggesting to Robert that they take the approach of refactoring and Robert’s tacit acceptance of this suggestion, aligning with the leadership dimension of process as depicted in figure 1 on page 4.

There is also an interesting dynamic that unfolds between Walt and Robert where Robert is withdrawn and uncommunicative, as evidenced by his not looking at the camera, his mumbling when asked what he thinks, and his failure to mention that the screen is not being shared between them. It is not until Walt realises he has not shared his screen that this fact materialises. Consequently, until that point, Robert has not been able to see what Walt has been doing and instead was only able to hear it by virtue of Walt’s talking. It is Walt, not Robert, who responds to this detail of the state of the material-discursive practice.

Thus, to borrow Larsson and Lundholm’s terminology, Robert is exhibiting a ‘resistance to closure’ (2010, p. 1102), however, in my use of this term, I extend it to include interactions that go beyond...
<table>
<thead>
<tr>
<th>Computational Object</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop computer</td>
<td>The desktop computer is centrally positioned and acts as the primary locus of human attention (Guimbretière 2002, pp. 15-19, 2003, p. 53). It is where programming activities are projected and in general, it is the rendering of this screen that is shared/mirrored with the remote party in the other location, fundamentally constituting pair programming.</td>
</tr>
<tr>
<td>iPad™</td>
<td>The iPad™ is used primarily for FaceTime™ and Google Hangouts™ to virtually connect the remote pair. It is positioned to the left at about 11:00 and at eye level to facilitate ergonomic viewing. It is also mounted on an articulating arm so that it can be easily adjusted in situ.</td>
</tr>
<tr>
<td>Speakers</td>
<td>Centrally positioned speakers are plugged into the iPad™ and therefore place the audio of the remote pair spatially inline with the desktop computer.</td>
</tr>
<tr>
<td>Unidirectional microphone</td>
<td>A tripod-based unidirectional microphone is placed to the right of the speakers and is plugged into the iPad™ so that Walt can move freely within the workspace and be heard by the remote party in the other location.</td>
</tr>
<tr>
<td>Laptop computer</td>
<td>A laptop computer is positioned to the right of the desktop computer. This CO is generally not shared with the remote pair and provides Walt with a ‘private’ computational space.</td>
</tr>
<tr>
<td>iPhone™</td>
<td>While not in the photograph, another part of Walt’s array of COs is an iPhone™ which he used to send and receive various kinds of messages while involved in the pair programming activity. For example, these can be signals to the other party either before or after a pairing session to coordinate specific details, such as communication channel.</td>
</tr>
</tbody>
</table>

Table 1: Array of COs employed by Walt for remote pair programming.

talk. Specifically, I also include actions relating to COs such as initiating builds, and the dyadic typing, mousing, and watching of CO screens that naturally occurs as part of pair programming. I argue, therefore, that Robert resists closure in the material-discursive practice of pair programming through his various forms of nonverbal communication and/or inactivity.

Corresponding to Larsson and Lundholm’s argument that one of the functions of leadership is to overcome such resistance (2013, p. 1022), the preceding episode shows the dynamic of resistance going on for some time until just before 10:50AM when Walt offers Robert control of the keyboard. This, in turn, appears to engage Robert at a higher level in that he demonstrates the active typing of code, the initiation of builds, and the utterance of fully articulated words. As with Larsson and Lundholm’s study, through ‘repeated affirmative responses...agreement is gradually developed and the persuasion thus accomplished’ (ibid.).

The ‘persuasion’ here is to convince Robert to participate more fully in the material-discursive practice of pair programming. This is evident in Walt’s various offers and support to Robert. Accordingly, I characterise the approach that Walt took here as ‘empowering leadership’ (Zhang and Bartol 2010, p. 117). This is a mode of leadership that aligns with the dimensions of purpose and person as depicted in figure 1 on page 4, as it was evidently Walt’s aim to engage Robert in pair programming and the means by which he did so were through the capabilities of his personality — as mediated through the COs.

As a further point of analysis, within the human pair programming dyad there are particular constraints that derive from a given relationship with COs, one of which is that only one person can type at a time. In practice, this generally means one person holds the keyboard and ‘drives’, as it is commonly called by the practitioners I observed. In this sense, it bears a close resemblance to conversational turn-taking (Sacks, Schegloff and Jefferson 1978). The person ‘driving’ is the person actively
writing the code. In the instances of material-discursive practice I observed, this mostly took the form of the ‘driver’ talking out loud about what they were typing as they typed it. One way LP is visible here is through the articulation of what the driver’s thinking or rationale is regarding what they were typing. In other words, by simply thinking/talking out loud about how they planned to solve a particular software engineering problem, they were also engaging in the articulation of a vision or strategy toward some specific business goal (Guastello 2007; Montgomery 2012; O’Reilly et al. 2010). This interpretation of the data corresponds to the leadership dimensions of position (in terms of control) and process (in terms of strategy) as depicted in figure 1 on page 4.

Thus, at 10:50AM, Walt takes over ‘driving’ without any discussion — Walt simply starts typing in what might be thought of as an ‘open space’ where Robert was not, analogous to jumping in at a conversational turn (Sacks, Schegloff and Jefferson 1978). This is a phenomenon I observed quite often across many pairs. This phenomenon has also been closely observed in terms of the negotiation of authority in Linde’s research on helicopter flight crews (1988), however, I extend her argument to make the claim that such negotiation also constitutes acts of leadership along the dimension of position as depicted in figure 1 on page 4. Indeed, within the leadership literature, this kind of negotiation of control (Alvesson and Spicer 2012; Barker 1993; Collinson 2005; Hales 1986) is closely associated with its extant meanings.

I make this claim because a result of passing control of the keyboard is that the role each member plays changes. According to Beck (1999, p. 58), the ‘driver’ talks out loud, making audible their thinking process whilst writing code whereas the ‘observer’ offers strategic feedback, which, as noted above, can be interpreted as a LP along the dimensions of position and process as depicted in figure 1 on page 4.

Moreover, the kinds of practices identifiable in this role of the ‘observer’, according to Hernandez et al., involve ‘strategic choices…[which are the] behavioural processes by which strategic leadership influences organizational outcomes’ where such leaders ‘can guide interactions among other organizational members and channel knowledge’ (2011, p. 1179). Such an approach is prefaced on the leadership dimension of result as depicted in figure 1 on page 4.

Thus, the passing of keyboard control, I argue, constitutes a LP within the material-discursive practice of pair programming across a number of leadership dimensions as depicted in figure 1 on page 4. First, when one party spontaneously ‘takes over’, they enact through their personality and with a specific purpose a change in process. Second, in so doing, the material-discursive practice is dynamically restructured such that the roles are reversed and the person formerly ‘driving’ is now placed in a role where they are to offer leadership in the form of strategic guidance. In this fashion, I argue that there are specific LPs that can be identified with each role. This shared form of leadership provides evidence for leadership in the plural (Denis, Langley and Sergi 2012).

Yet within the dyad described in the episode above, I rarely observed Robert playing the role of observer as a strategic guide. Instead, what was more readily observed was Walt playing both of these roles in ways that were more closely identifiable to Beck’s description. Thus, when Walt offers commentary at close to 10:50AM about the limitations of the approach Robert is taking he injects an alternative perspective in line with Beck’s vision of pair programming (1999, p. 58). And again, around 10:53AM, Walt advises Robert while he is writing code that he might want to approach the writing in a particular fashion, providing strategic direction (O’Reilly et al. 2010). In these interactions, while the roles shift dynamically, we see how particular roles are played that align with the dimension of position as depicted in figure 1 on page 4.

In the duration of this interaction, we see an increasingly fluid dynamic between the pair where control passes freely between the two of them and where tests are being consistently written and run.
as part of the material-discursive practice of pair programming. This kind of interaction was typical of the instances of pair programming I observed, although it is also clear that in this remote pairing context, the COs play a constitutive role in enacting the material-discursive practice. Thus, in addition to providing the context of a shared programming environment, which is also the case in face-to-face pairing, in remote pairing the COs play an additional constitutive role by providing the communicative link between the pair.

In conclusion, I argue here that within the short space of 45 minutes, the empirics provide a basis for interpretations of material-discursive practice that align with established behaviours in the leadership literature as well as logically mapping to all five dimensions of leadership as depicted in figure 1 on page 4. This is not to say that these material-discursive practice are LPs; rather, my argument is that such mappings may be one of the underlying mechanisms that allow for members to attribute leadership to such material-discursive practices.

Verily, within Eta, evidence of such attributions are present. For example, in analysing an internal electronic discussion board that is mediated by and accessed through COs, a number of statements are made by both employees and senior leaders ascribing leadership to the material-discursive practice of pair programming. For example, one employee asserts with respect to a client engagement that the practice of pair programming clearly led to a change in both engineering leadership and process. (Eta Internal Discussion Database)

Here, the employee links leadership on the part of engineers as a management function resulting in effective changes to business process, aligning this attribution through the dimension of position and process as depicted in figure 1 on page 4.

The founder of the company as well, offers similar remarks, linking the desired outcomes (results) of pair programming with the dimensions of purpose and process as depicted in figure 1 on page 4. He writes that

The key to sticking with a process — or perhaps a better way to express it would be to continue to *care* about process, since it doesn’t really matter if it maps exactly to what we do — is support at the executive level. (Eta Internal Discussion Database)

The founder makes an explicit link between producing results through a process, in this case, pair programming, through ‘caring’, or purpose, all of which he claims is underpinned by people who hold certain leadership positions within the organisation, in this case, executives. Further, the statement exemplifies what is viewed as important or valued at Eta.

Moreover, during interviews, many of the senior executives at Eta asserted their explicit attributions that pair programming is a central and crucial LP within the organisation. For example, the Chief Operating Officer (COO) of Eta explains that programmers who ‘pair’ together

are actually doing a leadership practice because they’re having discussion [and making decisions] about what lines of code to allocate as resources. (Interview 1013, May 10, 2013)

Here, the COO implicitly invokes Useem’s argument that leadership is present in decision-making through a ‘discrete, tangible, and realistic opportunity to commit enterprise resources to one course or another on behalf of the firm’s objectives’ (2010, p. 510). His attribution is further prefaced on
producing results that require decision-making positions, and implies a particular process as depicted in figure 1 on page 4.

Thus, within these attributions, all five dimensions of leadership as depicted in figure 1 on page 4 are present. Therefore, the thesis I want to take forward is that leadership is not simply understood in certain ways as Grint and Kempster et al. argue, but that it is understood as leadership precisely because it is attributed as such. Thus, upon interrogation, leadership always stands for something else, some value or values within the active social system, for which the word ‘leadership’ is shorthand. From this perspective then, two programmers working together as a pair through one or more COs, making decisions about each line of code that gets committed as a software asset to a larger enterprise system qualifies — at least at Eta — as an enactment of leadership.

In sum, I argue that the practice of pair programming is a central feature of Eta’s ideology (Kunda 1986, p. 54), is highly valued within the organisation, and through these various mechanisms is recognised and attributed as ‘leadership’.

Thus, I claim, not only embedded within the material-discursive practice between Walt, Robert, and their COs, but reflected within the broader sphere of Eta itself there is evidence of an association between specific material-discursive practices and their relation to what is valued within the organisation and attributed as forms of ‘leadership’. I therefore suggest, based on such evidence, that leadership acts as a symbolic resource (Ailon-Souday and Kunda 2003) or repository for values. That is, it points to an underlying process of human categorisation (Bowker and Star 1999) of value and worth (Boltanski and Thévenot 2006; Mailhot et al. 2014).

5.3 Episode two: When machines lead

In the next episode, I explore a different location within Eta: an office in the UK. In this setting, as opposed to the previous episode, all of the pairs are physically together, as depicted in figure 3 below:

Figure 3: Pairs situated at a worktable at an Eta European office.
In this figure, we see several groups of pairs together at a single table. This configuration was far more common at Eta than the remote pair programming presented in the first episode.

Looking closely at figure 3, there are four pairs working simultaneously on a single software project, with each pair working on different tasks for the project as delineated in a work item tracking system (WITS). Each pair, as part of their pair programming practice, selects a pending work item from the system they wish to undertake. This approach reflects an imported material-discursive practice from lean manufacturing called Kanban, where workers select from available tasks based on their predilections (M. Poppendieck and T. Poppendieck 2003, pp. 72-76).

Also, within figure 3, prominently placed in the middle of the frame is a focal CO (Guimbretière 2002, pp. 15-19, 2003, p. 53). This is in the form of a large monitor, sometimes referred to as a build monitor or information radiator based on its role to disseminate vital project information to the team on an ongoing basis (Elssamadisy 2008, pp. 157-160). As I will show, this particular CO plays a role of leader in a number of ways, both in terms of the manner in which it directs the pairs, and in their responses to it.

In this episode, I focus on the pair consisting of Paul and Etienne, who are depicted sitting in the bottom left of figure 3, closest to the viewer:

15:01 - I focus now on what I see on the screen directly in front of me and begin to listen more closely to Etienne and Paul. They are building a content management system and right now I see the login screen for the system they are building. There seems to be an error.

While Etienne is tracing the error, an instant message (IM) comes in from a colleague not physically at this site. The colleague has asked Etienne a question about deployment; Etienne answers it and then returns to the tracing/debugging.

16:33 - They begin work on the next work item. This one involves setting the system up for internationalisation. They first try to remember where to look in the file hierarchy of code for the files they need.

As they are getting their heads around the files they need to work with, Paul looks up and says ‘Uh Oh’. Etienne looks up and says ‘No!’ Someone else in the room makes an artificial sound analogous to the ‘wrong answer’ sound one might hear on a game show. Someone laughs. The office director says, with a slightly joking tone in his voice ‘everybody stop’, taking the role of a mock policeman who has caught some criminals in the act.

Paul says, ‘I just happened to be looking there and it flipped red.’ He is referring to the build screen. The build has failed. The office director laughs and says, ‘Who did it?’ No one answers, but my sense is that Etienne and Paul’s last check-in may be what broke the build.

16:37 - Etienne brings up the web-based system for inspecting builds. They start looking at the log documenting the broken build. ‘Uninitialised constant action view,’ announces Jack from off of the log, following up with ‘That’s weird.’ He then reads questioningly, ‘Asset tag? That makes no sense at all.’ Several seconds of silence follows, and then Etienne says ‘Oh, that’s not ours.’ Paul reads off more of the log and again, Etienne repeats, ‘That’s not ours’ and then immediately breaks into a refrain of ‘That’s not ours, 

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9This is a process whereby software is made functional across a number of languages (Aykin 2004, pp. 3-16).
someone messed up…’ to the tune of the ‘Na-nana-nana-nah’ song familiar to many western children.

Paul interjects with ‘But… well, hold on’ and continues looking at the log. Then a few seconds later, he identifies a line in the log and says, ‘Oh, that’s ours, OK’.

Acknowledging the difficulty in identifying the source of the error, Paul says ‘I don’t know, there are so many things in here, it’s hard to figure out…’ and then a few seconds later, ‘Ah, OK, yeah, OK, so we need to open that,’ suggesting that he may have found a possible source for the build failure. After further inspection, Paul mentions a merge operation\(^\text{10}\) they did awhile back that seems to be missing from this file set.

Paul has now identified that problem as coming from their check-in where the code that they pulled from source control had not been properly merged. They now need to fix this.

Etienne takes the code that they have been working on and ‘stashes’ it in the source control system, and then retrieves the code that was previously checked-in.

Paul works on finding the missing code that was not properly merged and adds it to this set. They run the tests locally and they pass. Etienne then pushes (stores) the code and they return their focus to the newer work item. (FD 1058/1065 02 December 2013)

5.4 Analysis: Episode two

While there are a number of similarities in this and the previous episode in terms of the LPs observable in Paul and Etienne’s interactions, what is distinctive about this account is the manner in which the CO comes to the fore as an actant that ‘tells’ humans what to do — analogous to a human leader giving commands to her subordinates.

However, I’d first like to call attention to the periods of material-discursive practice involving remote activity found in the episode around 15:01. Despite Paul and Etienne being an embodied human pair situated in the same room, there was nevertheless a common current of IMs between Etienne and remote colleagues that in some cases were materially related to the deployment of the project that Paul and Etienne were currently working on. The ongoing communication between Etienne and these colleagues was situated within the same visual topography as the pair programming, reinforcing the visual locus of attention (Guimbretière 2002, pp. 15-19, 2003, p. 53) and the primacy of the screen (Braidotti 2006, p. 204; Haraway 1991, pp. 188-189). Such behaviour, in analysing its contextual detail, can also be understood as part of LP, because Etienne was being asked specific questions to vouch for the readiness of certain code to be deployed. Thus, based on his authorial position as depicted in figure 1 on page 4, the deployment team deferred to him for a decision (Useem 2010, p. 510) before they proceeded.

Moreover, the fluidity with which Etienne’s IM exchanges occurred was notable. There was a sense of flow with which Etienne handled these, one that I argue arises out of the communication

\(^{10}\)A good deal of managing code in larger software projects revolves around source control systems (Loeliger and McCullough 2012). Within such systems, a merge operation ‘unifies two or more commit history branches’ (ibid., p. 121). For example, developers may be working with some code from branch \(\alpha\) on which their code depends. As they work on this code they incorporate their own changes and when committed to the source control system, would be referred to as branch \(\beta\). Meanwhile, the original developers of branch \(\alpha\) make changes to branch \(\alpha\) concurrently to the changes being made by the developers on branch \(\beta\). This creates a situation where the changes from branch \(\alpha\) must eventually be merged with branch \(\beta\) in order to bring the codebase up-to-date. This does not happen automatically; the developers working in branch \(\beta\) must merge branch \(\alpha\) and ensure that their code still performs correctly. This is normally done at a convenient time or at particular project milestones.
system itself being situated within the same CO as the pair programming work. Thus, the ‘one-stop shopping’ approach that the CO offers to its human can provide particular affordances that impact cognitive and communicative practices including the externalisation of thought (Nickerson et al. 2013), coordination (Zammuto et al. 2007), and increased specialisation (Leonardi 2011, p. 161). Such layered material-discursive practices beautifully illustrate the distributed nature of activity, including leadership, much in the same way that Hutchins’ study of how a collective of people, artefacts, and machines navigate a submarine (1995, pp. 355-356).

Indeed, relational (Cunliffe and Eriksen 2011; Fletcher 2012; Ospina and Uhl-Bien 2012), distributed (Bolden 2011; Gronn 2002; Spillane 2006), and processual (Day and Antonakis 2013; Koivunen 2007; Wood 2005) approaches to leadership rely on this same observation that Hutchins makes about cognition; namely that as a phenomenon not directly visible, we must attribute it in some way. All of the approaches to leadership I just mentioned implicitly understand that attributional process as occurring through social systems, which as can be seen from these episodes, must necessarily include the COs entangled as part of the material-discursive practices. In the specific case of the deployment team asking Etienne to confirm certain information, I suggest this signals particular values around authority and responsibility that align with the leadership dimensions of position and process as depicted in figure 1 on page 4.

Then at 16:33, as Paul and Etienne are working on their next work item, the focal CO stands mutely before the group but switches its colours from green to red, signifying a problem. Then, in response to it, Paul says ‘Uh Oh’, the office director says ‘everybody stop’, laughs, and says ‘Who did it?’ In terms of the temporal order of these speech acts, they were preceded by the CO signifying the issue and in so doing, issuing a command to the group. Therefore, an important question at this juncture is who — or what — is acting as the leader?

One way to answer this is to say that the programmers who wrote the software, the people that built the CO and the operating system, and all of the other components as well as the management who decided that this approach to operations would be implemented, were part of the sociotechnical assemblage of actants (Latour 1999, p. 198) that produced the phenomenon. Such a view includes the CO as an enabler in this enactment of leadership where the group was directed to solve a crucial problem. With this actor-network theory (ANT)-style analysis, we arrive at a minimum to a conclusion where a highly distributed form of leadership is present.

However, I would like to suggest something more radical. I propose that we have a situation where the CO has become the source of leadership command authority (Grint 2005b, p. 1477), where, as Haraway (1991, pp. 188-196) has suggested, the visual dimension is employed to control a group of people; not necessarily for nefarious means, but to control them nonetheless. In the performance of this material-discursive practice, it is the CO that silently evaluates and delivers feedback to the group, analogous to a human leader offering performance feedback. And from a temporal perspective, it is the CO that explicitly initiates this chain of events where the group perceives a ‘problem’ that must be addressed as a priority. The command has been issued and has been received. Thus, in an important sense, I argue that the CO is playing the role of a leader, where the CO is initiating action toward compliance followed by the evident receipt by humans of authoritative orders on what to do. It therefore constitutes a form of leadership as authority or command (Air Command and Staff College 2005; Benoit-Barne and Cooren 2009; Miller 2008), one that can be interpreted as aligning with the leadership dimensions of result or process as depicted in figure 1 on page 4.

But there is yet another sense that the CO in this context suggests leadership. In its given formal role, it issues a command in a language that humans readily understand regarding a problem that needs to be addressed with some urgency. Thus, the role it plays is analogous to the one that Larsson
and Lundholm’s manager (2013) plays in her leadership interaction with a subordinate, however, in their case, what requires a lengthy conversation between manager and subordinate to enact occurs in this episode within the space of eight seconds. Here, the dimensions of CO’s ‘personality’ and its implicit purpose as depicted in figure 1 on page 4 are established by the ways humans respond to it. Unlike Larsson and Lundholm’s human manager, the CO in this episode is beyond question. Thus, in this episode, interpretations of the data aligning with all five of the dimensions of leadership: person, result, position, process, and purpose — were enacted by the CO.

It is important to recognise, however, that this is not simply a claim about a CO playing a leadership role. Rather, it is a claim regarding shared meanings and values that can be embodied by and/or attributed to humans and other objects through material-discursive practice. For just as leaders cannot lead without followers (Bligh and Riggio 2012; Burke 1965; Kahai 2012), so too must the humans in the room understand the meaning and ramification of the message from the CO and then play their parts in order for the ‘leadership’ to occur at all. The office manager articulated to and for the group this sensibility in his utterance of ‘Who did it?’ By making this statement, he implies that someone ‘did it’, verbally establishing the existence of a problem, and by extension, that someone needs to ‘fix it’. Etienne and Paul then demonstrated their recognition of the discursive nature of what just transpired. They understood that the build was broken and they needed to determine whether it was their fault. Whether one accepts that the CO ‘led’ or not, what this episode illustrates is a case where direction was initiated by a CO that was subsequently responded to by the humans attending to it in kind. It is in this sense that I suggest that the phenomenon of ‘leadership’ was performatively produced from the particulars of this material-discursive practice (Barad 2007, p. 178).

In this episode, I have shown how LPs are enacted by both humans and COs and then further distributed through the scaffolding provided by COs and their underlying systems. I argue that in this episode we have witnessed a case where the CO plays the role of leader in a distributed system of leadership, authority, and responsibility where the human participants are committed to the rules of the game (1953 / Wittgenstein 2009, 6-8e; Lyotard 1984). And yet, unlike the previous episode, I did not find evidence of members making the same sorts of explicit attributions ascribing leadership to COs that they applied to material-discursive practices such as pair programming. This difference raises interesting questions I will take up in the discussion below.

6 Discussion

The two episodes I have presented here are two of many that were observed in situ. I summarise from the episodes presented in this paper as table 2 below the observed material-discursive practices analytically associated with behaviours found in the leadership literature and interpretively mapped to the dimensions of leadership as depicted in figure 1 on page 4.

The foregoing episodes and accompanying analyses of LP reveal a processual view of leadership (Day, Fleenor et al. 2014, p. 70; Dinh et al. 2014, p. 41; Langley et al. 2013). In this view, leadership emerges through ongoing material-discursive practice. This is a particular vantage point where what ‘leadership’ is — is enacted over time. Langley et al. describe this as the point at which ‘process’ meets ‘practice’, since how the past is drawn upon and made relevant to the present is not an atomistic or random exercise but crucially depends on the social practices in which actors are embedded. (2013, p. 5)

These notions of ‘practice’ and being ‘embedded’ are precisely what I am attempting to foreground
Table 2: Analytical summary of pair programming material-discursive practices and their association with dimensions of leadership, grouped by episode

<table>
<thead>
<tr>
<th>Episode(s)</th>
<th>Observed material-discursive practice</th>
<th>Associated leadership dimension(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Overcoming 'resistance to closure' through 'persuasion' (Larsson and S. E. Lundholm 2010, p. 1302) or 'empowering leadership' (Zhang and Bartol 2010, p. 117)</td>
<td>person process purpose</td>
</tr>
<tr>
<td>I, II</td>
<td>'Driving' and the negotiation of (keyboard) control or authority (Grint 2005b, p. 1477)</td>
<td>person position process result</td>
</tr>
<tr>
<td>I, II</td>
<td>The 'driver' talking out loud; the 'observer' offering direction (Van Velser and O'Connor 2007, p. 32; Uhl-Bien et al. 2014, p. 90); strategic leadership (Hernandez et al. 2011, p. 1179)</td>
<td>process result</td>
</tr>
<tr>
<td>II</td>
<td>IM as a medium for decision-making (Useem 2010, p. 510)</td>
<td>position process</td>
</tr>
<tr>
<td>II</td>
<td>Build break alert: CO as the source of leadership command authority (Grint 2005b, p. 1477)</td>
<td>position position result process purpose</td>
</tr>
</tbody>
</table>

through my insistent analytical emphasis of Barad’s material-discursive practice (2007, p. 178). In other words, I am arguing that it only through material ‘intra-actions’ (ibid., pp. 139-140) that meaningful phenomena such as ‘leadership’ are produced through successive material-discursive practices involving attribution. The theoretical requirement of such an approach is that the phenomena under study cannot be decoupled from the material apparatus that produces them. Or said a third way: it is always a specific material arrangement that produce a phenomenon. Thus, research aligned with such a view must attend not only to the phenomena, but also to the material conditions of their production.

Simultaneously, by including the CO as an actant in the analysis, I demonstrate how COs are intimately involved in the constitution and transmission of LP irrespective of member acknowledgement. This is demonstrated in the first episode where the entire interaction between Walt and Robert is prefaced on their interactions with local COs. It is also demonstrated in the second episode where I present a case where the CO has been granted an authoritative role. Specifically, like a teacher or a manager, the CO in the second episode evaluates work that has been submitted by humans and issues feedback to the group, sometimes resulting in direct commands to stop what they are doing and attend to a problem that it has detected. In so doing, the CO plays a particular position as depicted in figure 1 on page 4 in the organisational hierarchy, but one that is not explicitly acknowledged as leadership by members.

This accomplishment involves a subtle but crucial shift from the canonical relation of CO as tool where the user is the subject and the CO is the object whose being is subordinated to the human (1927 / Heidegger 1996, pp. 64-67). In the case I presented, the role is reversed: the CO takes the role of subject and directs its command to its object, the group.11 Such a state closely aligns with Haraway’s views of technology and with the views I am putting forward regarding leadership. Thus, leadership, or leading, in the contexts I have presented, can be described as a phenomenon where

11 This is notable in that the canonical case of subject-object reversal occurs when the tool breaks down (Sandberg and Tsoukas 2011, pp. 344-346; Verbeek 2005, pp. 79-80). It may well be that the reversal I have identified is novel in that it occurs without any breakdown required.
social relationships get congealed into and taken for decontextualized things... [and where] social relationships include non-humans as well as humans as socially... active partners. (1997, p. 8)

However, as I showed, members did not see what the CO did as leadership, opening up the terrain of sceptical constructivism where the question becomes why some forms of material-discursive practice are attributed as leadership and others are not. Here, I suggest that this lack of recognition may be a sort of blind spot engendered by enlightenment philosophy that privileges humans above all else. In contrast, the posthuman analysis I have offered to the second episode provides a possible explanation as to how various situations occur where people find themselves ‘at the mercy’ of computational systems without ever realising it, as evidenced by a wide range of large-scale computational system failures (Nicas and Carey 2013; US Commodity Futures Trading Commission and US Securities & Exchange Commission 2010).

Accordingly, when these ideas are diffused (Barad 2007, pp. 86-94; Nicolini and Roe 2014) through the empirics presented above, whether it is the way keyboard control is managed or the ways humans and COs influence each other through various dimensions of leadership, what this perspective helps us to grasp is the processual emergence of particular phenomena that can be interpreted in new ways as LP arising from material-discursive practice. These phenomena may be understood and attributed as ‘leadership’ by members, but irrespectively remain enmeshed with the material-discursive practices that (re)produce them as causal effects (Barad 2007, p. 170).

7 Conclusions

This practice-based study has explored questions about the relationship between LPs and COs by analysing such practices in terms of material-discursive practice (ibid.). It has focused on a particular set of material-discursive practices under the form of pair programming, where within the pair there are no formal leaders.

As a means to analytically identify material-discursive practice as LP, I have combined Grint (2005a, p. 18) and Kempster et al.’s (2011) models of leadership. I have then highlighted particular material-discursive practices within the empirics that illustrate how both humans and COs are mobilised along the five dimensions of leadership: person, result, position, process, and purpose. I suggest that this synthesis of theoretical perspectives is itself a contribution to the leadership literature along with my proposed extension to their work. Here I claim, based on the evidence of attributions offered by Eta’s own members, that leadership is not simply understood through the dimensions that Grint and Kempster et al. suggest but that material-discursive practices are understood as leadership precisely because they are attributed as such. Thus, I have argued that leadership functions as a symbolic resource (Ailon-Souday and Kunda 2003) or repository for values. That is, it points to an underlying process of human categorisation (Bowker and Star 1999) of value and worth (Boltanski and Thévenot 2006; Mailhot et al. 2014).

I presented two episodes to support this argument. In the first episode I demonstrated LPs that included the negotiation and assertion of control (Grint 2005b, p. 1477), the elaboration of strategy (Guastello 2007; Montgomery 2012; O’Reilly et al. 2010), and empowering leadership (Zhang and Bartol 2010, p. 117). I also showed that within the broader sphere of the site I studied the existence of an ideology (Kunda 1986, p. 54) around the association of various practices and their relation to what is valued within the organisation and attributed as forms of ‘leadership’.
In the second episode I expanded these ideas to show that the CO was responded to as a source of leadership command authority (Grint 2005b, p. 1477) and I linked these ideas to the work of Haraway who has argued extensively regarding the means by which the technological and the visual are employed to control humans (1991, pp. 188-196). In sum, I illustrated how LPs are enacted by both humans and COs and further distributed through the scaffolding provided by COs and their underlying systems. Specifically, I argue that in the second episode we have witnessed a case where the CO plays the role of leader in a distributed system of leadership, authority, and responsibility where the human participants are committed to the rules of the game (1953 / Wittgenstein 2009, 6-8e; Lyotard 1984), which may or may not involve the attribution of leadership.

Finally, in my discussion, I highlighted how the AR perspective I have taken in my analysis aligns closely with processual (Day, Fleenor et al. 2014, p. 70; Dinh et al. 2014, p. 41; Langley et al. 2013) views of leadership. I also suggest that Barad’s AR is a useful analytical stance to help us grasp the processual emergence of particular phenomena arising out of material-discursive practice. These phenomena may be understood and attributed as a symbolic resource (Ailon-Souday and Kunda 2003) commonly called ‘leadership, but remain enmeshed with the material-discursive practices that (re)produce them as causal effects (Barad 2007, p. 170). In this sense, building on Grint and Woolgar’s sceptical constructivism (1997, p. 143), what this paper has explored are possible versions of ‘leadership’, some of which are recognised by members as such and some of which may go unrecognised. To this point, I have suggested that the posthuman analysis I have offered provides a possible explanation as to how various situations where people find themselves ‘at the mercy’ of computational systems occur without them ever realising it, amply evidenced by a wide range of large-scale computational system failures (Nicas and Carey 2013; US Commodity Futures Trading Commission and US Securities & Exchange Commission 2010).
**Acronyms**

ANT  actor-network theory
AR  agential realism
CO  computational object
COO  Chief Operating Officer
CS  computer science
FD  field diary
HCI  human-computer interaction
IM  instant message
IS  information systems
LP  leadership practice
UI  user interface
WITS work item tracking system
List of Terms

**ideology**  My use of this term follows Kunda’s definition as ‘bodies of knowledge that must be understood in the context of the social arrangements within which they arise and which provide the grounds for their assertion’ (1986, p. 54).

**material-discursive practice**  I employ this term with specific reference to the work of Barad, who describes such practices as ‘possibilities of change entailed in reconfiguring material-discursive apparatuses of bodily production, including the boundary articulations and exclusions that are marked by those practices in the enactment of a causal structure. (2007, p. 178). My interpretation of this is that Barad asserts an ontological inseparability between meaning and matter, substance and significance, through the ‘material-discursive’ and their associated ‘apparatuses’ and ‘bodies’ enacted in practice.

**pair programming**  Pair programming is an approach to writing software involving a human dyad where ‘One of the programmers, the driver, has control of the keyboard / mouse and actively implements the program. The other programmer, the observer, continuously observes the work of the driver to identify tactical (syntactic, spelling, etc.) defects, and also thinks strategically about the direction of the work. On demand, the two programmers can brainstorm any challenging problem. Because the two programmers periodically switch roles, they work together as equals to develop software’ (Williams 2001, p. 27).

**sceptical constructivism**  This approach addresses charges raised by of critics of constructivism who claim that constructivists see all truth claims as equally valid. Sceptical constructivism avoids falling into a recursion of relativism by emphasising that ‘the constructivist does not assert that all claims have equal status; instead she asks which claims attract the most significant support and why.’ (Grint and Woolgar 1997, p. 143) Thus, this approach to scientific enquiry seeks not to identify truth as such but instead to understand how that which is identified as truth comes to be.

**source control system**  A source control system (SCS) is a software based system, normally implemented through a database, that manages versions of files. Such systems are also referred to synonymously as ‘version control systems (VCS), source code manager (SCM), a revision control system (RCS), and several other permutations of the words “revision”, “version”, “code”, “content”, “control”, “management”, and “system”’ (Loeliger and McCullough 2012, p. 1). This family of computational systems enable a group of collaborative and often disparate users to ‘develop and maintain a respository of content, provide access to historical editions of each datum, and record all changes in a log’ (ibid.).
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