Technology and restructuring the social field of dairy farming: hybrid capitals, 'stockmanship' and automatic milking systems

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Abstract

This paper draws on research exploring robotic and information technologies in livestock agriculture. Using Automatic Milking Systems (AMS) as an example we use the work of Bourdieu to illustrate how technology can be seen as restructuring the practices of dairy farming, the nature of what it is to be a dairy farmer, and the wider field of dairy farming. Approaching technology in this way and by drawing particularly upon the 'thinking tools' (Grenfell, 2008) of Pierre Bourdieu, namely field, capital and habitus, the paper critically examines the relevance of Bourdieu's thought to the study of technology. In the heterogeneous agricultural context of dairy farming, we expand on Bourdieu's types of capital to define what we have called 'hybrid' capital involving human-cow-technology collectives. The concept of hybrid capital expresses how the use of a new technology can shift power relations within the dairy field, affecting human-animal relations and changing the habitus of the stock person. Hybrid capital is produced through a co-investment of stock keepers, cows and technologies, and can become economically and culturally valuable within a rapidly restructuring dairying field when invested in making dairy farming more efficient and changing farmers' social status and work-life balance. The paper shows how AMS and this emergent hybrid capital is associated with new but contested definitions of what counts as 'good' dairy farming practice, and with the emergence of new modes of dairy farmer habitus, within a wider dairy farming field whose contours are being redrawn through the implementation of new robotic and information technologies.

Introduction

This paper draws on Pierre Bourdieu's social theory to analyse how the embodied discourses and practices of 'stockmanship'[1] change when innovative technologies are introduced into agricultural systems. This is important because rapid technological change in livestock agriculture implies significant changes in the knowledges and skills demanded of stock keepers, and produces situations in which the relationships between humans and nonhuman animals are being fundamentally renegotiated. Following Bourdieu's lexicon, we focus on how 'habitus' (an acquired set of dispositions), 'field' (a network of competitive relations and forces between entities occupying particular positions), and the different 'capitals' associated with dairy farming, affect the deployment of new technologies in farming situations, and on how in turn new technologies restructure the dairy farming habitus and field. The technology we use as a case study is the robotic or automatic milking system (AMS), used increasingly extensively in northern Europe and to a lesser extent across the world. AMS milk cows without the need for immediate human presence. Cows enter the AMS stall, where a robotic arm cleans the udder, places the milking cluster on the teats, milks the cow, and removes the cluster when milking is finished. Using RFID tags, the AMS can identify and monitor each cow as an individual, collecting large amounts of management-relevant information on productivity and health. This enables changes in dairy management at the levels of the individual cow and the herd, and also changes significantly the work of dairy farming (see Butler et al., 2012; Holloway, 2007; Holloway et al., 2012 and Holloway et al., 2014a for more detail). In other papers, we and other authors have used AMS to explore changing human-animal relations, shifting 'situated' agricultural ethics, and the potential for applying a range of social scientific perspectives to situations which include nonhuman animals (see for example Holloway, 2007; Holloway et al., 2012; Holloway et al., 2014a; Holloway et al., 2014b; Driessen and Heutinck, 2015; Porcher, 2006; Porcher and Schmitt 2012). Holloway et al (2012; 2014b) have drawn on Foucault in order to explore how AMS is associated with the ordering of dairy farm space and the disciplining of both farmers and cows. The use of Bourdieu in this paper, however, provides a novel perspective on the questions raised by a shift towards robotic and information technologies in livestock farming by exploring

[1] This gendered term is commonly used in the field alongside the term stockman, although there are also references to stockwomen, stock keeper and stockperson. We use the terms 'stock keeper' and 'stock keeping' unless citing others' uses of other terms.

changes in dairy farm practices and capitals in relation to a wider 'field' of dairy farming. We seek to deal with three key issues.

First, we draw on Bourdieu's concepts to provide a framework for analysis of the 'field' of dairy farming. The field here is the UK dairy industry, currently experiencing major structural change, not least the loss of many, often smaller, dairy farmers from the industry. Within this field, the individual dairy farm can be represented as a social entity, embodying a collective objective (i.e. sustaining a viable farm business) linked to an external environment constituted by various institutions. The UK dairy field is significant within the paper as it helps contextualise the field in which AMS are being adopted by individual farmers. The importance of such an approach is in the central place accorded by Bourdieu to the social conditions under which power relations internal and external to the farm are produced, reproduced and contested. Our utilisation of Bourdieu's concepts helps to situate individuals within the context of their dairy farm, the UK dairy industry and in the relations that exist between stock people, their animals and technology.

Second, Bourdieu rarely wrote about technology *per se* (although he did write extensively about scientific practice – see Camic, 2011) and his work is rarely used in studies of technology. Sterne, however, argues for the relevance of Bourdieu's thought to the study of technology. Sterne's interpretation of technologies as 'crystallizations of socially organized action' (Sterne, 2003: 367) suggests that instances of technology adoption and use should be viewed as similar to other kinds of social practice that recur over time. This in turn links to Bourdieu's theory of practice that connects action to culture, structure and power and undergirds his key concept of habitus (Shove et al, 2012; Swartz, 1997). For Bourdieu, habitus is 'constituted in practice and is always oriented towards practical functions' (1990, p.52). Use of a new technology such as AMS transforms the microgeographies of the farm, and changes working practices so shifting the social relations within the dairy field and affecting the dairy farmer's habitus, something we explore in terms of the emergence of new 'hybrid' capitals which involve humans, cows and technologies in co-constitutive relationships.

Third, we illustrate how the introduction and intervention of AMS alters the social practices and habitus of the dairy farmer, changing the production and accumulation of 'capital' in the field of dairy farming. We argue, then, that in fields like dairy farming, which involve human, non-human animal and technological entities as active agents, forms of 'hybrid capital' can be conceptualised, providing a way to move beyond the anthropocentrism of Bourdieusian theory and take into account the roles of nonhuman participants in the structuring of fields of social activity.

From here, we begin by providing an outline of relevant areas of Bourdieu's thought, and then consider how these areas are related to understandings of technology and stock keeping. We then briefly outline the nature of our empirical research in the UK dairy sector. Our theoretical perspective is developed through discussing how technology, regarded as an assemblage of machine, cow and stock keeper, can be seen as contributing to the formation of hybrid cultural capital. Finally we use this concept of hybrid capital to illustrate how technology changes the habitus of the dairy farmer, challenging traditional cultural assumptions of what being a dairy farmer should entail.

Field, capital and habitus.

In this section we outline Bourdieu's key terminologies of field, capital and habitus, and begin to think about how they might be applied in the case of AMS and the UK dairy field. This provides a foundation for our empirical examination of how the introduction of AMS affects stock keeping and working practices. Bourdieu's sociological 'thinking tools' (Grenfell, 2008: 2) have been applied to a wide range of areas of study. For example, they have been used to analyse religious and philosophical doctrines (Silvasti, 2003), consubstantiality (Gray, 1998), reflexivity (Stock, 2007), science (Camic, 2011), sporting practices (Nettleton, 2013; Rees et al, 2014) and the agency of orchards (Hunt, 2010). In studying the practices of farming specifically, Bourdieu's work has been used to explore the social construction of 'good farming' and changes in farming practice (Burton 2004; Burton et al, 2008; Burton et al, 2012; Burton and Paragahawewa, 2011; De Krom, 2015; Haggerty et al, 2009; Sutherland and Burton, 2011; Sutherland and Darnhofer, 2012) with Burton's work (2004; Burton et al, 2008; Burton and Paragahawewa, 2011) focusing on the importance of cultural capital in farming practice. De Krom (2015) explores how technological changes affect pig-farming, drawing on Bourdieu to show how stock keepers' knowledges and practices change as farm infrastructures and technologies change. In this paper we further develop the concept of capital, together with the concepts of field and habitus, by applying them to another quite radical situation of technological change, associated with change in the social and power relations of the dairy field.

Bourdieu (1993) uses the term *field* to express the structuring of social relationships between actors involved in a collective set of practices. The field, for Bourdieu, is the most important of his conceptual tools (Camic, 2011). For Bourdieu, fields are 'structured spaces of positions (or posts) whose properties depend on their position within these spaces and which can be analysed independently of the characteristics of their occupants (which are partly determined by them)' (Bourdieu, 1993: 72). A field is thus a configuration of relationships between the 'posts' within it. These positions and the forces that bind them

together constitute an emergent state of power relations within what is, for Bourdieu, an ongoing struggle for authority and control over the field.

Bourdieu's concept of *capital* allows the structures of a field to be mapped; 'capital does not exist and function except in relation to a field' (Bourdieu and Wacquant, 1992:101). Different kinds of capital are seen as specific to and important in particular fields. Capital is accumulated labour, and takes time to acquire (Bourdieu, 1986). Bourdieu differentiates between economic capital (wealth), symbolic capital (honour and prestige), social capital (networks of social connections and relations) and cultural capital. Cultural capital can take three forms. First, it can be embodied in the form of persistent dispositions of the mind and body; second, it can exist in an institutionalized state, such as in the value of educational qualifications; and third it can be objectified in the form of cultural goods, such as pictures, instruments and machines.

The third of Bourdieu's concepts we deploy is *habitus*, defined in terms of (human) embodiment. For Bourdieu, it is:

> A socialised body, a structured body, a body which has incorporated the immanent structures of a world or of a particular sector of that world – a field – and which structures the perception of that world as well as action within that world (Bourdieu, 1998: 81).

Habitus is created through social, rather than individual, processes, leading to enduring patterns that are transferable from one context to another but that also shift in relation to specific contexts and over time. To Bourdieu,

> Habitus is neither a result of free will, nor determined by structures, but created by a kind of interplay between the two over time: dispositions that are both shaped by past events and structures, and that shape current practices and structures and also, importantly, that condition our very perceptions of these (Bourdieu, 1984:170).

Conceptually, habitus sits between field (groups of interrelated social actors) and capital (specific forms of agency and embodiment within a given field) as a set of social dispositions. Habitus acts as a kind of 'generative principle' (Bourdieu, 1977: 78) of spontaneous and creative social action based on an individual's position within a field and the possession the individual has of the different types of capital which are important to that field. The relations in a field change over time, as does the specific capital in that field. Habitus is thus not merely a mental state; it is embodied social knowledge – it comes

through (in) everything we do (Bourdieu, 1990: 68). It is a powerful concept because it is emergent: it changes over time and it contains both spontaneous and structural aspects. For example, individuals are able to use technology in the way it was designed, but they can also use it to transform the field in which they are situated. Whilst Bourdieu made brief reference to the conditions in which habitus can change and accepts that habitus changes in response to experience, he never completely engaged with the formative capacity of the habitus and its consequent liability to change over time (Butler, 1999:116). In part, this paper addresses this gap in Bourdieu's conceptualisation of the habitus by focusing on the interventions made by a particular agricultural technology which potentially affects habitus, field and capitals quite radically. Change in practice therefore occurs when habitus encounters changes in fields' structural relations, brought about in the case of AMS by technological shifts (see De Krom, 2015). We show how, whilst the dairy field might determine the stockkeeper's habitus, change in practice might in turn modify the dairy field itself. For Bourdieu, practices cannot be 'deduced either from the present conditions which may have seem to have provoked them or from the past conditions which have produced the habitus... [but from their] interrelationship' (Bourdieu, 1990:56)

Thus it is our aim in this paper to develop a perspective on technological change, inspired by Bourdieu, which actively transposes his conceptual framework onto a new terrain, that of the robotic dairy farm.

Stock keeping, technology and 'hybrid capital'

Here, we begin to outline how the ideas discussed in the previous section can be related to the notion of 'stockmanship' and to the stock keeper responsible for the care and productivity of a group of livestock, and second, to technology. We also consider the concept of technology a little further and develop our idea of hybrid capital in dairy farming.

We use the term 'stock keeper' to refer to the individual who has responsibility for the day to day activities involved in milk production, so, for instance, milking and cow husbandry. The nature of the work requires tacit knowledge. This form of knowledge, argues Polanyi, is impossible to make explicit: its essence is that we 'know more than we can tell' (1966:6). Tacit knowledge, therefore, relies fundamentally on 'hands-on' experience, and is a concept can be closely allied to that of the habitus.

In the case of the transformative effects of AMS, we focus on material human-technology relations evident on dairy farms, illustrating how, in material terms, technology shapes the lived experience and tacit knowledge of the stock keeper and how, in turn stock keepers

utilise technology to bring about change in the dairy field . This approach is partly influenced by science and technology studies accounts of the hybrid, co-constitutive relationships between living and non living (including technological) actors and actants (see, for example, Holloway, 2007 and Michael, 2000). Indeed, there are close links (but also some tensions) between aspects of theories of practice (including Bourdieu's) and STS (Shove et al, 2012). However, using Bourdieu, we also want to suggest that the co-constitution of users and technologies is not simply governed by the scientific and engineering logics which define AMS and other agricultural technologies in terms of their functionality. It is also influenced by the emergent, experiential knowledge-practices of stock keeping and its associated human-animal-technology relations. Next, then, we briefly outline our perspective on technology in relation to Bourdieu's work. We return here to Sterne's (2004) argument that Bourdieu's thinking is valuable in discussing technological change and its effects on social relations. For Sterne, technology is not simply an object that fulfils a predetermined social purpose. Technologies are instead socially shaped, co-created by their makers and users to perform roles that can change over time, and be different, for different groups of people. However, we find Sterne's view of technology as 'crystallisation' problematic in its focus on materiality and fixity. Instead we view technology as more than just material, and as emergent.

As Bijker et al (2012) show, 'technology is a slippery term', characterised as having three layers – a technology can be a physical object or artefact, it might refer to a process or activity, and it can refer to what people know as well as what they do (MacKenzie and Wacjman, 1999). Talking about AMS, for instance, can mean talking about a machine, can refer to the processes of milking and of collecting and analysing data, and can also suggest talk about the changes in knowledge-practices the machine and the processes demand. AMS do change many aspects of farm management. The nature and organisation of labour is altered, manual labour can be replaced by management and control via computer systems, and the presence of an operator at regular milking times is no longer required as cows 'voluntarily' milk themselves, contrasting with the proximity of human-animal relationships associated with conventional milking parlours (Meijering et al, 2004). AMS are described as replacing the human touch, based on human movement but being in some respects better than a human. For example, DeLaval boasts that its robot is modelled on a human arm's flexible movement range and that this arm is 'quiet, robust and gentle. Its repetitive procedures are consistent too, just as the cows like it' (DeLaval webpage C). Thus AMS significantly change human-non human relations: the working relationship between cows and their stock keeper is changed, and stock keepers' knowledge and skills in relation to their cows must be restructured.

Technologies might thus be understood in terms of how they embody and produce particular dispositions. AMS structure human (and bovine) practice through automatic milking, and data collection and analysis. When AMS is adopted human roles and practices are redefined with an emphasis placed on the stock keeper's need to enhance their skills in closely observing their cows at other times and places, as there is not the usual opportunity to do this at milking time (Butler et al, 2012; Owen, 2003). The stock keeper also needs to become proficient in using the large volumes of data which the AMS records. Using AMS means the role of the stock keeper has, to a great extent, been altered by technology. However, the work of stock keeping continues as a process of acquiring skills and dispositions which reconstitute it in relation to the AMS, so that stock keepers become ready to be called upon by the robot for the purposes of enhancing efficiency and improving the performance of both human and cow.

In a context where the inter-relationship between humans and nonhumans (both cows and technology) is crucial to the structure of a field, we argue here that an alternative form of capital can be explored as a useful way of making sense of how AMS change dairy farming practices, the dairying field, and stock keeper habitus. The concept of *hybrid capital* brings together some of the qualities associated with other kinds of capital, and attempts to express how something valuable to a field emerges from a particular configuration of humans, nonhuman animals and technology, and might thus be useful in other instances of human-animal-technology relations, including other agricultural situations, and including non-AMS dairy farming: we are not arguing that such hybrid capital is new and exclusive to AMS dairying. The concept allows for an expression of the heterogeneous relations involved in a field, and at the same time decentres humans as the *possessors* of capital, to understand them as one part of an assemblage which, along with animals and machines, *constitutes* a capital. We regard this assemblage *as* a capital in Bourdieu's sense because it can help to understand or map the changing structure of (in this case) the dairy farming field; it is the product of accumulated labour (of humans, cows and machines together); and its production and investment is what generates the farm's productivity. We see this hybrid capital as an accumulation of capitals where dairy farmers using AMS employ strategies of capital investing, accumulating and converting different types of capital in order to maintain their position in the social order. As such the robot, cows, the redesigned farm layout and the stockperson all act as resources which act together as a capital. Hybrid capital is thus exchangeable for economic capital (through the sale of milk), as well as being related other forms of capital, such as social status (which may be contested. For some, adopting AMS is regarded as enhancing the stock keeper's social status; for some non-AMS users, users'

status is diminished: see below). Within this emergent hybrid capital, stock keepers contribute an embodied capital gained through labour in dairy farming, i.e. an accumulation of specific knowledges and skills. Milking robots contribute an objectified cultural capital, embodying the labour, knowledge and skills of manufacturers, economically invested in by individual stock keepers as well as introducing different knowledge cultures into dairy farming practices. Finally, cows contribute as both objectified economic capital (and, perhaps, particularly in the case of pedigree animals, as bestowing social status on their owner, see Ritvo, 1986) and as embodied capital acquiring experience of living and 'labouring' on a dairy farm.

Hybrid capital is partly analogous with what Irvine (2004) calls 'animal capital'. Animal capital refers to resources that enable the development of meaningful relationships with animals. It includes a commitment to the animals as subjective beings, as active participants in human life, and as having potential. For Irvine, this notion of animal capital relates to non- exploitative companionship with animals, and the situation in dairy farming is clearly different. But we feel it has some resonance for dairy farming where cows are simultaneously property (and can be bought and sold as a more-or-less conventional form of capital) and worked *with*, in conjunction with machines, in ways which can be regarded as inter-subjective and in some ways companionate or co-operative. This, we feel, takes the idea of hybrid capital beyond the definition of other kinds of capital, and justifies its deployment here as an analytical tool.

The shift in human-animal-technology relationships implied by a move from conventional to robotic milking has important effects on the lines of power which structure the field, as relative dominance and subordination changes. However, unlike shifts in possession of conventional capital, the human is regarded as part of hybrid capital: humans at once possess and are possessed within relationships constituting hybrid capital. With a move from conventional to robotic milking, there is a shift in the constitution of the hybrid capital which structures the dairy farming field. In the context of an individual farm, we note three shifts. First, AMS shifts the locus of power in dairy farming towards the robot and towards actors external to the farm (especially the AMS manufacturer, who becomes strongly influential in terms of how the farm's microgeography is ordered and how dairy farming is practised – see Holloway, 2007; Holloway et al., 2014a). The robot takes on 'responsibility' for milking, for informing the stock keeper, and for summoning him/her in order to deal with problems. Second, AMS also shifts the locus of power towards cows, although we have reservations about simply accepting manufacturers' claims that AMS give cows autonomy, freedom and choice (see Holloway et al., 2014a). Cows too, take on, or are given, responsibility to manage their milking routines, being expected to present themselves

regularly and to make appropriate use of milking, feeding and resting areas within the dairy farm's microgeography. Third, as implied by these changes, the stock keeper is to an extent decentred in relation to the practices of milking. He/she no longer actively milks cows, but services and responds to the robot. His/her ability to control and manage the dairy farm is, however, amplified in some ways through the emergence of AMS hybrid capital. For example, the plethora of data created by the robot allows improvements in cow management and farming efficiency. These changes, then, are suggestive of changes in the power relations associated with dairying, both within the context of a farm and between a farm and external actors, and thus with the restructuring of the wider dairy farming field. They have implications for the dairy farming habitus too, as we explore in more detail below, following an outline of our empirical research into AMS.

Methodology

The empirical research that this paper refers to investigated the way in which robotic and information technologies are used by dairy farmers and cows, and how their development takes account of, but also changes, the cows and humans that use them. It investigated how knowledge about robotic milking is produced and communicated, and it examined the ethical issues raised by robotic milking (see Holloway et al, 2014a; 2014b)

The research involved in-depth interviews with manufacturers of AMS equipment in the UK and other European countries, interviews with representatives of a wide range of UK institutions associated with dairy farming, and interviews and observational research with dairy farmers in the UK, USA and EU. This paper draws specifically on the UK farmer interviews and observations made at three case study farms. Qualitative interviews were conducted with 10 pairs of AMS users and conventional dairy farmers. Interviews with manufacturers of AMS produced suggestions for potential farmer interviewees using different brands of AMS. During interview, AMS users were asked to identify a neighbouring dairy farmer who used conventional milking technology, and who could be approached for interview. This recruitment method had the advantage of selecting conventional farmers who would know about AMS through their experience of their neighbour's farm, we would thus obtain their informed views of AMS as non-users. Interviews focused on farmers' attitudes towards dairying technologies, how technologies changed their working practices and their 'philosophies' of dairy farming, and on their changing relationships with their dairy cows. Three in-depth case study farms were also established, including an established AMS user, an agricultural college with both robotic and conventional milking systems, and a dairy farm transitioning from a conventional system to AMS. Interviews with case study farmers, and week-long periods of observational research at each farm, allowed the

researchers to gain a detailed view of how AMS became implicated in the field and habitus of dairy farming.

Drawing on this research, we first explore how the adoption of AMS changes dairy farming practice and illustrate how the interventions of technology alters the social practice and habitus of the dairy farmer, changing the established role of the stockperson. As noted earlier, we see AMS as more than just a milking machine, but instead as related to changes in the dairying field and to emergent on-farm practices. This implies that AMS can be seen partly as a response to a need, within the social system of dairy farming, to radically change management and working practices, rather than simply as a 'driver' of change. Secondly, we discuss how the adoption of AMS changes power and social relations within the dairy field. We cast this in terms of the development of 'hybrid capital', exploring the implications of this term for our understanding of social contexts in which humans and farmed, 'domestic' animals are closely associated.

Changing dairy practices: opening the gates to AMS.

As Wauters and Mathijs (2004) found, the reasons given for changing to AMS are not solely economic, such as a need to increase milk production. Social factors also played a part. Their data, derived from a survey of 107 farmers with AMS in Belgium, the Netherlands, Denmark and Germany, corresponds strongly with the responses of our UK interviewees. Three factors (availability of labour, lifestyle, and control of working practices) exemplified how external social factors led to significant changes in stock-keeping practices. Lack of alternative labour sources created conditions demanding a technological solution; the demands of normal twice- or three-times daily milking meant that AMS could be seen as enhancing stock-keepers' quality of life; and a perceived need to better monitor and regulate the work of the farm and cows' productivity and health could also be seen as demanding the particularly technological responses available through AMS. AMS was, however, brought into farming situations where the stock-keepers' existing habitus and embodied cultural capital remained valuable. In this relational understanding, AMS effected change in habitus and capital, but at the same time was put to work in ways affected by habitus and capital.

Dairy farmers who adopt AMS can be seen as having/co-constituting hybrid capital which is developed further *along with* the AMS. This is something implicit in what manufacturers describe when discussing how prospective to AMS converts will have to change their practices. The performative demands of AMS can make herd management more efficient,

although this is dependent on the stock keeper making use of the additional data provided by AMS and changing their approach to management accordingly. Manufacturers were clear that adopting AMS meant adopting a whole new farming 'philosophy':

> For a farmer who's never managed his cows properly the robot computer will force him to do so. It tells him about blood in the milk, conductivity, yield per quarter. If a cow's possibly lame it can indicate that, it tells him how many times a cow has been fed every day…. Farmers sometimes put robots in thinking that it's all automatic, it's like, you know, the cows will feed themselves automatically, and milk themselves automatically. But it doesn't work like that. And those are all the things that we've got to make sure the farmer understands (AMS manufacturer).

Manufacturers argue that whilst AMS involves a complete change in how a dairy unit operates it has the potential to increase overall milk yields, make the farm more productive, profitable and improve farmers' and cows' 'quality of life'. Indeed, many farmers adopted robots for 'quality of life' reasons, not simply for increasing efficiency and profitability.

AMS gave the dairy farmers interviewed the chance to readdress their farming practices in relation to what they referred to in terms of a work-life balance. This involved making choices, and can be related to a pattern of habits and beliefs which in the case of the dairy farmer traditionally involves milking twice daily, every day. The whole dairy farm is thus geared around milking time. One dairy farmer with young children made a decision to change his system to AMS so he 'had a life' (AMS user) and could share parenting responsibilities. Before introducing AMS, he found his working day revolved around milking and looking after his dairy herd with little time left to do anything else on the farm or spend any time with his young family.

In spite of this AMS users highlighted new constraints on their time and freedom through the ability of AMS to send alerts and alarms to their mobile phones at any time.

> ... which brings me on to the downside that my wife would say, with a relief milker at least if you went somewhere you have someone to look after them. If we go anywhere I'm the only one who can pilot this [gesturing at computer], not that there's much to it but, you can put any muppet in a parlour within reason whereas you can't say to someone just look after that... Say if we go away somewhere you have to have someone in the house in case there's an alarm and ideally that someone

> knows what to do if it goes wrong. That's what I would say is the biggest downside. I've had an alarm about the last 7 nights running. I can live with that, I'm just having a bad run, sometimes you go ages. That's my personal downside. (AMS user).

As such the AMS can transform social relations on dairy farms, with the robot given an agency which allows it to intervene in the life of the farmer in a way which reverses what might be expected as the usual human-technology relationship. The AMS, Automatic Milking *System*, which includes the associated humans and cows, is not simply a robot, it has powers of surveillance and intervention, and co-constitutes a hybrid capital composed of stock keeper, machine and animals, a capital which can be invested in pursuit of aims such as enhanced productivity, cow welfare or human quality of life. Within this hybrid capital, stock-keeping practices and habitus are transformed to some degree through the presence of the robot. The stock-keepers' experiential knowledge of cows, milking and farming more generally is still crucial but is given new inflections by the ability of the robot to 'make demands' on the stock keeper, and to provide him/her with a significant amount of data and with the 'freedom' or time to analyse and respond to the data. Cows' prior embodied capitals are similarly re-inflected and re-invested in AMS systems, which are highly dependent on cows learning to behave in ways very different to those animals milked in conventional systems. While 'new', AMS as hybrid capital thus is dependent on prior embodied human and bovine capitals and knowledges. We explore the concept of hybrid capitals a little further in the next section.

Technology, hybrid capital and habitus.

AMS demands that stock keepers acquire a specific set of skills and knowledges relating to the technology; in particular they must utilise and manage data produced by the AMS efficiently and productively. According to AMS manufacturers, the stock keeper has to learn about and adopt the technology completely if it is to work efficiently and productively. We see this as the constitution and investment of a hybrid capital which also involves the enrolment of the cows. As outlined above, AMS thus involves a complete change to dairy farm practices in terms of work-life balance, working practices and labour requirements. AMS has the power to transform the roles of both stock keepers and cows, and thus takes a powerful role in the field. Yet the AMS remains dependent on human and bovine capacities. For example, whilst AMS users were enthusiastic about the benefits of robotic milking, they were keen to emphasise that AMS could only advance cow health and welfare if the stock keeper remained 'cow-focused'. AMS thus do not replace traditional stock keeping skills. For the following farmer:

> Robots will never take over from a good cowman but they provide you with a lot of information that you can make your decisions on without necessarily having to be the greatest cowman in the world (AMS user).

Many AMS users reiterated what the manufacturers of their robots said: robotic milking demands even higher levels of 'stockmanship', commitment and discipline than conventional milking. Enhanced stock keeping can thus be an effect of the hybrid human-nonhuman relations constituting emergent AMS dairying practices, and is a valuable constituent part of an emergent hybrid capital.

As one stock keeper succinctly put it:

> I think you must be really sharp up on dealing with cows. It is a personal thing, you must be extremely hard on yourself and disciplined. The robot is not an easy option (AMS user).

The effectiveness of an emergent AMS hybrid capital thus relates to the extent to which the stock keeper is able to adapt their habitus through changes in transformed dairying practices. In these cases, the hybrid capital can be successfully invested to improve productivity and herd health and welfare, and to enhance human quality of life.

It was interesting and useful to gain the views of non-AMS users in this context. While some were prepared to acknowledge the potential advantages of AMS, others saw the technology as leading to slovenly practices; AMS dairying could not be 'good' farming in their eyes. AMS, as a hybrid capital associating technology, stock keeping and cows, allowed corners to be cut and standards to be lowered because asking robots to do the labour of milking took the stock keeper's attention away from the cows. In conventional milking cows are physically interacted with daily, and stock keepers argue that this provides opportunities to check cows' health and welfare. AMS, it is argued, makes the stock keeper too dependent on the robot and its data:

> They're into these computers … the one who put a robot in, I was looking at his shed, the shed that he used to use, he's revamped his shed, you look at the shed next to it and you think Christ almighty what a bloody mess! You can't believe that some of these people spend all this money on robots and they're actually farming a shit hole! A lot of their problems are … they're never caused by the robots; their problems are caused by the way they keep their cows (non-AMS user)

The value of AMS hybrid capital is thus contested, and variable dependent on the stock keeping expertise of its human (stock keeper) component, and his/her willingness to transform their knowledges and practices in accordance with the requirements of its robot component. Some non AMS users viewed those who used AMS in a derisory way, as office managers rather than dairy farmers, reducing the social capital a farmer using AMS might have in their eyes. As Tsouvalis et al (2000) found in the examination of precision farming technologies in arable farming, there was similarly some derision expressed towards arable farmers using these technologies. It was implied by non-users of these technologies that the arable farmers who used it were clearly less skilled if they needed to rely on it. They were re-cast as 'office managers' who replaced agronomists with IT specialists as the primary influencers of farm decision making. Similar accusations were made towards AMS users in this study whose identities were likened more to those of office workers, sat at a computer rather than working outside or with the cows, and increasingly dependent on external expertise to service and repair the AMS. For AMS adopters, hybrid capital in the AMS dairy field can be accumulated where the capacities of the AMS combine with those of the cows and the 'right' stock-keeping expertise and labour, but might deteriorate (as suggested in the above quote) where the human component is ineffective or distracted, where there is a 'disinvestment' in cows and a redirection of the stock keeper's attention towards what can be presented as the 'wrong' objectives, such as an attempt to simply minimise work.

Where the stock keeper effects the appropriate AMS habitus and begins to accumulate hybrid capital, the AMS measures and records milk production and assesses milk quality, so that the stock keeper can use the embodied, tacit stock keeping knowledge integral to their habitus, but inflecting this habitus with new data analysis skills. The robot and stock keeper together, then, construct new hybrid, informational capital concerning the cows. The following quote exemplifies how an AMS user had built his work routines around data analysis and rapid responses to what the data tells them.

> You need to be looking at the records and the computers twenty-four hours a day effectively, so everybody needs to know what everybody else is doing … everybody will know how to dissect the information, the correct information because as we're never handling these cows you've got to have a damn good stockman's eye but you've also got to be computer literate to understand so that you can…why has that cow not been milked? Why is there a deviation in milk? ... You've got to be able to look at the computer and dissect this so we've built a

> lot of reports within the system so whoever comes on first thing in the morning we've five reports that we quickly look at so that we can flag up the issues that could be occurring and the cows that need to be looked at as soon as possible. We've got lots of standard operating procedures in place and it's so important that we have that with this system (AMS user).

Thus AMS changes what the stock keeper is expected to know and do on the farm; it affects the farm layout, system and routine as well as the stock keeper's attitudes and dispositions, their habitus. AMS effects changes to the farming practices which the stock keeper performs, and the stock keeper's ability to adjust to the new operational procedures associated with AMS is important to the co-production of hybrid capital.

As with other forms of capital, the accumulation of hybrid capital involves the management of collective bodies, a collective enterprise that involves both the monitoring of animal bodies by the stock keeper through a 'web of relations of information and cooperation' (Wacquant: 1995:80-1) and the disciplining of the stock keeper's whereabouts and work practices by the AMS. An AMS user explained how he used his embodied cultural capital and the information provided by the AMS to assess his cows:

> [It's] just management, just looking at cows' feet, looking at whether they're chewing the cud, whether they've got shiny coats…whether they're losing weight…all the information that I get from a computer telling me what various things there are that I can look at to help me manage the cows better really …you know having the robots and knowing what the computer is telling me and then making my mind up what to do (AMS user).

The value of this information was disputed by some non AMS users; to them experiential, tacit knowledge was more important than data collated by the AMS:

> …I don't think you can ever replace a human looking at an animal and seeing that she's bright, alert, you know cudding all things like that. A robot will pick up milk drop or mastitis in the milk; it can't sort of look at the general health of a cow. (non AMS user).

Yet for some AMS users, the technology enhanced the relationship they had with their cows, contributing to a valuable hybrid capital co-produced by, and incorporating, humans

and machines. The following comment exemplifies an affective corporeality that technology can potentially bring into a dairy management system, and which again assists the co-production of hybrid capital by stock keepers, AMS and cows.

> Because I think in an old milking parlour whether you've got them out or in, they were all fetched into a collecting yard and you just went out, shouted at them, sent a few in, milked them and that was the end of it. Whereas [with AMS] you just wander quietly through them … they're quiet, they'll come to you, well a lot of ours will … I think you do sort of get to know your cows an awful lot. I think you do. Definitely! (AMS user)

Agricultural scientific literature makes it clear that cow 'suitability' (in terms of animals' bodily conformation and, increasingly, their genetic potential) in relation to AMS is an important concern. Whilst AMS robots have been designed around the bodies of cows as well as humans, the establishment of AMS on farms, in turn, requires that cows become suited to AMS. Artmann and Bohlsen (2000) suggest taking an instrumental approach to cows who do not conform to technological change, in that all cows not suited to AMS should be replaced with those that conform to the demands of the system. Hybrid capital in robotic milking systems might thus be thought of as dependent on the investment of particular sorts of bovine embodiment. Nevertheless stock keepers in this study were often prepared to keep cows who did not conform and by experimentation and by tinkering with the technology they worked out how it was possible to milk cows manually through the AMS. In such cases robotic milking as hybrid capital is accumulated on the basis of human knowledge and manipulation of animals and technology:

> Well with this machine you can manually milk through a robot. What you do, you get her in the crate itself, and put the milking arm roughly in the position to milk the cow, turn the air off to the arm, the compressed air to the arm, and you just attach the cups manually …you can get around the problem. There are not many problems you can't get around. Well to be fair you could milk any cow… It seemed to work, it milks her anyway, it still records her, because she's still recognised by the computer because she's still got a pedometer on. But yeah I thought we'd have to get rid of her you see? (AMS user)

Earlier in the paper we discussed how habitus sits between field and capital and how it can change in response to experience (Butler, 1999), although Bourdieu had been criticised for not fully engaging with the formative capacity of the habitus to change. In this section we illustrated how hybrid capital emerges and accumulates through the adoption of technology

and a different herd management system: AMS users change their dispositions and practices in order to engage with AMS and make it work efficiently. Part of the objectified cultural capital which comes with adopting AMS requires the users to engage with a different type of knowledge, as illustrated in the following reflection from a non AMS user on what his AMS-using colleagues do:

> …the successful robot people…have got a different…slightly different mindset because they're into technology and they're into computers […] we'll look at, we'll pick up a conductivity list but we don't take a great deal of notice of it because we've had our hands on that cow that day. But … we do go back and look at the graphs on yields and conductivity if we think they're starting to play up. It's quite interesting, how you can see conductivity[2] going up. We do use it a bit but not as much as we could, but we've seen that cow that day, but sometimes it will tell you before you spot it (Non AMS user).

For this farmer, 'having one's hands' on a cow each day means that the automated electronic monitoring offered by AMS is less useful, whereas the AMS-using farmer becomes increasingly dependent on the technology.

Thus the 'sedimented ritual activity' (Butler, 1999:115), the habitus that the body absorbs together with a change in routine, changes, as the AMS modifies working practices, produces new tacit knowledges, and creates new technologically-mediated human-cow relationships. Stockkeepers' willingness to engage with, and to an increasing extent be guided by, computer-generated data illustrates the emergence of a hybrid dairying capital which enrols stock-keepers, cows and technologies into a collective entity. Clearly all farmers work with technologies of different sorts. Key here, however, is the extent to which the microgeographies of the dairy farm and dairy farm practices are now being modified and remodelled because of the introduction of AMS technology.

Conclusions.

In this paper we have drawn on the work of Bourdieu , and his concepts of field, capital and habitus, to explore the changing nature of 'stockmanship' in dairy farming in relation to the adoption of a relatively new and potentially transformative technology. The paper suggested that in practices within fields involving complex associations between humans, nonhuman animals and technologies, and the negotiation of new ways of 'being' a dairy stockperson through the emergence of new kinds of stockperson habitus, existing categories of

[2] Milk conductivity is used to indicate the presence of mastitis, an udder infection.

Bourdieusian capital can be usefully supplemented with the concept of hybrid capital. The concept aims to capture a sense in which the capital which is created by and accumulates within AMS dairying is co-produced by people, nonhuman animals and technologies. The paper drew on an understanding of technologies constituted within, and also constituting, the social field in which they are located. In the case of AMS, the technology is part of an entangled hierarchy of machine-cow-stock keeper where each component is reliant on the other for the hierarchy to function efficiently. This hierarchy changes the nature of the capital that can be accumulated in this particular field, producing what we have called hybrid capital. Hybrid capital has a number of properties which are defined only in relation to technology, animals and the stockkeeper.

Technology, as objectified cultural capital, becomes defined in the relationships it has with human embodied and cultural capitals and bovine embodied capital: in the case of both the humans and the cows, their habitus (embodied knowledges and skills) are prerequisites for the creation of these capitals. To possess the AMS a stock person only needs to buy it, but to be able to operate it efficiently and productively, and to create and become part of a hybrid capital associated with AMS, the stock person needs to draw on historically acquired experiential knowledge together with a willingness to create and transform the field in which they are situated.

AMS as an agricultural technology is predicted by some to become more popular (Gibson, 2014). As such, the field-specific hybrid capital it is associated with is likely to become more recognised, valuable and widespread as the UK dairying field changes accordingly. At the moment, the hybrid capital associated with AMS would appear to hold little by the way of exchange value in the traditional dairy field where tacit, ‘hands-on’ knowledge has a greater value than data generated by a computer. However, even ‘conventional’ milking systems are increasingly capable of generating data equivalent to that of AMS, and thus although the AMS-versus-conventional milking distinction is currently seen as something of a fracture line within the wider field of dairy farming, it is unlikely to lead to the emergence of entirely separate (AMS and non-AMS) fields. Instead, AMS contributes to an existing heterogeneity within the diary field. However, AMS is implicated in the reconstitution of the dairying field, as (at least some) farmers learn to cope with and use greater amounts of electronic data in their farming, increasingly expect such data to be available, and see the generation and competent use of data as core to their understanding of what it is to be a good dairy farmer. It is, perhaps, an emerging distinction between dairy farmers who generate and use complex datasets (whether via AMS or other milking technologies) and those who do not, which will become more important in the dairying field than the use, or non-use, of AMS.

The concept of hybrid capital has traction, of course, in other agricultural contexts in which the interventions associated with new technologies become entangled with emergent human-nonhuman relationships of different kinds, and as specific agricultural (Bourdieusian) practices and fields are restructured around changing human-animal-technology combinations. Examining the implications of these changes in different contexts will be valuable in understanding how the farming habitus of particular situations changes and becomes newly valorised through accumulations of the human knowledge-practices which partly constitute hybrid capitals.

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