The work of repair: Gesture, emotion and sensual knowledge

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Abstract

As the pressure on limited natural resources and energy increases so the trend of the consumer society of the twentieth century towards discarding things that stop working and replacing them will shift towards a recycling and repairing things. This paper contrasts the work of production with the work of repair and argues that the later is an artisanal process in tune with the species being of humans identified by Marx. Amongst the distinctive characteristics of the work of repair are the use of a complex repertoire of gestures, a variable emotional tone and the gathering of sensual knowledge. These distinctively human characteristics are not amenable to systematisation or replication in a machine process. The argument is illustrated with reference to more than sixty years of research on mechanised production in the car industry and a recent study of the work of repairing cars in local garages. Video data – here summarised with still images – is used to show the complex process of the work of repair that is explored in the light of theoretical perspectives from Leroi-Gourhan, Hendrick, and Merleau-Ponty.

Keywords: work, repair, cars, phenomenology, material interaction

Acknowledgements:

This paper draws on the project, 'Car Care: The Professional Repair and Maintenance of the Private Car', that was conducted at University of East Anglia in 2002 and was funded by ESRC Small Grant No: R 00023370. I would like to thank Dr. David Bowles who undertook the fieldwork and participated in every aspect of the project.

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Introduction

The techniques of mass production have not only reduced the number of goods that are made with craft skills, they have also led to goods that are less amenable to repair (Graham and Thrift 2007). But as we enter an era when the conservation of material resources and especially energy becomes urgent, the repair of useful objects offers even higher value than re-cycling components and materials. As well as making the best use of natural resources the work of repair, as this paper will argue, offers more interesting and rewarding work than that of original machine-based production.

So why has the work of repair not been valued more highly? If the item is not put together by hands, then it is often more difficult and more expensive to make it accessible to the hands of those who might repair it once it fails to work. There are other incentives to manufacturers to make things that are unrepairable. Firstly, when the item breaks down, the user is compelled to throw it away and buy a new one. Secondly, by 'black boxing' the item, sealing it so that it cannot be opened for repair, the risk of damage by tinkerers – the would-be repairer or the simply curious – is removed. Thirdly, the item may be designed to be smaller, more compact and simpler if reusable connections are excluded (e.g. rivets instead of screws, heat sealed joints instead of pushfit clips). These factors play within a context in which the price of the labour of repair becomes relatively high compared with the cost of manufacturing a replacement, the reliability of machine-based manufacture greatly reduces the need for repair and the sophisticated engineering and manufacture of components can lead to planned obsolescence. A number of social systems in consumer societies also contribute to the a relative lack of interest in repair; the fashion system drives an aesthetic that is linked to status and a desire for the new, the progression of functionality makes older items out-dated and shifts in compatibility networks produce obsolescence (vinyl to audio tape to CD, video to DVD etc.)

Domestic electrical and electronic equipment from toasters to portable radios, video recorders to washing machines are the sorts of items where repair is in principle possible but it is often cheaper and more convenient to replace the item. Furniture, furnishings, clothes and other soft material items are also likely to be in this category; shoes with composite soles 'wear out' and are seldom repaired. The idea of the 'throwaway' society has however become less acceptable as concerns for finite resources, the massive consumption of energy in producing new goods and a resistance to the values of material progress and fashion have been questioned. The possibility of repairing the material stuff of our society is

perhaps an important response to these concerns that should attract our attention more than it did in the middle decades of the twentieth century. However, within the material culture of the western industrialised societies a number of strands of repair have been sustained in the face of consumerist, throwaway society. One is the repair and refurbishment of the material systems and environment of buildings, both those in some sort of corporate ownership and those possessed as homes. Another is the repair of systems, machines and networks (e.g. those delivering power, communication, transport) that have become integral to the workings of modern societies (Orr 1996). A third is the continued status of certain types of objects that have an aesthetic value that makes their repair worthwhile – e.g. leather-soled shoes, listed buildings, antiques and handcrafted objects. However, amongst the mundane objects within contemporary material culture, used by all, owned and possessed by most, the motor-car is one that continues to be regularly and routinely serviced and repaired.

The motor vehicle continues to be an object that is owned in a variety of ways but is seldom treated as a throwaway item by anybody; those who purchase and use cars, lorries, buses and motorcycles expect them to be repairable and at some stage to need repairing. These are things that are routinely serviced as well as checked under the MOT system in the UK on the principle that they are repairable to maintain them at a continuing standard of safe functionality. This work of repair goes on in any country where there are people and cars; in rural villages and suburbs, as well as the centres of cities and industrial areas (Edgerton 2006: 83; Verrips and Meyer 2001: 165-173; Young 2001: 49). Cars are repaired in a variety of different sites: in corner workshops, behind petrol stations, in large retail units, on industrial estates and on the site of car dealerships on the ring roads of cities (Edgerton 2006: 80).

In this paper I want to use the work of repair of the ordinary domestic car as an exemplar to point out differences in the work of repair from the work of manufacture, especially machine-based manufacture. I will firstly discuss work with machines – in particular the work of making cars – to provide a contrast with the work of repair. I will then point to three particular aspects of the work of repair from a study of service and repair work on cars; the importance of gesture, emotion and sensual knowledge. These are all embodied capacities of human phenomenology that are so fundamental to our being that we take them for granted. Many other animals clearly have gestures, emotions and acquire sensual knowledge, but what is distinctive about the importance of these for human beings is that they are an integral part of the creative process of making that, with Marx, I take to be fundamental to human ‘species being’ (Marx 1975). Here I want to argue that they are also integral to the work of repair that has much in common with craft or artisanal work except that it lacks a new, finished product

to show for it. Before looking in turn at gestures, emotions and the acquisition of sensual knowledge using examples from car repair work, I will first discuss the work of the manufacture of cars against which I will contrast the work of repair.

The work of manufacture

The species being of humans lies in their capacity for creativity beyond immediate need and Marx went on to describe the mode of production that exploited this excess of creative impulse through a progressively mechanised division of labour that reproduced, exactly and virtually endlessly, the gestures by which artisan workers had previously made things. Industrialised production changed not only the mode of production but also the mode of interaction between the worker and the objects of their creativity; tools and products (Marx 1976 – see Dant 2005: 14-18). The work needed to produce things that people need for living – domestic equipment, clothes, furniture, furnishings, tools, communication devices, cars and so on – has progressively been industrialised over the course of the twentieth century. But it was the mass production of cars that led the way and the Ford factory provided an exemplar of this emergent system of manufacture giving us the label 'fordism' to describe centralised industrial production dependent on capital accumulation, sophisticated machine tools, a de-skilled but high-waged labour force and a high demand for the finished product. Fordism produces standardised goods at dramatically lower prices than similar goods produced by an artisanal production system – but at a cost.

As early as the 1950s Georges Freidmann was analysing the dehumanising consequences of divided, automated work. In 1948 he was told by a manager of a motorcar factory 'We try to reduce skill to a minimum' (Friedmann 1956: 2) and his subsequent investigation explored the harmful effects of replacing manual work to leave only the serving of machines with blank parts that drilled, pressed or moulded them to shape quickly and exactly, tasks that lacked the 'balancing virtues of real work' (Friedmann 1956: 155). The problems of monotony and boredom with a mechanically controlled work pace, the minimal skill required, the predetermination of tools and techniques and the superficial mental attention needed by the auto-assembly line worker were identified early on (Walker and Guest 1952). In the late 1960s Huw Beynon studied the tedium, monotony and dullness of work on the line in UK Ford plants that meant the workers 'blanked out their minds' to get by (1973: 127). The 'degradation of work' (Braverman 1974) was associated with the way that the car industry developed machine tools and the moving assembly line to maximise the division of labour to dehumanising effect (Linhart 1981). Of course the alienation of workers had consequences in terms of industrial disputes (Beynon 1973) and falling productivity so that later in the

twentieth century there were changes, most notably the introduction of ‘lean production’ (Womack et al. 1990). There is skilled work in mass auto manufacture (Beynon reckons no more than one in a hundred jobs were skilled - 1973: 126) but it is often to do with repair of the line and cars that have been improperly made. One of the things that Toyota’s lean production system led to was team working and less division of labour so that the workers would be able to stop the line and fix things that had gone wrong themselves. ‘Reworking’ of poorly made vehicles was reduced by the ‘relentless attention to preventing defects’ by the workforce that was highly motivated by their job for life and involvement in managing the line (Womack et al. 1990: 78-80). A different version of team working was the ‘parallelised’ long cycle, whole car, ‘tilted assembly’ system at Volvo’s Uddevalla plant in the late 1980s that closed in 1993 (Sandberg 1995). A further variant was the ‘short flow’ or assembly cell that fitted truck cabs in-situ introduced at Volvo during the 1990s that again for managerial and organisational reasons did not continue beyond 2002 (Wallace 2008).

The stress of just-in-time production, that gives the worker responsibility for managing the stock of parts on the line but no control over their delivery, is described by Laurie Graham’s (1995) first hand account of work ‘on the line’. Although in principle any worker can stop the line, in practice the team leader does this only when there is no alternative. Unusually in the literature, Graham does not extol the benefits of lean production but actually describes the work, including the sequence of 23 tasks that she completed in a five-minute cycle of work at station ‘one left’, that, once completed, began again and was repeated throughout the eight-hour day. For each station the sequence of tasks is different as different components are added to the ‘body’ of the vehicle on the line; some are trickier to complete in the time, others involve physically demanding tasks such as pushing grommets and clips into tight holes that, through repetition, lead to injury (Graham 1995: 84-93). Rotation of jobs – something identified back in the ‘50s as a managerial response to boredom and monotony (Walker and Guest 1952) – depended on agreement from the team leader and was not routine (Graham 1952: 66-69). The Japanese system of lean production gives workers responsibility for improving work tasks through ‘kaizening’ their own tools, racks or sequences of action to increase the efficiency and safety of the work (Graham 1995: 105-106). However, the overall account of the work Graham gives is of dull, physically hard, intellectually undemanding, repetitive, fast-paced and pressured work with no time for thought, reflection or social interaction while the line is running. What Graham calls ‘Japanese production’ achieves compliance with the company’s requirements hegemonically through behaviour training and a team structure that gives employees responsibility but virtually no control over their work.

In the 1950s Friedmann (1952: xvi) was anticipating the impact of computerised technology that has since then extended the domination of production by automated machines. Machine tools and the moving assembly line shaped the work of car manufacture during the twentieth century and although we now think of this type of work as undertaken by computer controlled robots mimicking the gestures of human bodies, much of the 'fitting' of parts continues to be done by human workers. There are work tasks in mass car manufacture that require creativity and imagination but these are mostly in designing, selling and organisation. Those workers employed on the production line continue to have jobs that require them to repeat the same task of fitting a set of components or a part to each vehicle in exactly the same way within a strict time cycle.

Car production has provided the exemplar of mechanised industrialisation during the twentieth century but the same cannot be said of the car repair industry. It continues to be an artisanal, semi-skilled type of work that routinely confronts workers with many quite different tasks. The worker in a car repair shop is daily presented with different tasks. Even when the tasks are the same (e.g. changing brake pads), each new vehicle is different – different makes, models, ages and conditions. Often the nature of the task is only imprecisely specified in advance and its actual demands only emerge as the work progresses. The repair worker's task has developed over the twentieth century from making, modifying and repairing damaged parts to almost exclusively fitting and adjusting pre-formed new parts. Nonetheless, there is an artisanal skill in identifying the source of a problem and then rectifying it by fitting appropriate spare parts. Removal of old parts can be very difficult and fitting, even of the original manufacturer's specially prepared spare parts, usually requires a range of embodied skills including imagination, dexterity, strength and finely tuned perception. The gestures required for each task can be very different and demand a varying emotional tone that affects how the work proceeds. Car repair technicians need an abstract knowledge base about how cars fit together, how their parts operate and how to use different tools but their knowledge often depends on a sensual, embodied knowledge that is gathered in situ through interaction with the array of objects.

Unlike production line work car repair is then a mode of work that continues in the twenty-first century to call on the imaginative creativity that is entailed in species being. Early in the twentieth century Thorstein Veblen described this human quality as the 'instinct for workmanship' and early in the twenty-first century Richard Sennett (2008) has celebrated once more the role of the 'craftsman'. Repair work (Harper 1987; Orr 1996; Graham and Thrift 2007) is not highly skilled craftsmanship like the making of individual pieces of furniture or even contributing to the hand-building of a car. But it is work that employs many of the

embodied skills that are characteristic of creative human material interaction. Unlike the industrialised production of commodities, the work of repair does require; a complex repertoire of gestures; a variable and responsive emotional tone and a developed capacity for gathering knowledge of particular objects through all the senses.

Gesture

All humans in western industrialised cultures learn common gestures in relation to technical objects that are encountered in everyday life such as twisting knobs, pushing down on levers, pressing buttons. A fundamental device in industrialised society is the screw thread used to firmly join two rigid pieces – a bottle and cap, jar and lid, a screw, nut or bolt – that everyone learns to cope with. But many different types of specialised repair work involve a range of particular gestures and particular tools. The gestures needed to 'screw things together' are familiar, especially for the do-it-yourself engineer and the hobby mechanic, but skilled technicians, such as those who work on cars, learn to handle different types of screw thread (which are usually right handed, but occasionally left handed), different degrees of tightness and a range of tools, each requiring their own distinct set of gestures. The screwdriver and the spanner provide the basic forms for tools to work on objects with threads but car technicians develop skills for using ratcheted, extended and powered versions of both devices with a variety of 'bits' for engaging with screws, nuts and bolts that have different 'heads' and threads. They also adapt tools and incorporate them into gestures that are not those for which they were originally designed.

I am using the word 'gesture' in a way that is a departure from its normal use in English to refer to the movements of the body and the hands for expressing thoughts or feelings to other people (Kendon 1986: 24). André Leroi-Gourhan (1993) uses the word gesture to refer to movements of the hand and body that have a cultural meaning because of what they do; there does not need to be a symbolic code or a recipient for the action to count as a gesture. Leroi-Gourhan recognises that human actions with things are also gestures in the sense that they are learnt from within the culture and have meaning in the way that they transform objects. In a series of works from the 1940s, Leroi-Gourhan, explored the evolutionary relationship between human beings and technology from an archeo-anthropological perspective. He distinguishes the evolution of the human form from that of apes by the ability to use both hands simultaneously while controlling the position and mobility of the body using the legs and lower torso. This produces the animal form that he calls the 'anthropomorph' – hands completely free, erect posture, with brain freed from the vertebral column and able to develop in size and so skill (Leroi-Gourhan 1993: 38).[i] He argues that

the anthropomorph is a distinct evolutionary line from the pitheomorphs – the apes – who do not share the same erect posture (1993: 61). This is important because the physical equipment for gesture – the muscles, bones, flexibility and so on – are present in the apes but they have not been developed to anything like the same extent as in humans. The gestures that are mechanically available to primates are much the same as those available to anthropomorphs; grasping, touching, picking, kneading, peeling, handling. Both apes and anthropomorphs can hold food while tearing it with teeth, crushing it with molars, cutting it with incisors. Both evolutionary lines can hammer with fists, scratch and dig with nails. But gesture in the anthropomorph extends beyond the mechanical capacity of the body. 'From primate to human being, grasping operations do not change in nature but develop in terms of the variety of ends pursued and the delicacy of execution… the result of a technical gesture does not require any part of osteomuscular apparatus that is not already present in the higher monkey: The difference is one of nervous apparatus alone' (Leroi-Gourhan 1993: 239). It is the relationship between gestural capacity and brain capacity that has enabled human evolution to continue outside the body in a way largely unavailable to other species. This evolution has continued through the development of objects, gestures and practices created to meet human needs and desires. Gestures are extended in range and effect by tools that enhance the body in complex and variable ways not nearly matched by any other species. So, it is not the possession of a hand, or the mechanics that surround it, but the hand in relation to posture and brain capacity that enables the gestural complexity of humans in the realisation of species being. Of course working on a production line precisely reduces the range of gesture and the relationship between 'delicacy of execution' guided by the 'nervous apparatus'. Working on a production line requires the exact same gestures to be repeated and the only brain power required is to coordinate bodily actions to coincide with those of a machine. The division of labour derives efficiency through the worker repeating the same sequence of actions many times over, thereby becoming fast, precise and efficient at practice of a single work task.

Working in the repair shop, the technician often repeats the same basic gesture many times, but usually with slight variations to make fine alterations and adjustments in the array of objects. A basic gesture that has been learnt – such as how to hold and turn a screwdriver – is shaped to fit the particular situation and then the gesture and the tool may be combined in a number of different variants on basic gestures. For example, a technician (I'll call him Reg), was observed during a field study of car repair work using a range of different gestures with a series of screwdrivers in his attempt to re-align a sliding van door to make it close smoothly.[ii] The images are a sequence taken from twenty minutes of video of this job – they occur minutes apart. In Fig. 1. Reg uses his hands, together as a soft hammer, in 2. he is

using a sort of screwdriver, one with a star head and a lever style handle, (notice the way his left-hand takes a precision grip on the fitting behind the screw head), in 3. he is using the same screwdriver on a different screw with quite a different grip, the left hand now taking a precision grip to direct the head of the tool. In Figure 4. he is using a traditional slot-head screwdriver but this time as a lever on the middle of the door. A similar levering gesture is used in 5. but here with an old fashioned tyre lever. In 6. the handle of the screwdriver is used as a wedge while his hands are used again as a soft hammer. And then in Figure 7. Reg uses a screwdriver in his right hand and the tyre lever in his left, but both for levering the door; the top one is levering the door outwards towards him, the bottom simultaneously levering it to his left. In Fig. 8. he uses the tyre lever not as a lever but as a 'drift' with a ball pein hammer to drive it.

What the sequence shows is that Reg is able to draw on a wide repertoire of gestures that incorporate a series of tools used in a series of different ways. Just what the task is develops over time; the lack of success in realigning the door early in the job leads to the introduction of more tools and different gestures. The tools chosen are somewhat constrained by the task so the star driver must fit the screw head and the levers must fit the slots. But neither tools nor gestures are specified by the job, they are introduced as and when Reg thinks they are appropriate. The sequence interestingly demonstrates a progression from smaller to larger tools, from finer to larger – and more forceful – gestures as the door appears to resist being realigned. Leroi-Gourhan sees this distinctly human capacity to develop gestures with the hand as linked to the capacity of the mind to develop variations and sequences of gestures that can be drawn on as situations unfold. As he puts it 'The operational synergy of tool and gesture presupposes the existence of a memory in which the behaviour program is stored' (Leroi-Gourhan 1993: 237). Tool use requires technique which must be remembered and brought into play in a flexible and adaptable way in this type of work. Raymond Tallis takes even further the significance of the hand in making humans the particular animal they are:

> **The grip, unlike other motor activity, is always customised to a unique occasion; so variation is both necessary and at the same time, limited in its range…. This constrained arbitrariness is a supreme awakener, awakening the sense of the body as a tool and hence of agency. Of all bodily doings prior to the emergence of speech, those involving the hand are most developed as voluntary actions and the key to the ultimate development of the sense – that we enjoy, uniquely among the animal kingdom – of our bodies as instruments.**
>
> **(Tallis 2003: 204).**

Reg is not making an original object and is not creating something from scratch as we would expect from the artist or the craftsman. But he is exercising the same sorts of skills in using tools and gestures with which to transform the material world; he is using his body as an

instrument. This complex range of gestures (many of which are ineffective) are employed in the particular task of repair, of trying to put the material world back to how it was before damage or deterioration. If it is successful, then there is no sign of the complexity of the work.

Emotion

Working on a production line requires only sufficient emotional tone to repeat the required task, the same series of gestures, without variation or modification. A feature of the system of 'Japanese production' is the cultivation of emotional commitment not to the work itself but to the sustaining of output through commitment to the team, the company and the finished product. This is achieved by collective warm up exercises, team slogans, targets and the 'kaizening' of the production process (Graham 1995: 68-69). Even in repetitive production work a certain emotional attention is continually necessary to spot and correct things before or as soon as they are not right. But in the work of repair the emotional commitment is to the unfolding task, in which there are many unknown possibilities; the work process can only be anticipated in very broad terms. Each task must be assessed and planned and emotional attention needs to focus on not only a final goal but also on the continually changing array of material objects. To complete a repair, some tasks require the technician to modulate emotion as they progress. For example, in an unusual disassembly task observed at a different garage in the same study of repair work in garages, two technicians were working together to remove the subframe from underneath the front of an old Jaguar, originally built in the 1990s. At a particular phase of the job lasting just over three minutes, the emotional tone, which had built up steadily over days, was at a much higher pitch than was usual.

One of the mechanics, who I'll call Rick (in the red overalls), is doing the job of renovating the Jaguar, and the other, I'll call him Oliver (in the orange shirt) came in to help out. Rick and Oliver don't know each other well but what is clear is that Rick is very unconfident about what they are about to do. He has spent the best part of two days in the mundane work of detaching all the bits of the car such as the steering rack and controls from the subframe. But now he is nervous about whether he has read the objects completely and accurately; has he perhaps missed a bolt? Is there a connection of another sort that he didn't spot? Oliver's job is ostensibly as another pair of hands but he has also been welcomed as someone confident to help with a tricky task. This is a potentially dangerous job because if the subframe fell it is heavy enough to do serious injury to anyone in its path (see Fig. 16). The car is up on a lift with the wheels at about head height and ropes supporting the engine from a bar across the engine compartment. Another of their fears is that as the subframe is

removed, these supports fail and the engine simply drops out. The sequence of still images is taken from the tense two minutes that it takes to lower the subframe out of the car and get it onto the floor – the culmination of about eight hours preparatory work. The still images with their pixelated faces cannot communicate much of the emotional tension in the voices and the demeanour of Rick and Oliver during the short travel of the subframe as it is lowered.

They remove the last two bolts holding the subframe and then lower it slowly on a hydraulic jack with a cradle that is designed to lower gearboxes – Rick turns to the researcher and says 'I don't like this… at all!' and as it starts to move says 'Whoa… She's coming'. Oliver stretches underneath the car to open and close the valve on the jack to control the rate of descent (Fig 9). At one point they are concerned that it is snagged – Rick says 'what's that tight on?' They cannot see, but they can ***feel*** through the subframe that it is not descending smoothly on the jack. Rick has to move the subframe on its axis to get it to slide around the roll bar and the steering rack. They are 'reading' the changing array of objects as they move in relation to each other, through their hands and the subframe, through their whole bodies. When Oliver stops the cradle (Fig. 10), he also looks around underneath to see what might be snagging it. Things seems clear but once he opens the valve and the subframe starts to descend again they hear bits falling onto the floor and Rick remarks in a shaky voice, 'washers fallin' off everywhere' (Fig. 11). Their 'visual' and 'haptic' embodied knowledge depends on having experienced similar things before. Neither of them have ever done ***this*** job before but they can feel when it is snagged or has to be manoeuvred round things, the falling washers were not expected and could indicate something in place that should have been removed.

Rick especially has face to lose as a professional mechanic – he hasn't long been in the job and doesn't want to mess this up. His knowledge about the possible consequences of action gives a particular emotional tone to how the two men interact with the objects and with each other. This is not a rational weighing up of risk, it is precisely not calculative, but is a fluid judgement that situates the person in relation to the unfolding situation. Oliver takes a much cooler emotional line and much of what he says are things like 'mine is out', 'I think we're clear', 'that's clear on mine' and the reassuring 'Awright mate?' followed by the warning that the subframe 'might roll to the front slightly' as it eases past the anti-roll bars (Fig. 12). Oliver's spread leg stance is firmly confident and his face looks impassive – the tone of his voice with its rich East Anglian vowels is clear and definite. Rick by contrast looks nervous from the off – his voice is more hesitant and inclined to drop away, as if he is half talking to himself. The emotional tone affects how the two men act – Oliver may be more confident but he respects Rick's nervousness. There was no 'by-the-book' way of removing the subframe;

they had to work out how to do it and then have a go. They take things slowly, stopping and checking a couple of times; this is not a slapdash process, nor is it mere routine. The fact that it went well without damage or injury shows their collaborative mastery over the objects. Rick is relieved and relaxes noticeably afterwards – Oliver is more phlegmatic but is quietly pleased that his command was warranted (Fig. 13).

In the corpus of data from which this incident comes, there are other occasions when there are clues to lack of confidence although none shows quite this level of apparent emotion. What is common to this and many other examples is the pleasure in achievement, a change in emotional tone once a task has been successfully completed. This pleasure comes from the exercise of what Ives Hendrick calls the 'instinct to master' (1943a; 1943b see Tisseron 1999: 134-138). Hendrick, a psychoanalyst, saw the instinct to mastery as something fundamental to human being in a similar way to Thorstein Veblen's (2005) notion of the 'instinct for workmanship'. Neither instinct is like a lower animal's innate biological drive to act in a certain way, but is an instinct to ***learn*** to act with skill. The instinct that Hendrick writes about has the aim of 'effective and integrated performance' that can include bodily interaction with material objects. The emotions of pleasure and satisfaction come from mastery over things; understanding, manipulating and controlling the world of material things like heavy objects and tools that may fail. This always involves a blend of perceptual work in identifying components and their orientation to each other, diagnosing what parts are not working properly and the tactile work of transforming material stuff. In the work of repair, mastery is in confronting the particular task on the particular vehicle and often requires imagination and creativity in improvising a solution to what seemed at first an impossible problem involving old, damaged, obscured, dirty and sometimes rusted-in parts. Mastery involves coping with unpredictability, overcoming obstacles and bringing embodied capacities together to achieve a desired outcome in a given situation.

Sensual knowledge

Where a work task has been precisely specified, the embodied gestures become routine and mastery is removed from the body of the worker and located in the system or machine that controls the task. An array of standard objects should fit together as expected if a machine tool or press has recently manufactured them (though see Graham 1995: 90). But repair work draws on subtle perceptual skills to identify how the effects of wear and damage have led components to deviate from their standard, working, form. These perceptual skills that lead to diagnosis of fault and remedy are very similar to those of craftsman reviewing their progress in making an artefact. The cabinet-maker for example runs his hands over adjacent

surfaces to learn whether they are continuous and smooth or if there are lips, grooves or steps. In working with things of all sorts, eyesight is usually paramount but, as Merleau-Ponty frequently reminds us, perception is not reducible to the workings of a single sense (e.g. 1962: 213). Perception is an embodied process in which the senses work together with the mind to learn something about the world. Eyes work with the body; the head moves, the torso supports the head, the legs bend as necessary and the hands bring objects into viewable range. The sense of sight works in concert with the memory and imagination as well as the senses of touch and proprioception to make sense of surface texture, weight and density. This process of sensual knowledge is continuous, at least monitoring the way in which limbs and tools are working. But some gestures are simply about gathering sensual knowledge to plan future actions.

Reg, who we met using spanners and levers to transform a van door and its fixings, actually spent much of his time simply trying to learn how the door was working and where the defects were. Many of his gestures involved eyes, hands and body but made no attempt to change any of the material objects in the array he was concerned with – he applied no force and used no tools. Much of what he does is opening and shutting the door – from inside, from out, quickly, slowly – as testing actions during which he watches carefully what happens especially at the end of its travel. The door slides parallel to the van side along runners designed so that the final few inches guide it through an angle to fit in line with the side panel and engage with catches at front and back. During the twenty minutes of video of him working on the door he opens and shuts it 35 times – of those some are slow, just-testing-the-movement shuttings but 23 are normal full-effort shuttings to test the closing.

At the beginning of the video, Reg pushes the door gently just to – it clicks shut at the front but it doesn't close completely at the back. He is looking carefully to see how the door moves. Then he releases the door and gives it a more deliberate swing shut, the way that people who use this type of door normally shut them – with a bit of a slam. The door shuts completely this time with both catches at the front and back of the door engaging and it looks as if it works just fine. But Reg is not happy. In a section that lasts less than a minute he begins to run his hand over the bodywork, in a thoughtful way, especially where the closed door is adjacent to body panels. Firstly he touches the middle of the door over the join, then squats and touches lower down, looking at the bottom corner (Fig.15). As the stroking gesture of his right hand comes off the join between the surfaces of the van panels, it touches the join on his face between nose and cheek, reinforcing his reflective engagement with the problem (Fig. 16). Then he looks up, stands up and runs his hands onto the top rear corner of the door panel (Fig. 17). Almost immediately his glance moves to the front of

the door and his body moves, followed by his right hand, which goes to touch the top front of the door (Fig. 18). From the video we can see that his glance leads where his hands follow, his body moving down, up and to the left to support his visual and haptic apparatuses. What is very difficult to see on the video is that there is a much wider gap at the front of the door than there is at the back. Early in the job he had said gruffly to the researcher 'needs to go a little bit higher and in a bit more' after he had failed to get the catch at the back to shut. He solved that problem by adjusting the mountings to get it a little bit higher but still he is not satisfied. Then about five minutes later he turned to the researcher and said 'tremendous gap here isn't it?' as he was touching the gap at the front of the door. Then, a further six minutes later, the video shows him explaining the problem to a mate, George, who he wants to assist him. Reg indicates, by putting his finger into each gap in a measuring gesture, that the one at the front is still much bigger than the one at the back. He points at a nearby van with a similar door for George to compare. Reg says 'y' see the difference?' and George says 'oh yeah'.

Reg brings some important embodied knowledge to the situation; he knows how a door should shut on one of these vans and he knows that the gaps at front and back of the door should be about equal. He also knows that the door should be flush or level with the body panels adjacent to it once it is shut. As he gathers sensual knowledge about ***this*** van door he learns that the gap is bigger at the front and that the door is slightly bent at the back. His previous knowledge tells him this is not as it should be and the comparison between it and how the door is now, as it changes slightly while the work progresses, tells him how to proceed. If the van door continues in its warped, misaligned state, to require a hefty shove to get it to move quickly enough to close properly, its users will notice. But if it opens and clicks shut with a single steady push each time, then they will treat it as normal.

Conclusions

What I have argued in this paper is that the work of repair, here illustrated by examples from repair work on cars, may frequently use standard components that simply need to be 'bolted into place' but in fact the material interaction involved is of a complexity that is similar to artisanal work. However, unlike artisanal making there is no finished product to display the embodied skills employed in the work. In contrast to the machine-based manufacture of objects, including cars, the 'craft' of repair work, such as it is, involves capacities that are distinctively human and very difficult to replicate in a machine and include a repertoire of gestures, a variable range of emotions and the gathering of sensual knowledge. The gestures have been learnt through the culture from a combination of watching others and

embodied experience, sometimes modified or shaped by advice or instruction. These gestures are effective in transforming the material world in subtle ways, frequently through the use of tools, and the skilled repair worker needs an extensive repertoire of gestures appropriate to her or his field of expertise. The worker draws on the repertoire of gestures and tools iteratively along the lines of 'if this doesn't work, perhaps that will' according to imagination and experience rather than system or a programmable sequence. There are programmes and systems used in the work – such as the sequence of operations listed in a repair manual or the set of tasks specified for a service – but even these tend to be adjusted and modified by the worker to fit the particular situation. Emotional tone is important for choosing what gestures are appropriate for particular situations; the repair worker must confront each task with the right blend of boldness and caution if they are not to risk further damage to the car and its equipment or to themselves and their tools. Emotional tone keeps the senses alert to the unforeseen possibilities that may arise. Sensual knowledge is continually being gathered to monitor the work as it progresses but it plays a particularly important role in diagnosing problems and gathering detailed information that, together with embodied knowledge of previous situations, can lead to the right gestures to achieve the repair. In the work of repair these three facets – gesture, emotion and sensual knowledge – may be characteristic but they are indivisible as each capacity is a part of the others in the embodied form of material interaction. Working with things may seem at first glance merely mechanical – indeed those who work on cars to service and repair them used to be known as 'mechanics'. The word mechanical suggests something machine-like; systematic, predictable, precise and exact, whereas the work of repair presents a wide variety of broadly similar but in detail quite different tasks. It is no accident that while machines have progressively ousted craft skills in the work of production, they have only made limited inroads into the work of repairing the stuff of the modern world. In the next phase of post-industrialised material civilization, the work of repair will become more important than it has due to the pressure on resources and energy. It should be accompanied by a revalution of the human work that it involves.

Figures 1-8: Gesture

Fig 1. Hands as soft hammer

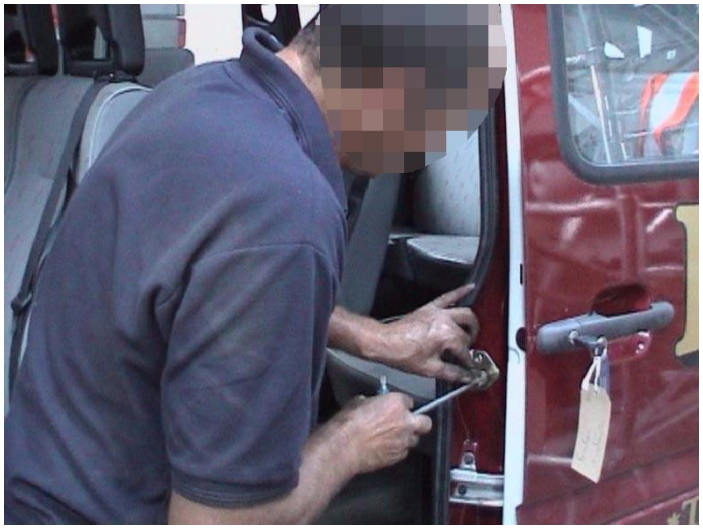

Fig 2. Star screwdriver (grip 1)

Fig 3. Start screwdriver (grip 2)

Fig 4. Screwdriver as lever

Fig 5. Tyre lever as lever

Fig 6. Screwdriver as wedge

Fig 7. Two levers

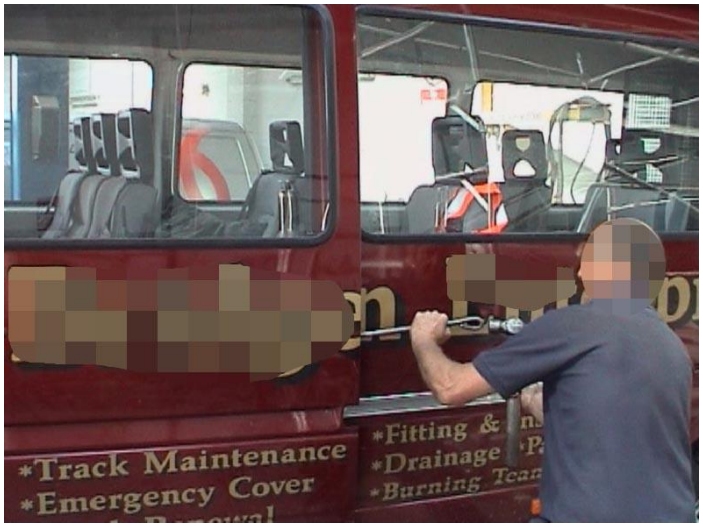

Fig 8. Tyre lever as drift

Figures 9-16: Emotion

Fig. 9. 0:20:20

Fig. 10. 0:38:15

Fig. 11. 0:53:15:

Fig.12 1:08:01

Fig. 13. 1:43:13

Fig. 14. The subframe removed

Figures 15–18: Sensual knowledge

Fig. 15. 0:25:18

Fig. 16. 0:27:16

Fig. 17. 0:34:02

Fig. 18. 0:37:18

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[i] 'Those whose body structure corresponds to the greatest freeing of the hand are also those whose skull is capable of containing the largest brain, for manual liberation and the reduction of stresses exerted upon the cranial dome are two terms of the same mechanical equation' (Leroi-Gourhan 1993: 60).

[ii] The study (see the acknowledgements) involved fieldwork in five local garages of different sizes and organisational structure over a period of seven months in 2001/2. The principal form of data gathered was video of repair and maintenance work as it proceeded normally; the research was designed not to interfere with the flow of ordinary commercial work.