Metering everyday life:
feedback, feedforward and the dynamics of practice

Draft, do not quote: SASE meeting, Budapest, 30th June - 2nd July 2005

Mika Pantzar, NCRC, Finland (mika.pantzar@ncrc.fi**)**
Elizabeth Shove, Lancaster University, England (e.shove@lancaster.ac.uk**)**

Abstract

Where do devices as diverse as bathroom scales, pedometers, electric meters, heart rate meters, bank statements and 'hedonimeters'[1] belong with respect to the construction of societal problems and the reproduction of everyday life? We focus on two aspects. First, metering permits aggregation. As such it influences state-level concerns and informs the design and implementation of policy regarding national health, welfare and well being. Second, metering technologies provide users with feedback on the outcomes and consequences of past practice. This is of some significance for what happens next and for what they do in the future.

Metering is one amongst other forms of connective tissue that have the dual effect of a) linking individual-micro performances thereby generating images and knowledge of macro-societal performance at any one point in time whilst b) spanning between past, present and future. We are interested in both forms of connectivity. While we deal with different metering technologies, we concentrate on the personal monitoring of heart and weight. Our aim is to show how metering and feedback - as institutionalised forms of memory - are implicated in patterns of continuity and change.

Introduction

"The collection of ground data by video, audio, and other sensors, night and day round the clock, is routine…One of the effect of the Information Age has been to promote all kinds of scorekeeping, for personal performance, group performance, and team performance.
(Coates etc. 1997, 52- 53).

"The assimilation of real-world data of every form…enables new computers…Radio networks and GPS opens up more possibilities by having objects that know where they are and can report their state and that are not just adaptations of cellular phones. Nothing – from keys to cars to people – need be lost". (Denning, 1997, 29).

"Fully awake, you head to the bathroom. You brush your teeth, and some of your mellow disposition starts to disappear. That terrible sink is at it again. It has detected minor traces of blood from your gums and is now scolding you in a deep parental voice: "At the rate you are going there is a fifty-fifty chance that you will have a periodontal incident in twelve to fifteen months and a loss of half your teeth by the time you are fifty-five years old". Mumbling to yourself, you reach for the rubber tip and hope for the best." (Dertouzos, 1997, 117).

"Robert wandered into the bathroom, which turned on its lights when it detected his arrival. "Your sugar level appears to be satisfactory", announced the house computer, having received the urinalysis from the instrumented toilet in the bathroom." (Cerf, 1997, 34).

"Once the electronics are integrated into the house and with one another, you will not notice them any more or less than you notice your present hot water hater, furnace, refrigerator, washer and dryer and other electromechanical gadgets. The difference, of course, is that the new devices will communicate with one another about their goals and their problems"(Dertouzos, 1997, 130).

As these quotations show, futurologists see everyday life as an arena increasingly dominated by performance meters and metering devices. Although we are sceptical about some of these anticipated future developments, there is no doubt that meters and practices of everyday metering

have developed significantly over the last century. Not only are meters more common, their accuracy has increased and metering/measuring devices have become ever more portable, more individualised and more widely distributed. The digitalisation of new kinds of data such as that produced by GPS systems is likely to have a greater role in everyday life and to permit new kinds of accumulation and record keeping. It will perhaps become possible to follow and record real time data representing the weight, the pulse and the speed of a nation.

This paper is part of a larger project in which we develop an *integrative* theory of practice (Pantzar and Shove 2005; Shove and Pantzar 2005). As we explain below, everyday metering and what we term the ' analytics of daily life' is interesting and important because of the part it plays in sustaining, defining and reproducing practice. More specifically, it is through metering that different practices influence and inform each other. Equally important, meters permit specific forms of feedback (and feed forward) in time and space. Critically, these processes and effects occur at the level of individual actors and of society as a whole. Taking these ideas forward, we focus on the part metering devices play in the reproduction and production of everyday life. Before investigating a couple of cases - personal weight and heart rate metering - we introduce relevant aspects of our more general argument.

Circuits of reproduction

Practices like jogging, cycling, cooking and eating exist as recognisable entities. At the same time, they require constant and active reproduction (performance). In analysing the relation between practice-as-performance and practice-as-entity we pay particular attention to necessary and sustaining ' circuits of reproduction' . We use this term to refer to a process which underpins what Giddens conceptualises as the duality of structure and Bourdieu writes about as habitus: both having in mind a two-way relationship between actions and the consequences of such actions. Similar notions are introduced by Weick who suggests that "the structure that determines what an organization does and how it appears is the same structure that is established by regular patterns of interlocked behaviours" (1969: 43).

These and other such statements about the duality of structure rarely specify just how these processes of mutual establishment work out in practice. We suggest that a study of metering provides some clues as to the qualities and characteristics of everyday circuits of reproduction.

The literature on practice theory points in a similar direction. Accounts of order that refer to practice presume a society made of active members, not passive elements in a ready-made structure but "members who reconstitute the system of shared practices by drawing upon it as a set of resources in the course of living their lives" (Barnes 2001: 17). Taking up the story, Schatzki continues: practices are linked by "cross-referencing and interdependent know-hows that they express concerning their performance, identification, instigation and response" (Schatzki 2001: 50). Minimally, practice theory sensitizes and structures thinking about the dynamic reproduction of business and everyday life. It shows how consumers as well as producers change within social and material structures and how they also effect changes in these structures. Seen in this way, metering devices are not simply solutions to existing needs: they have transformative potential in the lives and practices of individuals and of society itself.

To summarise, practices exist as recognisable entities. At the same time, they require constant and active reproduction. Metering is one among other forms of connective tissue that link a) performance and entity and b) past, present and future. Feedback is critical for the endurance of practices over time and for their diffusion and aggregation. Methods of metering (partly) construct the practices they sustain

It is, in addition, possible that the rise of metering is symptomatic of a more general phenomenon that has to do with changes in the ' connective tissue' of society. For example, Clegg and Wilson (1991) identify a general cultural shift from a mechanical worldview (e.g. Hobbes) to a circulatory

conceptualisation (and materialisation) of power (e.g. Foucault, Machiavelli). Whether we go along with this analysis or not, systematic tendencies in metering deserve careful scrutiny for they are deeply implicated in, and in a sense constitutive of, critical circuits of reproduction.

Approaching metering

With these issues in mind, we approach metering from a socio-historical perspective. We ask where metering devices as diverse as personal weighing technologies (bathroom scales), speedometers, pedometers, GPS technologies and heart-rate meters belong with respect to the construction of societal issues and the reproduction of everyday practice. As hinted at above, we suggest that there is a strong sense in which meters constitute what they measure with the result that there is a close, mutually generative connection for instance between ' weight watching' and bathroom scales. There are several dimensions to this connection.

First, metering permits aggregation of cases. It can be used to generate statistics - a move in which individual data is combined to produce a collective picture, for instance of the weight or financial well being of a nation. As such, it influences state-level concerns and informs the design and implementation of national policy. The more general history of statistics is relevant for our argument here, as is the work of David Armstrong, who writes about the aggregation and averaging of data involved in producing the ' normal' patient (Armstrong, 1983).

Second, metering technologies provide users with feedback (some instant, some delayed) on the outcomes and consequences of past performance. This is typically of some significance for what they do next. Accordingly, record keeping is not only a matter of history; it also shapes the future.

Alex Preda' s (2002) work on the ticker provides a model for our analysis. As Preda explains, the ticker, invented in 1867, changed the cognitive bases of financial markets. The ticker introduced a new language and a new mode of abstract representation. As such it turned out to be much more than a neutral medium for the speedy and accurate transmission of price information. The ticker required the permanent presence and attention of investors. It changed the ways in which financial markets operated. Paradoxically affective structures emerged which ran counter to rational responses based on maximizing profit (Preda, 2002, 3). Preda suggests that ticker was “a nexus of mutually reinforcing language and representation modes, cognitive instruments and rules, and teleo-affective structures” (Preda, 2002, 2). Do other everyday meters work in the same way, do they permit systematically different types of feedback and exactly how do they function ' in practice' ? We begin with a discussion of the human ' ticker' and of heart rate metering.

Heart rate metering

The (financial) ticker made manifest and in a sense made possible two-ways linkages between macroscopic (financial economy) and microscopic (private calculation) order. New roles emerged as the ticker technology brought new emotions into the world of investment. Are there parallels with heart rate metering?

The first wireless heart rate meter (the portable Polar PE2000) was introduced in 1983. It consisted of a transmitter and a receiver. The transmitter was attached to the chest using an elastic electrode belt. The receiver was a watch-like monitor worn on the wrist (Laukkanen and Virtanen 1998). Initially developed as a means of recording and processing ' serious' information about critical medical conditions, the heart rate meter has become an increasingly necessary piece of sports equipment and a symbol of healthy living.

For several centuries, heart rate monitoring involved placing an ear on the patient’s chest. 200 years ago the stethoscope was invented. This device made heart rate metering more accurate[2] but the real turning point came at the start of the 20th century when the Dutch physiologist Willem Einthoven, developed the first electrocardiograph (ECG). Soon afterwards, a portable version - the

Holter monitor - capable of monitoring individual ECG for 24 hours was introduced (Achten, 2002). With ECG it became possible to make a graphic recording of electric activity present in the heart. As Bert and Harterink (2004) have shown, graphic recordings of the state of the body challenged and radically changed how patients and illnesses were understood at the end of the 19th century.

Today, according to a rough estimate, some five million people around the world are using portable heart rate meters. These devices have moved out from hospitals and doctor' s surgeries and have been associated first with extreme sports and exercise and now with ' ordinary' fitness and weight watching.

So far, Polar Electro has been the dominant supplier of heart rate meters. In the beginning it was important to demonstrate that portable heart rate meters produced reliable data in the field. Today nearly 30 years and over 500 research trial later, measuring heart rate is standard practice (La Forge, Kosich, 1996, 21). Most studies report that portable electronic monitoring is more accurate than manual pulse palpation (La Forge R., D. Kosich (1996, 25) or than methods of detecting heart rate at the earlobe or fingertip via photo-optic techniques. The accuracy of portable heart rate meters was initially compared with older versions like the electrocardiogram and the Holter monitoring device. Several clinical studies demonstrated that there was no significant difference in the accuracy of wireless monitors and large ECG units (Burke 1994) but it was not until the mid 1990s that "Reliable light weight telemetry systems (heart rate monitors)"… became "available at a reasonable cost" Maughan 1994)

As heart rate metering shifted from a medical to a sporting environment so the nature and significance of measurement changed. For example, the fitness industry has a long-standing interest in the concept of a ' target' heart rate. Early guidelines for aerobic fitness were set out in the mid-60s by Kenneth Cooper, who went on to set standards for cardiac rehabilitation. An important but more recent development is an explicit emphasis on the role of heart rate metering as a technology of self-governance. As a coach from Finland' s Vierumäki sport institute explains: “We need more coaches and trainers to make Finns more fit. HRM is a good substitute for human coach” (Matti Heikkilä 15.02.2004). . This role is clearly articulated in the following headings taken from Polar Electro' s 2005 booklet. “Tune up your engine”, “Black belt in fitness”, Turn Information into speed”, “Listen to your body”, “Measures everything but guts”. One press release by Polar electro proclaimed that now it is possible to measure “how old you really are", the idea being that by doing sport one can resist aging.

These slogans suppose that heart rate meter users are information processors hungry for information and self-observation. This is an image in which modern ideals of control are taken to a new level: our body is increasingly controlled by our reason (the Cartesian project perfected) with the aid of new technology. Once equipped with a heart rate mater, an individual becomes a knowable, calculable and administrable object. Are we transforming ourselves into machines whose predictability and governability matters? Is body monitoring acquiring a role similar to that of cost accounting and cost sheets in business contexts?

A Cooper Institute expert in obesity studies talks in terms that echo those used in business. For example, weight watching is about "skill building" and helping people "to make strategies to help themselves". The result is a Taylorism of everyday life in which American self-help traditions are combined with a rhetoric of business management. In commenting on such trends, Peter Miller and Nikolas Rose develop Foucault' s concept of governmentality, especially its programmatic character: "The ' autonomous' subjectivity of the productive individual has become a central economic resource, such programmes (e.g. team concepts of business consultants) promise to turn autonomy into an ally of economic success and not an obstacle to be controlled and disciplined" …"Work is an essential element in the path to self realization…Our argument has been that in advanced liberal democracies…these technologies increasingly seek to act upon and instrumentalize the self-regulating propensities of individuals in order to ally them with socio-political objectives"(Miller and Rose, 1990, 26-28).

Miller and Rose suggest that policy should be located within a wide discursive field in which conceptions of the proper ends and means of government are articulated. They propose “an analysis of what Michel Foucault terms ' political rationalities' ". Somewhat in contrast, we argue for a view of ' discourse' as an outcome of technologically mediated processes of writing, listing, numbering and computing that "render a realm into discourse as a knowable, calculable and administrable objects" (Miller, Rose, 1990, 5).

The drift of our argument is that technological developments in the portability, precision and ' accuracy' of heart rate meters has transformed the realm of everyday calculability. They allow us to ' see' our own heart (instant feedback), and in seeing, allow us to make adjustments in what we do: they allow us to quite literally tune our own engine. The results are made evident through longer term record keeping - a personalising of the medical record. As such heart rate meters have the potential to re-define the meaning of being well. For the time being, it is the individual body rather than the body of society that is the subject of this kind of attention. The ' pulse of the nation' is not yet a concept that makes much sense.

Personal weight and the bathroom scales

In a number of western countries, obesity is becoming something of a national crisis. Data from the USA illustrates the rate at which certain sections of the population are becoming ' overweight' (Mokdad et. al. 1999; 2001). Cumulative analysis of trends depends, in this instance, on millions of individual readings based on the output of a rather simple device: the bathroom scales. We have so far failed to find a good social history of this technology but it seems that the first personal weighing instruments for everyday use were produced by Salter in the UK 1897, and that bathroom scales were widely diffused by the 1930s. In everyday life, people stand on the bathroom scales and keep an actual or mental note of what they weight. For those who want to gain or lose weight, this information is ' activated' as input to a range of related practices including cooking, eating, shopping and exercising. Standing on the scales again constitutes a form of individual feed-back.

As indicated above, specification of national trends in obesity and its definition as a problem depend upon a) the aggregation of individual data and b) record keeping over time. The ' weight of the nation' is already a meaningful concept and one which is itself a subject of concern for health policy. As with individual heart-rate metering, so the weight of the nation provides a benchmark against which to evaluate the impact of different strategies - (re-designing school meals, providing advice and information campaigns, facilitating exercise.. etc.) designed to ' correct' the national body. This sort of feedback has further effects, for example, on the decision to invest more in modifying the nation' s diet or the nation' s habits.

Monitoring and reproduction

Returning to our opening comments on practice theory, this brief discussion of heart-rate metering and of personal weighing allows us to distinguish between four metering situations, each relating to a different circuit of reproduction.

1. instant individual feedback
Certain forms of metering provide instant feedback related to a close-coupled circuit of reproduction. A heart rate meter shows the effect of exercise in real time. A GPS device gives an instant reading of location and a speedometer shows how fast you are going at a particular moment. Such information leads to modified or revised actions and performances, the effect of which is instantly revealed.

2. individual performance over time
More commonly, individuals make use of records and successive meter readings collected over time. Accounts of gaining and losing weight (and associated strategies of dieting etc.) are

grounded in a comparative review of data from the bathroom scales gathered over a number of weeks, months or years. Such information leads to modified or revised actions and performances, the effect of which is not instantly revealed.

3. instant but cumulative feedback
The constantly mobile state of financial data (stock exchange, the national equivalent of on-line banking etc) comes closest to the ideal type of instant but cumulative metering. Such information leads to modified or revised actions and performances, the effect of which is instantly if distantly or indirectly revealed.

4. collective performance over time
Historical records of aggregated data relating to national health, wealth, well-being or weight fits this pattern perfectly. Such information leads to modified or revised actions and performances, the effect of which is not instantly revealed and which requires several additional steps of interpretation.

We can represent these types in various ways. Figure 1, for example, plots each in terms of the two dimensions: "time" and "space" (which refers here to the aggregation of multiple data points).

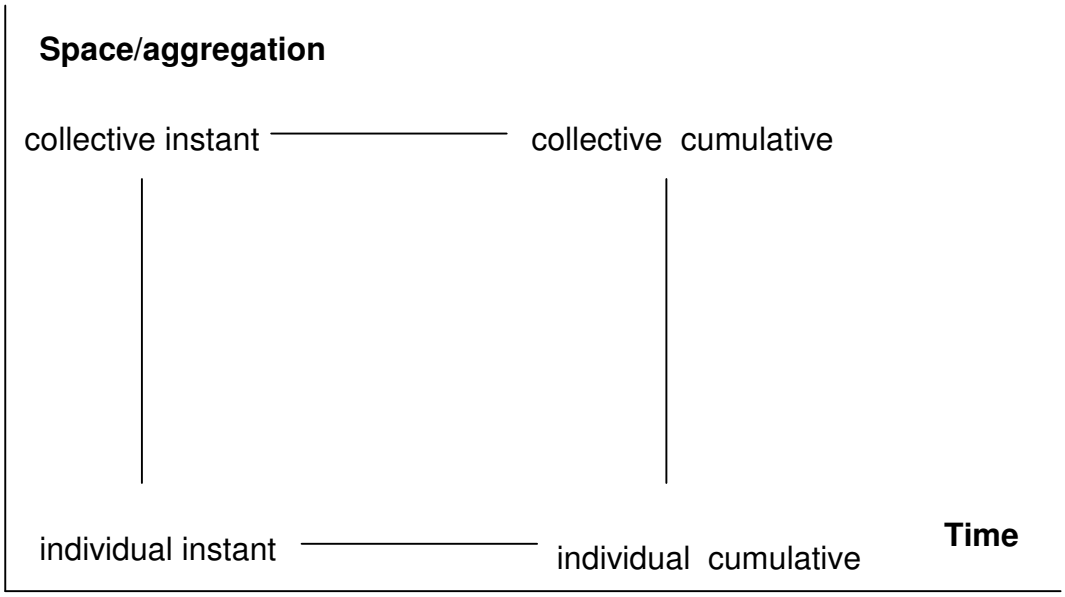

Figure 1. Metering situations and forms of feedback

.
Toying with similar ideas we might think about classifying different types of monitoring into which specific metering technologies fit. Table 1 exemplifies such an approach.

Table 1: meters: their uses and users[3]

	Individual instant	Individual cumulative	Collective instant	Collective cumulative
Bathroom scales	y	Y	n	Y?
GPS	y	N	n	N
pedometer	n	Y	n	Y
Electricity meter	n	y	y	y
speedometer	y	N	n	N
On-line bank account as measure of capacity to spend	y	Y?	Y (stock)	Y (flow)

Although it has some useful features this relatively static scheme fails to show how metering is implicated in the dynamic ' circuits of reproduction' on which practices depend. For that we need another type of representation. Figure 2 comes closer in recognising that specific metering situations have distinctive spatial and temporal qualities. The spot in the centre represents a moment of metering. The two loops describe a) the temporal frequency/interval of metering episodes[4] and b) the number of other cases with which one metering moment is to be aggregated.

Figure 2: Characterising metering episodes

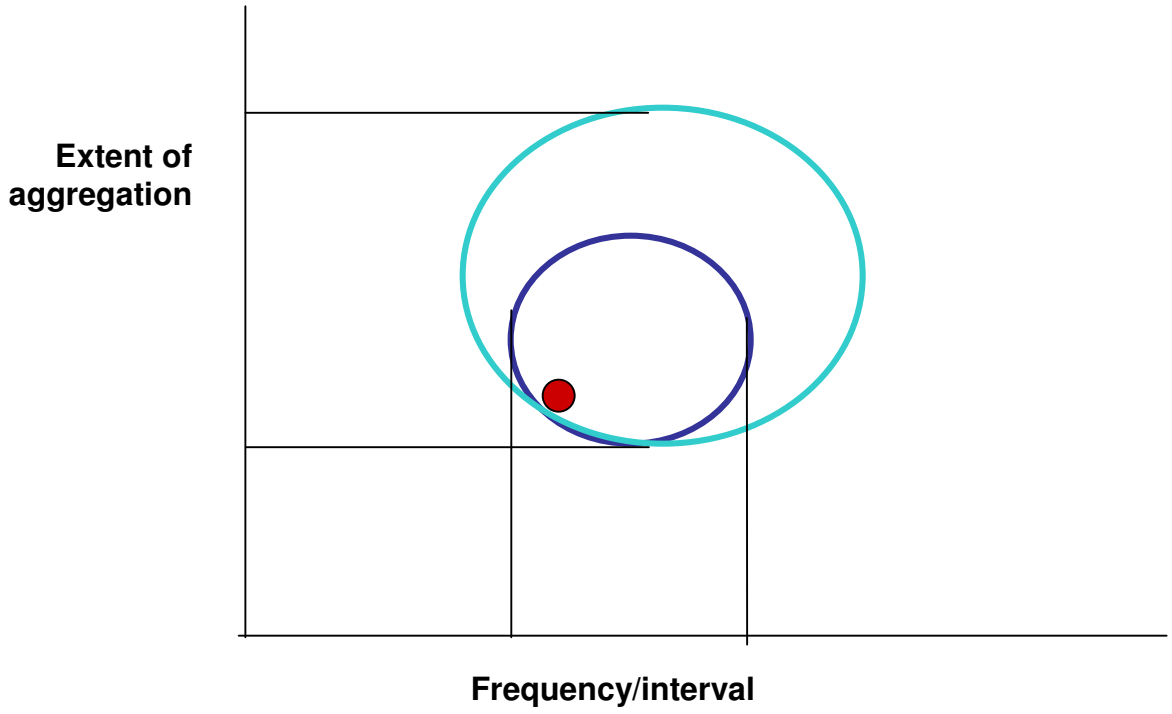

Figure 3 attempts to represent successive moments of metering, showing, in particular, how the extent or spatial reach of feedback can change over time and how the intervals or frequency of feedback and recording might also change. Again the spots signify one moment of metering.

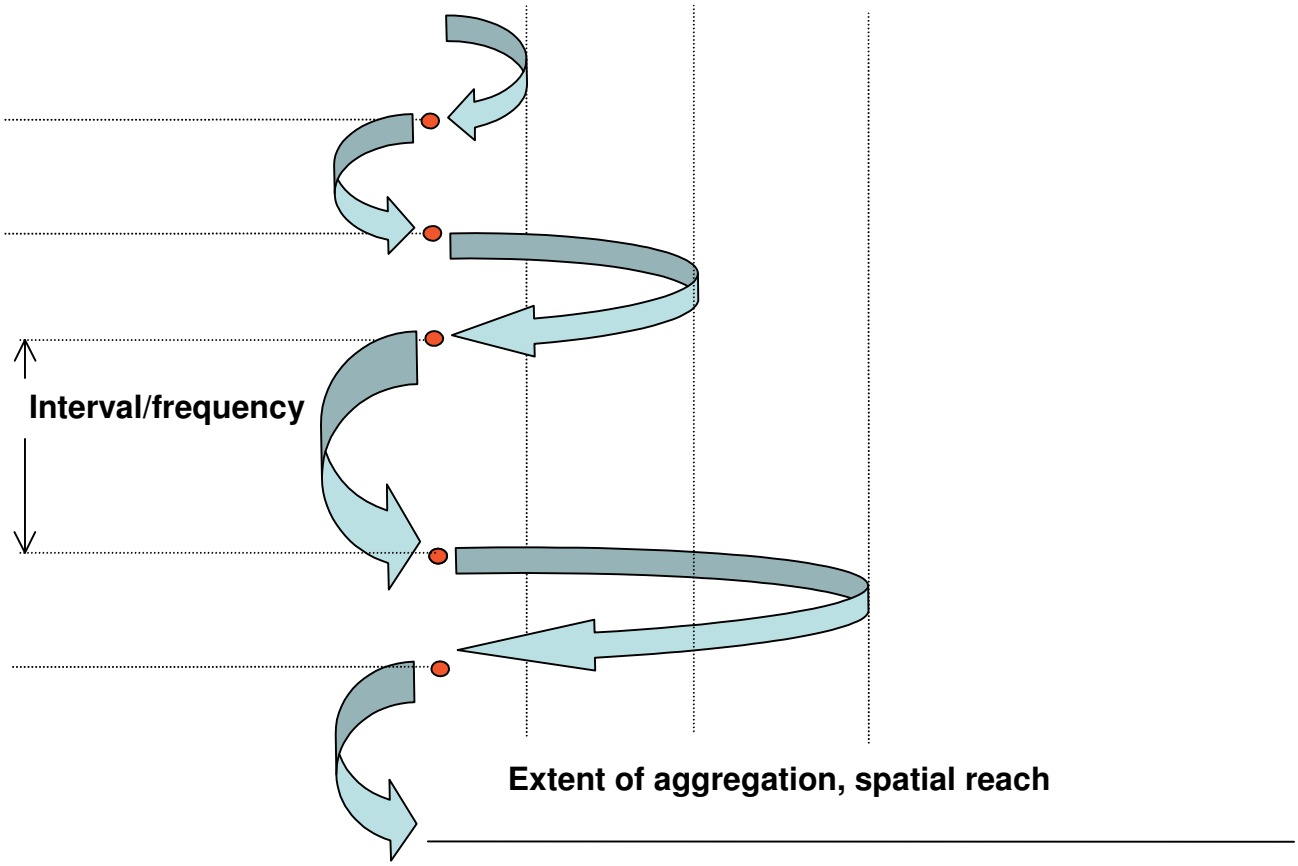

Figure 3: successive moments of metering

Although we are getting closer, we have yet to find a convincing way of showing how metering connects one moment of performance to another, and how performance monitoring influences the evolution of practice-as-entity. This is partly because metering is one amongst other forms of connective tissue that have the dual effect of *simultaneously* a) linking individual-micro performances thereby generating images and knowledge of macro-societal performance at any one point in time whilst b) spanning between past, present and future.

Discussion

By comparing a couple of metering technologies (bathroom scales and heart rate meters) we have begun to isolate some of the ways in which performance feedback works both for the individual and for society. However provisional our analysis, it demonstrates the distinctive role played by metering devices. We conclude that this class of technologies has a special part to play in the reproduction of practice. This leads us to ask further questions, for example, is everyday metering increasing, what types of metering (individual instant; individual collective; collective instant; collective cumulative) are declining and falling and what new metering technologies are being developed and appropriated in practice?

In so far as metering constitutes a form of connective tissue - vital for the reproduction of everyday practice - it is important to pay attention to the following issues:

a) **What is metered** - for example, we might imagine some future instrument, ' the hedonimeter' designed to measure happiness. How might this instrument transform practices that count as fun?

b) **Precision** - Mackenzie (1990) has written about the project of inventing accuracy (for nuclear missiles). In everyday life, how does increasing precision or accuracy re-define types of response and feedback and hence the evolution of practice itself.
c) **Portability** - the development of light weight, portable metering technology has extended the range of situations that are realistically subject to monitoring. Again we might ask what this does to the reach and scope of aggregation, and to the characteristics and qualities of everyday feedback.
d) **Ease of aggregation** - aggregation is typically easier when individual metering technologies generate digital information in a standardised form. Are the latest generations of everyday meters making it easier to generate statistics and instant as well as cumulative portraits of society?

We might also wonder about trends across a range of metering devices: is the tendency towards more frequent but also more localised self-monitoring, is the pattern one of increasing aggregation, or are both taking place simultaneously? In thinking about these questions it is instructive to consider - and speculatively extend - the timeline of a selection of ordinary meters.

1775	Odometer, Benjamin Franklin
1885	Speedometer for rail engines, Charles Babbage
1897	Personal weight scale, Salter, UK.
1892	Electric meter, Edison
1901	Speeding law (12 mph for countryside, 8mph for city) Connecticut
1902	Car speedometer, Otto Schulze, (Siemens) patent
1903	Car speedometer, Samuel Smith in the UK
1910	Car speedometer introduced as standard
1916	Car speedometer, Nikola Tesla
1930	Instrument ' cluster' on the dashboard of a car
1938	Bicycle speedometer
1950	Electrical speedometer
1978	Digital bathroom scale (Tanita, Japan)
1980	Electronic speedometer
1983	wireless heart rate meter
2005	
2010	
2050	….….….….?

We conclude this introductory and somewhat speculative paper with the following observations: all measurements feed into some sort of circuit of reproduction. Metering makes performance visible, and practices depend upon the reproduction of performance. With these ideas in place, we have asked: how do meters construct practices, relations between practices and social systems? What does the proliferation of different types of metering reveal about society? We have yet to answer these questions in any detail but we have nonetheless demonstrated their centrality for theories of practice.

References

Achten, J (2002) Influence of Exercise intensity and training on substrate utilization. dissertation, Human performance laboratory, University of Birmingham, November, 2002

Armstrong, D. (1983), Political Anatomy of the Body: Medical knowledge in Britain in the 20th century, Cambridge: Cambridge University Press.

Barnes B. (2001) Practice as collective action. in Schatzki, T., K. Knorr-Cetina, E. von Savigny (eds.) (2001) The Practice turn in contemporary theory. Routledge. London.

Bert M., P. Harterink (2004) Embodying the patient: Records and bodies in the early 20th century US medical practice. Body&Society, Vol. 10 (2-3), 13-41

Burke (1994). Sports Science Exchange Roundtable Vol. 5, No 2

Cerf, V. G. (1997). When they're everywhere. In *Beyond Calculation. The next fifty yearts of computing*, edited by P. J. Denning and R. M. Metcalfe, pp. 33–42. New York: Springer-Verlag.

Coates, J., Mahaffie, J. and Hines, A. (1997). *2025. Scenarios of US and Global Society reshaped by science and technology.* Greensboro: Oakhill Press.

Denning, P. and Metcalfe R. M. (1997). *Beyond Calculation. The next fifty years of computing.* New York: Springer-Verlag.

Dertouzos, M. (1997). *What will be. How the new world of information will change our lives.* New York: Harper Edge.

La Forge R., D. Kosich (1996) Heart rate, what does heart rate really tell you, and how you apply the information. Idea personal trainer , Sept. 1996, 21-27.

Laukkanen R., Virtanen, P (1998) Heart rate monitors: State of the art. Journal of Sports Sciences, 1998, 16, S3-S7.

Maughan in Sports Science Exchange Roundtable (Vol. 5 (1994)

MacKenzie, D. (1990), Inventing Accuracy: A historical sociology of nuclear missile guidance, Cambridge MA: MIT Press.

Mokdad A H, et al. J Am Med Assoc 1999;282:16, 2001;286:10

Miller, P. - Rose, N. (1990) Governing Economic Life. Economy&Society, 19, 1-31.

Miller, P. - Rose, N. (1997). Mobilizing the Consumer. Assembling the Subject of Consumption. Theory, Culture & Society, Vol. 14(1), 1997, 1-36.

Pantzar, Mika & Shove, Elizabeth (2005a) (eds.) Manufacturing leisure. Innovations in Fun. Helsinki: National Consumer Research Centre.

Pantzar, Mika & Shove, Elizabeth (2005b) Towards a theory of practice innovations – first and second order producers of Nordic Walking; submitted

Reckwitz, A. (2002), ' Towards a Theory of Social Practices: A development in culturallist theorizing' , in European Journal of Social Theory, 5(2)243-63.

Schatzki, T. (1996), Social Practices. Cambridge: Cambridge University Press.

Schatzki (2001a) Introduction: practice theory. in Schatzki, T., K. Knorr-Cetina, E. von Savigny (eds.) (2001) The Practice turn in contemporary theory. Routledge. London

Schatzki (2001b) Practice-mind-ed orders. in Schatzki, T., K. Knorr-Cetina, E. von Savigny (eds.) (2001) The Practice turn in contemporary theory. Routledge. London

Schatzki, T., K. Knorr-Cetina, E. von Savigny (eds.) (2001) The Practice turn in contemporary [5]theory. Routledge. London.

Shove, E., M. Pantzar (2005) Consumers, producers and practices: understanding the invention and reinvention of Nordic Walking, Journal of Consumer Culture. 1/2005

Warde, A. (2003), ' Consumption and Theories of Practice' CRIC Discussion Paper, University of Manchester.

Notes

[1] Hedonimeters are instruments with which to measure happiness.

[2] HRM rests on many uncontrollable black boxes, e.g. to what extent does HRM tell us about real heart beats, to what extent does HRM relate to fitness or weight management, - what does accuracy mean?

[3] Are there some items that are only of interest to the individual and that are NEVER subject to collective recording, what is it that the national-state data collectors can and cannot influence. There is a potentially interesting relationship here between individual agency and collective agency.

[4] One issue is the extent to which change is measured and how – the difference between points in time is important as with weight on the bathroom scales. What are the intervals of measurement? e.g. with tickers. How long do people keep bank statements for – what is the temporality of the issue to which they relate? Does this temporality relate to other features like accuracy – notice that bathroom scales can be digital, GPS gets more accurate, heart rate meter – what is accuracy anyway – speedometer has unchanging accuracy, bank accounts are instantly “accurate”?