

## Fredric Bartlett: through the lens of prediction

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*The major purpose of prediction is to provide amusement for those who live in the future.*  
[Oscar Wilde]

### 1. Preamble

I have little doubt that most of the commentaries on Bartlett's (1962) predictions will be at the very least complementary if not manifestly honorific. And to a large extent these assessments will be appropriate. Bartlett is a giant of our science and it is doubtful if our field would have reached its present status without both his profoundly influential advocacy and his personal intellectual contributions. However, as I myself am the second son of an English middle-class family, born in Gloucestershire, with a penchant for golf on Wednesday and a love of cricket (all characteristics I hold in common with Bartlett) I feel a degree of latitude in presenting a more critical slant in my commentary. I shall apologise unreservedly for traducing Bartlett's memory at the end. However, before examining his specific propositions, I first want to make some brief observations on the pitfalls of prognostication.

*Prediction is very difficult—especially about the future.* [Niels Bohm]

### 2. Predictive under specification

The first essential when making any predictions about the future is to make sure you inject the requisite level of ambiguity. Bartlett's temporal identification of 'the next few years' certainly honours this principle. Was this interval meant to represent the next few years up to the completion of the decade of the sixties? Or, in contrast, was it to connote the next five decades, as the present sequence of responses seems to imply? If the specified timeframe was the former interval then Bartlett's propositions seem over-optimistic, if it is the latter period they seem eerily prescient. In contrast to the rate of progress, his identification of the topics of progress prove much more precise and in

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this he seems to exercise an impressive degree of foresight, but I will argue that these are largely direct linear extrapolations of evident trends of the time and make no great demands on Bartlett's undoubted intellect. Bartlett himself acknowledges this a little later in his own discourse. Indeed, almost any meaningful prediction about the future is close to being utterly meaningless. By this I mean that future predictions that are based upon such direct linear extrapolations of current trends might well prove surprisingly accurate. However, they require no great exercise of intelligence nor do they provide much in terms of informational value. There are, of course, a number of other tricks involved in the generation of predictions of the future that serve to make one look highly impressive and charlatans as well as those who delude themselves into believing in their own psychic powers make either implicit or explicit uses of these strategies all the time. However, to his credit Bartlett eschews any such flummery, although it is virtually certain that he was aware of several of the psychological principles involved since some derive from his own seminal scientific contributions (Bartlett 1932).

### **3. Disputations on the central premise**

The major foundation of Bartlett's general prognostication is threefold. He asks the ergonomist to remain familiar with and cognisant of new innovative technological developments. He next requires the ergonomist to inject their science early in the process of development using what we now term human-centred design principles and finally, he points to the need to study how to reduce the latency between innovation and implementation. I shall not look to discuss the first two propositions, since I believe they are, to a degree, reasonably well grounded and furthermore any dispute of such assertions would take an extended treatise (see Feyerabend 1975). However, the implication of the final exhortation, that we should accelerate the process of widespread adoption by minimising the lag between conception and general implementation cannot pass without challenge.

Let me first say that Bartlett's vision, in respect of this meta-aspect of technological productivity, has been coming more and more into reality. Indeed, his specific example of modelling efforts can be easily equated with the growth of computer aided design (CAD) systems and the ever-greater usage of modelling and simulation technologies and software advances in the process of conception, development, design, test, evaluation, and diffusion of an ever-increasing range of technological innovations. Thus, I am not disputing whether this has happened to a reasonably substantive degree. What I am questioning is whether we should seek to minimise this interval further. In this, I am riding an old and well-beloved personal 'hobby horse' that Bartlett's proposition of accelerated implementation takes no fundamental cognizance of the purposeful or intentional aspect of such innovation. It assumes that ergonomics acts as the passive handmaid of each sequential incarnation of the dominant production system and should therefore serve to facilitate whatever technology is conceived of, irrespective of its fundamental purpose. And this is wrong in its very nature. Paradoxically, as a student of politics and as a political tactician of the highest evident calibre I exonerate Bartlett of any ignorance of this fact and lay any putative 'blame' on his ability to further explore this vital facet of the future to the restricted space that his commentary evidently required, as I will be so limited in my comments also.

But let us consider the end point of such an acceleration strategy. If the full vision of this lag dissipation strategy were achieved, then to conceive would be to create. If the lag

between imagination and realisation were completely erased, and if this capacity were open to all (as it almost inevitably would become), then among technologies of great utility we would also spontaneously be bringing into existence a whole spectrum of maladaptive entities whose measured effects and general integration could result in collective disaster, on a moment by moment basis. I think Bartlett would argue that his general proposition should hold up to a point and that he was looking to this trend as a vector of progress and not a specific end-point to be achieved. In this persuasion, I would generally agree with him. But my argument is not one derived from extrapolation to the absurd. Over the intervening decades, we have trimmed the lag time from intervals of years and months now down to weeks and even days. It is not too much of a stretch of the imagination to conceive of a future where this lag is reduced to hours if not minutes. If this continued progress does come about, the situation as I have indicated it would not be an absurdity, but a reality. Under these circumstances, the mandate of the ergonomist is not simply to facilitate just any technological development that happens along. Indeed, on this time-scale, no ergonomist will be actually be able to, '... keep in close touch with the advance of invention in whatever fields constitute (their) special range of interest ...'. The speed of innovation will prevent this achievement except to the smallest degree and ergonomics involvement will be largely engaged by access to dynamic databases of ergonomics knowledge rather than direct person (ergonomist) to person (designer) interaction. As this cycle time accelerates, the basic aim of the science of ergonomics should actually be to direct and inform what types of technological innovations are made and the ways they might integrate with existing systems and especially how they then contribute to manifest purpose. Thus, as can be seen, other of Bartlett's original premises must also be re-considered as our world progresses and our science matures. If I were able now to ask Bartlett only one question, it would be about the value and morality of the apparently eternal search for efficiency and the potential destruction that it may wreak when carried to its logical extreme. Alas, this is not now possible.

#### **4. Acknowledgment of specific trends**

In seeking to dispute with Bartlett's basic assumptions, we must not then neglect to acknowledge the fundamental veracity of some of his more specific propositions. It is clear that Bartlett was an acute observer of events and even at the age of 76, when his commentary was published, he clearly still had his finger very much on the contemporary pulse of events. Of course, time has proved his extrapolations about the penetration of automation, the subsequent change in the nature of work (see Hancock 1997), and the influence of advanced telecommunication capacities to be almost preternaturally accurate. It is churlish to merely criticise what one disagrees with and then fail to acknowledge the manifest success of Bartlett in this matter. However, I would still maintain that what Bartlett has achieved here is the logical extrapolation of trends in progress that were evident at least as far back as Craik's influential observations (Craik 1947, 1948). That being said, Bartlett's identification of the forthcoming importance of multi-tasking remains impressive. Clearly, he also anticipated the coming of concerns for mental workload (see also Hancock and Meshkati 1988). However, his emphasis on fatigue has largely not been fulfilled in the intervening years (but see Hartley 1998) while the interest in vigilance, which was exceptionally vigorous in the early sixties (see Buckner and McGrath 1963), has itself declined across the decades (see Warm 1984, Warm *et al.* 1996).

Perhaps the most important of Bartlett's observations concerns the still unresolved problem of information. Long has information been the fulcrum of argument in our

science. Its origins in the quantitative modelling of communication systems (see Shannon and Weaver 1949) and the central role it played in Wiener's most influential conception of cybernetics (Wiener 1961) have fostered the fragile hope that human cognition can still be captured and tamed within the confines of some mathematical formalisation. It is at once both an admirable yet slender hope. As Bartlett readily appreciated, much of what constitutes any operator's reality is generated from internal expectation as much as external stimulation (see Hancock *et al.* 2002). And when we add this continuing uncertainty with respect to each individual internal state to the fundamental problem as to how to capture each meaningful aspect of the ambient operational environment and specify measures of this meaningfulness, it will be clear that this vital issue continues to remain unresolved today, but still occupies the importance that it did, now five decades ago.

Bartlett's final comments (and the ones I would have liked to have seen the greatest elaboration upon, and which are here frustratingly short) concern the wider socio-political impact of what he sees as emerging issues and trends. Bartlett sees very clearly the metamorphosis in work that the digital revolution was then bringing about. He was especially sensitive to the way in which new technologies actually served to change not simply the way of doing things, but indeed, the fundamental task itself. In this, he would be sadly unsurprised by any glimpse of our modern working milieu. Where Bartlett is almost fatality over-optimistic is in his assessment of people. From his brief comments it can appear that what he fails to foresee is our progressive, modern-day emphasis on the pragmatic utilitarianism of education at all levels. This lacuna is forgivable for Bartlett himself was imbued with the value of classical education and his Cambridge was the Institution of Newton and of Erasmus. Living and working within the confines of that university is indeed an enviable opportunity and Bartlett must have had the chance to interact with many of the great scientists of his day, perhaps talking with a Watson or a Crick? Also, his own individual history suggests a very strong, self-motivated drive for personal betterment founded in his very early childhood. But the predominant contemporary social goals and aspirations for higher education have now fallen far short of the Elysian heights contemplated by Bartlett. I cannot speak for British education, but in the United States, we see an ever-greater emphasis on professional studies and an ever-increasing concern for the practical necessities of education, which is now often changing into high-level technical training. The sort of graduate whom Bartlett envisaged would indeed have demanded better of our technological innovations, requiring performance from it rather than being subservient to it. If anything, Bartlett's predictions about future technological progress have proved very accurate. However, his maddeningly brief observations about future of human capacities have not been near as successful.

## 5. Apologia

It might appear the height of discourtesy (especially as one of the proud holders of the Sir Frederic Bartlett Medal of the Ergonomics Society) to cast such aspersions on one who has contributed so much. But I sense that Bartlett himself would be supportive of criticism as I must, of necessity, be of my own observations. But Bartlett was looking to survey developments in 'the next few years' and so apportioning criticism in respect of his lack of observations on effects over longer intervals is largely an attack merely for polemical purposes. Thus, I conclude by making a direct and untrammelled acknowledgement that his is a fine series of observations and even with the benefit of hindsight bias I am doubtful

whether many of us could have done any better today. As our science progresses we very much need several more Bartlett's (if such a thing were ever possible).

The formal enterprise of Ergonomics remains lamentably small and one that, with few exceptions (Bond 1989), remains largely unacknowledged by the greater society. Yet, ours is a science that touches individuals every day of their life. Beyond the cognizance of our professional ergonomics organizations are millions of informal ergonomists who seek, on a daily basis, to improve their own environment and that of those around them. That they do this with only an implicit understanding of the challenges and issues that confront them rather than the explicit knowledge that our literature provides still remains perhaps our greatest source of frustration. Commentaries and observations on Bartlett's remarkable prescience, such as the others embodied in this issue, are important and appropriate. Yet, these are observations that must be seen beyond the confines of our own community alone. We have already convinced ourselves, we must now set about convincing others and using our knowledge of ergonomics to do so. Perhaps a first step could be a Bartlett Scholarship for the study of the implications of technological innovations on the future of society; it would be a fitting recognition of the contributions of a remarkable scientist.

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