

## The bleeding of conscious intensity.

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### Defining Disability

Most mornings I stand alone in line at the coffee shop. But I am not by myself of course. Indeed, I am surrounded by people who are all gazing intently at some small screen they are holding in front of them. Physically, they are present but cognitively they are very much elsewhere. They stumble forward like mindless automata; their consciousness wandering across remote virtual landscapes but with just enough residual attention to shuffle that next step forward. As you can see, I am fascinated by this behavioural dilution of experience and in this commentary, look to explore some issues that this vector of evolution raises for all of us; researcher and coffee drinker alike. This exploration is founded upon a deceptively simple, but rather perverse inquiry-what is normal? For if we are to specify abnormality and the way it can be remediated, we must be certain sure about the goal we are aiming at.

Now for almost a decade, my Laboratory has explored human interaction with robots (HRI). We very much focus on behavioural issues such as trust levels within that interaction [1], the degree to which the robot has to make its intention transparent to its partner; the stress and workload associated with delegating control to a non-human entity, as well as numerous other dimensions. We have used a variety of physiological indicators and neuro-physiological methods that permit us access to macro-level insights into cognitive state, all while the ambulatory individual is interacting with such entities. Our work has necessarily extended to human collaboration with automated and now emerging autonomous systems [2]. This extension to HRI results from the fact that the boundaries of the term robot are themselves in flux and the topic of quite polemic debate. Most recently, we have been tasked with creating effective and supportive robots for individuals with disabilities. It has forced us to come up squarely against an issue that I am sure has had a widespread airing in multiple disciplines-just what is a disability? Hence the corollary inquiry-just what is normal? I shall not regale my readership with our various empirical findings from these HRI projects [3], although the fact that an apologizing robot is forgiven much more readily and trust is restored much more quickly than is an apologizing human is an intriguing finding. Here, I want to comment on some wider issues. In particular, looking to distinguish 'dis'-ability and ability (possibly a synonym for normality), force us to focus upon the nature of modal human behavior.

In some ways this is an irresolvable question. Technology supports persistent change in behavioural patterns and any successful specification of 'normal' must encapsulate such changes. However, I think we can use the perception-action theory promulgated by Gibson [4-6] to guide us on this journey. The intimacy of this perception-action link, where what is perceived supports a following action and that act in its turn

presents new panoplies of percepts, enables us to specify where in the cycle that some putative processing 'shortfall' occurs. Our traditional picture starts with perception and disabilities in these perceptual capacities are evident and obvious. Just as obviously, many communities have sought to attack these shortfalls and restore, replace, or reorganize these inherent human sensory and perceptual capacities. That we can take such technical prosthetic ameliorations and turn them into orthotic extensions of perception is an exciting, daunting, and potentially risky enterprise. And all perception is not created equal [7]. In Gibsonian terms, our next focus is on action. Here, putative physical disabilities come to the fore. Significant advances in the technology of body armor have created military conflicts which have proven to be much more survivable. However, this comes at the cost of lost and damaged limbs. Commensurate funding has meant that advances in limb prosthetics have taken great strides, especially in a world supported by evermore compact and efficient computational capacities [8]. But with surrogate limbs, why stop at the goal of equivalent replacement. Can we not, should we not, create prosthetics that out-perform their 'natural' human forbears? It may then be argued that such augmented powers for action change the nature of what might be considered natural conscious experience itself just as radically (but perhaps not as 'immediately') as differing ways of 'wiring' sensation and perception do. However, as cyborg science progresses, enhanced abilities necessarily affect the evolving nature of the associated conscious experience.

### A New Normality?

If our vector of cognitive evolution is to then effect action over an ever greater range of perception whence in its turn such actions reveal ever greater perceptual opportunities; why my angst in the coffee line? The answer here lies, I believe, in the limited nature of human attention. It has been argued by the Nobel-Prize winner Daniel Kahneman that attention is a limited cognitive resource [9]. Those increasing ranges of perception-action are processed through this limited capacity system. More colloquially, if we adopt the 'searchlight' metaphor for attention, then the further that attention is asked to range, the more dilute the associated conscious experience [10]. By this I do not mean that chasing Pokémon cannot be an involving activity, assuredly it can be. It is simply that we cannot successfully focus our attention on the here and now, if we are always directed to other theres and thens. And the increasing proliferation of multiple technologies means that each sequential human generation is being exposed to ever greater vistas of such theres and thens. I think a concrete example will be of help here. Attention, the mediator of the perception-action link, likes to be busy. Under most conditions, humans try to avoid stultification of attention and boredom in any way possible [11]. One place where attention to the here and now is vitally required is in driving. Today there are many sources of distraction that are either already within the

vehicle, or are carried by drivers into the vehicle, or are outside the vehicle but still drag the driver's attention away from the road ahead; sometimes with tragic consequences [12]. In our contemporary world, attention has become a commodity and commercial enterprises want in. Even in driving, and at the risk to ourselves and others, we cannot simply 'ignore' perceptual stimuli of great novelty and intensity. This is because these stimuli promise so rich a return on any attentional investment. As information foraging animals, we are almost wired to seek such return, especially when the primary task before us is not using up all of the limited attentional capacity. Thus, even at the expense of present risk we are often hijacked by such 'thieves of attention' [13]. But this issue is more than one of skipping limited attention from location to location [14]. Rather, it is the spreading and dilution of consciousness, and the diminution of the concomitant richness and immediacy of experience, across ever expanding virtual landscapes that challenge us to consider what the new 'normal' is? Already we see potential symptomatology that the growing symbiosis with technology presents as, for example, in the case where Google is proposed to affect 'normal' memory processes [15]. I could expand this line of argument to encompass inter-generational changes, or even base it on variation in the growing length of lifespan and advancing human longevity, but I think such sequelae are arguments for another time and place. The principle, of course, also holds across society which has diluted the nature of holidays and festivals across multiple weeks and months (e.g. it is early November but already the Christmas decorations are up). Therefore, I think it is arguable that the evolving new normal may not be one that promotes greater human happiness. And is it not the purpose of pathological remediation to promote the recovery of the greatest possible happiness? In sum, if we are to talk of 'pathologies' and 'recoveries,' we must keep a weather eye on the evolving nature of normality. After all, no wind blows fair for the individual without a destination.

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