Stephen Fairclough

Stephen Fairclough is a Professor of Psychophysiology at Liverpool John Moores University in the UK. He has been involved in applied research on psychophysiology and neurosciences for almost thirty years. In that time, he has worked on human factors topics, such as driver impairment, adaptive automation and the measurement of mental effort. His current research concerns the area of physiological computing - where measures from the brain and body are used as real-time inputs to a technological system. He has co-edited four collections and three special issues of journals on this topic. He has served as President-Elect of Psychophysiology In Ergonomics (PIE - part of the International Ergnonomics Association) and Program Co-Chair for the International Conference on Physiological Systems. He is currently a member of the Editorial Board for IEEE Transactions on Affective Computing, Co-Chair of the Neuroadaptive Technology Conference and a member for the Executive for HFES (European Chapter). His research website is: physiologicalcomputing.com

1 To start with, could you tell us something about your work and your scientific interests?

I have a background in psychophysiology and neurophysiology, I developed those skills whilst working in human factors research. So, my scientific interests, broadly speaking, are concerned with measurement of signals from the brain and body in the context of interaction with technology. This background led me quite naturally to develop my current work on physiological computing, where implicit measures are used to adapt technology via closed-loop control. On one level, I work on the topic of real-time measurement, classification of user states and how we can make inferences about the state of the user based on psychophysiology and neurophysiology, especially outside of the laboratory and in the context of safety-critical tasks. At another more conceptual level, I'm very interested in the relationship between physiological computing and intelligent adaptation. In other words, how we build machines that learn from interaction with their users, and what these developments may mean for the relationship between people and technology over the coming decades.

2 What was your educational background? When, how and where did your career begin? What made you go into the field of human factors?

I graduated with a degree in psychology and a strong interest in cognitive experimental psychology. My plan was to do a Masters degree in experimental methods, but the funding for that course fell through at the last minute. Upon hearing of my situation, my undergraduate dissertation tutor mailed an advertisement to me for a research job at Loughborough University and I was fortunate enough to get the position. At that time, Loughborough and specifically my new employers at the HUSAT Research Institute, were working hard to promote research in ergonomics and persuading engineers and computer scientists to incorporate user-centred methods into the way in

which they designed technology. We take this type of philosophy for granted now, but back in the late 1980s, it was quite novel and there was resistance from engineers and other technologists. To be honest, I found this initial exposure to the field of ergonomics quite confusing, my undergraduate training had not really prepared me for research work that was both applied and multidisciplinary. So, to answer your question - my career began at that point (although I did not really appreciate it at the time) and I entered the field of human factors quite by accident. But something clicked when I did my first project on driving behaviour, I found a way to make a contribution and stayed at Loughborough for thirteen years and did my PhD there (on cardiovascular and EEG-based measures of mental effort).

3 What do you consider to be your greatest findings, discoveries or insights? In relation to this, can you name two or three publications that you are most proud of?

If I had to pick a few papers as personal highlights, there are three that come to mind. I worked for a long period on the topic of driver impairment, specifically looking at sleep deprivation and alcohol, we published a simulator-based study in 1999 (Fairclough, S. H. & Graham, R. 1999. Impairment of driving performance caused by sleep deprivation or alcohol: A comparative study. Human Factors, 41(1), 118-128) comparing sleepy drivers with drunk drivers. That was quite special because it was such a laborious piece of data collection (due to technical issues) and the results were interesting (that doesn't always happen). At around the same time, I attended my first HFES conference in the USA and was made aware of work at NASA where they were using real-time EEG measurement to control adaptive automation. I co-wrote a paper on this concept of physiological computing in 2003 and a few years later I decided to revisit the topic in a second review paper. I remember writing that paper was a real pleasure, but the topic also seemed quite niche - and while I was putting a lot of work into the writing, I did wonder if the paper would ever be published or even if anyone else would want to read it. The paper was published in 2009 (Fairclough, S. H. 2009. Fundamentals of physiological computing. Interacting with Computers, 21, 133-145) and interest in the paper wildly exceeded my admittedly very low expectations. I'd obviously managed to articulate a category of technology and research topic that resonated with other members of the research community. One direct consequence of that 2009 paper was an invitation in 2013 to write a short article for Nature (Fairclough S.H. 2014. Physiological data should remain confidential. Nature, 505, 263). Of course it is very flattering to be asked to contribute to a publication of that calibre, but I also felt the topic of the article (data privacy in age of pervasive sensors) was an important one.

4 As a teacher and mentor of graduate students and junior researchers what is your philosophy on teaching and mentoring? What do you expect from your students? What can your students expect from you?

In my view, if you are placed in the position of teacher or mentor, you are trying to develop a high degree of independence and autonomy in your

mentee - because the whole idea is that they won't be working with you forever and will eventually need to stand on their own two feet. In order to support that process, I treat my students as equals and encourage them to express their own ideas. I'm also flexible in my approach to mentorship, students and junior researchers have different strengths and weaknesses, they also have different personalities - so you have to try and figure out the best way to support their development and that process can only be achieved on a case-by-case basis. In terms of what I expect, it's the obvious qualities required in a good researcher: motivation, diligence, critical thinking and creative problem-solving. As a teacher and mentor, I always try to be available as a sounding board for research discussions. I think that's really important. When a student undertakes a significant project, such as a PhD, it can be a long and lonely road and the supervisor is the one of the few people with whom the student can share their experience.

5 Could you tell us something about your scientific vision? What, according to you, should change in our field, or what will become an important issue in the future?

I'm interested in technology that monitors covert signals from the human nervous system in order to create a dynamic model of the user state, which subsequently informs a process of intelligent adaptation on the part of technology. That's my scientific vision in a nutshell. With respect to the field of human factors in general, I have a couple of comments to make. First of all, it's my opinion that our discipline occupies a position of unique importance as our relationship with technology as a species becomes deeper and more pervasive with each passing year. As we move towards a world of autonomous technology and mixed reality systems, it has never been more important to study the way in which humans interact with machines. One way in which I think we should change is to become more forward-looking as a discipline and have greater focus on those emerging technologies that have not yet arrived in the workplace or home. It's been my experience that human factors practitioners have more influence and are better equipped to represent the needs of the user when they are working proactively rather than reactively. On a related point, I think perhaps we ought to be a little bolder as a discipline. We're often called upon to work at the micro-level as problem-solvers, but technological innovation is often associated with broad impacts on society as a whole, such as: unemployment, privacy, industrial relations, health. I think as technology becomes more entwined with societal issues over the coming decades, our discipline needs to expand its horizons and address the relationship between human and machines at the macro- as well as micro-level.

6 What would you like to do in the coming years?

There are few things that I'd like to do in the immediate future. I like the idea of technology having therapeutic benefits for the user. I'm currently working on an adaptive game system designed to distract people from pain - and would like to see that work come to fruition. In the same way, I'd like to further

explore the potential of wearable sensors to be used to facilitate management of mental health problems. For the last six years or so, I've worked a lot with fNIRS (Functional Near-Infrared Spectroscopy) and would like to explore mobile neuroimaging in the context of safety-critical behaviours, such as driving.