

iHealth studentship: detailed descriptions of proposed projects:

Intelligent Persuasion Technology in Healthcare

Computational models of argument (an exciting and emerging area of artificial intelligence) are beginning to offer ways to formalize aspects of persuasion. They have the potential to be incorporated in valuable tools for changing people's behaviour (including in personal financial decision making, as a healthcare treatment, for promoting healthy life styles, and for decreasing anti-social behaviour).

Persuasion technology based on computational models of argument can integrate a model of the decision to be taken (which we call the system's view), a model of the user's view of the decision, and a protocol for dialogues that can be used to change the user's view with the aim of getting a convergence (i.e. the user agrees with the system's view). The dialogue may involve steps where the system finds out more about the user's beliefs, intentions, needs and desires, and where the system offers arguments with the aim of changing the user's beliefs, intentions, needs and desires. From preliminary work we have undertaken in supporting personal financial decision making, developing these ideas in the health domain appears to be promising.

In this project, the student would need to develop a good understanding of the role of persuasion in behaviour change and healthcare treatment (already an important area of digital health), identify the requirements for a specific healthcare problem (e.g. persuasion in weight control, or diabetes management, or alcohol abuse, etc), develop a formal model of the decision, develop a formal model of the user, and develop a formal protocol for generating the dialogues that would meet the requirements of the specific healthcare problem. A prototype system would be evaluated for its clinical potential.

This project would suit a graduate in computer science who is keen to develop computational models of argument for application in persuasion technology for specific healthcare treatments. The student should have a strong background in computer science theory (logic, probability theory, graph theory, etc), and a keen interest in developing solutions for healthcare.

Proposed supervisors:

Anthony Hunter (UCL Dept. of Computer Science)

Fiona Hamilton (UCL eHealth Unit)

Discussion of the internet in general practice consultations: an interactional understanding.

Despite the potential benefits of the internet as a source of health-related information and support, patients may be wary of introducing information from the internet into consultations and GPs may not always welcome it, with concerns raised about 'cyberchondria'; research suggests that negative reactions from GPs can lead to a complete breakdown of therapeutic relationships. Internet use has expanded dramatically: it is estimated that 83% of UK

households have access, with large numbers of users searching for health-related information online. Use of the internet by patients is in keeping with UK government policy to promote self-care for both long and short term conditions. Yet if the role of the internet in managing health is not discussed as part of consultations this may have serious implications.

This PhD will use video-recorded GP consultations to consider how, by whom, and in what way the internet is raised as a topic in GP consultations. Consultations will be transcribed verbatim and analysed using conversation analysis: a well-established qualitative methodology that has been widely applied to medical interaction data. It focuses on structure and patterns in the sequential organisation of talk in order to understand how interactions affect the outcomes of consultations, for example the inappropriate prescription of antibiotics. This PhD will consider the ways in which patients and doctors raise the internet as a source of information and how this is managed interactionally within the consultation. Despite the volume of health information available on the internet we do not know how discussion is managed interactionally and thus about the likely integration of the internet and e-health more generally into health care. This project will identify strategies that can be used to aid integration and outline implications for the design of both health websites and technologies to support medical consultations.

Proposed supervisors:

Fiona Stevenson, Research Department of Primary Care and Population Health (Sociology)

Paul Marshall, UCL Interaction Centre (Human-Computer Interaction)

Digital engagement with health-related personal informatics systems

Personal informatics (PI) technologies like Fitbit, Runkeeper, Strava and MyFitnessPal are designed to enable people to collect data about different aspects of their lives and to help them to reflect upon their health and change their behaviour. There has been a huge increase in recent years in the number of PI systems available). There has also been significant interest within academia in developing systems to better support people in collecting and understanding personal data (e.g., Li et al., (2010), in encouraging behaviour change (e.g., Consolvo et al., 2008) and in understanding and supporting the development of habits (Judah et al, 2013, Stawarz et al 2014).

However, we know little about how best to design personal informatics systems to ensure engagement with the system that lasts long enough to enable people to develop healthy habits. What encourages people to reflect on their data? How effective are leaderboards in this context? Does reflection lead to new goals being set? Are those goals effective and realistic? How can the system encourage strong enough engagement to result in habit formation? The aim of this PhD project will be to develop prototype personal informatics systems aimed at supporting healthy behavior change and evaluate the effectiveness of design decisions using in-the-wild experimental techniques. Applicants should have a strong background in quantitative and qualitative research methods and will probably have an MSc or work experience in HCI or interaction design.

Proposed supervisors:

Anna Cox: UCL Interaction Centre, Div of Psychology & Language Sciences

Ben Gardner Sood: Health Behaviour Research Centre, Dept of Epidemiology & Public Health

Personalised Muscle Activity Coaching for People with Chronic Pain

Almost 1 in 10 people experiences chronic pain with much of it with no treatable pathology; 40% experience severe pain which is so restrictive it leads to social exclusion. Altered muscle activity patterns have been observed in people with chronic musculoskeletal pain (CMP) and contributes to increased pain and limits people's ability to move. This altered muscle activation is often due to fear of movement and movement avoidance strategies. Detection of this altered muscle patterning would allow personalised interventions to be developed.

Recently EMG sensors are being integrated into clothing targeting healthy people interested in maximising their function or simply using EMG to control devices for fun. The aim of this project is to investigate the possibility to detect altered muscle activity in people with CMP while on the move and provide runtime feedback which help to regulate the activation. The automatic detection and feedback systems will be first tested at the Pedestrian Accessibility Movement Environment Laboratory which will simulate a range of challenging outdoor environments before testing it outdoors, on both healthy and those with CMP.

The ideal candidate should have a biomechanics background or have specialised in signal processing of EMG. Through multidisciplinary training they will acquire physical computing skills to build Arduino-based EMG mobile phone applications and basic machine learning techniques. Close collaboration with the Royal National Orthopaedic Hospital (RNOH) will facilitate interaction with patients and understanding of ethical dilemmas as well as the idea of risk in the rehabilitation process. The Accessibility Research Group are currently developing assistive technology devices to market and the student will be exposed to this process.

Proposed supervisors:

Catherine Holloway (CEGE)

Nadia Berthouze (UCLIC)

Susan Alexander (Royal National Orthopaedic Hospital)

Making sense of personal health data and medical knowledge: New approaches to online health interventions

Online systems – from Personal Health Records to peer support – are commonplace in modern medicine. In the UK, individual online access to GP records is forthcoming to help deliver the policy of ‘no decision about me, without me’.

Many online interventions have proven successful at improving patient outcomes, yet many others still fail. A traditional evidence-based medicine approach struggles to explain why: a recent systematic review concluded “insufficient reporting of implementation and context of use makes it impossible to determine why some health IT implementations are successful and others are not.” We need different methodological approaches: ones that can explore the detailed factors that influence outcomes. Such techniques have been developed within

human-computer interaction research, and are increasingly applied in healthcare; they deliver insights that complement those from established health research approaches.

The current project will take a cross-faculty, interdisciplinary approach centred on two case studies: Patients Know Best at Great Ormond Street Hospital, and Shift.ms. PKB is a patient-managed online health record, currently available in over 25 UK hospitals (including GOSH) and internationally. Shift.ms is a social networking and information provision site for people suffering from multiple sclerosis, used in UCLH.

We will investigate how users (patients and carers) use these online systems to make sense of their own health conditions, what information they share or keep private, and how design features and contextual factors influence people's use and experiences of such systems. Data gathering will be qualitative and longitudinal (involving interviews, observations, think-aloud protocols and patient diaries), supplemented by quantitative measures of degree of engagement. Data will be analysed through established qualitative and quantitative techniques, drawing (as appropriate) on theories of information interaction, sense making and health cognition. Findings will inform the design of future online health interventions as well as contributing to our theoretical understanding of this area.

Proposed supervisors:

Henry Potts, CHIME, Faculty of Population Health Sciences

Ann Blandford, UCL Interaction Centre (Human-Computer Interaction)

Argument-based aggregation of clinical evidence

Evidence-based decision making is becoming increasingly important in healthcare. Much valuable evidence is in the form of the results from clinical trials that compare the relative merits of treatments. In recent work, we have presented a new framework for representing and synthesizing knowledge from clinical trials involving multiple outcome indicators.

The framework generates and evaluates arguments for claiming that one treatment is superior, or equivalent, to another based on the available evidence. Evidence comes from randomized clinical trials, systematic reviews, meta-analyses, network analyses, etc. Preference criteria over arguments are used that are based on the outcome indicators (e.g. increase in life-expectancy, risk of a specific side-effect), and the magnitude of those outcome indicators, in the evidence. Meta-arguments attacks arguments that are based on weaker evidence.

We have evaluated the framework with respect to the aggregation of evidence undertaken in three published clinical guidelines. For each of the three guidelines, the treatment we identified as being superior using our method is a recommended treatment in the corresponding guideline. We have also reevaluated a Cochrane review showing how more specific recommendations can be identified with our approach.

There are a number of ways that the approach could be developed in order to facilitate the use of the approach in practice and/or broaden its applicability. This could include extending the techniques to handle other kinds of evidence such as cohort studies or case series analysis, or extending the techniques to handle evidence obtained by data mining of locally available clinical records.

We have also undertaken a promising preliminary study with colleagues in the natural language processing area to automatically extract the required evidence from published

reports of clinical trials. This was developed for a specific condition. However, these information extraction techniques could be extended to a wider set of conditions. This would offer real-time automatic, even if preliminary, aggregation of evidence for users.

Proposed supervisors:

Anthony Hunter (UCL Department of Computer Science)

Matt William (Dept of Oncology, Charing Cross Hospital)

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<http://prism.ucl.ac.uk/pgadmissions/apply/new?advert=65>