Thesis Project Portfolio

S.U.R.E.: Soft Upper-Limb Rehabilitation Exoskeleton

(Technical Report)

Beyond the Podium: Investigating the Legacy of the London 2012 Paralympic Games on Public Perception of Disability in the United Kingdom

(STS Research Paper)

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Sociotechnical Synthesis

Disabled people are subject to increased barriers perpetuated by harmful stereotypes and costly medical care. Strokes are among the leading causes of chronic disability worldwide. Disabilities resulting from strokes are associated with substantial financial burden due to costly rehabilitation programs and medication, as well as lengthy duration of care. My technical design project addresses the high burden of accessing stroke care by providing effective, affordable, and accessible at-home stroke rehabilitation. In addition to physical interventions, it is crucial to investigate the effectiveness of social interventions to improve the disabled lived experience. My STS research will analyze the impact of the broadcast of the London 2012 Paralympics on perceptions of people with disabilities within the United Kingdom. Technology can be used to alleviate physical challenges posed by disabilities whereas social interventions are required to mitigate social barriers. In response to these barriers to equality, I investigated whether the broadcast of the Paralympic Games was an effective social intervention for discrimination against people with disabilities in the United Kingdom, as well as developed technology to lower the financial and physical burden of upper-limb disability resulting from stroke.

Following a stroke, patients often exhibit paresis of the upper limb on either side of the body. A common rehabilitation method is constraint-induced movement therapy, abbreviated as CIMT. For the upper extremity, this consists of flexion and extension of the arm and fine motor movement of the hands and fingers. The benefits of CIMT come at a cost to both the patient and the physical therapist providing the medical care. Therapists are expected to provide up to six hours of rehabilitation, five days a week. This results in therapist fatigue, which jeopardizes positive rehabilitation outcomes. Stroke rehabilitation exoskeletons have come about to combat this problem. Currently, the vast majority of stroke rehabilitation exoskeletons are hard

exoskeletons. Although extremely useful and effective, this technology is exceptionally expensive and thus is only available in hospitals and physical therapy centers. To address the high cost and limited accessibility of care, we propose S.U.R.E: the Soft Upper-limb Rehabilitation Exoskeleton. Our objective was to design a rehabilitation mechanism for upper-limb stroke disability which addresses problems relating to access to stroke care. Specifically, the design was constructed from affordable, ergonomic, and lightweight materials. It is easily operable by the wearer, so that it can be used at home and reduce the need for in-patient and out-patient rehabilitation care. To expand the reach and scope of the exoskeleton, it will be applicable to a range of body types and cover two motions: flexion and extension of the elbow and grasp and extension of the hand. As a result of these factors, accessibility as well as the frequency, duration, and scope of care can be increased as opposed to traditional physical therapy, resulting in improved rehabilitation outcomes.

The Paralympic Games are held every two years in conjunction with the Summer and Winter Olympics. This event allows elite athletes with a variety of physical and intellectual disabilities to partake in sporting events which they would otherwise be unable to participate in at an elite level. During the London 2012 Paralympics, the International Paralympic Committee had the opportunity to host an iteration of the Paralympic Games which would be a catalyst for positive social change in the United Kingdom. The messages expressed by the broadcasting and advertising of the Paralympic Games reached nearly two thirds of the United Kingdom's population. As a result, this iteration of the Paralympic Games can be studied to evaluate the potential sporting mega-events have for improving perceptions of people with disabilities. My research explores the impact of the marketing and broadcast of the London 2012 Paralympic Games on public perception of individuals with disabilities in the United Kingdom. The

advertisement of the London 2012 Paralympic Games perpetrated harmful tropes while the broadcast of the events featured socially responsible coverage of Paralympic athletes. As a result, the London 2012 Paralympic Games improved perceptions of disabled elite athletes but failed to be an effective social intervention for mitigating broader social barriers faced by people with disabilities in the United Kingdom.

The process of completing these projects synchronously has allowed me to gain insight into the disabled lived experience as a researcher developing technology intended for people with upper-limb disabilities. Traditional engineering education emphasizes technological solutions and promotes the medicalization of disabilities. Disability STS theory broadened my perspective by allowing me to understand that disabilities are experienced differently by each person affected. This informed my priorities as a researcher by ensuring that our rehabilitation exoskeleton was highly customizable to accommodate differing body shapes and ability to undergo rehabilitation exercises. My research into the high burden of care and accessibility challenges faced by stroke survivors reaffirmed the importance of investigating how social interventions can be used to alleviate systematic problems faced by people with disabilities.