HCI, Disability, and Sport

A Literature Review

HCI ACCESSIBILITY

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Abstract

Equitable access to sport for disabled people remains challenging, and technology is often viewed as a way of addressing barriers. However, little is known about how disability is approached in such research and the purpose of sport that is afforded to disabled people. We address this issue in a review of 60 publications in the field of Human-Computer Interaction. We leverage Template Analysis in combination with Mueller and Young's lenses on virtues of sport to also explore the experiential side of sports technology for disabled people. Our results are threefold: (1) We show that disability shifts the intended purpose of sports technology away from leisure to health, and that technologies such as exergames are viewed as an opportunity to replace real-world sport to address barriers and increase motivation. (2) We highlight that in(ter)dependence plays a strong role in technology development, but that disabled people are not extensively involved in research. (3) We show that virtues beyond health as per Mueller and Young do apply to existing work, but that value frameworks need to be re-worked in the context of disability, placing a stronger emphasis on sport as leisure, and the enriching role that technology can play.

An Experiential Perspective on Sports

Sport has many benefits but the purpose of technology needs to be further explored. *Why do we design sports technology for disabled people? How do we enable inclusion? And does technology provide disabled people opportunities for equitable sports experiences beyond health aspects?*
Mueller and Young [1, 2] proposed a framework to design sports technology that goes beyond the purpose of health (see below) which may also serve as a starting point to discuss how sports technology can move beyond an interventional focus on disability.

Five Lenses to Design Sports-HCI:

1. Reverie — appreciate a void
2. Pleasure — find pleasure in exertion
3. Humility — become humble
4. Sublime — enjoy the stimulation that come from fear
5. Oneness — be more aware of ones own body

More lenses:

6. Sacrifice
7. Beauty
8. Pain
9. Consistency
10. Perseverance

Research Questions

RQ1: What is the perspective of HCI research on disability and sport, and what kinds of contributions are made by existing work?

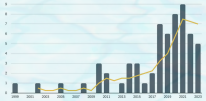
RQ2: How does existing work relate to Mueller and Young's 10 Lenses to Design Sports-HCI, and how would the lenses need to be expanded to facilitate the design of equitable and enriching sports experiences for disabled people?

Method

We searches the ACM Guide to Computing Literature [3] and constructed our corpus applying the PRISMA 2020 [4] guidelines and our inclusion and exclusion criteria. We thematically synthesised the resulting 60 items using Template Analysis [5].

Corpus Description

- Publication between 1999 and 2023
- Strong upward trend until the COVID pandemic
- Popular venues: ASSETS, CHI, HCII, ICCHP



- Mostly people who are blind or have low vision and people with motor impairments addressed (communities from [6])
- Rather pyhsical activity in general than focus on specific sports such as ball games or endurance activities

Finding for RQ1

Disability Shifts the Intended or Perceived Purpose of Sport

- **Sport as therapy:** No medical technology, but focus on health can still promote the medical model of disability.
- **Social Barriers and sport as means of inclusion:** Addressing the social model, technology serves as facilitator of inclusion, e.g., by levelling the playing field.

Exergames as Replacement of Traditional Sport

- Games to **escape barriers in the real world** and built accessible virtual world
- But side-stepping **real world** sport can **limit efforts** for equity there

Involvement of Disabled People in Technology Design and Evaluation

- Researchers often preferred **confirmatory evaluations rather than open-ended exploration**, limiting participatory efforts and empowerment
- **Relying on non-disabled stakeholders** as proxies for research, e.g., blind-folding non-disabled people to represent blind athletes

Finding for RQ2

We found limited engagement with aspirational values but promising avenues. Mueller and Young focus on personal growth mostly isolated from social relations, but this perspective may not cover experiential aspects in conjunction with aspects of **community** which were prominent in our corpus. Below we list one consideration for each lens to encourage reflection:

Reverie: Disabled sports benefits from the presence of guides and collaboration, how can we promote reverie there?
Pleasure: Focused on in exergames, intervention against "sedentary lifestyle".
Humility: Becoming humble should not only be supported through performance metrics only, especially in mixed-ability groups
Sublime: May be challenging to facilitate in virtual worlds, e.g., indoor climbing [8]
Oneness: Technology can increases perception of self and control over body, e.g., for blind swimmers [7].
Sacrifice: "Sacrifice to be someone" through a sense of coherence [9] (if requested) could be facilitated through community and social relations.
Beauty: Rarely focused on, appears in rhythm-based sports and exergames [10]
Pain: Viewing the ability to perceive pain as a virtue can be a privilege.
Consistency and Perseverance: Would benefit from long-term research.

How Does This Translate to HCI Research?

Four Points to Reflect on

- **Who defines virtues?** What is the underlying philosophy (on disability)?
- (How) can we **reconcile the focus on health** with other purposes of sport?
- Should immersive systems be used to **sidestep real-world access barriers**?
- **How can we involve disabled people** in the creation of technology?

References:

[1] Florian 'Floyd' Mueller and Damon Young. 2017. Five Lenses for Designing Exertion Experiences. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, https://doi.org/10.1145/3025453.3025746.
[2] Florian Mueller and Damon Young. 2018. 10 Lenses to Design Sports-HCI. Foundations and Trends® in Human–Computer Interaction, https://doi.org/10.1561/1100000076.
[3] ACM, Inc. 2025. The ACM Guide to Computing Literature.https:// libraries.acm.org/digital-library/acm-guide-to-computing-literature, https://libraries.acm.org/digital-library/acm-guide-to-computing-literature
[4] Matthew J Page, Joanne E McKenzie, Patrick M Bossuyt, Isabelle Boutron, Tammy C Hoffmann, Cynthia D Mulrow, Larissa Shamseer, Jennifer M Tetzlaff, Elie A Akl, Sue E Brennan, Roger Chou, Julie Glanville, Jeremy M Grimshaw, Asbjørn Hróbjartsson, Manoj M Lalu, Tianjing Li, Elizabeth W Loder, Evan Mayo-Wilson, Steve McDonald, Luke A McGuinness, Lesley A Stewart, James Thomas, Andrea C Tricco, Vivian A Welch, Penny Whiting, and David Moher. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, https://doi.org/10.1136/bmj.n71.
[5] Chapter 24 in Gillian Symon and Catherine Cassell. 2012. Qualitative Organizational Research: Core Methods and Current Challenges. SAGE Publications, Inc, https://doi.org/10.4135/9781526435620.
[6] Kelly Mack, Emma McDonnell, Dhruv Jain, Lucy Lu Wang, Jon E. Froehlich, and Leah Findlater. 2021. What Do We Mean by "Accessibility Research"?: A Literature Survey of Accessibility Papers in CHI and ASSETS from 1994 to 2019. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, https://doi.org/10.1145/3411764.3445412.
[7] Elena Gibelli, Diego Morra, Mirko Gelsomini, and Maristella Matera. 2023. Improving Swim Accessibility through Vibro-Tactile Sensory Substitution: A Preliminary Study. In Proceedings of the 15th Biannual Conference of the Italian SIGCHI Chapter (CHItaly '23), https://doi.org/10.1145/3605390.3605418.
[8] Mike Richardson, Karin Petrini, and Michael Proulx. 2022. Climb-o-Vision: A computer vision driven sensory substitution device for rock climbing. In Proceedings of the Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems (CHI EA '22), https://doi.org/10.1145/3491101.3519680.
[9] Ahmad Alsaleem, Ross Imburgia, Mateo Godinez, Andrew Merryweather, Roger Altizer, Tamara Denning, Jeffery Rosenbluth, Stephen Trapp, and Jason Wiese. 2019. Leveraging shared control to empower people with tetraplegia to participate in extreme sports. In Proceedings of the 21st International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '19), https://doi.org/10.1145/3308561.3353775.
[10] Kathrin M. Gerling, Regan L. Mandryk, Matthew Miller, Michael R. Kalyn, Max Birk, and Jan D. Smeddinck. 2015. Designing wheelchair-based movement games. ACM Transactions on Accessible Computing 6, 2 (Mar. 2015), 1–23, https://doi.org/10.1145/2724729.