Tangible Cognition: Bringing Together Tangible Interaction and Cognition in HCI

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ABSTRACT
This workshop will explore the relationship between HCI using tangible user interfaces (TUIs) and cognition. We see exciting opportunities for tangible interaction to address some of the cognitive challenges of concern to the HCI community, in areas such as education, healthcare, games, reminiscing and reflection, and community issues. Drawing together the Australasian community, with those from further afield, we hope to strengthen research and build a local community in this exciting and rapidly developing field. Participation is invited from researchers working in tangible user interfaces or those interested in cognition and interaction. During the workshop the majority of the time will be spent in small group discussions and brainstorming solutions.

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Tangible interaction, Cognition, Workshop

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Most people will readily acknowledge that the real, physical world is intrinsically meaningful and that we are well adapted to navigate it seemingly effortlessly (as opposed to the digital world of computers). The innate ability to perceive one's surroundings, whether through its visually apparent configuration, the touch of physical artefacts, or even proprioception (that is, the awareness of one's own bodily pose), the tangible world offers some compelling benefits over a virtual counterpart. Part of the appeal lies in the expressiveness, the tangibility, and how we can make sense of this. Cognisant of these qualities of the physical world, an active community has developed within HCI with interest in tangible interaction, seeking to understand and incorporate some of these qualities into capable human-computer interfaces. For example, in 1993, Wellner, Mackay and Gold argued for the inclusion of interaction repertoires that do justice to our natural abilities. Many others have followed, which perhaps is best exemplified in the international Tangible, Embedded and Embodied Interaction (TEI) conference held since 2007. Despite this academic attention, most of the interfaces we touch in daily life and do research on in HCI are of a less tactile nature, typically opting for the flexibility of on-screen interactions and various GUIs. Yet, as the tangible interaction community holds, such interactions reduce our repertoire for interaction to pointing, dragging, clicking, and pressing buttons.

While such screen-based GUI interfaces bring many benefits, chiefly among them the flexibility to show and manipulate a wide variety of interfaces, cognitive challenges remain. Such challenges include issues with comprehension, decision making, cognitive load, learning, remembering, etc. For example, in an educational context, teaching children the basics of programming is often considered complex and dependent on the possession of basic language skills. However, when approaching this challenge with things children already know, such as building blocks, it turns out that young children are already able to reason about programmatic flow. The use of tangible blocks invites children to experiment, as shown in (among many other examples) Horn and Jacob (2007) and recent work by Google Research on Bloks (Blikstein et al., 2016). In healthcare training, it remains an ongoing challenge to translate theoretical knowledge of patient care to its expression in practice, which requires a translation into a more embodied form of thinking. That is, knowing where bodily internals are and being able to point these out does not fully prepare for the more visceral approach in actual care and medical procedures. This challenge may be

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addressed by using tangible training apparatus to prepare soon-to-be medical personnel (e.g., mimicking tissue tenderness for sensitivity training, as in Tsimeris, Stevenson, Broughton & Gedeon, 2015).

It is not surprising that tangible user interfaces have been a fruitful subject for discussions on the nature of embodied cognition; that is the notion that cognition happens not just within the limits of our mind/brain but is readily supported and replaced by elements around us in a fluid fashion (Sutton, 2006; Dourish, 2001). What our mind is willing to accept and rely on as a cognitive scaffold remains a hot topic for discussion in both cognitive philosophy and the HCI community. Tangible interfaces are where physicality, embodiment, and cognition meet, hopefully unlocking possibilities for effective and enjoyable systems beyond the digital interfaces so commonly seen today. Solely for reasons of brevity, we refrain from talking about further HCI examples of tangible user interfaces in games, community building, and other social issues.

However, we would like to consider challenges ahead with the increasing connectivity of everyday things. In the next decade, more and more digital devices will move into the domestic and work environments. This so-called Internet of Things assumes a plethora of connected devices, each catering to its functional niche (see Koreshoff, Robertson & Leong, 2013). It is a challenge to design these systems such that their functioning and their system state are articulated well enough for people not to worry about them, so that these systems operate and fade into the background (as envisioned by a.o. Weiser, 1991). This is (partially) a challenge of matching user understanding with a system's functioning, and the overall consideration of cognitive load due to these (ideally) supportive things. We see opportunities for tangible interface elements to feature in such future systems to address some of the issues we highlighted. Somewhat related to this trend of increasingly present technology, another interesting avenue for TUIs and cognition can be found in the area of autobiographical remembering and reflection on the self (van den Hoven, Sas, & Whittaker, 2012; Mols, van den Hoven, & Eggen, 2016). Much of the interest in this area is driven by how we come to think of ourselves through our media, our storytelling, and how technology can best support this. Across research done in this field, the immediate visual and tangible notability granted to those hybrid or digital objects not consigned to screen-based interfaces appears positive in terms of being able to cue memories and stimulate reminiscing and reflection.

We believe that principles of tangible interaction and their match with our natural abilities provide ways for interaction designers to respond to these cognitive challenges. In this workshop, we are keen to address some of the challenges through discussion of recent work and thoughts on the application and future of tangible interaction. This workshop aims to bring together researchers and practitioners with an interest in tangible interaction and/or cognitive aspects in HCI. While this area receives intermittent attention at, for example, recent editions of OzCHI, we believe there are opportunities to grow the Australasian community around this topic.

WORKSHOP GOALS AND EXPECTED OUTCOMES

Our primary goal for the workshop is to build an Australasian community around tangible interaction research. We see value in bringing together those with interest in this area of HCI research within Australasia, to discuss the state of this field in the region and how we may build towards the future. We are especially keen to explore how tangible interaction, as compared to other interaction paradigms, can be beneficially employed for cognition-related purposes, such as in the education and health fields. Both researchers working within tangible interaction and cognition fields stand to benefit from active collaboration with specific benefits discussed in the previous section. Therefore, we intend to attract researchers and practitioners from the HCI community with an interest in interaction design and how tangibles play into that. Alongside, we are keen to attract those not yet so familiar with this paradigm to join us and explore opportunities. Our desire and short term goal is that this workshop allows the participants to form connections that extend into future collaborations. A long term objective is for some of the organisers to edit a book on tangible interaction and cognition, with the option to invite selected workshop participants to contribute.

To advertise this workshop, we shall approach personal contacts, faculties and departments active in HCI, as well as broadcast our call for papers (see below) via relevant mailing lists (e.g., CHI-Announcements, BCS-HCI, PhD-design, SIGCHI-Oz, SIGCHI-NZ). Additionally, social media networks will be used to distribute this call.

WORKSHOP STRUCTURE

The workshop aims to generate discussion among participants of the issues faced by HCI researchers working in tangible interaction or cognition. We adopt a hands-on approach to encourage participants to explore the future direction of tangible interaction with emphasis on the role of cognition in shaping this path.

Preparation

Participants are required to write a position paper (up to 4 pages in SIGCHI extended abstracts format) about their work that addresses topics related to tangible interaction and cognition.

Pre-Workshop

Each of the position papers will be made available to participants through the workshop website. We ask that all accepted participants read each of the position papers before the workshop to facilitate meaningful discussion and allow for greater progress towards accomplishing workshop goals in the time available.

Workshop Setup

The structure of the workshop is detailed below, followed by a breakdown of planned activities.

09:00 - 09:45	Introduction
09:45 - 10:45	Papers discussion activities: 'Post-it Papers' + 'Paper Clustering'
10:45 - 11:00	Coffee break

11:00 - 12:00	Group discussion: Themes
12:00 - 13:30	Lunch
13:30 - 14:45	Hands-on group work: Brainstorming 'Tangible solutions to challenges'
14:45 - 15:45	Group discussion: Challenges and barriers to 'Tangible solutions'
15:45 - 16:00	Coffee break
16:00 - 17:00	Wrap up / conclusion

Introduction (45 minutes)
The workshop will start with organisers introducing themselves, welcoming participants and providing an outline of the aims for the workshop and the planned schedule for the day. The participants will then be asked to briefly introduce themselves to the group. We hope to invite a small selection of the attendees to briefly present or demonstrate their submitted work to aid in informing attendees with varied backgrounds of the research conducted by others within the group.

Papers discussion activities: 'Post-it Papers' + 'Paper Clustering' (60 minutes)
Workshop participants will be asked to distill the content of their position papers into a single sentence to be written on a provided post-it note. All participants will then be asked to read out their 'post-it paper' and then be tasked to further discuss the key aspects of their position papers with one another, attempting to form clusters of 'post-it papers' that address similar themes within the topic of tangible interaction and cognition. By the end of this activity, the aim is for participants to have collectively created several clusters of papers that are formed from common themes generated through discussion.

Group discussion: Themes (60 minutes)
Following the 'paper clustering' activity, participants will break off into groups of their respective 'cluster' and be asked to discuss a number of theme / statement issues in relation to their papers and their own personal experiences. This includes three themes (as per the example questions given below), and we intend to adjust these questions based on the submissions we receive:

Tangibility
• How does tangible interaction enhance or take away from a sense of control in the user?
• How will changes to the cognitive load of tangible interactions influence user's memory and understanding?
• Is it likely there will be a learning gain through using tangible interactions?

Conversation
• In what ways do new methods or scenarios of interaction alter the dialogue between human-computer?

Direction
• In what direction is tangible interaction headed?
• How will cognition play a role in this direction?
•What is gained, lost or kept in this advancement of the way we interact with physical things?

To conclude this activity, the organisers and participants will summarise the main points of discussion.

Hands on group work: Brainstorming 'Tangible solutions to HCI challenges' (75 minutes)
Participants will be divided into groups of 3-4 (preferably with group members from separate clusters). Groups will then be asked to brainstorm potential future tangible interaction-based solutions for a HCI challenge related to one of five contexts (health care, education, play / games, work and community)

For example, a challenge related to education could be teaching young children programming skills, so that they grasp the basic concepts of logic and flow of a program. Such a challenge will be presented in the form a vignette.

This brainstorming session will involve and stimulate within-group discussion of the future possibilities of tangible interaction and the needs of people within a specific context.

Group discussion: Challenges and barriers to 'Tangible solutions' (60 minutes)
To follow on from the brainstorming activity, all groups will briefly present their proposed tangible solutions and the identified barriers. Participants will be asked to discuss the challenges and barriers for their proposed enhancements. This group discussion will aim to raise several issues faced in the design and evaluation of tangible interactions relating to cognition such as the division of control, trust, dialogic feedback and what might be lost in the process of change compared to other interaction paradigms.

Wrap up / conclusion (60 minutes)
The outcome from the group discussion of challenges and barriers in tangible interaction will be summarised and elaborated upon with relation to the main discussion points and conclusions drawn across the entire workshop.

Post-Workshop
As participants are invited to talk about ongoing work that may feature in their future publications, we shall not compile proceedings in the traditional sense (that is, making available the collection of position papers presented) unless authors give us consent to do so. Instead, we shall provide summary proceedings (based on each position paper's abstract) on the workshop's webpage (https://tangiblehci.wordpress.com/). However, we intend to invite some of the attendees to contribute to a book on tangible interaction and cognition.

ORGANISERS
The organisers of this workshop are all active in HCI and interaction design, at the University of Technology Sydney (UTS) and the University of Auckland. We are:

Doménique van Gennip (main contact) is a joint degree PhD student in interaction design for everyday remembering using personal media in the School of Software at the University of Technology Sydney, and Industrial Design at Eindhoven University of Technology. His interests lie in how technology affects people and vice versa, with a focus on design for remembering, affective computing, and tangible interaction.

Daniel Orth is a master's research candidate at the Faculty of Engineering and IT at the University of Technology Sydney. His research focuses on designing for emotional significance, emphasising the role of self-identity in the formation of user-object relationships. His research also looks at the differences between the physical and digital medium of objects to explore the strengths of medium-specific properties in their contribution to the emotional significance of objects for users.

Md Athar Imtiaz is a PhD student at University of Auckland working in the area of Human Computer Interaction, specifically in the area of digital ink and education tools. His research interests lie in the area of natural user interfaces, cognition, intelligent education tools and artificial intelligence.

Professor Dr Elise van den Hoven MTD is a Professor of Human-Computer Interaction in the School of Software at University of Technology Sydney and a part-time associate professor in the Department of Industrial Design, Eindhoven University of Technology. She has two honorary appointments: honorary senior research fellow in Duncan of Jordanstone College of Art & Design, University of Dundee, and associate investigator with the Australian Research Council's Centre of Excellence in Cognition and its Disorders. Her research interests span different disciplines, including human-computer interaction, design and psychology, including people-centered design, designing interactive systems, physical interaction, and supporting human remembering.

Associate Professor Dr Beryl Plimmer works in the computer science department at the University of Auckland. She researches human computer interaction with a focus on digital ink and other tangibles. Her work spans applied artificial intelligence for the recognition of gestures and tangibles, to development of tools using various pen/touch/tangible interaction and evaluation of the tools' efficacy for problem solving and learning support.

CALL FOR PARTICIPATION

This workshop will bring together researchers and practitioners working in the fields of tangible interaction and cognition to share their experiences of working on issues such as but not limited to embedded / embodied interaction, cognitive load, tangibles and education, the Internet of Things, and interaction design. The aim of the workshop is to generate discussion among participants of the issues faced by researchers working in tangible interaction and cognition. Workshop participants will adopt a hands-on approach to explore the potential of tangible interaction to further advance solutions to cognition-based issues. They will also draw on their own personal experiences to share insights and alternate perspectives of ways in which these two research fields stand to benefit from one another.

We invite interested researchers to submit a position paper about their work that addresses topics related to tangible interaction and cognition. Papers may be up to four pages in SIGCHI extended abstract format (http://www.sigchi.org/publications/chipubform/sigchi-extended-abstracts-format-2016/view). Please do not hesitate to contact the workshop organizers if you are unsure about the eligibility of your work, via our contact details or https://tangiblehci.wordpress.com/

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