Tangible Interaction

brief summary of research

Wendy Keay-Bright

"Both personal expressions and cultural artefacts become objects-to-think-with…people build them to make ideas tangible & they share them to negotiate meaning and to communicate" (Papert, 1980)

Early research came from:

Direct Manipulation

Shneiderman's three principals of "direct manipulation", although presented in the context of GUIs is also applicable to TUIs

- *continuous representation* of the objects of interest;
- physical actions or presses of labeled buttons instead of complex syntax;
- rapid incremental reversible operations *whose effect on the object of interest is immediately visible*.

Advantages and disadvantages of Direct Manipulation

Some points below are adapted from Shneiderman (1997) and Preece et al. (1994)

Advantages

* Visually presents task concepts.
* Easy to learn.
* Errors can be avoided more easily.
* Encourages exploration.
* High subjective satisfaction.
* Recognition memory (as opposed to cued or free recall memory)

Disadvantages

* May be more difficult to programme.
* Not suitable for small graphic displays.
* Spatial and visual representation is not always preferable.
* Metaphors can be misleading

Moving on

Really Direct Manipulation –
Embodied User Interfaces, *Fishkin et al*

Embodied User Interfaces go beyond the GUI to allow the user to "really directly manipulate" an integrated physical/virtual device

Manipulations are intuitive, they explore a range of interaction, just as GUI users try to find out what's clickable, users can try a variety of manipulations to explore the space of detectable manipulations.

To more recent

Cooperative Work and Lived Cognition: A Taxonomy of Embodied Actions

Heath and Luff (1991) used ethno-methodology to analyse how technology transforms verbal and non-verbal conduct, particularly on the ways on the ways in which individuals used gestures and other forms of visual conduct to establish and preserve mutual involvement and to co-ordinate work tasks and activities.

See also *Plans and Situated Actions: the problem of human-machine communication*. Suchman, L

When engaging in tangible interaction, the user is given control over the environment – **configuration**.

Bodily interaction, (manipulation, movement, gesture) stimulates mental energy and is expressive. Bodily interaction is performative and supports implicit co-ordination.

GUIs make fundamental difference between "**input devices**" such as keyboard and mouse, as *controls* and graphical "**output devices**" like monitors and displays, for the synthesis of visual *representations.* Tangible interfaces explore the conceptual space opened by the elimination of this distinction.
The seamless integration of *representation* and *control* is significant in TUIs

Perspectives on Tangible Interaction

We need to consider approaches from a number of perspectives most of which are represented in the Echoes team

HCI

Utilises physical representation and manipulation of data

- Offers interactive couplings of physical artefacts with “computationally mediated digital information.”
- Concerns couplings and representations

Design/Product

Goes beyond form and appearance to design interaction.

- Emphasises bodily interaction with objects, exploring the “sensory richness and action potential of physical object” Meaning is created through action

- Focus on expressive movement

Architectural perspective

Embedding systems in real spaces

- Combining real spaces and real objects with digital displays or sound installations
- Integrating tangible devices to trigger digital content or reactive/responsive behaviours.

Physicality in Tangible Interaction, *Hornecker, E*

This refers to the physicality of the user's body and the physical world.
Physicality is a central aspect of Embodied Interaction, although often ignored. Even when Dourish talks about embodied interaction, it seldom becomes clear what it means to be embodied – the human body is strangely missing.

Social Interaction

Dourish states that social interaction is embedded in settings, which are not only material, but also social, cultural and historical. However the focus tends to be on the construction of meaning and physicality is ignored. Whilst social interaction has been researched widely in ASD, very little appears to have considered materiality.

Our body is the central reference point for perception. Movement and perception are tightly linked & we interpret spatial qualities (or positioning of other objects) in relation to our whole body. Spatial qualities therefore have psychological meaning –space can feel protectively enclosing or claustrophobic etc

Recap: Relevance to EchoeS

Tangible Interfaces for Remote Collaboration and Communication
Brave, Ishii, Dahley

In the real world touch and physical manipulation play a key role in understanding and affecting our environment. Traditional interfaces to the digital world, in contrast, largely fail to address our sense of touch and offer only the generic keyboard and pointing device as tools for indirect manipulation of digital objects. Physicality also plays an important role in interpersonal communication. GUI-based systems for distributed interactions provide no means of this type of physical communication or awareness.

Contact Expressions for Touching Technologies

People use contact expressions when other forms of communication are inappropriate or impossible, to supplement other forms of communication, or because the physical contact itself has some significance (reference made to autism but no citations to research).

Makes links to Speech Act Theory where the emphasis (as I understand it) is on what people want to do with language, as opposed to trying to establish the truth in what any particular statement signifies.

Refers to the **locutory, illocutory** and **perlocutory** conditions that make such act possible.

The research cites two examples of tangible devices and analyses the range of locutory, illocutory and perlocutory acts. (All this is new to me, I just include it here in case someone on the Echoes team has experience and can illuminate!)

Sensory Integration Treatment (VR-TIS)

This is a study to develop a programme of sensory integration therapy (SIT) based on VR-TIS. Based on VR-SIT (references Parsons et al, and Hornecker) it has three components

1. Co-ordination ability measurement
2. Social Skill training (which should be of interest to us)
3. Sensory Integration Therapy

VR-TIS suggested the possibility for new interaction – it was noted that children performed tasks using tangible devices without any particular difficulties and showed interest while undertaking the tasks.

In this research social skills training and co-ordination ability measurement showed better results than sensory integration. The problem solving and social skills co-ordination tasks were more meaningful and interesting to the children. The social skills training programme produced more interaction by conversation with the therapist than the SIT.

Suggested further reading

Dourish, P. *Where the Action Is: The Foundations of Embodied Interaction.*

Suchman, L. *Plans and Situated Actions: the problem of human-machine communication.*

Vanderveken, D. *Meaning and speech acts: principles of language use (vol. 1),*

Goldin-Meadow, S. *Hearing Gesture: How Our Hands Help Us Think*

Karl Wall, London Institute…..PhD thesis on gesture and ASD