Theories and Applications of Social Science for Interactive Surfaces

Stacey D. Scott and Victor Cheung

Collaborative Systems Laboratory
Systems Design Engineering
University of Waterloo
csl.uwaterloo.ca

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Social Science is a HUGE Field
Where to Begin??
(Highly) Relevant Theories for Interactive Surfaces

• Communication theories
  - Face-to-face communications
  - Non-verbal communication

• Small group behaviour
  - Interpersonal behaviour

• Environmental psychology
  - Intersection of psychology, architecture, and industrial design
Particularly Influential Social Science Scholars

- Edward T. Hall
  - Proxemics

- Robert Sommer
  - Personal Space & Territoriality

- Adam Kendon
  - F2f behavioural patterns (body positioning, eye-gaze)

- Michael Argyle
  - Group process, function of non-verbal communication
Goal of this Workshop

To demonstrate how existing social science theories can be applied to human-computer interaction, and interactive surfaces in particular.

Will NOT be a comprehensive review of all relevant social science literature (not enough time!)

Outline of Workshop

• Functions of non-verbal communication

• Proxemics
  - Application of proxemics theory
    ▪ Proxemics implications for multi-device interaction
    ▪ Proxemics interaction with a wall display

• Territoriality
  - Application of territoriality theories
    ▪ Territoriality in interactive tabletops
    ▪ Territoriality in virtual reality environments

• Design activity and wrap-up
Two Major Types of Communication

• Verbal communication
  - Typically refers to spoken language between people

• Non-verbal communication
  - Augments and sometimes replaces verbal communication
Non-Verbal Communication

• Examples non-verbal cues:
  - Facial expressions, direction of gaze, body posture and positioning, dress, and physical distance

• Why are non-verbal cues important for communication?
Non-Verbal Communication

• Examples non-verbal cues:
  - Facial expressions, direction of gaze, body posture and positioning, dress, and physical distance

• Non-verbal cues play two main roles in communication:
  - **Integrational** – behaviours that facilitate the process of communication
  - **Informational** – passage of information from one individual to another
Purpose of Non-Verbal Communication

- Argyle (1969) defines six main functions of non-verbal cues:

  **Integrational**
  - Mutual attention & responsiveness
    - eye-gaze, head nods, gestures
  - Channel control
    - eye-gaze, head nods
  - Feedback
    - head nods, facial expressions

  **Informational**
  - Illustrations
    - gestures, pointing meant to illustrate an object or action
  - Emblems
    - gestures that replace a word (head shake or nod)
  - Interpersonal attitudes
    - proximity, gesture, facial expression
### Proxemtics

- A term coined by cultural anthropologist Edward T. Hall during the 1950's and 1960's to mean:

  **The study of how we use space**

- More formally: The study of how humans unconsciously structure microspace - the distance between people in the conduct of daily transactions, the organization of space in his houses and buildings, and ultimately the layout of their towns (Hall, 1966)
Proxemics

Hall's Distance Zones

- Public space (25 feet)
- Social space
- Personal space (12 feet)
- Intimate space (1.5 feet)

Hall’s Distance Zones

- **Intimate Distance (touching - 18 in)** - for embracing, touching, or whispering
  - Close: embracing, comforting, protecting, wrestling
  - Far: dominance, intimate companionship

- **Personal Distance (1.5-4 ft)** - for interactions among good friends
  - Close: usually only loved ones are tolerated in this zone
  - Far: keeping someone at “arms length”
  - Used to hold discussions of personal interest and involvement

- **Social Distance (4-12 ft)** - for interactions among acquaintances
  - Close: impersonal business, working together or social chat
  - Far: more formal business and social discourse
  - Important to maintain eye contact, people can work independently

- **Public Distance (12+ ft)** - used for public speaking
  - Close: people more carefully choose their wording and grammar
  - Far: 30 feet is automatically set around VIPs like the president
Application of Proxemics to Interactive Surfaces

I. Support proxemics in human-human interaction with technology
   - Support proxemics behaviour when groups of people in a co-located environment are interacting with technology

II. Proxemics-based technology design
   - Design the technology itself to expect and respond to proxemics behaviour
   - Typically used in ubiquitous computing environments
Application of Proxemics (Type I): Bumping & Stitching

"Bumping" (Hinckley, 2003)
Creating a shared, tiled display by physically touching multiple devices

"Stitching" (Hinckley et al., 2004)
Creating a connected workspace by performing a continuous pen gesture across multiple devices
• Makes use of the additional knowledge of device-device, user-device proxemic relationships (i.e., position, orientation, movement, and identity) to trigger and regulate interaction (Ballendat et al., 2010)
Facilitates cross-device transfer as a function of proximity (Marquardt, 2012)

- Communicate information exchange in 3 stages of increasingly gradual engagement: awareness of connectivity, reveal of exchangeable content, and transferring content.

- which devices can communicate with one another,
- what information they contain that is exchangeable,
- and how information can be exchanged in a controlled manner
Application of Proxemics (Type II): Siftor (Vogel, 2013)

• An art installation using interactive digital projection
  - Tracks peoples’ movements and translates them into different interactions (browsing, selecting, querying)

Application of Proxemics (Type II): Attention & Engagement

• Adaptive content in public interactive displays
  - Adjust what and how content is displayed (animated) in relation to passerby’s proximity to display and movements
Human Territoriality

non-verbal communication
proxemics
territoriality
design activity & wrap-up

safesoundfamily.com/wp-content/uploads/2013/05/gated-home-security.jpg
www.policemag.com/_Images/photogallery/SHS-Crip5-salisbury-1.jpg
www.law.georgetown.edu/library/about/services-policies/images/studyTable_2.jpg
“Human territoriality can be viewed as a set of behaviours and cognitions an organism or group exhibits, based on perceived ownership of physical space.” (Fisher et al., 1984, p. 176)

Territories “range in size from chairs, seats, or sides of a table, to street blocks” (Taylor 1988, p. 89).

Design Can Affect Territorial Behaviour:

- “The occupant of a public territory is at the mercy of a culture or spatial designer. For example, [...] restaurants sometimes seat different parties overly close to one another. Thus if the design of a public territory is bad [...] people will often have to rely heavily on other mechanisms, such as nonverbal and verbal behaviors.” (Altman, 1975, p.120)
Territoriality in Tabletop Collaboration

- Studies of traditional tabletop collaboration found that people establish **tabletop territories** on a shared tabletop workspace (Scott et al., 2004; Scott & Carpendale, 2010)
  - This finding corroborates other studies in the literature

- People tend to establish and maintain three types of tabletop territories:
  - **group**, **personal**, and **storage territories**
Establishment of Tabletop Territories

- Group
- Personal
- Storage

- non-verbal communication
- proxemics
- territoriality
- design activity & wrap-up

Scott & Cheung: Social Sciences for Interactive Surfaces
Task & Collaborative Benefits of Tabletop Territories

• Tabletop territories clarify which regions should be used for:
  - joint task work
  - assisting others
  - working independently in the group context

• Tabletop territories helps collaborators:
  - delegate task responsibilities
  - coordinate access to task resources
  - organize the task resources in the workspace
Application of Territoriality to Interactive Tabletops

- Mobile, resizeable tabletop containers provide digital storage territories

Storage Bins: Mobile, Flexible Storage Containers (Scott et al., 2005)

Interface Currents: Computationally Enhanced Interface Containers (Hinrichs et al., 2006)
Application of Territoriality to Interactive Tabletops

- Adaptive Personal Territories facilitates both joint and independent interaction on a shared tabletop museum exhibit (Klinkhammer et al. 2011)
Application of Territoriality to VR Environments

- PhotoPortals applies concept of personal territories in virtual reality environment to minimize interference among people in the shared space (Kunert et al. 2014)
Activity: Redesigning Interface Currents

(Hinrichs et al., 2006)
Activity: Redesigning Interface Currents

• Based on the theory we’ve just discussed, identify the design issue inherent to the existing Interface Currents concept?

• Work in groups to redesign the concept to better support social norms
Wrap-up

• Proxemics and territoriality are just a few of the many interesting social theories relevant to the design of interactive surfaces.

• Hopefully this gave you some inspiration to apply social science theories in your own work.
References