Human Computer Interaction

L&G: Agency in Mid-air Interfaces

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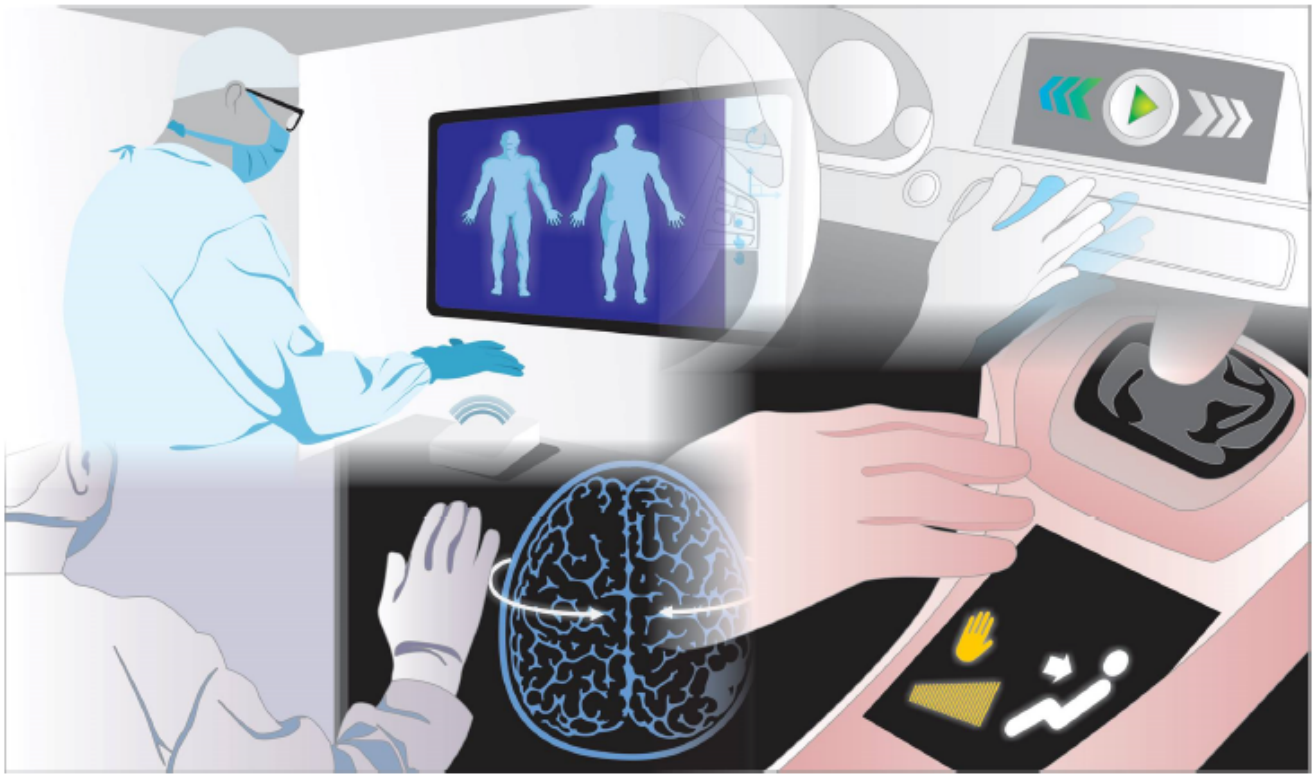
October 10, 2017

Outline

Overview

The main idea

- The main point of this work is to investigate the user's sense of being in control.
- Specifically, to look at the Sense of Agency in touchless interfaces.



Contributions

The main contributions claimed:

- Investigation of agency effects for touchless gesturebased interaction.
- Implicit and quantitative metrics show that touchless gesture-based input modality could be as responsive as a physical touch-based input modality.
- Demonstration that auditory and haptic feedback help to increase user's SoA in touchless interaction compared with visual feedback.

Related Work

Sense of agency

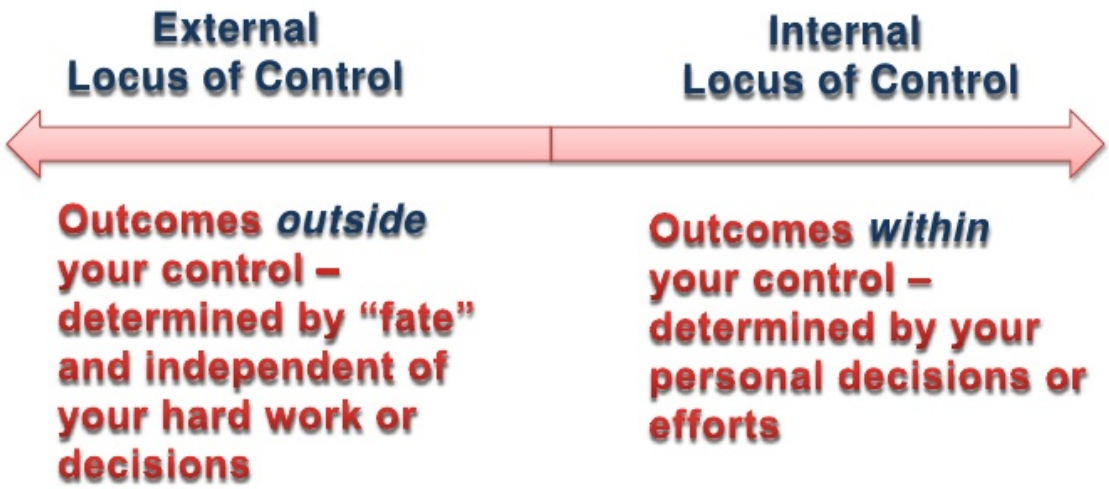
- The study of agency has a long history in psychology.
- This Sense of Agency refers to a person's sense of being in control, or of being the agent effecting outcomes in the world.
- In the world of psychological research it is important in the study of schizophrenia and other affective disorders where people do not feel in control of their actions or thoughts.
- Two important concepts:
  - Predictive model of agency: I intended to do something, and something happened as a consequence.
  - Postdictive model: something happened, and I was the cause.

Agency in HCI

- Sense of personal agency changes with the use of technology.
- It is important to understand how users feel in control (or don't) when using interfaces.
- Until now (i.e. this paper) concentration has been on studying SoA in desktop interfaces.
- Studies find that user perception of on-screen events depends on agency cues.
- And that the perception in time of participants differed depending on whether an auditory effect followed a machine or human-initiated click action.

Touchless systems and feedback

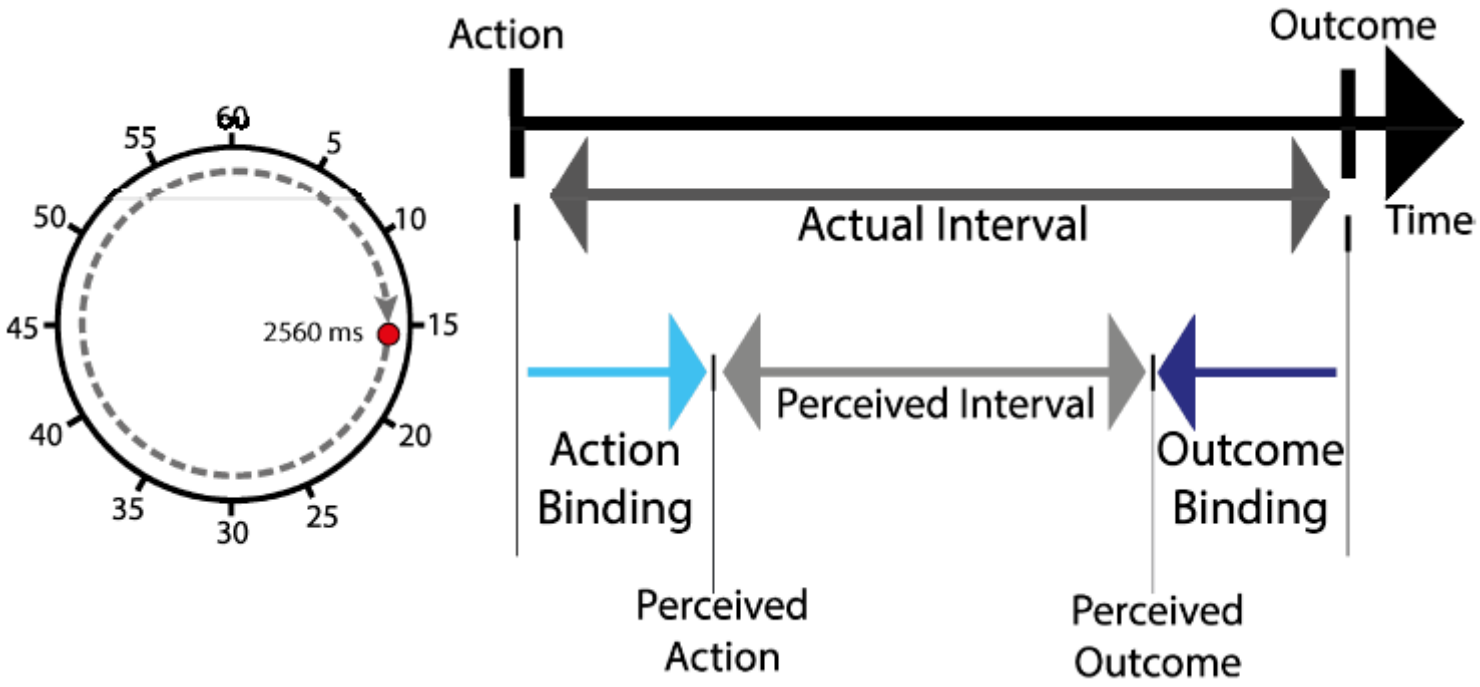
- This paper, however, looks at agency in touchless systems.
- Since there is no inherent tactile feedback due to their nature, naturally brings into question the user's SoA.
- Key to this is Shneiderman's Seventh Golden Rule of Interface Design – that interface design should support an internal locus of control:



Intentional Binding

Measuring Sense of Agency

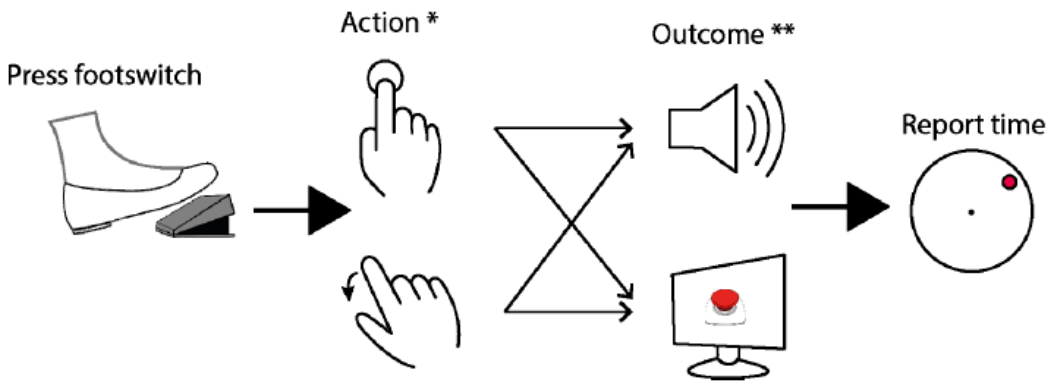
- How can we measure a sense of agency?
- Using the intentional binding model.
- This uses the measurable notion of time compression between the perception of action initiation and action outcome:



Experimental setup

The procedure

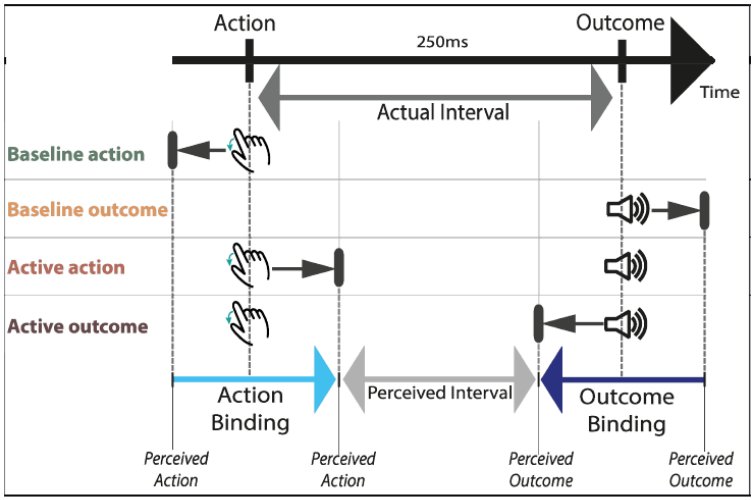
- The interface tested is quite simple: a single button press.
- There are two modalities of input: physical click and gestural click.
- Three types of feedback: audible, visual, haptic (tactile), haptic (mid-air).



Measuring intentional binding

- We can measure the existence of an intentional binding effect by measuring time compression.
- This means measuring the gap between the perceived start of an action and the perceived outcome.

Measurement Blocks				
Condition	Action	Outcome	Participant Report	Error
Baseline action		None	Action	Error= perceived time - actual time
Baseline outcome	None		Outcome	Error= perceived time - actual time
Active action			Action	Error= perceived time - actual time
Active outcome			Outcome	Error= perceived time - actual time

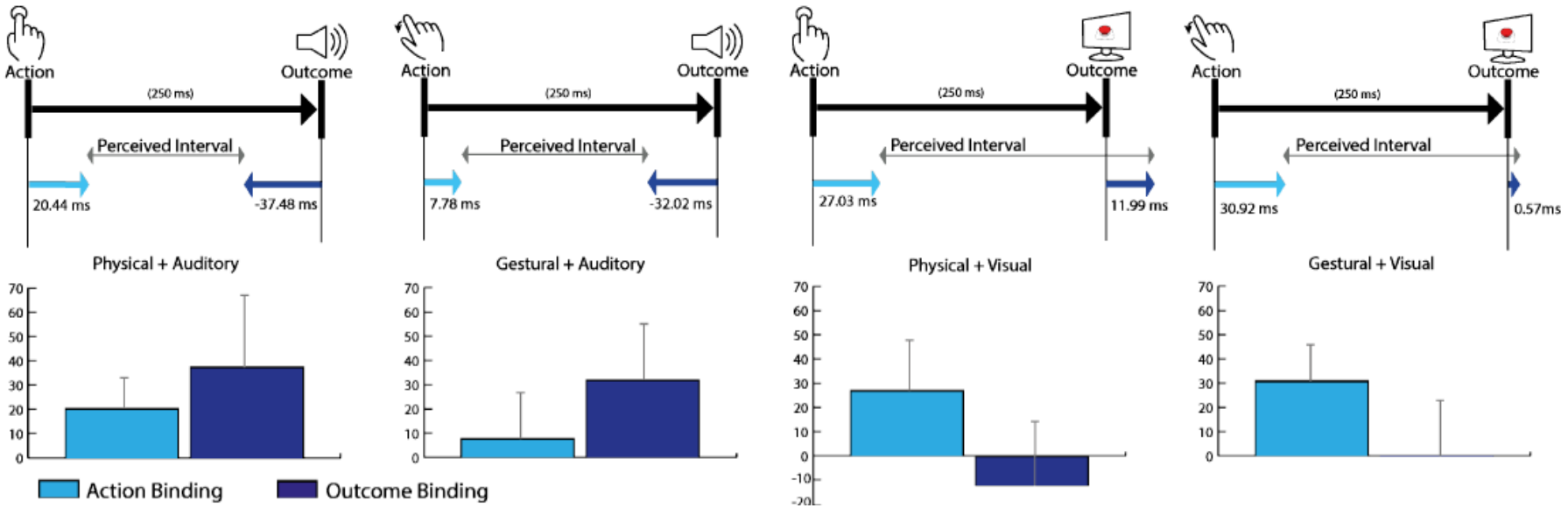


Error = Perceived time - Actual time
Action Binding = **Active action error** - **Baseline action error**
Outcome Binding = **Active outcome error** - **Baseline outcome error**
Total Binding = **Action Binding** - **Outcome Binding**

Experimental Results

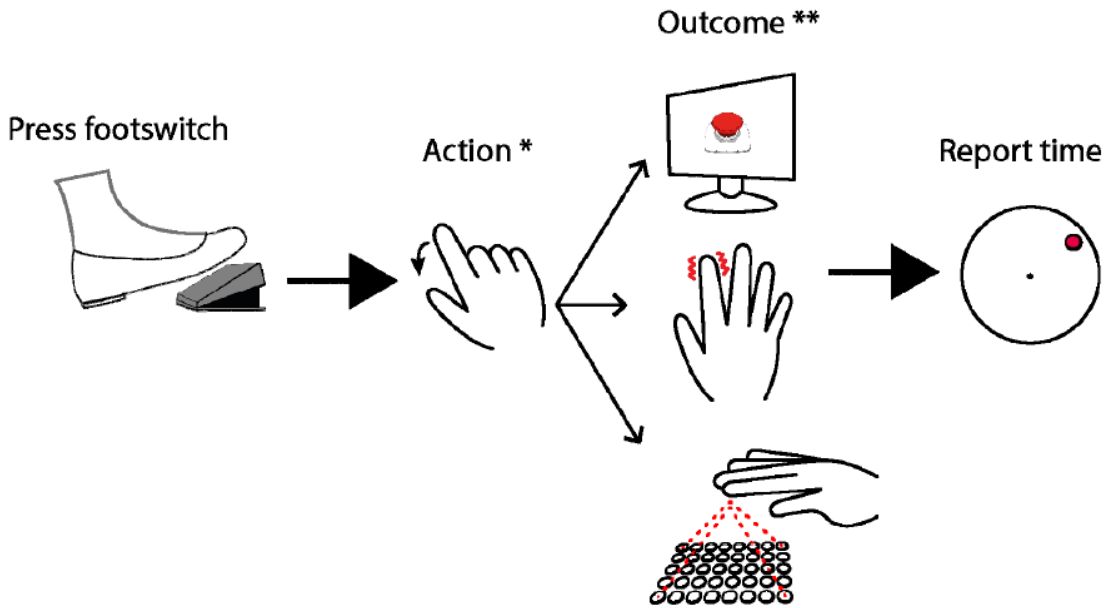
Touchless vs physical vs audible vs visible

- The first study was designed to determine if there is an intentional binding affect due to action or feedback.
- Interesting: feedback is more important than action.
- NO difference in binding across action/feedback combinations.



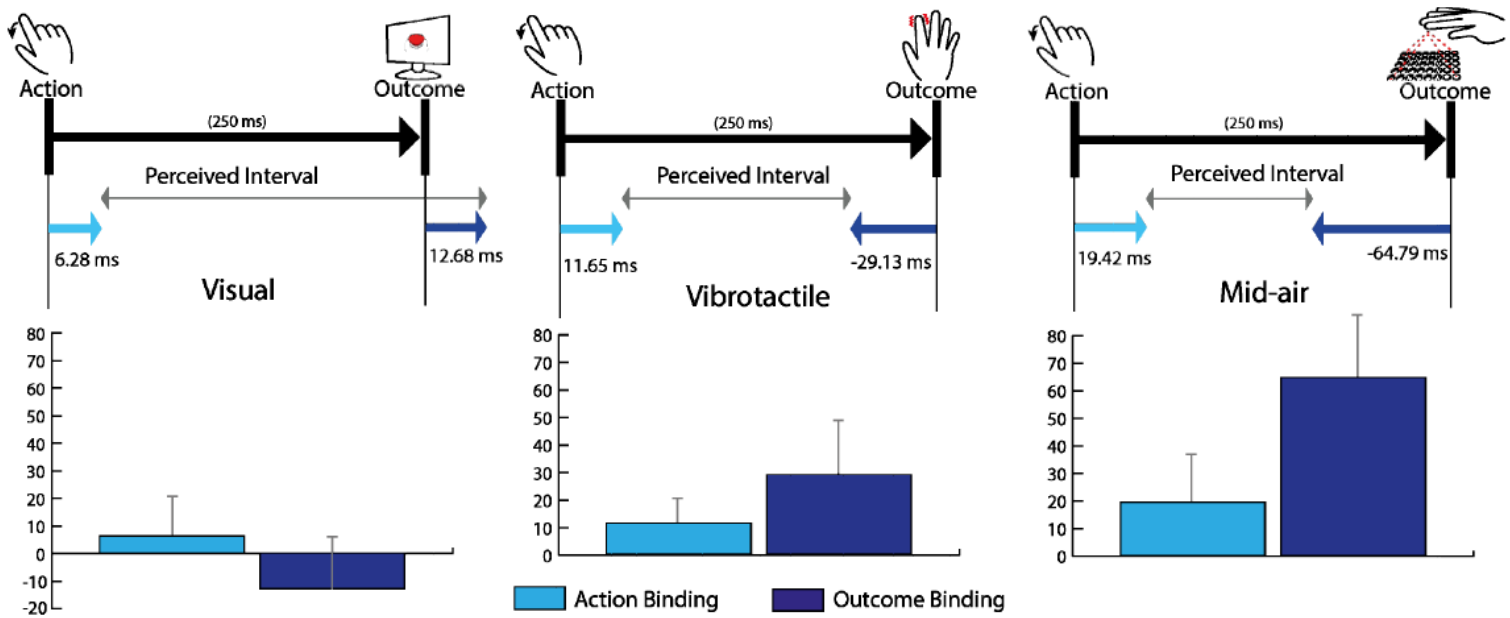
Touchless Visual and Haptics

- Setup nearly identical.
- However, now there is only one action, and three types of feedback.
- Visual, vibrotactile haptic, and mid-air haptic feedback.



Touchless visual and Haptics

- Results show a significant difference between mid-air haptics and visual feedback.
- But no significant differences between anything else.
- Conclusion: higher intentional binding with haptic feedback.



Discussion

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- The authors claim that these results demonstrate an intentional binding effect in touchless gesture-based interfaces.
- Also, that visual feedback is results in much less sense of agency compared to haptic or audible feedback.
- They attribute this to the postdictive influence of agency in the intentional binding paradigm.
- Meaning: audio and haptic feedback in gesture-based, touchless interfaces might be good candidates for increasing user's sense of being in control and feeling of interacting with a more responsive system.