An Analysis of the Conflict Between the User Control and the Need for Physical-Visual Consistency in Tangible Tabletop Interaction

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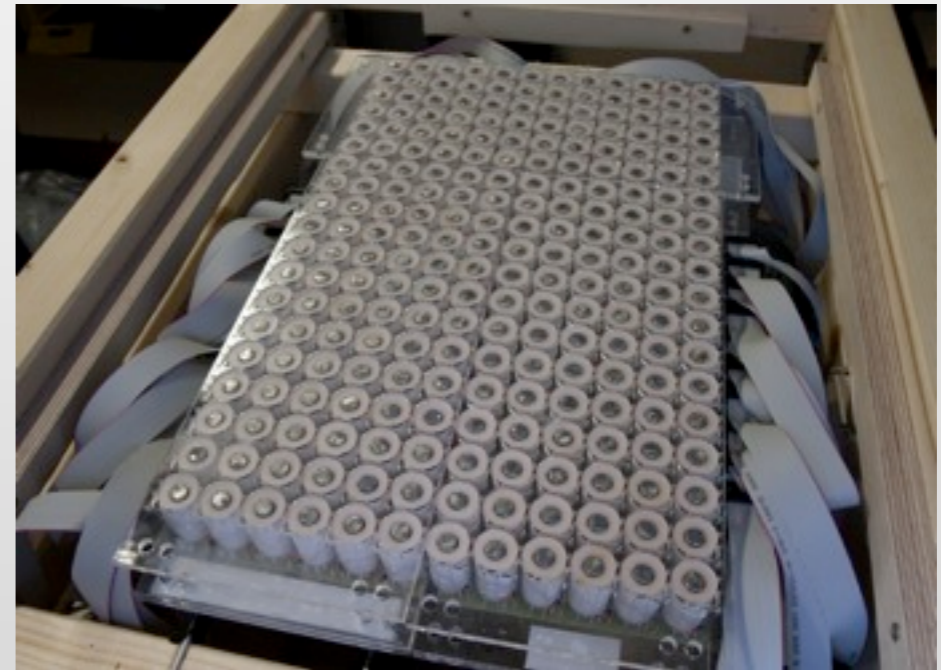
Supervised by Malte Weiss

Context
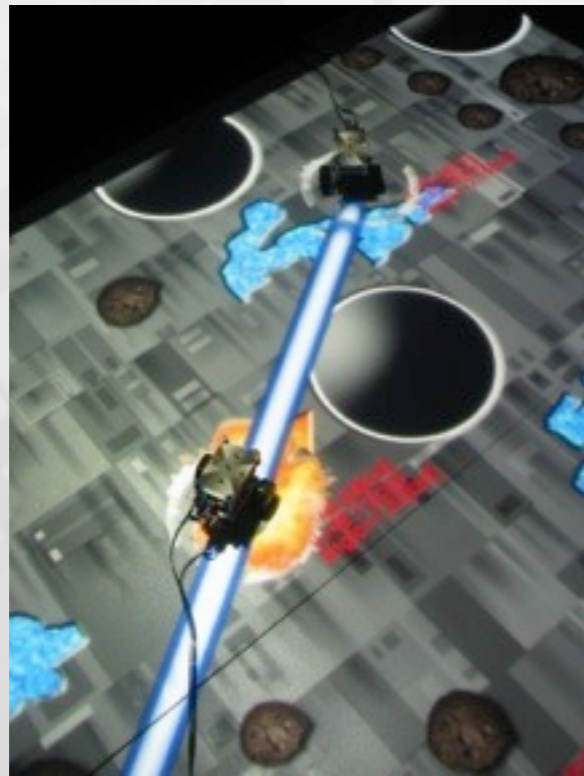

Tangible tabletop interaction

$+$

Actuation technology

➡ Illusion of a physical and digital unit

Motivation

+ Physical and digital consistency

– Loss of control

  • How do users respond to loss of control?

  • How to decrease loss of control?

Related Work

Augmented Coliseum
[Kojima et al., 2006]

Madgets [Weiss et al., 2009]

Mechanical Constraints [Patten et al., 2007]

Tangible Bots [Pederson et al., 2011]

Control in Psychology

- What is control?

- Three characteristics of control [Thompson, 1981]

  - Predict, explain, and influence events and their outcomes

- Effects of loss of control

  - Anxiety and stress [Deci and Ryan, 1987]

  - Aversive emotional reaction [Brehm, 1966]

  - Rejection [Depret and Fiske, 1993]

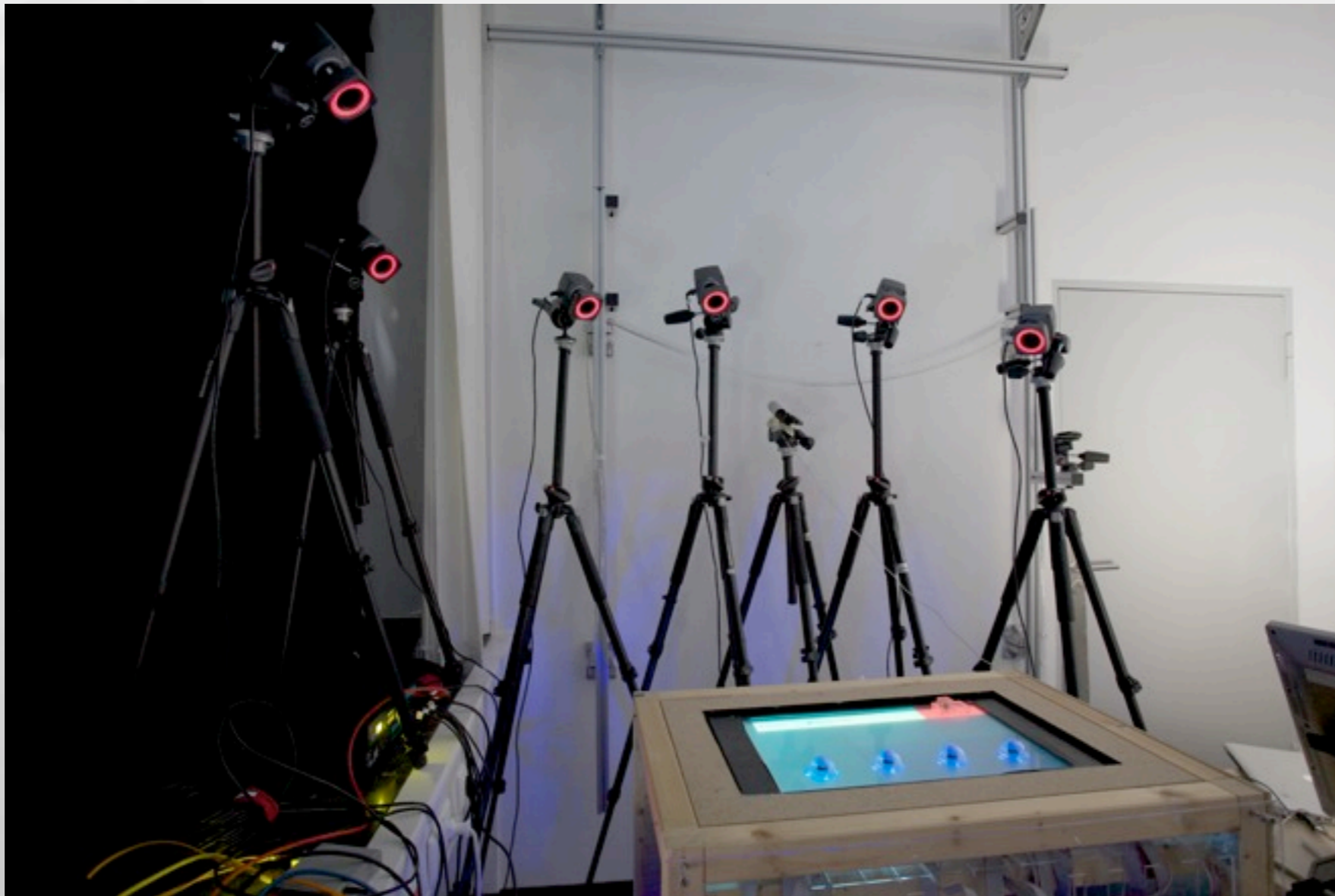➡ Behavior of actuated tangibles vs. characteristics of control

Assumption

- Visually augmenting actuation process

- Providing interruption mechanism

} decreases loss of control

➡ Increases interaction experience

User Study

- Evaluation of different support techniques

  - Visual support

  - Interruption support

- Execution of sorting tasks

  - Sharing tangibles with remote communication partner

  - Wizard of Oz simulates existence/movements of remote tangibles

- Qualitative evaluation techniques

  - Video observations, retrospective interviews, questionnaires, thinking aloud
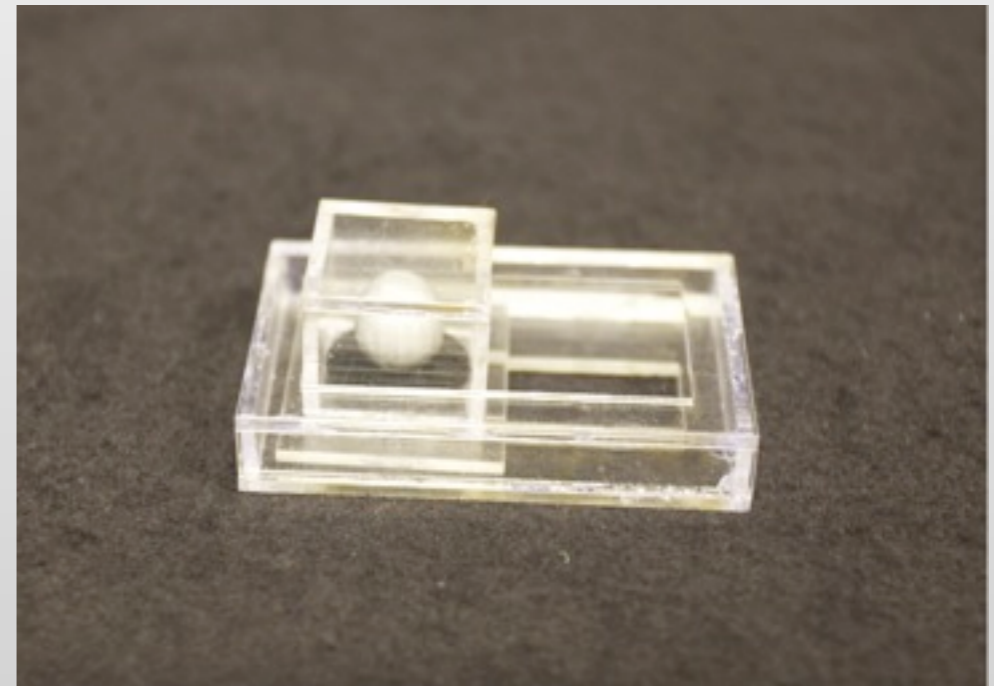
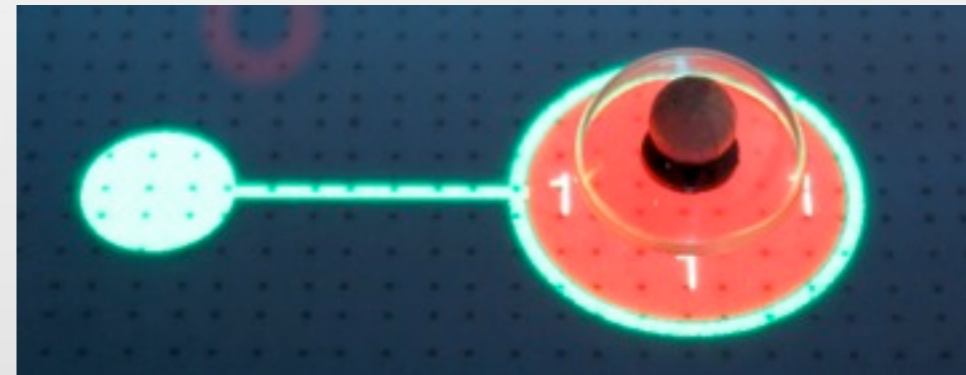# Test Environment

Tangibles

Puck

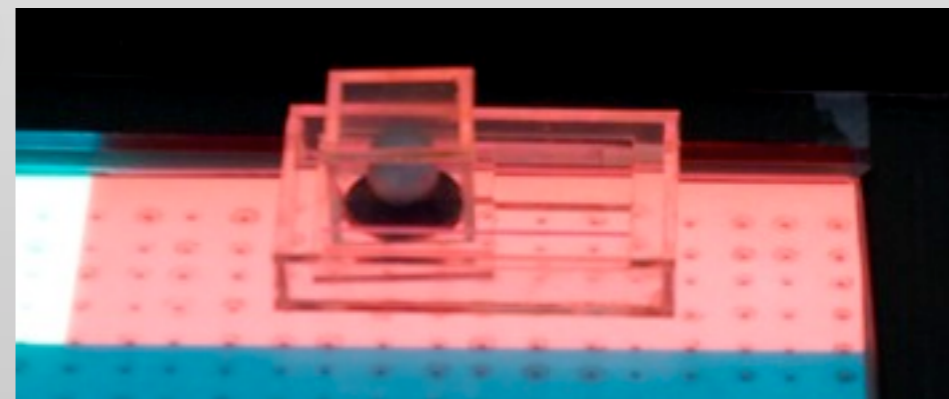

Switch

Visual & Interruption Support

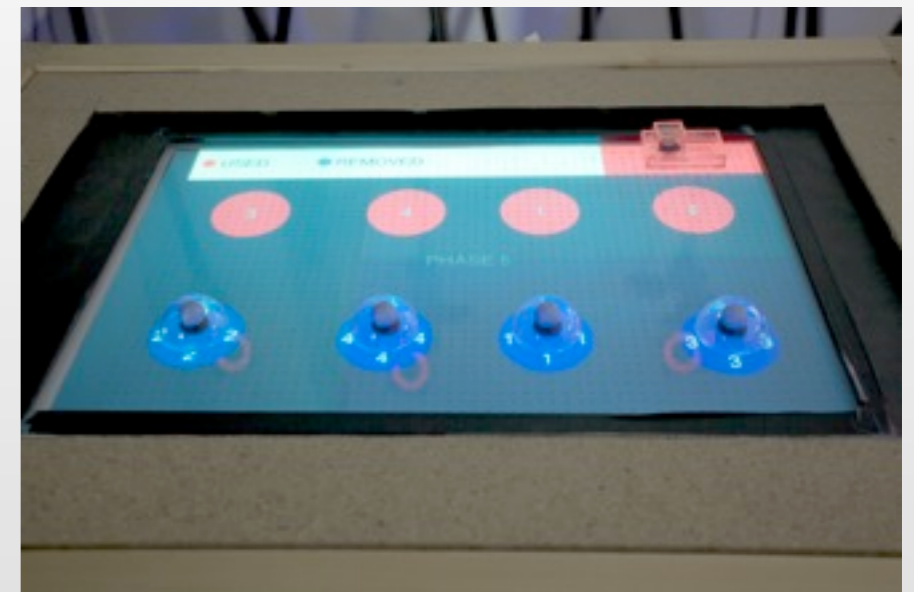Visualize upcoming actuation process

Visualize starting point

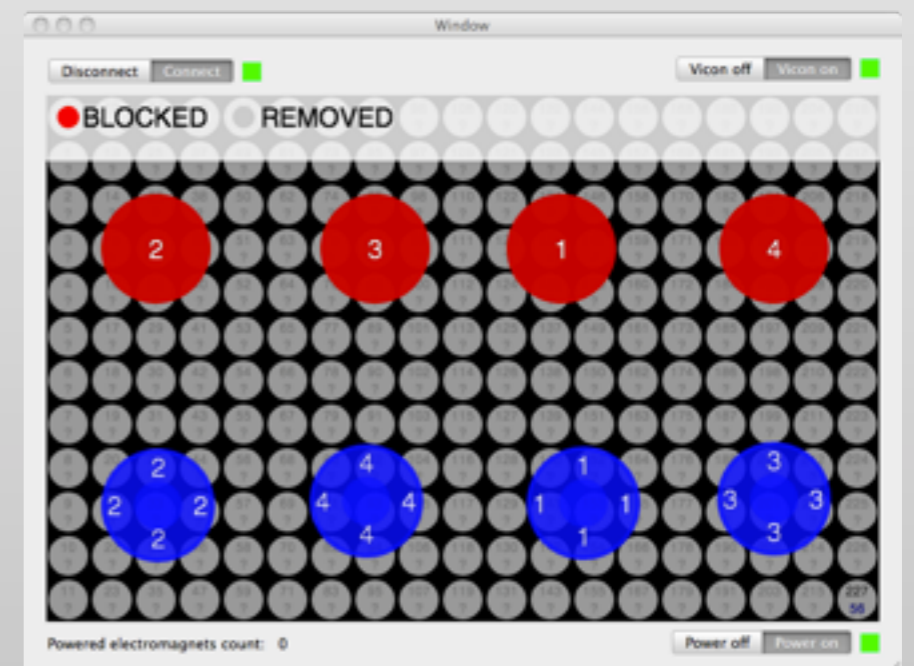

Visualize starting + destination point

Interruption via switch

Test Procedure

- 12 participants

- Several test phases, each with five sorting tasks

  - Phase differs in support technique

  - Task differs in target order

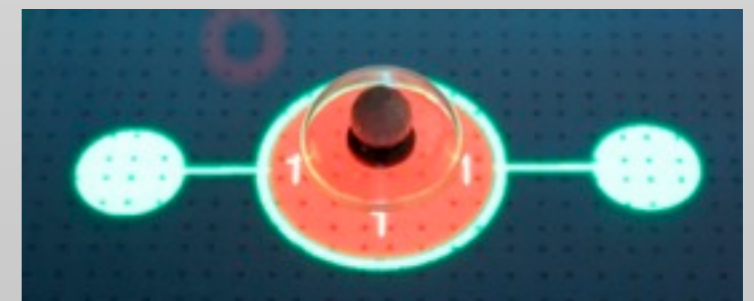- Wizard enforces conflicting situations

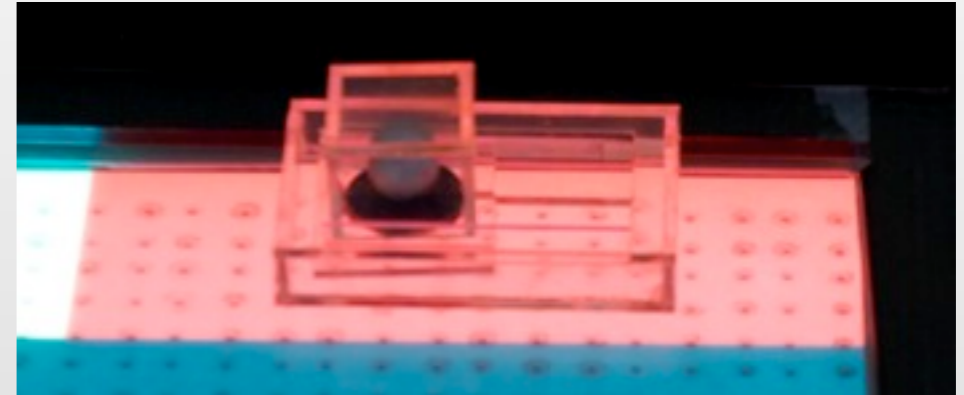 - Helps or annoys

Task UI

Wizard UI

Insights

– Visualizing starting point

- „No additional value regarding this scenario"

- „Maybe useful on larger table"

o Visualizing upcoming actuation

- „Did not changed my behavior"

- „Decided to position another puck"

+ Visualizing destination point

- „Knew the intentions of the remote user"

- „Increased feeling of actually collaborating"

Insights

+ General idea of interrupting

  - „I had the feeling of being in control"

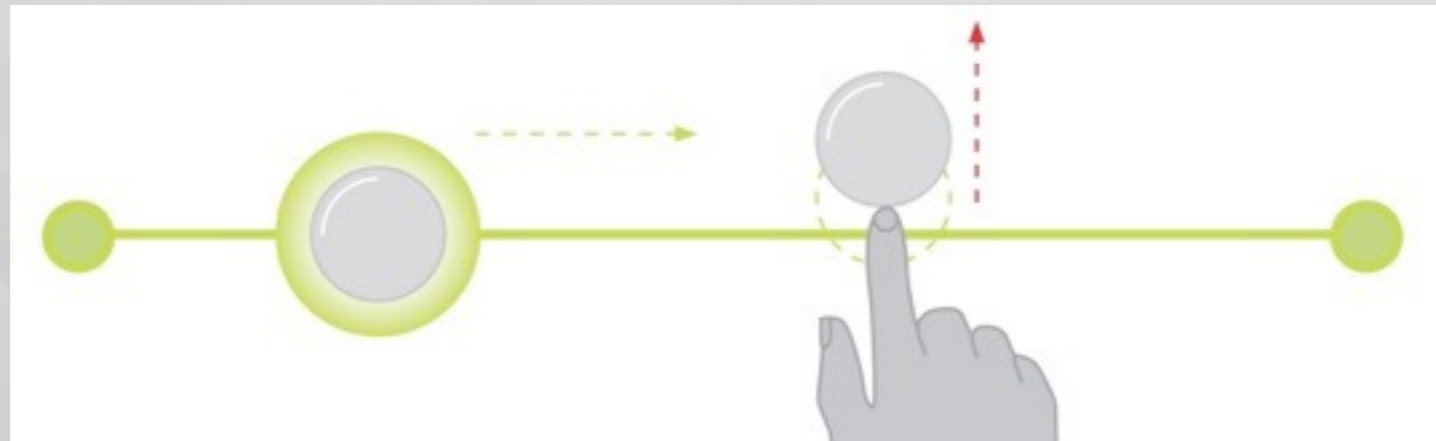 - „I was able to switch off the other user when he was wrong repeatedly"

− Implemented interruption technique

  - „Too drastically in realistic working environments"

  - „Consider the qualification of a user"

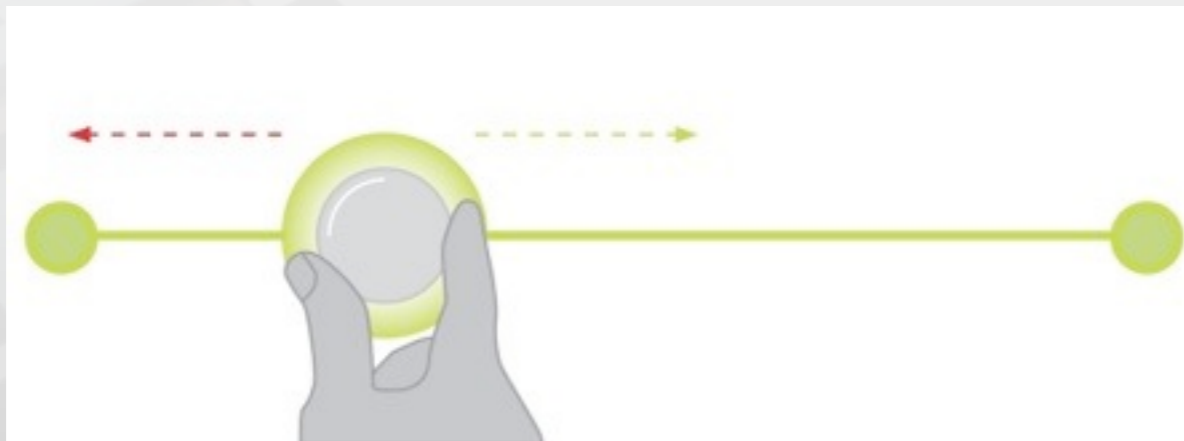 - „Decreases feeling of working together"

Insights

Waiting or switching focus on other puck

Helping to avoid collision

➡ Collaboration support

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Insights

Reposition or offering resistance

Pinning

➡ Desire to coordinate access

Conclusion

- Visual support is recommended

  - Users accept loss of control if actuation is predictable

  - Increases sensation of collaboration

- Interruption technique is problematic

  - Too drastic, impairs collaboration

  - Consider qualification of users

- Desire to communicate

  - Coordination of access to pucks seems important

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