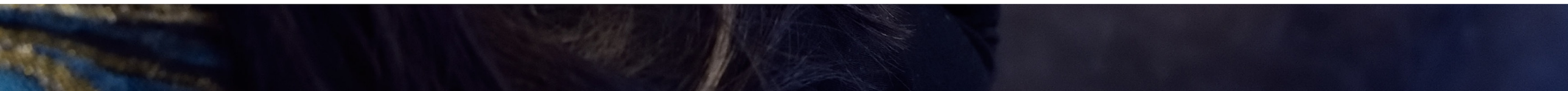
TANGIBLE, EMBODIED AND PERIPHERAL INTERACTION

Saskia Bakker, Eindhoven University of Technology



"Traditional" human-computer interfaces

http://eofdreams.com, http://9to5mac.com/, http://www.flickr.com/photos/liewcf/5229159351/

Interaction with physical artefacts in everyday life

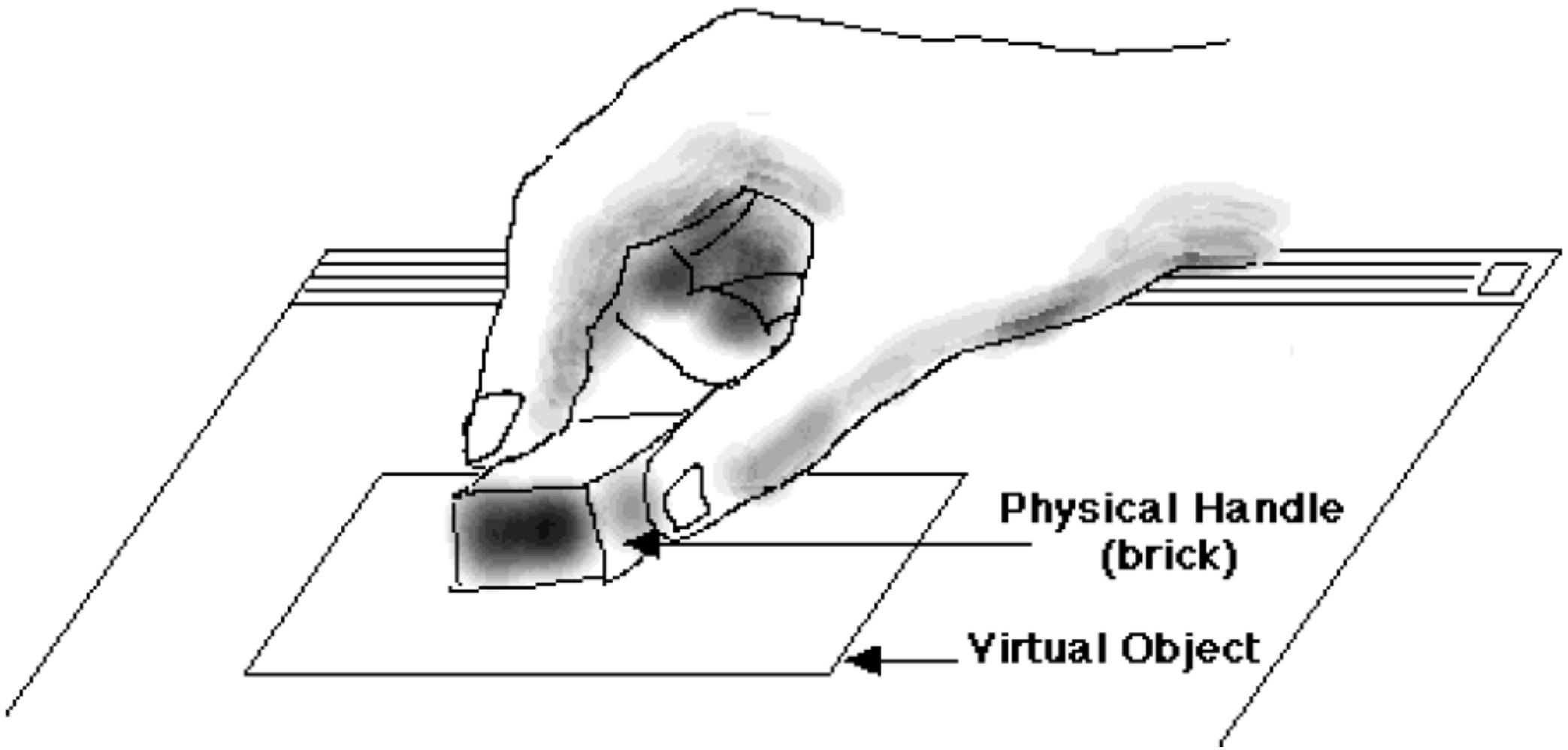
http://fojap.files.wordpress.com/2013/03/hammering.jpg/, http://www.fanpop.com/, http://.confessionsofahomeschooler.com, http://derek.broox.com

INTERACTION PARADIGMS INSPIRED BY INTERACTIONS IN THE PHYSICAL WORLD

- Inspired by physical movement and manipulation skills
  - Graspable User Interfaces
  - Tangible User Interfaces
  - Tangible Interaction
  - Embodied Interaction
- Inspired by attention management skills
  - Calm technology
  - Peripheral Interaction

GRASPABLE USER INTERFACES

- "Allow direct control of electronic or virtual objects though physical handles for control"



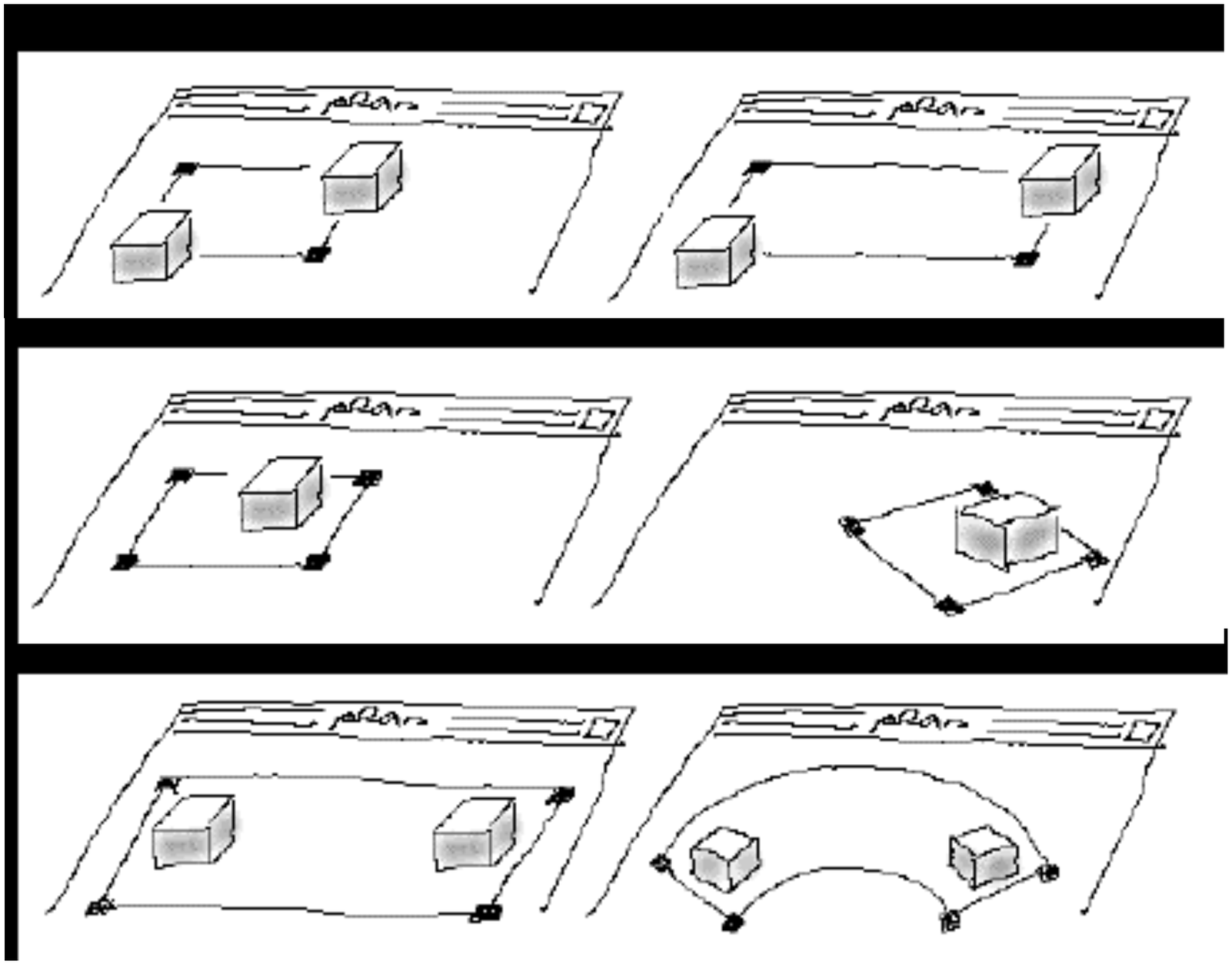
Fitzmaurice, G. W., Ishii, H., and Buxton, W. A. S. (1995). Bricks: laying the foundations for graspable user interfaces. In Proceedings of CHI'95, ACM Press, pp. 442–449.

GRASPABLE USER INTERFACES

Fitzmaurice, G. W., Ishii, H., and Buxton, W. A. S. (1995). Bricks: laying the foundations for graspable user interfaces. In Proceedings of CHI'95, ACM Press, pp. 442–449.

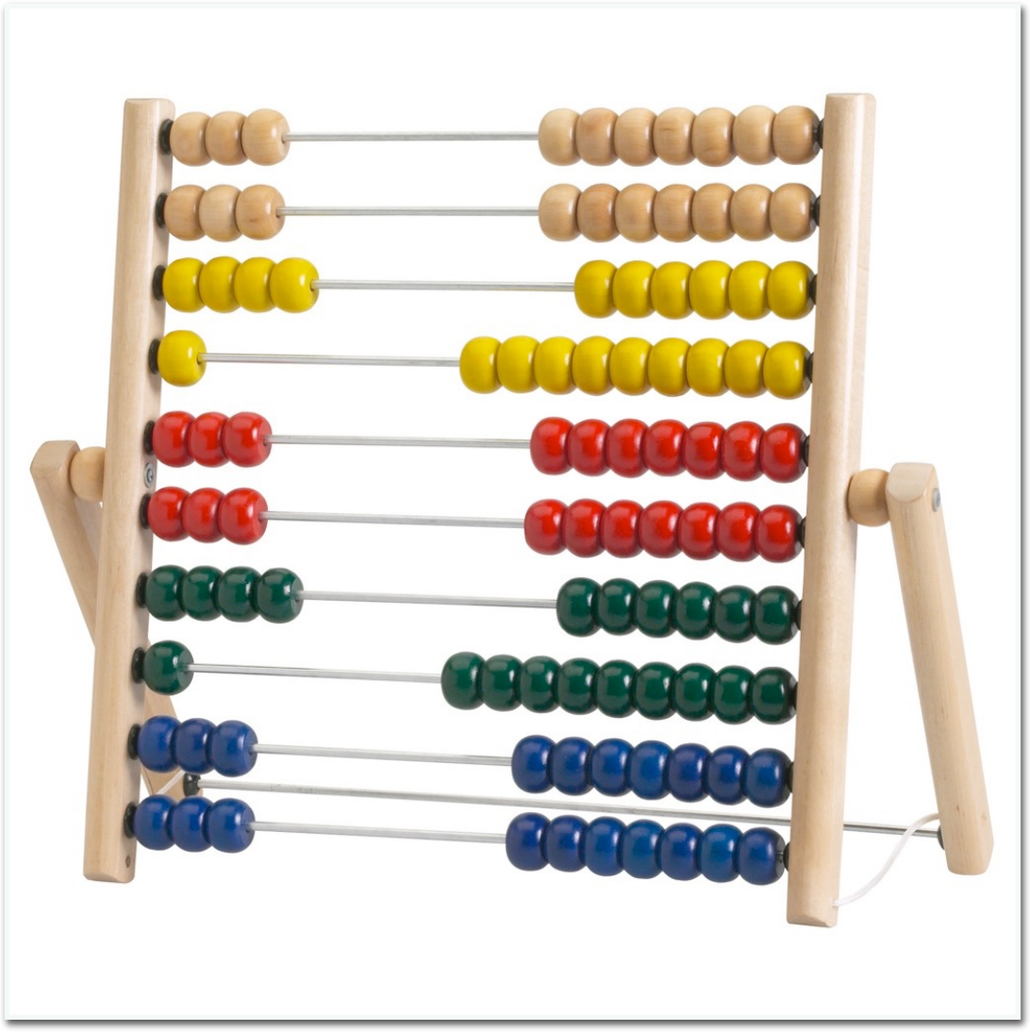
http://www.youtube.com/watch?v=V-TGEe-Imro

GRASPABLE USER INTERFACES



Fitzmaurice, G. W., Ishii, H., and Buxton, W. A. S. (1995). Bricks: laying the foundations for graspable user interfaces. In Proceedings of CHI'95, ACM Press, pp. 442–449.

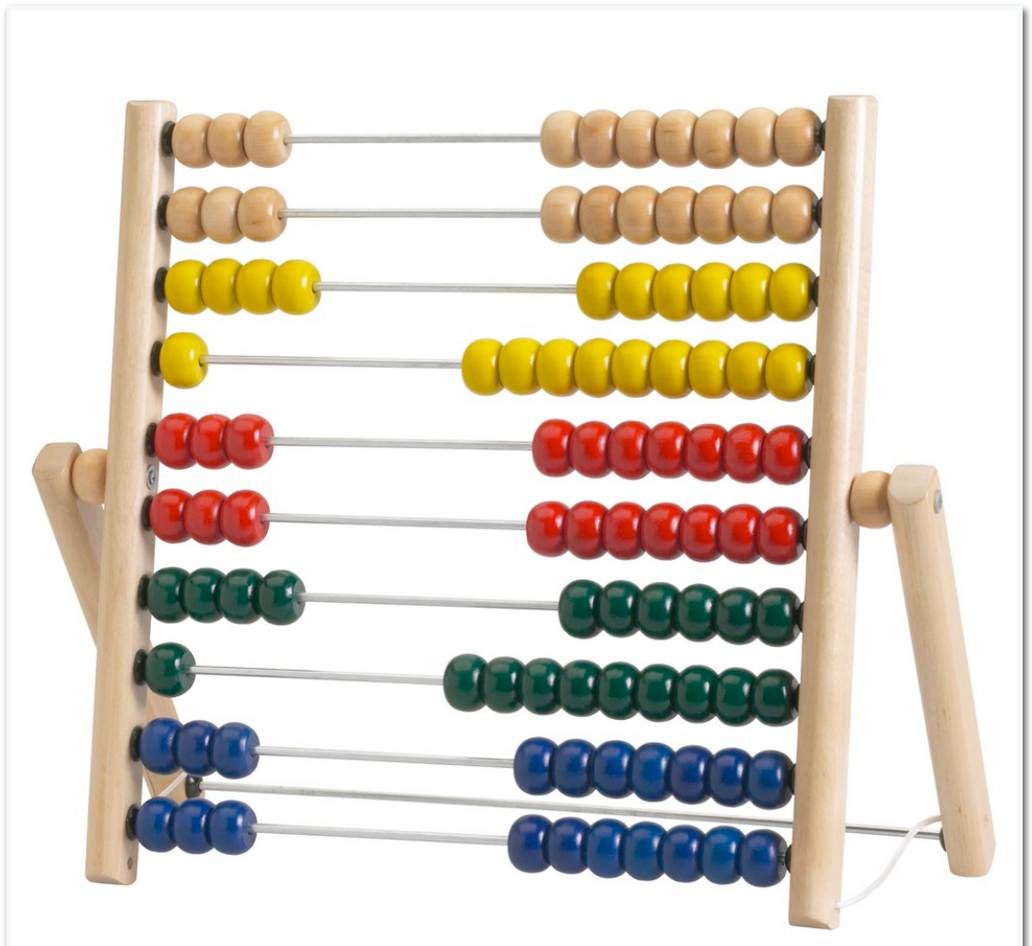
TANGIBLE USER INTERFACES



Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

http://www.ikea.com/PIAimages/21167_PE106157_S5.jpg

TANGIBLE USER INTERFACES



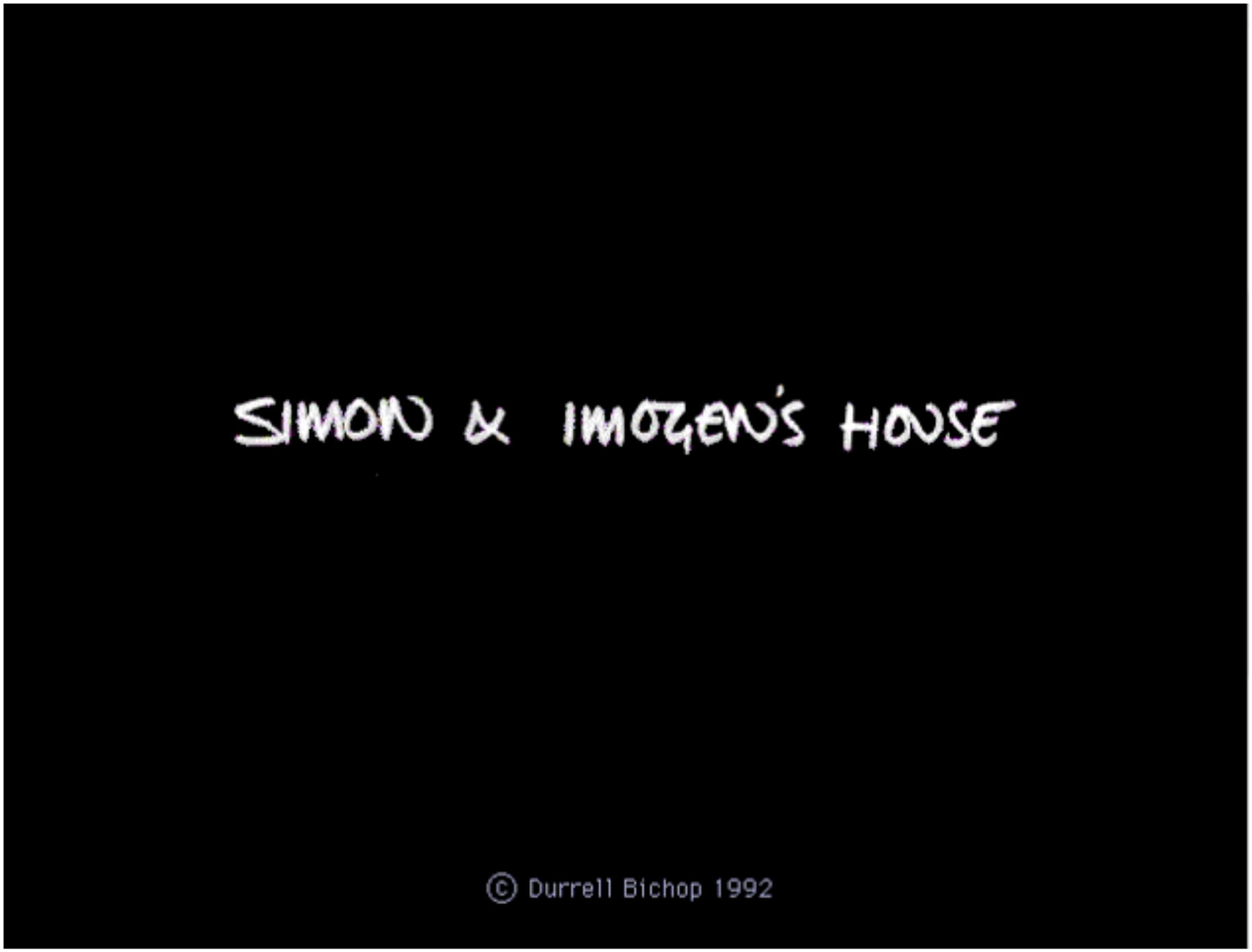
Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

TANGIBLE USER INTERFACES

- “Give physical form to digital information, and employ physical artifacts both as representations and controls for computational media”

Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

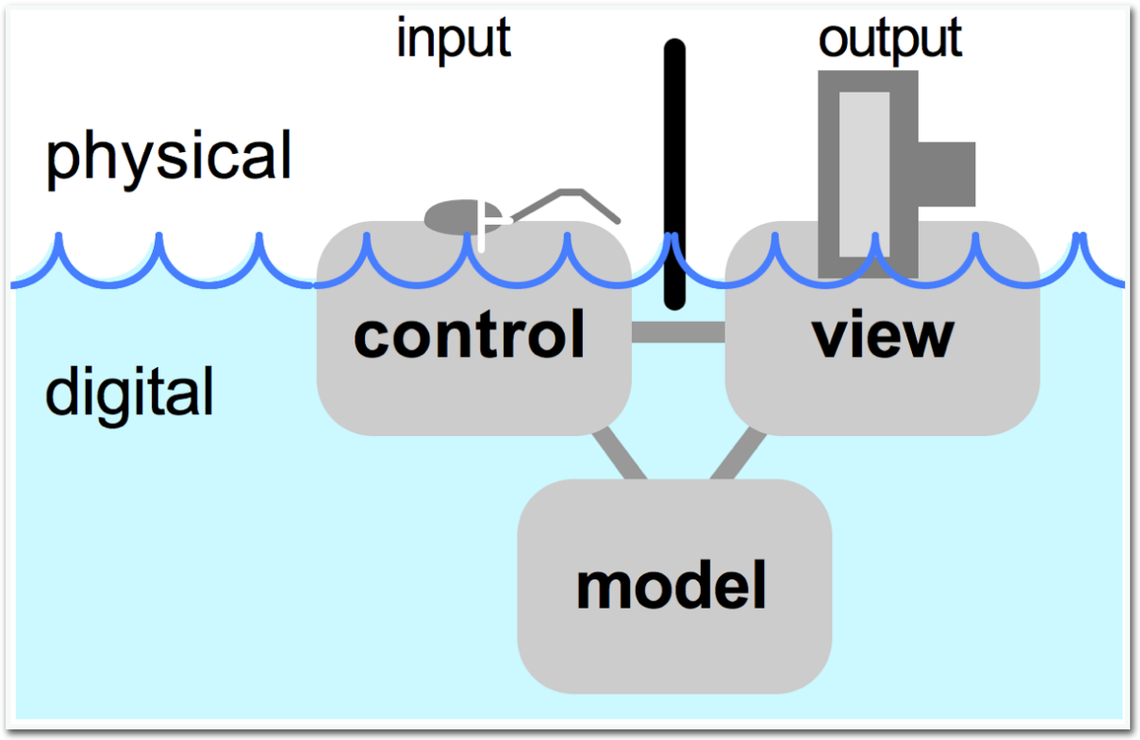
THE MARBLE ANSWERING MACHINE



Ishii H. and Ullmer, B (2000). Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. In Proceedings of CHI'97, ACM Press, pp. 234–241.

http://vimeo.com/19930744

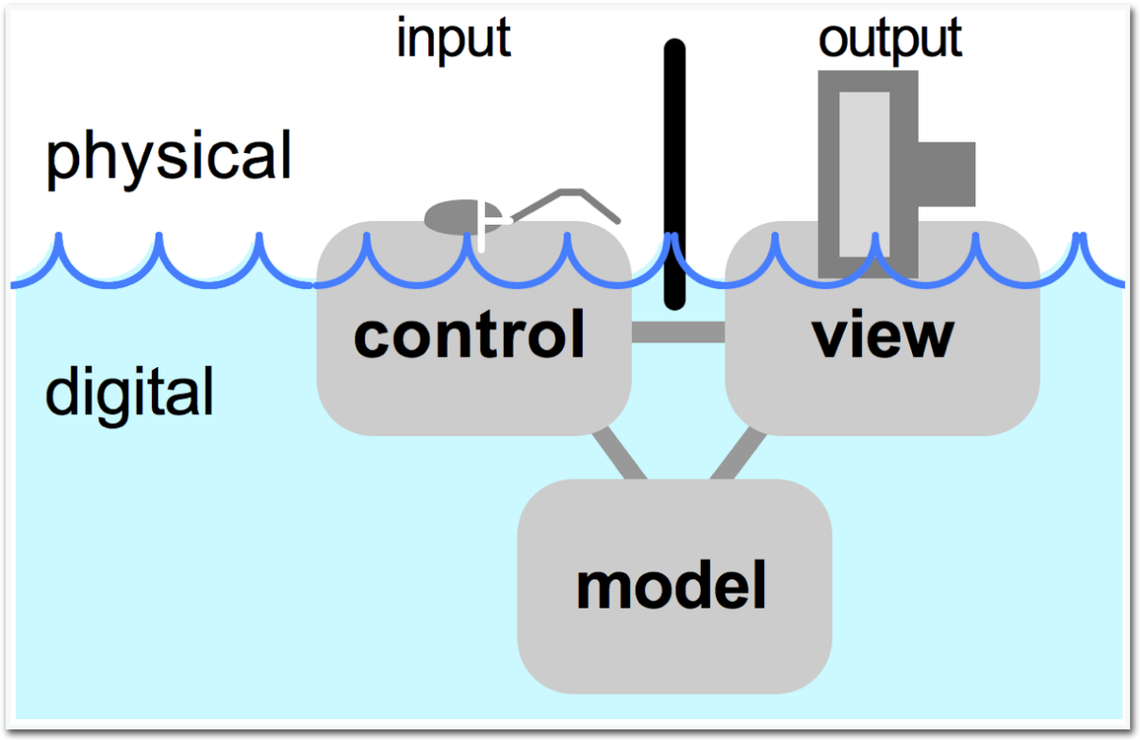
TANGIBLE USER INTERFACES



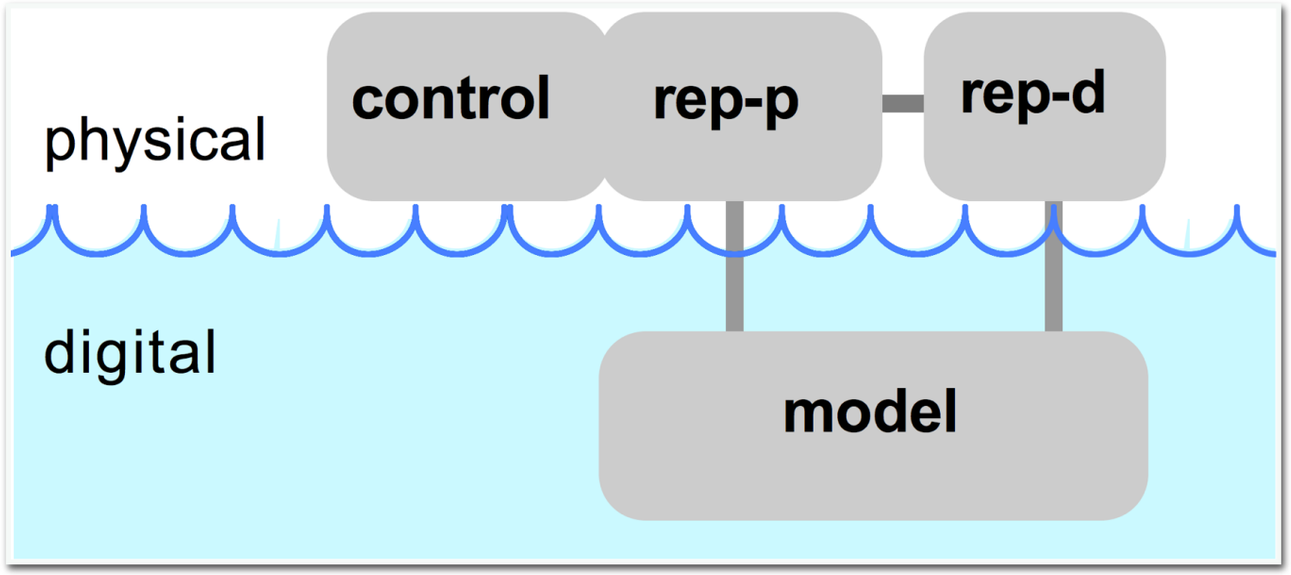
GUI (graphical user interface)

Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

TANGIBLE USER INTERFACES



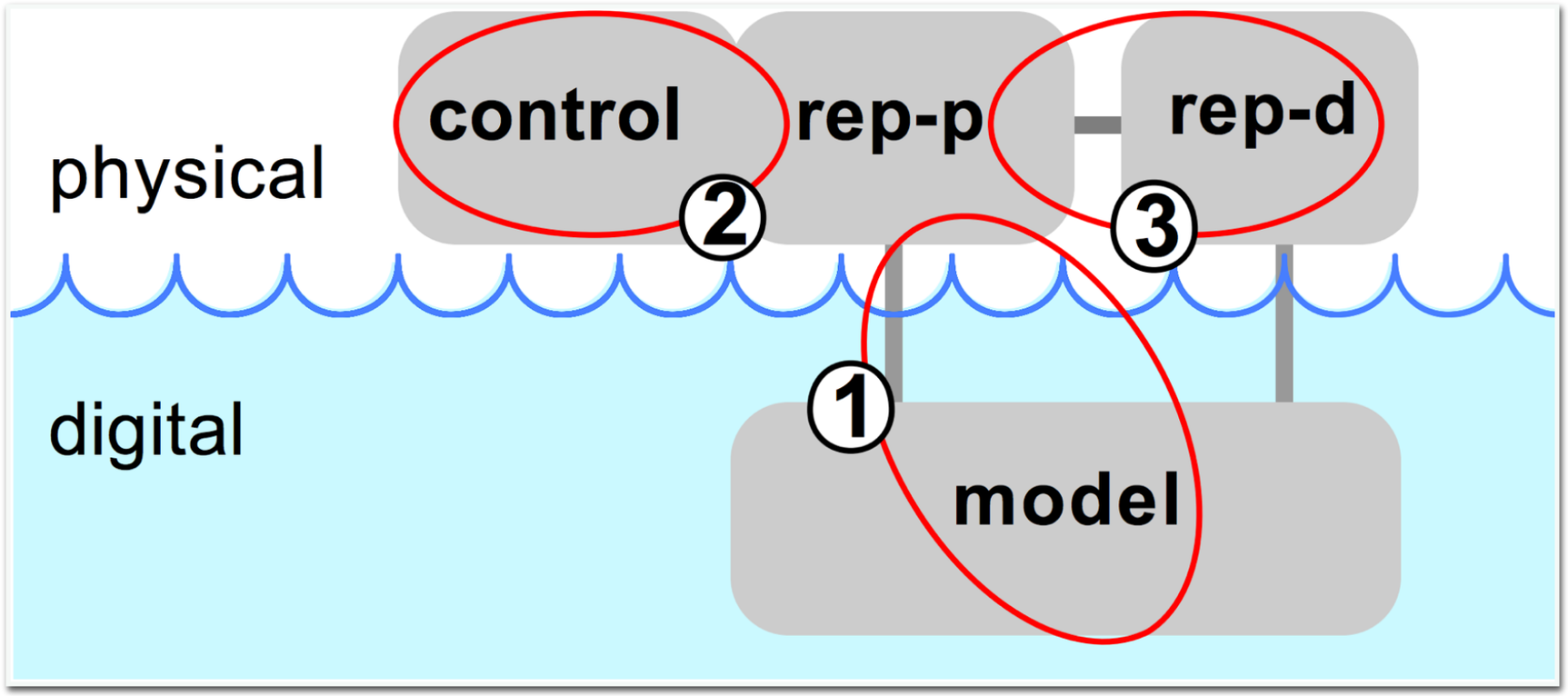
GUI (graphical user interface)



TUI (tangible user interface)

Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

TANGIBLE USER INTERFACES



Ullmer, B. and Ishii H. (2000). Emerging frameworks for tangible user interfaces. IBM systems journal, pp.915-931

TANGIBLE USER INTERFACES

- 5 strengths of tangible interaction (Shaer & Hornecker, 2009)
  - *Collaboration*
  - *Situatedness*
  - *Tangible Thinking*
  - *Space-Multiplexing and Directness of Interaction*
  - *Strong-Specificness Enables Iconicity and Affordances*

Shaer, O. and Hornecker, E. (2009). Tangible user interfaces: Past, Present, and Future Directions. Foundations and Trends in Human-Computer Interaction, 3(1-2).

TANGIBLE USER INTERFACES

- Limitations of tangible interaction (Shaer & Hornecker, 2009)
  - *Scalability*
  - *Risk of loosing objects*
  - *Versatility & Malleability*
  - *User fatigue*
  - ….

Shaer, O. and Hornecker, E. (2009). Tangible user interfaces: Past, Present, and Future Directions. Foundations and Trends in Human-Computer Interaction, 3(1-2).

TANGIBLE USER INTERFACES

- Application domains
  - *Learning*
  - *Problem solving and planning*
  - *Information visualisation*
  - *Tangible programming*
  - *Entertainment, play and edutainment*
  - *Music and performance*
  - *Social communication*
  - *Tangible reminders and tags*

Shaer, O. and Hornecker, E. (2009). Tangible user interfaces: Past, Present, and Future Directions. Foundations and Trends in Human-Computer Interaction, 3(1-2).

http://www.beatbearing.co.uk/

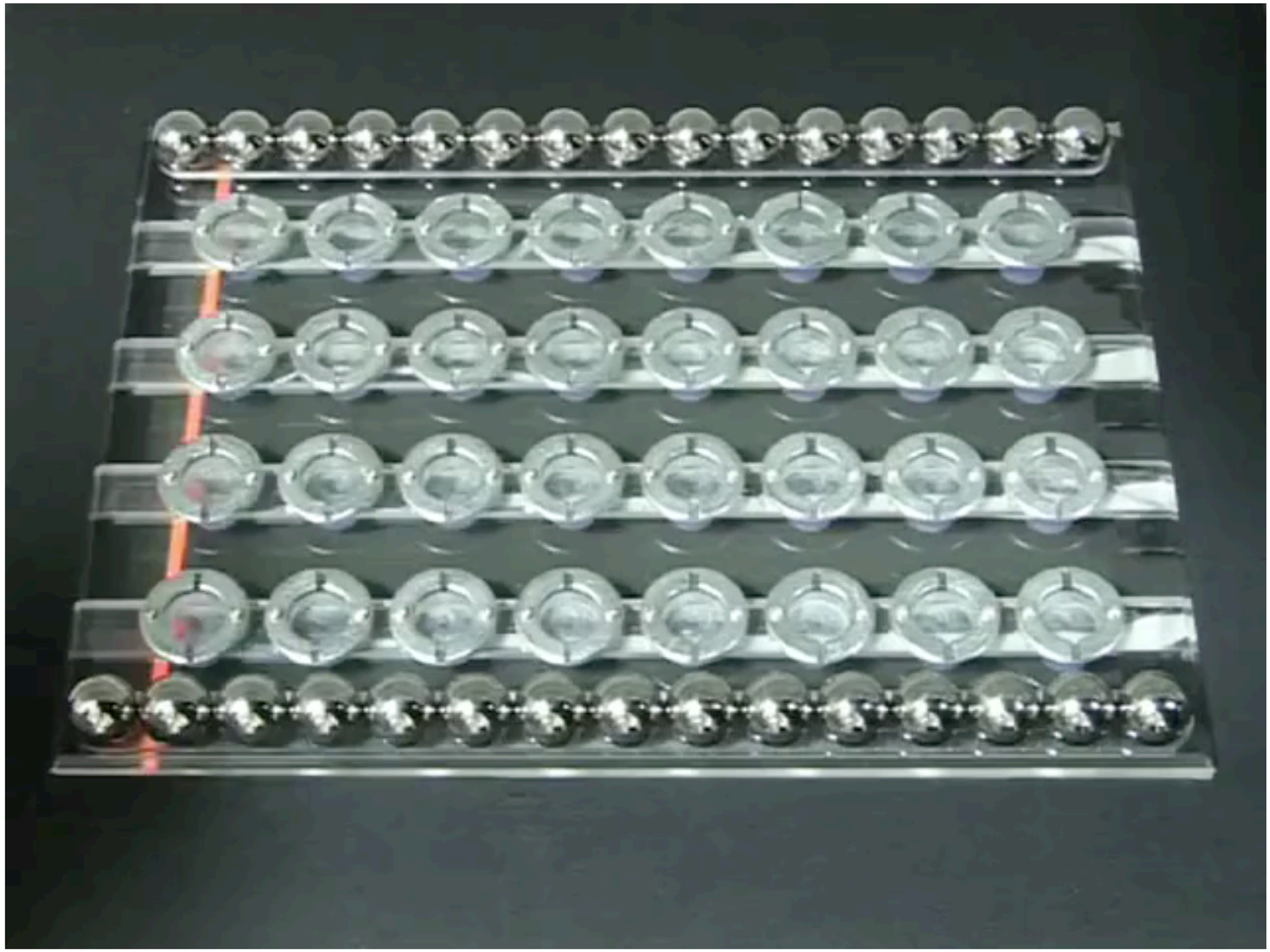
BEATBEARING

- Spatial
- Symbolic
- Dynamic binding

- Tangible Thinking
- Space-Multiplexing and Directness of Interaction

Bennett, P. & O'Modhrain, S. (2008) "The BeatBearing: a Tangible Rhythm Sequencer" Proceedings of NordiCHI'08.

BEATBEARING



Bennett, P. & O'Modhrain, S. (2008) "The BeatBearing: a Tangible Rhythm Sequencer" Proceedings of NordiCHI'08.

http://vimeo.com/19796259

http://web.mit.edu/course/other/sp.237/www/Parkes/FE_2004_topbo_387_p.jpg

TOPOBO

- Constructive
- Symbolic

- Collaboration
- Tangible Thinking
- Strong-Specificness Enables Iconicity and Affordances

Hayes Solos Raffle, Amanda J. Parkes, and Hiroshi Ishii. (2004). Topobo: a constructive assembly system with kinetic memory. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '04). ACM, New York, NY, USA, 647-654.

TOPOBO

Hayes Solos Raffle, Amanda J. Parkes, and Hiroshi Ishii. (2004). Topobo: a constructive assembly system with kinetic memory. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '04). ACM, New York, NY, USA, 647-654.

https://vimeo.com/44539844

https://upload.wikimedia.org/wikipedia/commons/e/e3/Reactable_Multitouch.jpg

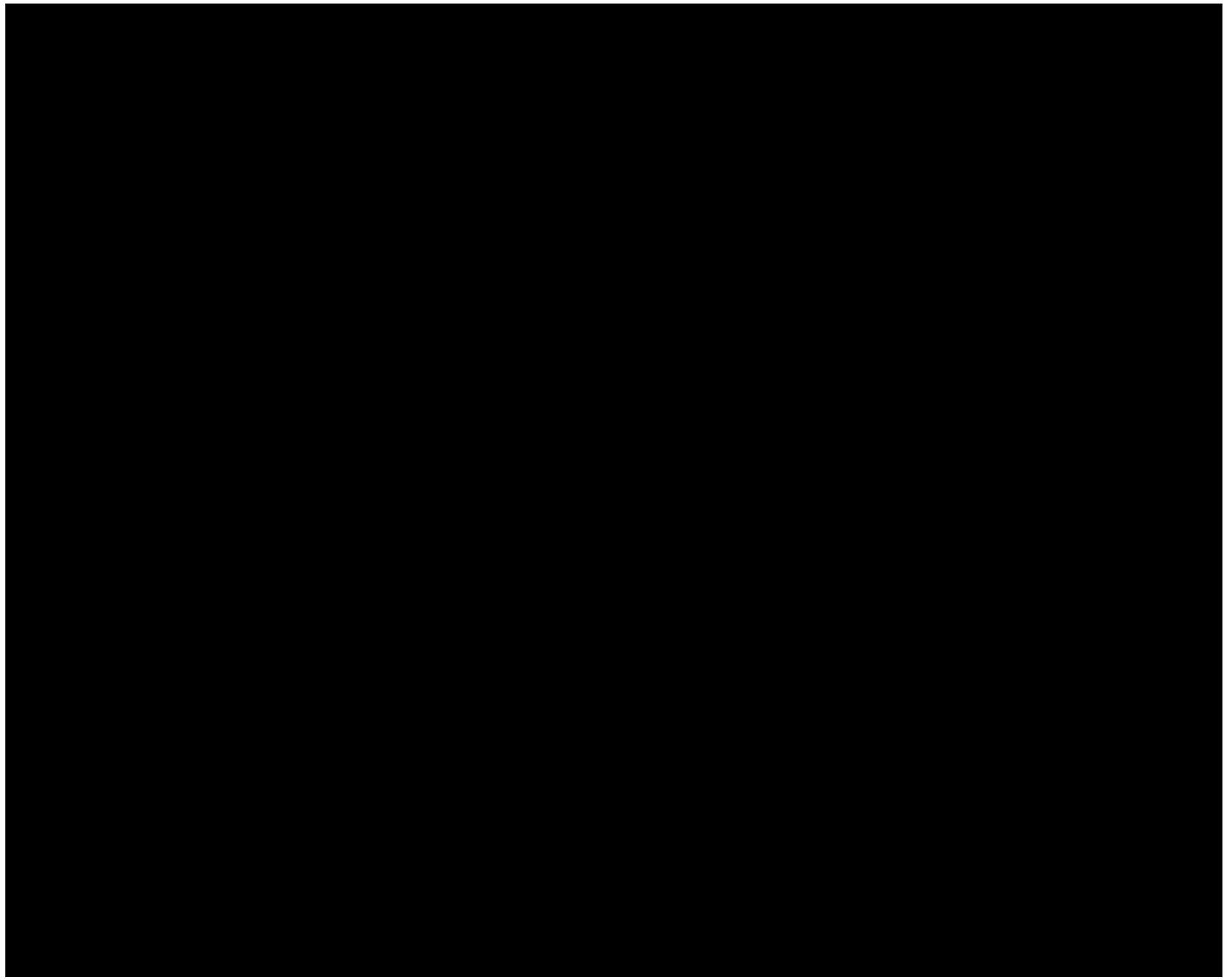
REACTABLE

- Relational
- Symbolic
- Dynamic binding

- Collaboration
- Space-Multiplexing and Directness of Interaction

Sergi Jordà, Günter Geiger, Marcos Alonso, and Martin Kaltenbrunner. 2007. The reacTable: exploring the synergy between live music performance and tabletop tangible interfaces. In Proceedings of TEI '07. ACM, New York, NY, USA, 139-146.

REACTABLE



Sergi Jordà, Günter Geiger, Marcos Alonso, and Martin Kaltenbrunner. 2007. The reacTable: exploring the synergy between live music performance and tabletop tangible interfaces. In Proceedings of TEI '07. ACM, New York, NY, USA, 139-146.

https://vimeo.com/4748386

TANGIBLE & EMBODIED INTERACTION

- Tangible interaction
  - *"Relies on tangibility and full body interaction and gives computational resources and data material form"*

- Embodied interaction
  - *"The creation, manipulation and sharing of meaning through engaged interaction with physical artifacts"*

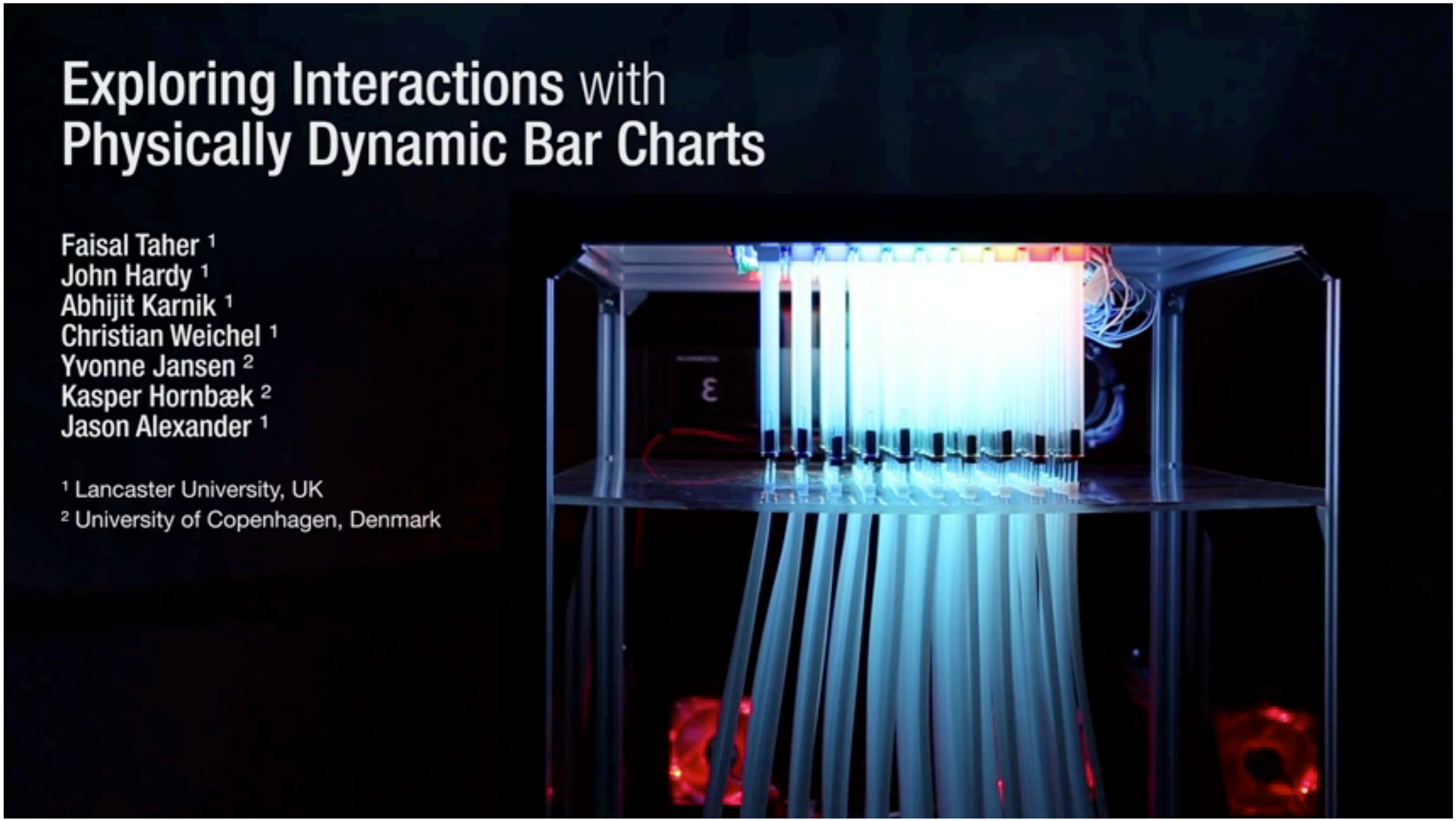
Hornecker, E., and Buur, J. (2006). Getting a grip on tangible interaction: a framework on physical space and social interaction. In Proceedings of CHI'06, ACM Press, pp. 437–446.

Dourish, P. (2001). Where the action is: the foundations of embodied interaction. MIT Press.

MUSTICK

http://www.youtube.com/watch?v=_1Nzi_DDHGM

SHAPE CHANGING INTERFACE



Taher, F., Hardy, J., Karnik, A., Weichel, C., Jansen, Y., Hornbaek, K. and Alexander, J. Exploring Interactions with Physically Dynamic Bar Charts. In Proceedings of the Conference on Human Factors in Computing Systems (CHI '15), ACM: 2015.

https://www.youtube.com/watch?t=81&v=UC6l6dy04zI

WRAP-UP TANGIBLE & EMBODIED INTERACTION

- Inspired by human physical movement and manipulation skills
- Suitable in various application domains such as:
  - *office work*
  - *education*
  - *musical performance*
  - *gaming*
  - ....

INTERACTION PARADIGMS INSPIRED BY ATTENTION MANAGEMENT SKILLS

- Calm technology
- Peripheral interaction

http://sophiecarr.blogspot.nl/2013/08/


MANFIELD
BLOKKER
sacha

http://www.flickr.com/photos/usdagov/6691228859/

http://www.flickr.com/photos/nognats/6213258784/

http://www.flickr.com/photos/vwjuniormasterssa/6219804649/

http://www.flickr.com/photos/vwjuniormasterssa/6219804649/

Everyday activities take place in the
periphery and in the *center* of attention

Interactive devices are usually designed
to be in the *center* of attention (i.e. ‘focused interaction’)

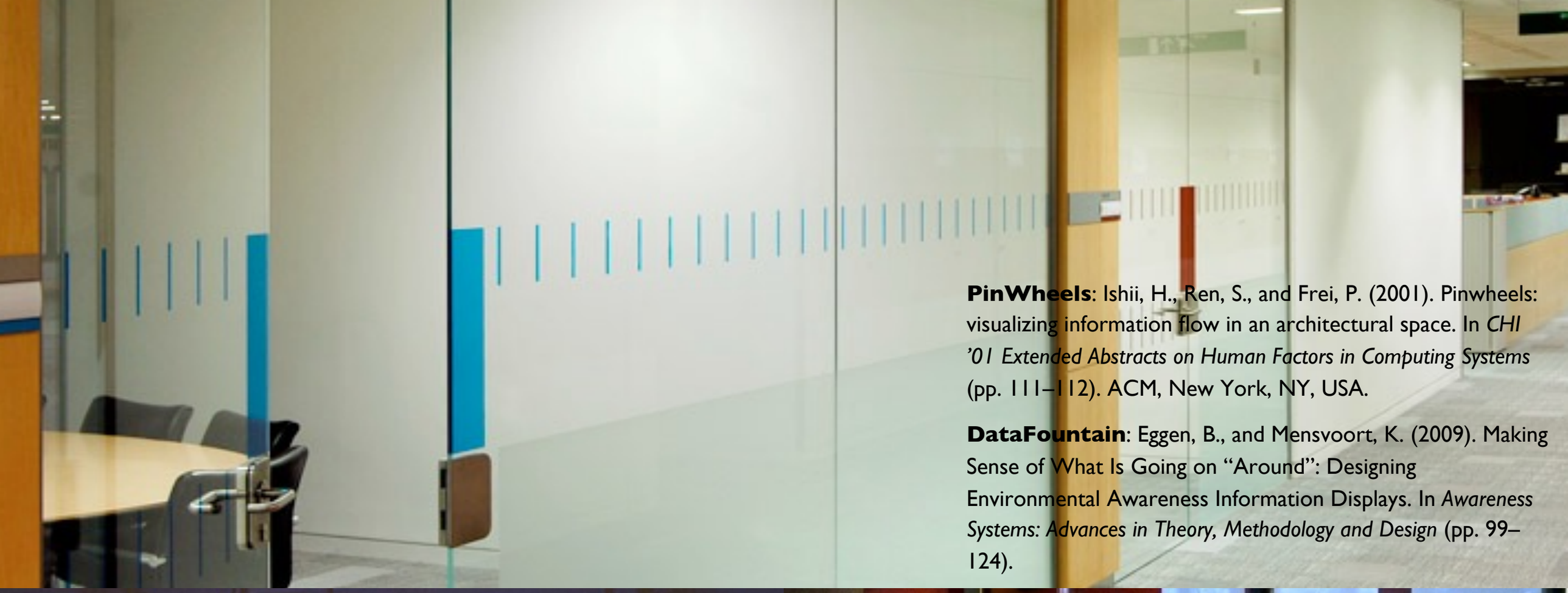
Can we design interactive systems such that they can also be
used in the *periphery* of attention? (i.e. ‘peripheral interaction’)

CALM TECHNOLOGY

a ‘predecessor’ of peripheral interaction

“Technology that engages both the center and periphery of our attention and in fact moves back and forth between the two”

Weiser, M., and Brown, J. S. (1997). The Coming Age of Calm Technology. In Denning P.J., and Metcalfe, R.M. (Eds.) Beyond Calculation: The Next Fifty Years of Computing, Springer-Verlag, pp. 75–85.



PinWheels: Ishii, H., Ren, S., and Frei, P. (2001). Pinwheels: visualizing information flow in an architectural space. In *CHI '01 Extended Abstracts on Human Factors in Computing Systems* (pp. 111–112). ACM, New York, NY, USA.

DataFountain: Eggen, B., and Mensvoort, K. (2009). Making Sense of What Is Going on "Around": Designing Environmental Awareness Information Displays. In *Awareness Systems: Advances in Theory, Methodology and Design* (pp. 99–124).

PINWHEELS

DATAFOUNTAIN

PERIPHERAL INTERACTION

Interaction with computing technology that takes place in the **periphery** of attention and **shifts** to the **center** of attention when relevant for or desired by the user

Peripheral interaction encompassed both **perception** and **physical** interaction

WHY PERIPHERAL INTERACTION NEXT TO FOCUSED INTERACTION?

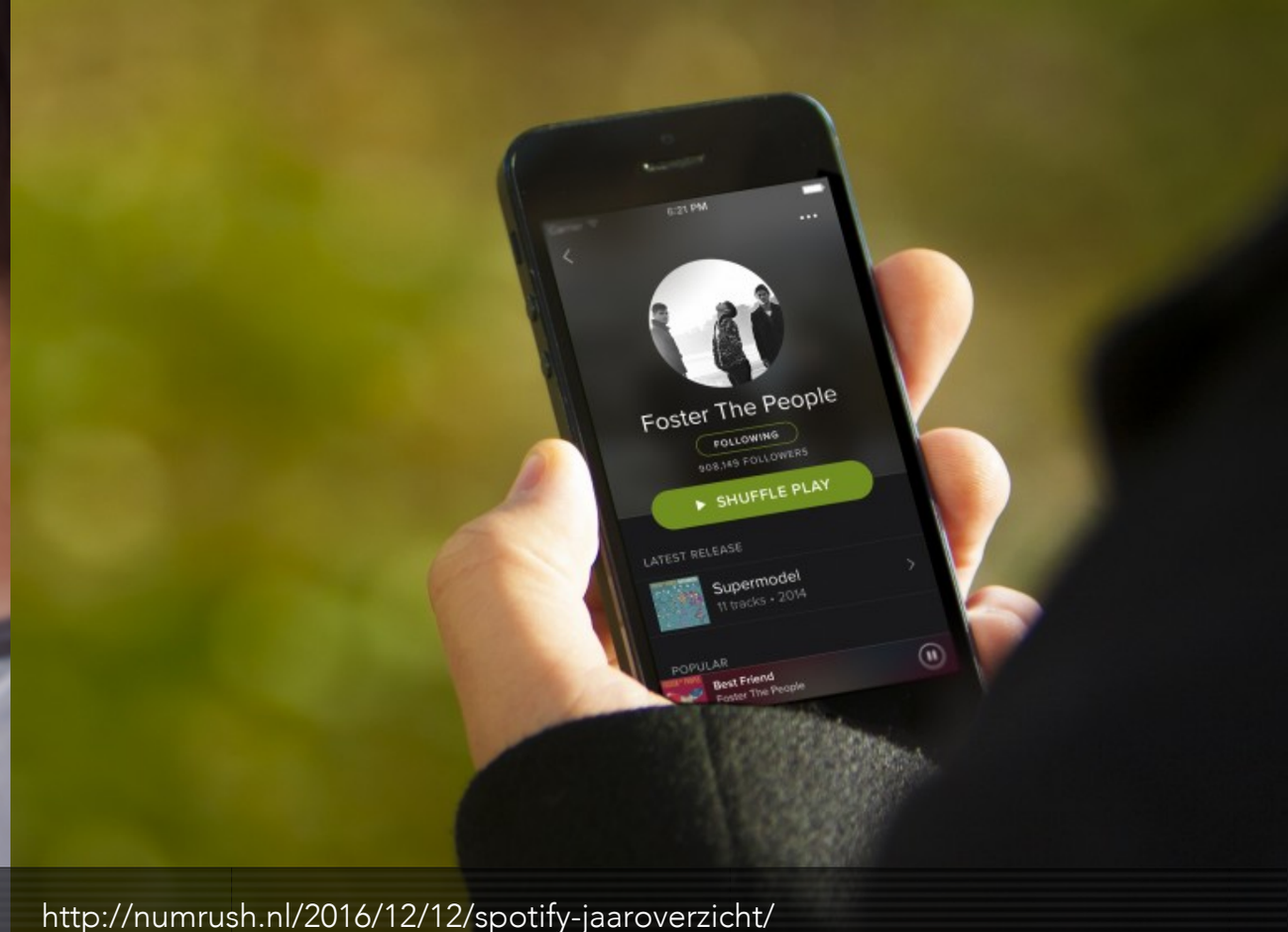
WHY PERIPHERAL INTERACTION NEXT TO FOCUSED INTERACTION?

- Computing technology is becoming omnipresent in everyday life: we can impossibly interact with all these technologies through focused interaction
- Inevitably, we will interact with many technologies in our periphery of attention
- This can be anticipated in interaction design for everyday life
- Peripheral interaction aim to fluently embed interactive technology in people's everyday life routines

EVERYDAY ACTIVITIES TAKE PLACE IN THE
PERIPHERY AND IN THE **FOCUS** OF ATTENTION

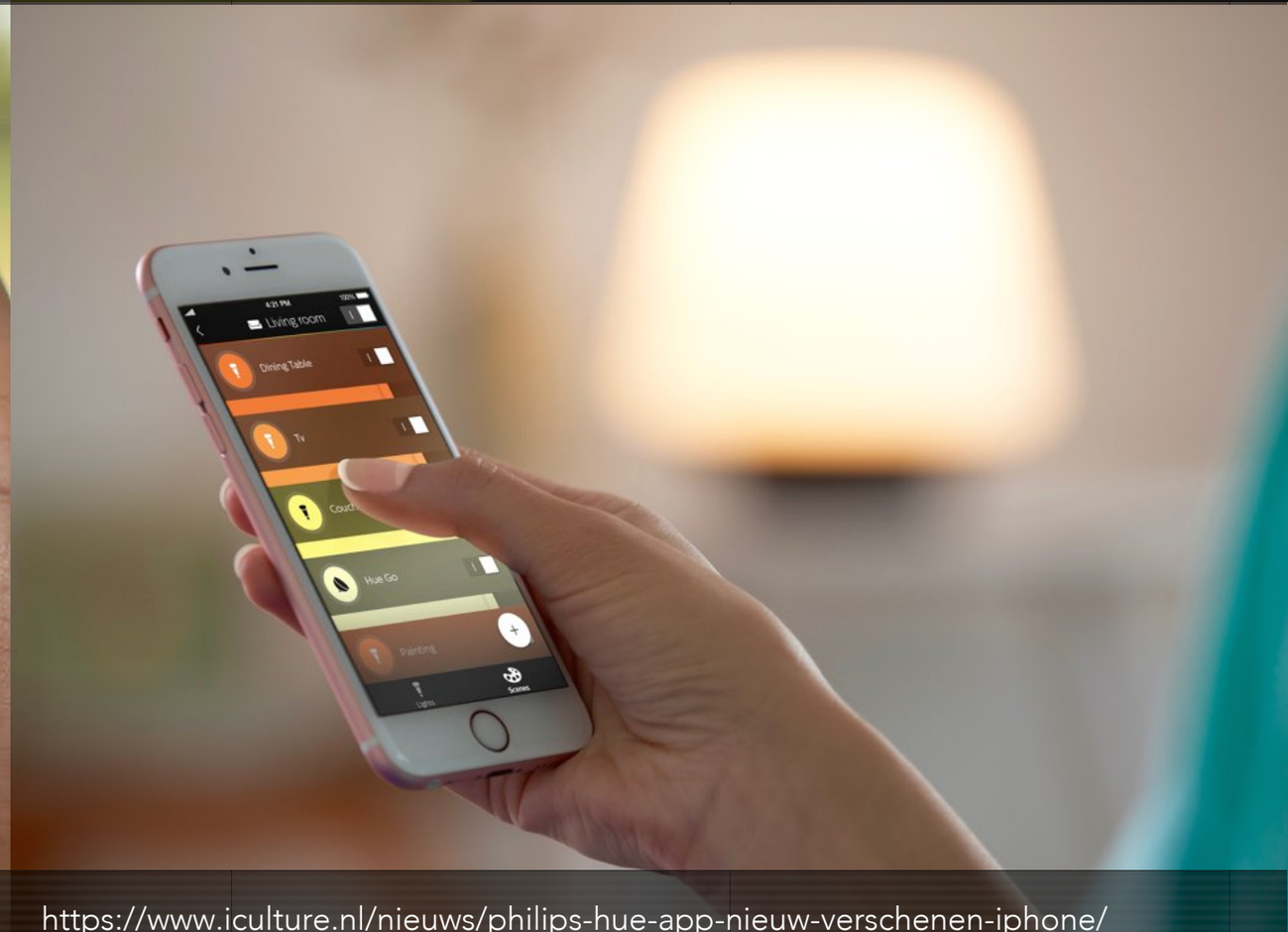
INTERACTIVE DEVICES ARE USUALLY DESIGNED
TO BE IN THE **FOCUS** OF ATTENTION ...

https://www.smarthomeoffice.nl/smart-home-app/



http://numrush.nl/2016/12/12/spotify-jaaroverzicht/

https://www.unilad.co.uk/wp-content/uploads/2016/07/whatsapp-iphone.jpg



https://www.iculture.nl/nieuws/philips-hue-app-nieuw-verschenen-iphone/

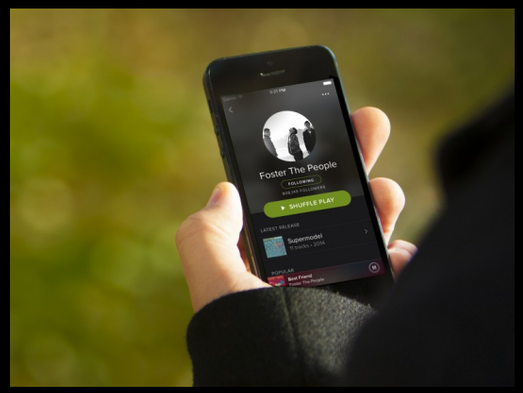
... OR, INTERACTIVE DEVICES ARE DESIGNED
TO OPERATE **OUTSIDE THE ATTENTIONAL FIELD**
OF THE USER

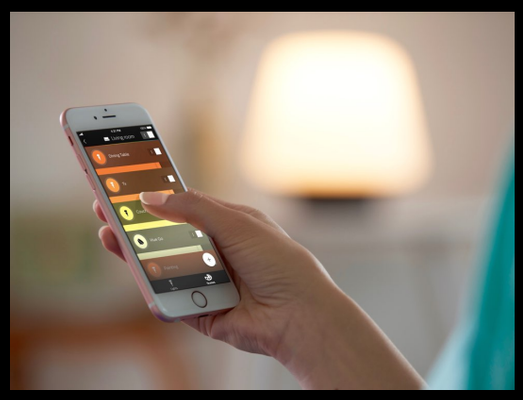
https://content.hwigroup.net/images/editorial/1200/011984_d2-heart-of-your-hue-system-square-2.jpg

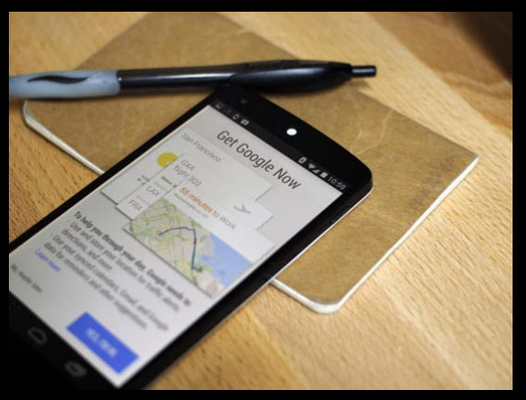
http://averagetechblog.com/topics/how-to/smart-home/

https://carfromjapan.com/wp-content/uploads/2018/04/featured-5-750x430.jpg

https://www.info-mage.ru/post.aspx?id=754

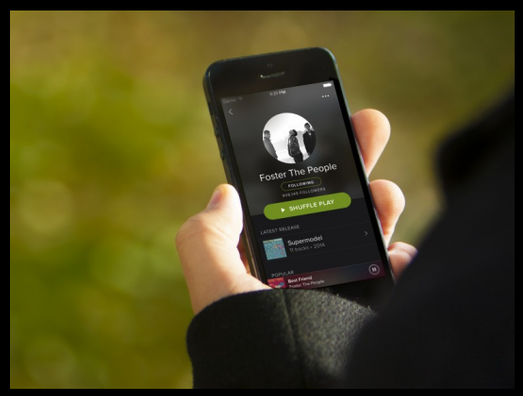




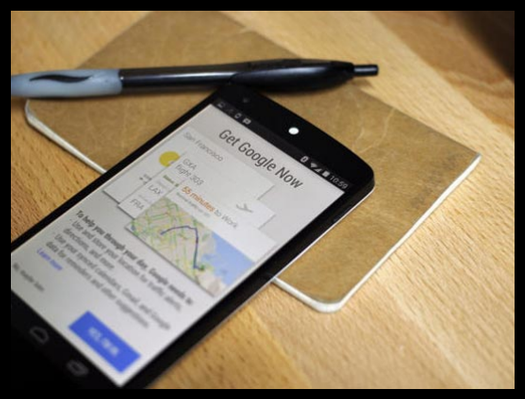


focused attention

outside attentional field

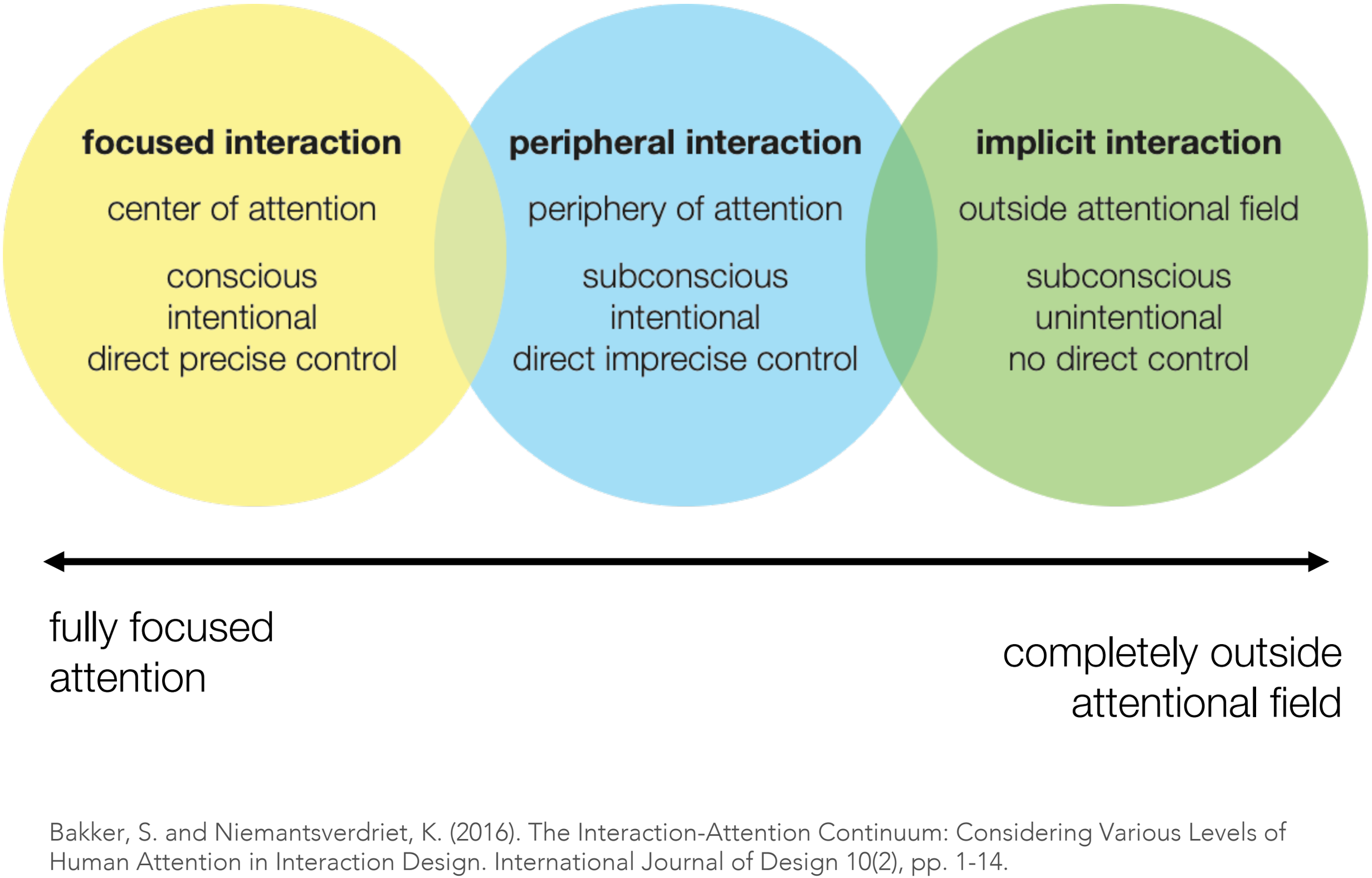


PERIPHERY OF ATTENTION



focused attention

outside attentional field



Bakker, S. and Niemantsverdriet, K. (2016). The Interaction-Attention Continuum: Considering Various Levels of Human Attention in Interaction Design. International Journal of Design 10(2), pp. 1-14.

focused interaction

center of attention

conscious
intentional
direct precise control

peripheral interaction

periphery of attention

subconscious
intentional
direct imprecise control

implicit interaction

outside attentional field

subconscious
unintentional
no direct control

focused interaction

center of attention

conscious
intentional
direct precise control

peripheral interaction

periphery of attention

subconscious
intentional
direct imprecise control

implicit interaction

outside attentional field

subconscious
unintentional
no direct control

huehomelighting.com/philips-hue-dimmer-switch-review/

focused interaction

center of attention

conscious
intentional
direct precise control

peripheral interaction

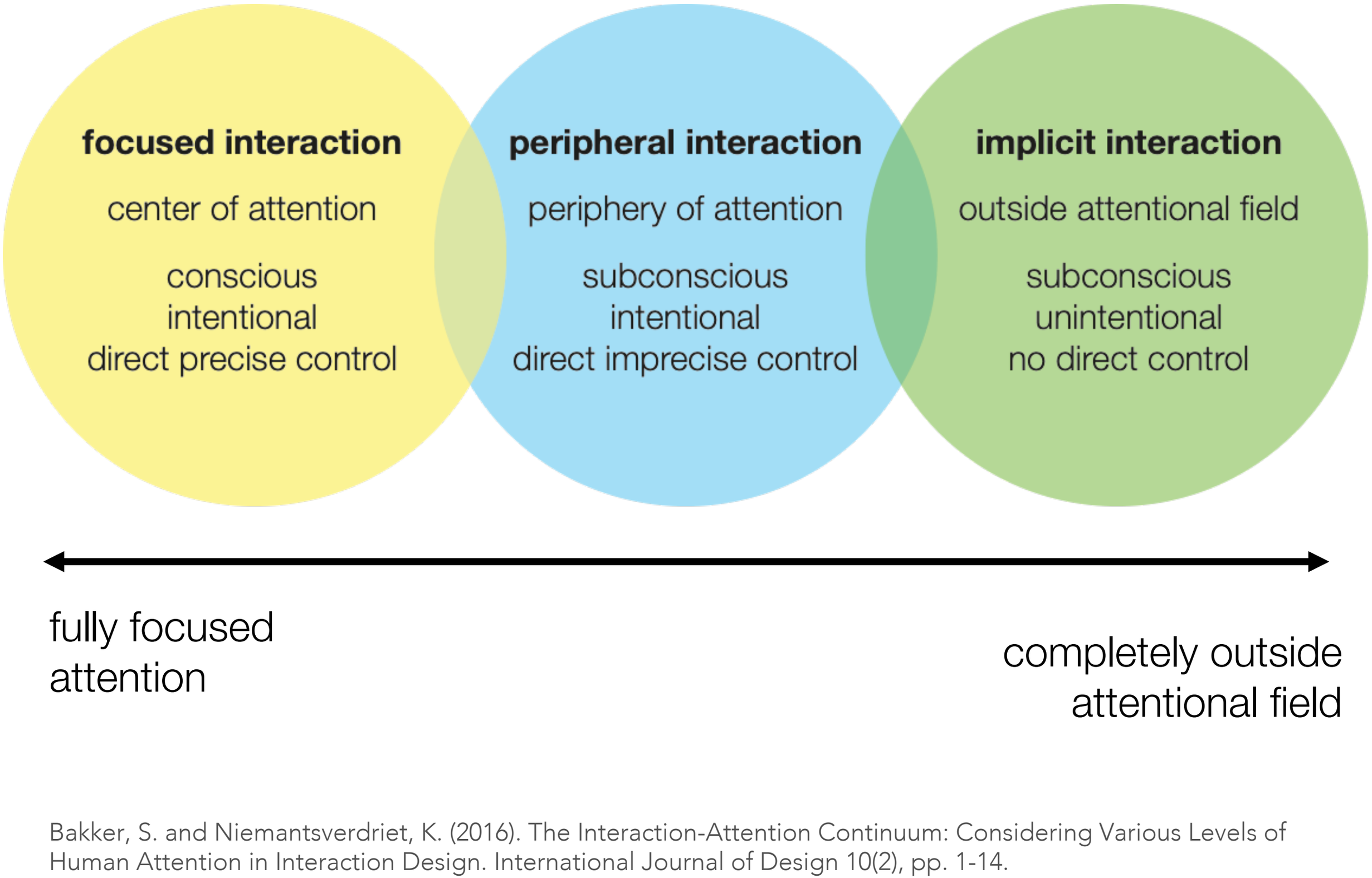
periphery of attention

subconscious
intentional
direct imprecise control

implicit interaction

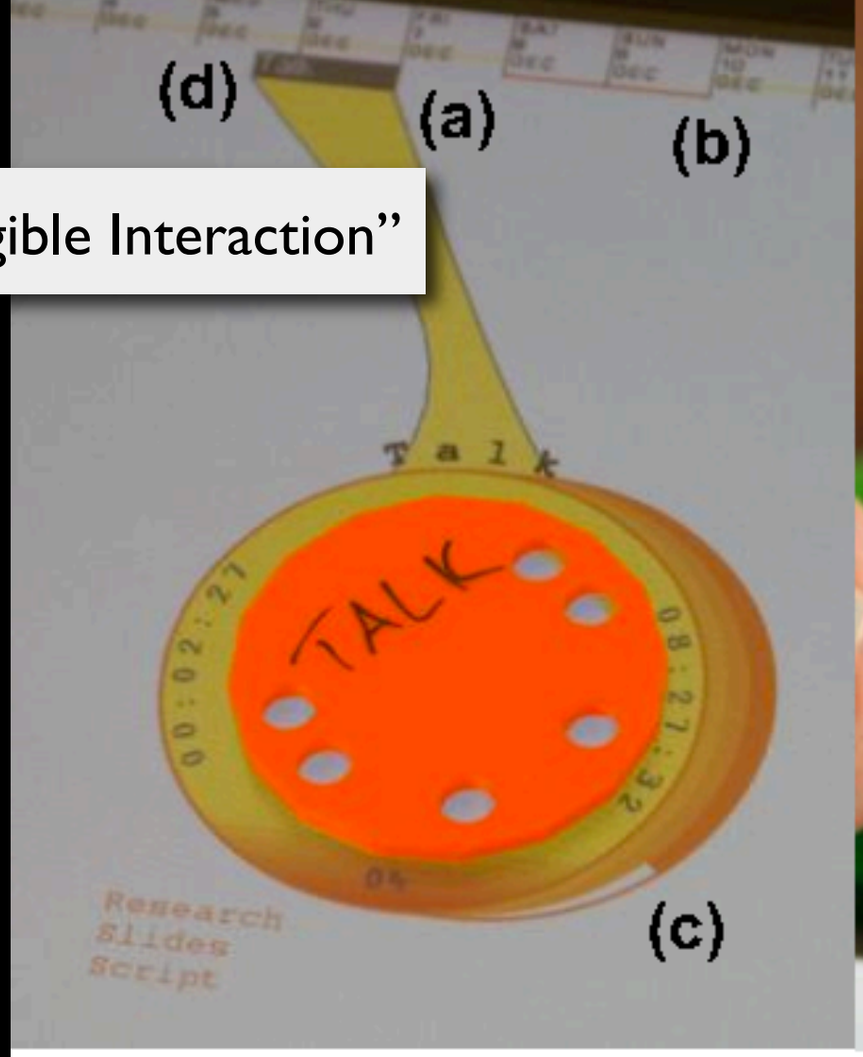
outside attentional field

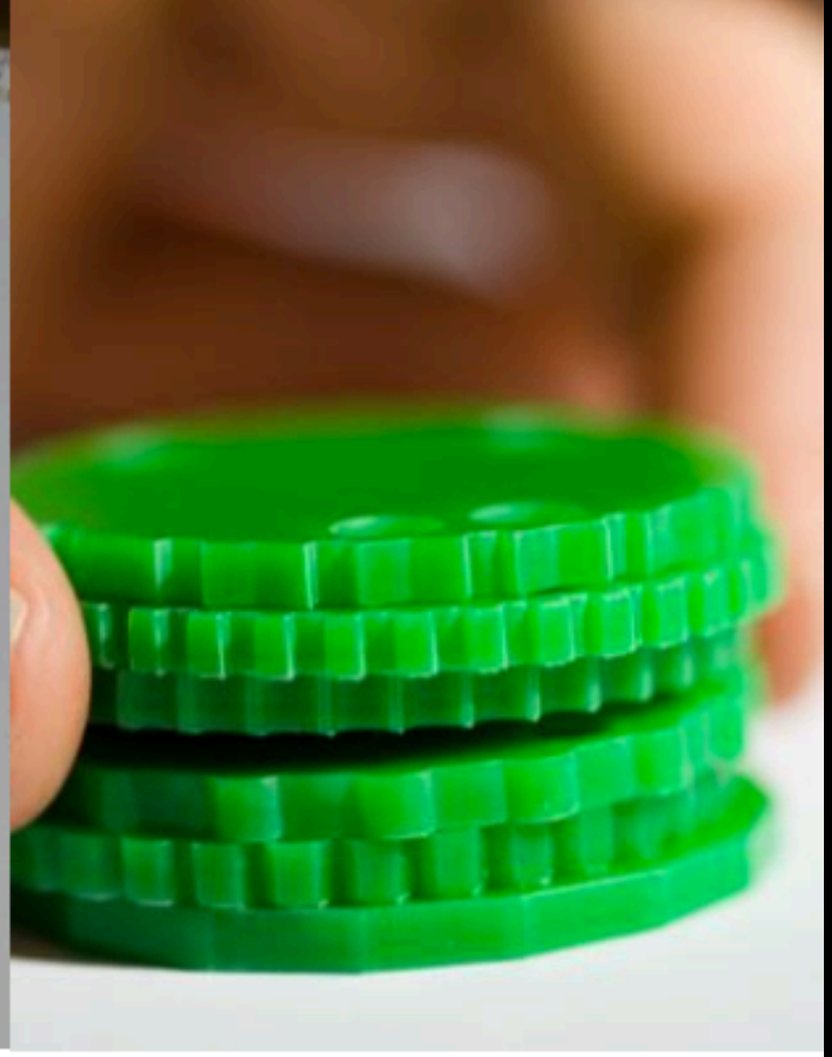
subconscious
unintentional
no direct control



Bakker, S. and Niemantsverdriet, K. (2016). The Interaction-Attention Continuum: Considering Various Levels of Human Attention in Interaction Design. International Journal of Design 10(2), pp. 1-14.

"Peripheral Tangible Interaction"





Edge, D., and Blackwell, A. F. (2009). Peripheral tangible interaction by analytic design. In Proceedings of the 3rd International Conference on Tangible and Embedded Interaction (TEI'09), ACM Press, pp. 69–76.

FIREFLIES

PERIPHERAL INTERACTION IN THE CLASSROOM

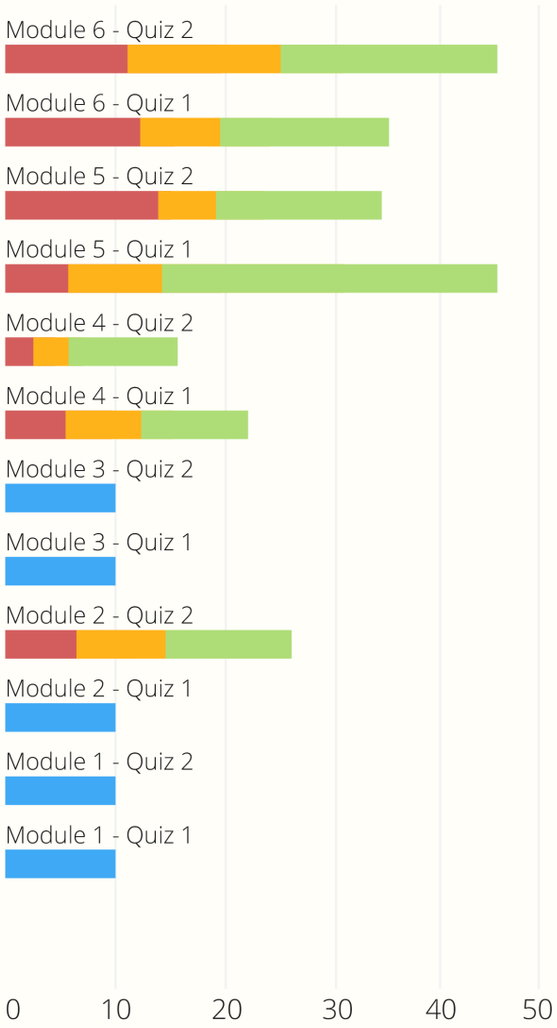
With: Pengcheng An, Berry Eggen, Elise van den Hoven, Ruurd Taconis

https://media.libelle.nl/m/n9p817riy2hk_home_landscape_top_article_1260x650.jpg

Dashboard

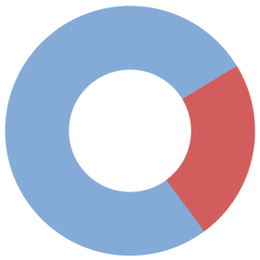
Search course or module

Level Pattern



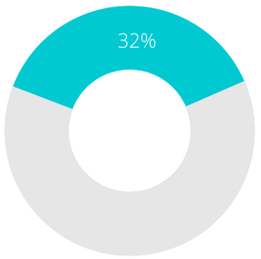
Course: Introductory Algebra 1

Answers (130 Questions)

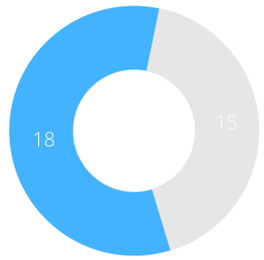


Correct / Incorrect

Pass Rate



Days of Activity

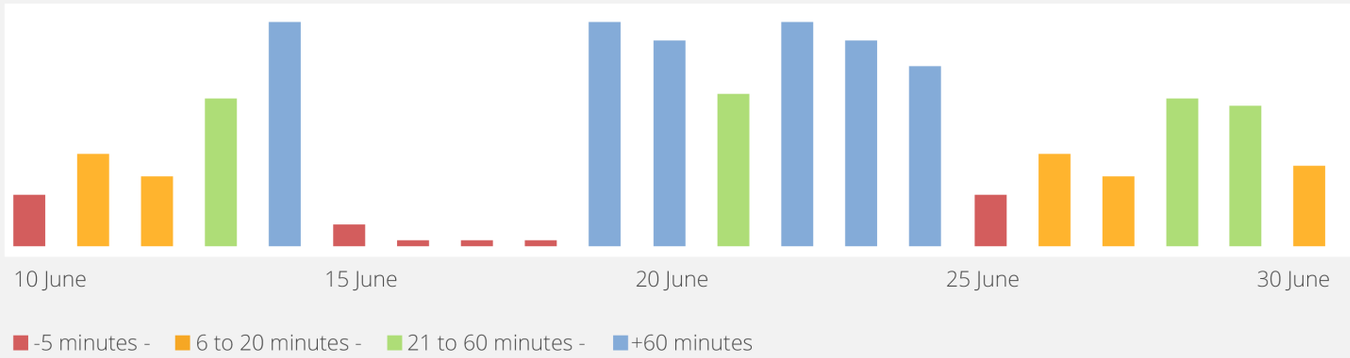


Active / Idle

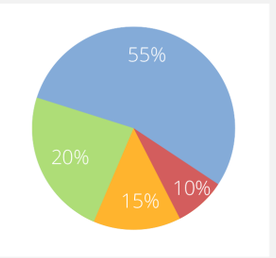
Support Calls

Motivation / Education

Study activity by day



Study pattern



https://www.curogenslearning.com/lms-solution/technology-lms/

FIREFLIES

PERIPHERAL INTERACTION IN THE CLASSROOM

With: Pengcheng An, Berry Eggen, Elise van den Hoven, Ruurd Taconis

MUSICO

PERIPHERAL INTERACTION IN THE HOME

By Petek Tezcan, with Berry Eggen

WRAP-UP PERIPHERAL INTERACTION

- Inspired by human attention management skills
- Suitable in various application domains such as:
  - *Information display*
  - *Office work*
  - *Education*
  - *Smart homes*
  - ....

THANK YOU FOR YOUR ATTENTION

Saskia Bakker

www.saskiabakker.com