

# Squaring the Circle:

How Framedness influences  
User Behavior around a  
Seamless Cylindrical Display

Gilbert Beyer, Florian Köttner, Manuel Schiewe,  
Ivo Haulsen, Andreas Butz

University of Munich and Fraunhofer FOKUS



CHASE



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THOMSON REUTERS

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W 42nd

Subway

TATTOO  
PIERCING

CHASE

Shaped Displays



Digital Advertising Column

# Audience behavior

# Defining qualities of shaped displays

Form Factor / Framedness /  
Seamlessness

# Q1: Form Factor

**SHAPE**

**primitive / complex**

**PLANARITY**

**flat / non-flat**

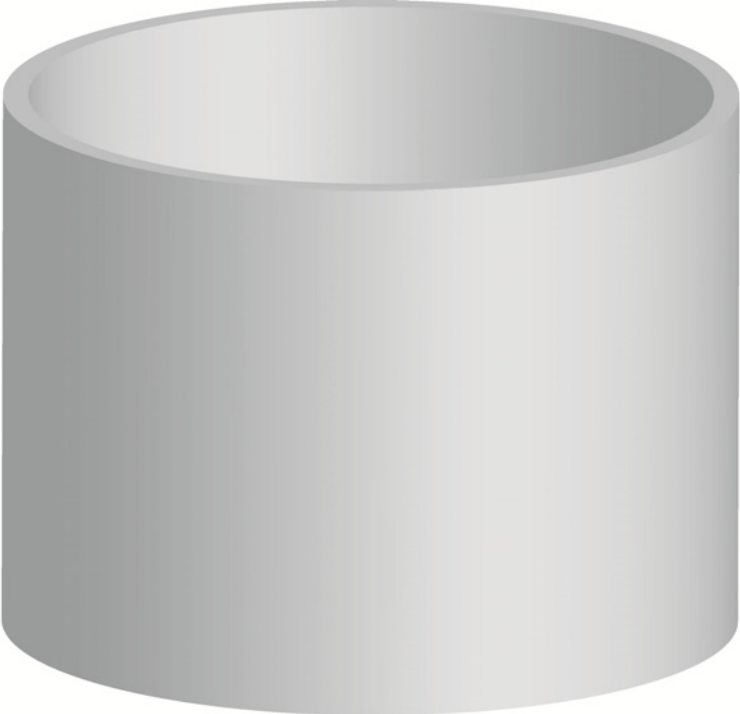
**CURVATURE**

**concave / convex**

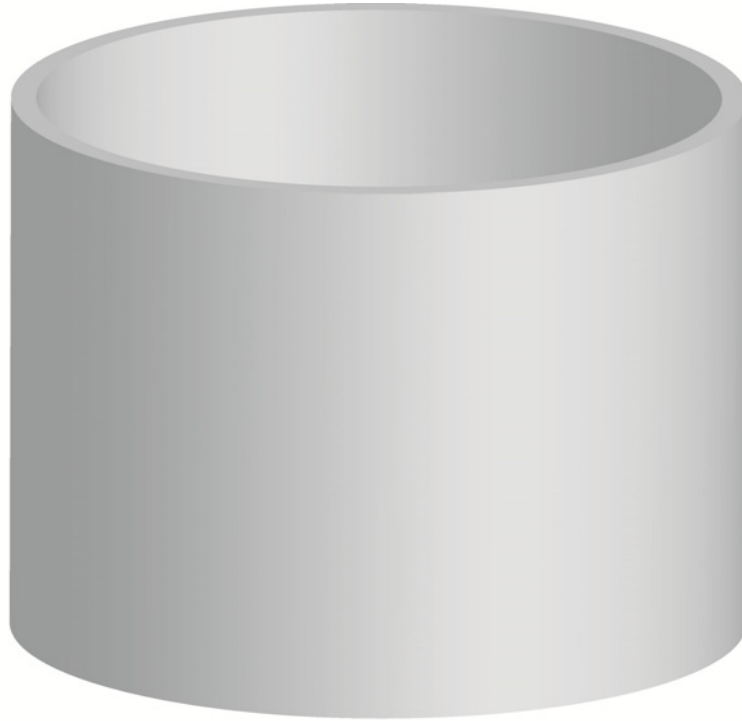
**SURFACE**

**ROUGHNESS**

# Cylinder

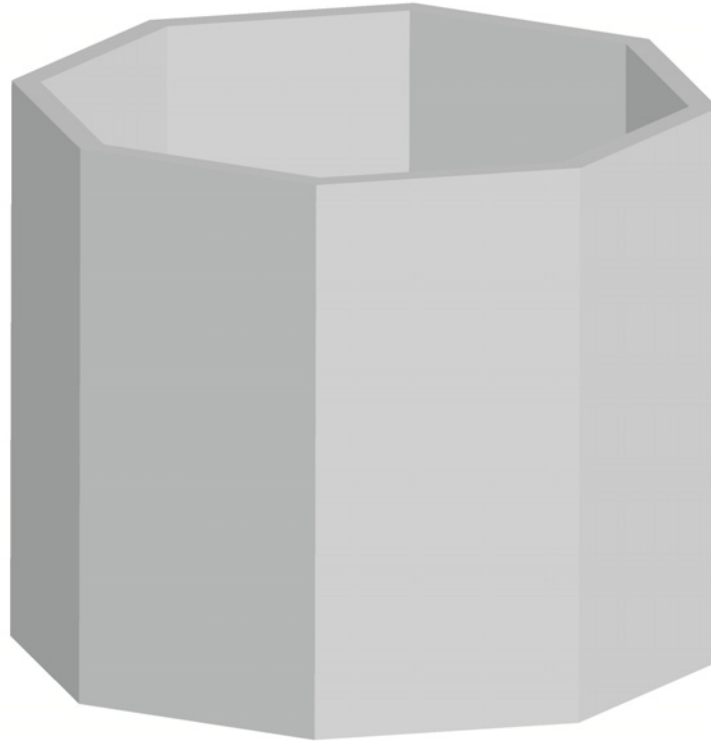


# Circular Cylinder



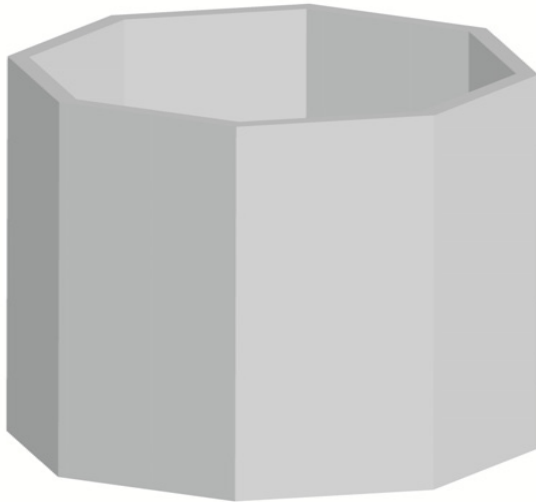
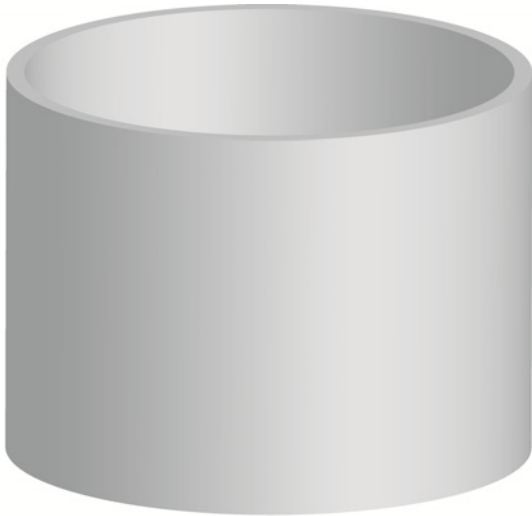


# Polygon (Octagon)



\*For a hexagon see Koppel et al. 2012

# Surface Roughness



## Q2: Framedness

**FRAMED DISPLAYS**

**4 boundaries**

**SEMI-FRAMED DISPLAYS**

**2 boundaries**

**UNFRAMED DISPLAYS**

**1-0 boundaries**

# Semi-framed (curved)



Advertising Column

# Semi-framed (flat)



**Banner Display**

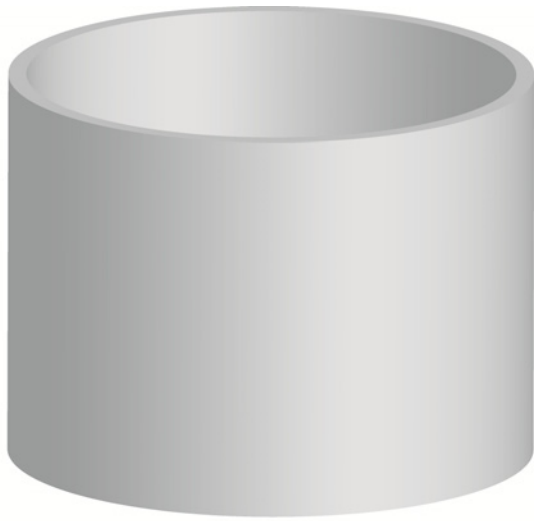
## Q3: Seamlessness

NO EDGES

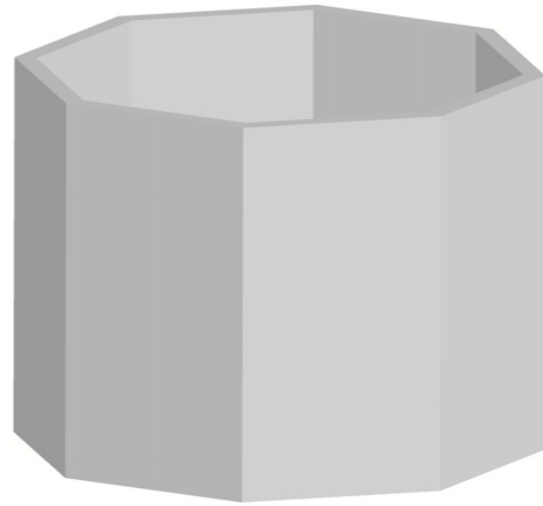
NO BEZELS

NO FRAMES

## Q3: Seamlessness



**seamless**



**not seamless**

The same?  
Or producing different  
user behavior?



# User positions and constellations

# Column Display

Interaction / Hardware /  
Challenges

# Interaction Principle



**Communicating the interactivity by means of an unaware or implicit initial interaction**

# Frontal approachers



Unaware initial interaction using a space-saving user representation

# Tangential passers-by



Unaware initial interaction  
using particles appearing  
slightly ahead

# Design Challenges

**SEAMLESS  
INTERACTION**  
within a circular space

**SEAMLESS  
CONTENT**  
not affecting positions

**UNBIASED  
INTERACTION STYLE**  
no specific poses

**COMPUTING  
POWER**  
8 Kinects

# Multi-Kinect load

name	core count	core clock	1	2	3	4
Core 2 Duo (Allendale , Conroe, Melom)	2	up to 2.8 GHz	Red	Red	Red	Red
Core 2 Quad	4	up to 2.8 GHz	Green	Yellow	Red	Red
Core 2 Quad	4	from 3.0 GHz	Green	Green	Red	Red
Core 2 Duo (Wolfdale)	2	up to 2.8 GHz	Yellow	Yellow	Red	Red
Core 2 Duo (Wolfdale)	2	from 3.0 GHz	Green	Yellow	Red	Red
Core i7 (Bloomfield)	4	up to 3.0 GHz	Green	Green	Yellow	Red
Xeon	2	up to 2.6 GHz	Green	Yellow	Red	Red
Xeon	4	from 2.8 GHz	Green	Green	Yellow	Red
Core i7 (Nehalem)	4(8)	2.5 - 3.3 GHz	Green	Green	Green	Red
Core i5 (Nehalem)	4	2.5 - 2.8 GHz	Green	Green	Green	Red
Core i5 (Westmere)	2(4)	3.2 - 3.6 GHz	Green	Green	Yellow	Red
Core i3 (Westmere)	2	2.9 - 3.3 GHz	Green	Green	Red	Red
Core i5 (Sandy-Bridge)	4	2.5 - 3.3 GHz	Green	Green	Green	Yellow
Core i7 (Sandy-Bridge)	4(8)	2.8 - 3.6 GHz	Green	Green	Green	Green
Core i3 (Sandy-Bridge)	2(4)	2.5 - 3.3 GHz	Green	Green	Green	Red
Core i3 (Ivy-Bridge)	2(4)	2.8 - 3.4 GHz	Green	Green	Green	Yellow
Core i5 (Ivy-Bridge)	4	2.7 - 3.4 GHz	Green	Green	Green	Green

# Hardware Setup



distributed system  
exchanging depth  
and skeleton data

integrating Kinects  
as unobtrusively as  
possible



# Hardware Setup



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# Study

Conditions / Design /  
Data collection

# Condition 1: Unframed Column



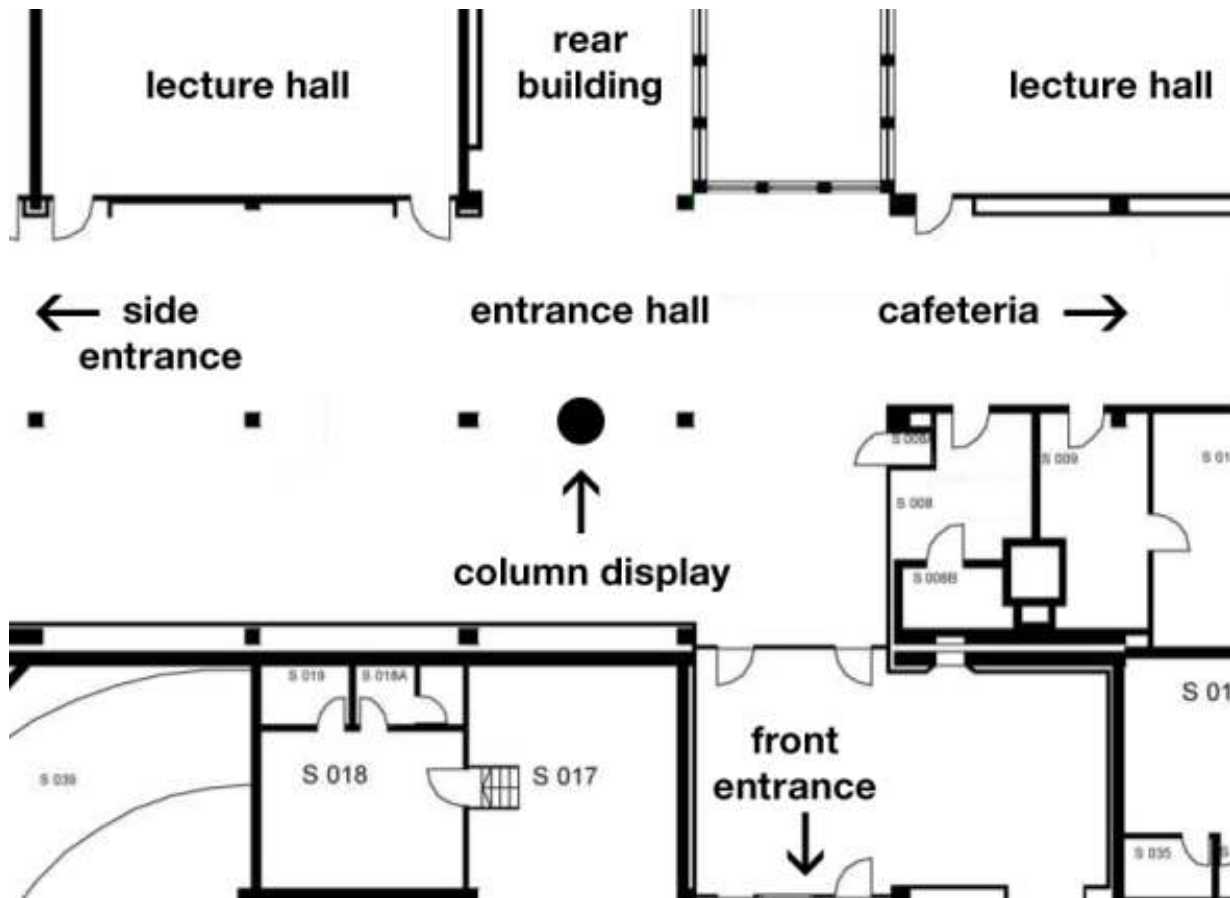
Seamless content and interaction

## Condition 2: Framed Column



Frames were just a visual overlay over the seamless content

# Four-week deployment



# Data Collection

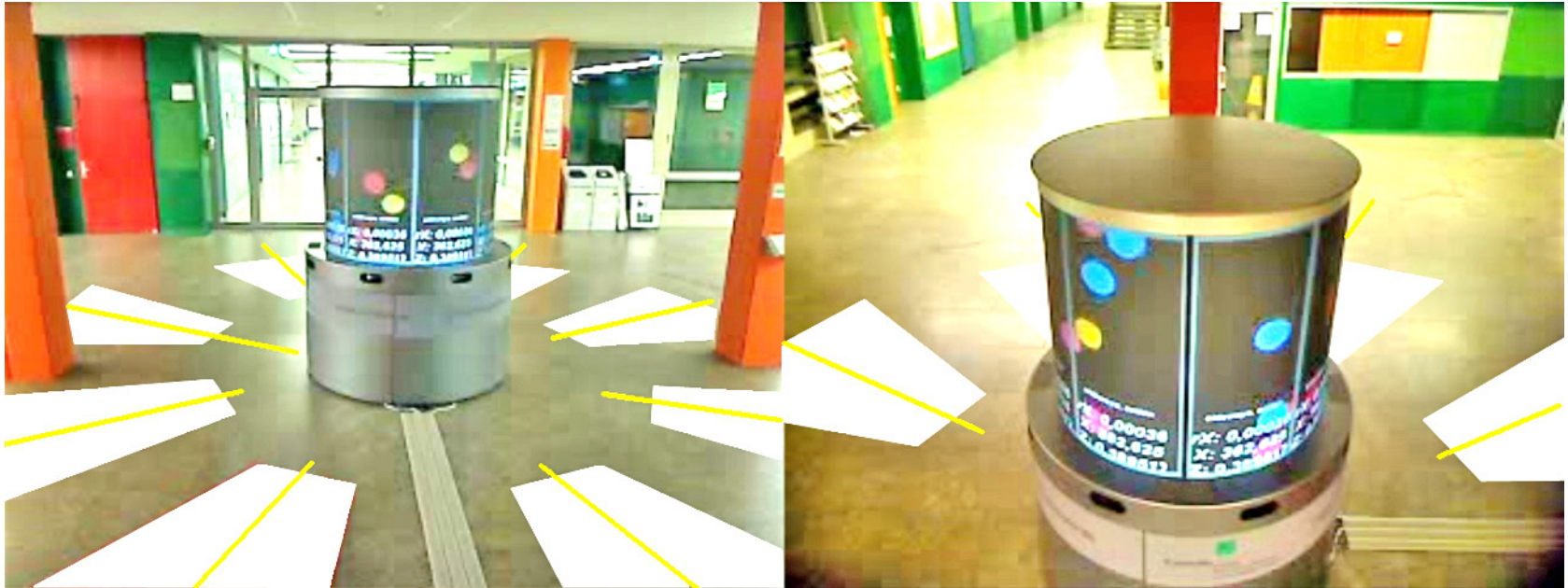
**FIELD RATER**  
**(hidden)**

**VIDEO-REC.**  
**220 hours**

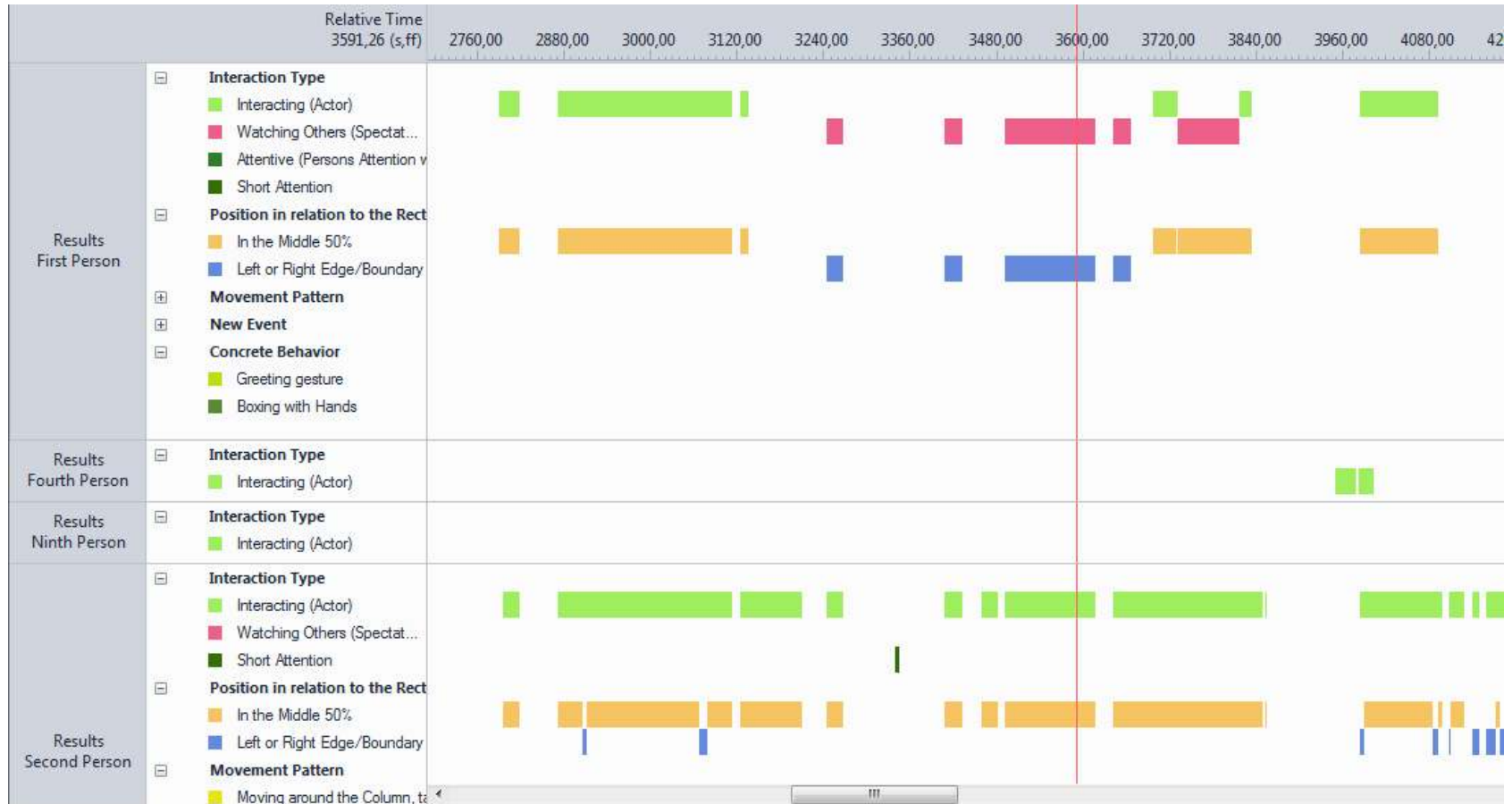
**LOGGING**  
**data assessed**  
**by Kinects**

**INTERVIEWS**  
**semi-structured**  
**after the study**

# Scoring Positions



# Nesting Behaviors





# Results

General / Conditions /  
Post-hoc analysis

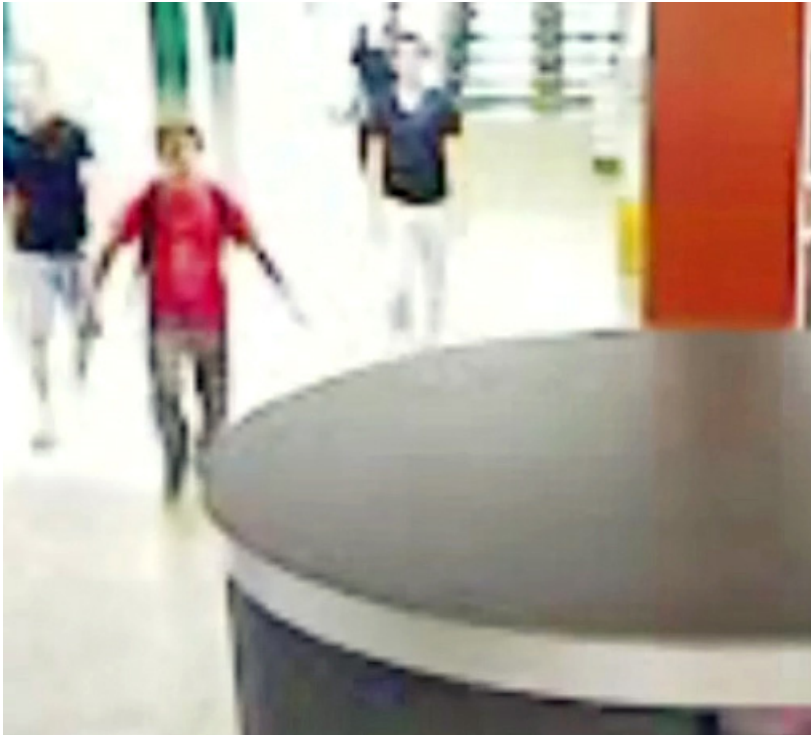
# General Observations



762 interactions and 205 people watching others within 33 hour sample

40.9 seconds average interaction interval length

# General Observations



Initial interaction: already reacting from a distance if approaching frontally – later when deviating

# General Observations



Pairs and groups interacted untiringly, but singles devoted as well

# General Observations



All kind of human behavior  
between cooperation,  
competition, self-activity

# Conditions

# Observations: unframed condition



Users assumed diverse positions, dispersed around the column to assume an active role

# Observations: framed condition



Significant association between frame and whether users assumed a central position



# Observations: framed condition



**Nested behaviors: Users reposition themselves when starting to interact**

# Observations: pairs and groups



Unframed condition:  
comfortable distances  
between users

# Observations: pairs and groups



**Framed condition:  
Conflicts when interacting  
in front of the same frame  
or cooperating between  
neighboring frames**

# Interviews



## Out of 79 interviewees

- most assumed purpose was entertainment
- most could reproduce detailed functionality
- only 1 recalled the presence of the frames

# Interpretation

Columns / Framedness /  
Seamlessness

**Framedness**  
**significantly influences**  
**user positioning**  
**around more complex**  
**display shapes**

The basic shape  
should not be  
considered in isolation

**when designing for  
new display shapes**

# Blindness for the Frames

?



# Advantages or otherwise



**CLOSE-BY  
INTERACTION**  
avoid  
frames



**MAXIMIZING  
USERS**  
avoid  
frames

**POSITIONING  
USERS**  
use frames



**REGULATING  
DISTANCE**  
use or avoid  
frames



# Seamless displays: more options



Virtual frames already performed well to draw users to a position

# Outlook: visual moderation



Actively shaping the audience by dynamically employing virtual frames?

# Discussion

