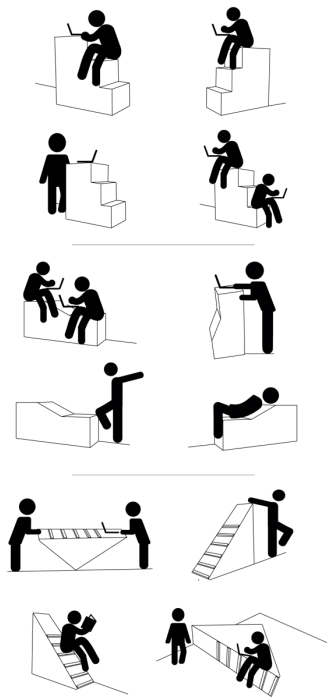


# PositionPeak: Stimulating Position Changes During Meetings



**Figure 1:** Examples of postures supported by the three PositionPeak artefacts

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## Abstract

In office environments, workers spend the majority of their workday sitting in a static position behind a desk or around a meeting table. Prolonged sitting time and sedentary behavior have severe negative health effects. Through this explorative study, we studied how different postures can be stimulated during meetings. We designed PositionPeak: three pieces of furniture aimed at composing a 'dynamic meeting room', subtly encouraging participants to avoid static postures. We video-recorded 5 meetings (N=16) and coded the number of position changes per participant. Participants also filled out a pre- and post-questionnaire about their experience. Our findings show that PositionPeak triggers people to adopt a variety of postures. Participants on average experienced a more efficient meeting but reported physical discomfort with some objects. We discuss the influence of PositionPeak on the meetings' social dynamics, the acceptance of new conventions and design recommendations for new meeting facilities.

## Author Keywords

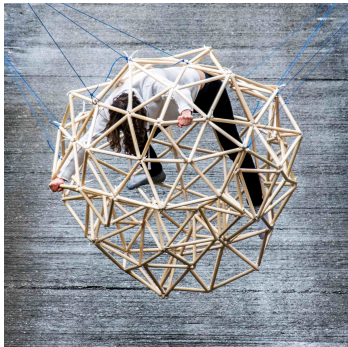
Office environment; Meetings; Preventive Health; Sedentary Behavior; Postures; Design Research.

## CSS Concepts

• **Human-centered computing;** Field studies.



**The End of Sitting** workplace installation by RAAAF [1]



**The Office Jungle** 'design for wildness' by Nieuweboer [8] (with permission)

**Figure 2:** Reinventing the office environment, design examples

## Introduction

Knowledge workers usually walk into a meeting, sit down, and stay in a static position for the duration of the meeting. Studies indicate that office work is mainly sedentary [3, 4, 10], which is considered unhealthy and can lead to cardiovascular diseases, diabetes, or obesity [1, 10]. An expert statement commissioned by Public Health England argues that one should strive for *"changing the ergonomic design of offices and workstations" and "movement behaviors during the working day should be supported"* [1]. In recent years, a myriad of interventions to improve physical activity or reduce sedentary behavior have been developed [3, 5, 7]. Most of these interventions however are limited by the fact that the stimulated physical activity is not integrated into work tasks and routines [5] but rather take the form of break taking. Standing or walking meetings are examples of integrated physical activity during meetings. But while some experience standing meetings as uncomfortable [8], walking meetings also have some limitations, for instance related to weather conditions or the inability to take notes and access presenting tools [6]. To address these limitations, and as a complement to existing active ways of meeting, we focus on the design of a more active meeting space. The present case study focuses on how design can trigger healthier meetings by stimulating posture change during a meeting. Adopting a Research-Through-Design approach [15], we designed and deployed PositionPeak, a research artefact, to obtain knowledge on how to stimulate posture change during meetings.

## Related Work

There is an increased interest in designing workplaces that promote physical activity [2,4,11,12,14]. A notable example is 'the End of Sitting' project (EoS), an office

installation presented as a 'world without chairs' (Figure 2). This large rock-like landscape integrates many affordances for standing and provides an alternative work environment that supports different work postures [2]. Experiments of the concept showed promising results with users working in more than one non-sitting postures and locations. Task performance, mood and postural comfort were positively influenced for young workers and not negatively affected for middle-aged workers. The authors thus argue that EoS should be taken seriously as an alternative office for regular office workers. Similarly, innovative and even provocative is the work of Nieuweboer [9], who proposes to 'design for wildness' by turning the office environment in an 'office jungle' that transforms the way we work (Figure 2). Probst et al. [11] suggest a concept of working "in-motion", which provides opportunities for seamless changes between different work tasks, such as typing, writing on a whiteboard or standing work. Similar approaches were developed as physical movement probes for the office, *Irritating chair* encouraging individuals to stand [14], *Active Desk* to arrange standing meetings [14] and Foot Interaction designs to control one's computer [13,14]. Beyond the aforementioned designs, only a limited number of designs can be found that target active ways of having a meeting. One example is the Workwalk by Damen et al [4, 6], a service design concept to stimulate walking meetings. This design however has practical limitations such as note-taking or presenting material. While offering a promising workspace design alternative, the aforementioned EoS project [2] does not support meetings. Following a similar approach to encourage posture changes and reduce sitting time, we aim at stimulating changing postures in the context of a meeting room.



**Figure 3.** PositionPeak, three pieces of furniture designed to trigger posture change during meetings

### PositionPeak

PositionPeak is a set of dynamic pieces of furniture designed to stimulate position changes during meetings and serve as a research artefact [15]. It is composed of three objects (Figures 1 and 3): The Stairs, The Slope, and The Lounger. Each artefact supports several body positions, allowing users to experiment a variety of postures. These were not designed as healthier postures but intend to make the participants more mobile.

*The Stairs (89x55x96cm).* This artefact supports several positions: cross-legged sitting, half-sitting, leaning and standing (or serve as a laptop stand). The staircase-inspired form invites people to place their feet on the steps or to climb to the top. It has integrated pressure sensors to collect user data for future research.

*The Lounger (122x40x62cm).* Inspired by a lounge chair, it supports sitting straight up, laying, sitting with feet up or as a laptop stand. The height of the highest surface allows taller people to sit comfortably with their feet to the side, while the lowest surface is more suitable for shorter people. The sloped surface is placed at such an angle that it is comfortable to hang against.

*The Slope (120x40x120cm).* Made to facilitate different leaning and half-sitting positions, the Slope is pretty steep, and it thus takes some effort to sit on it. Bars provide support for the feet and prevent the user from sliding down. The edge on top is flat and rounded. These details together with the bars make it possible to climb up The Slope and to sit all the way on the top.

### Methodology

The aim of our study was to explore: How can PositionPeak influence position change during meetings? We also investigated how the perceived efficiency and

social dynamics of the meetings were influenced.

Participants (N=16), involving both office workers and students, were recruited on a university campus. The PositionPeak room setup included a cardboard standing table, a wall-mounted screen and the 3 artefacts. A standing table was added to accommodate slightly larger groups in the room. At the start of the study, participants were asked to sign a consent form and to fill in a pre-questionnaire. To maximize ecological validity, participants had a real meeting and were instructed to use the room freely without time limit. The camera was located outside the room (with glass windows) to minimize interference. After their meeting, we interviewed each group about their experience and invited them to fill in the post-questionnaire.

*Observations.* Five groups of participants (N=16) were video recorded during meetings in our experimental room. The length of the meetings varied between 20 and 45 minutes. The videos were analyzed to observe participants' behavior and to count the position changes during the session. We define position change as people switching between defined positions such as sitting, standing or laying; large arm or leg movements causing the upper body to change or turn such as crossing legs or leaning on an elbow and significantly changing back position. For each position change, we coded the time, furniture used, and a description of the position. Pressure sensors were added to gain information on the position change when no one was observing the meeting (due to space limit, sensor data is not reported here).

*Interviews.* We conducted semi-structured group interviews after each meeting, focusing on how the group experienced the meeting, how comfortable the furniture was, how efficient and energetic the meeting felt, and why they shared pieces of furniture (or not).

Baseline ordinary meeting room			
Participant (#group)	Duration (min)	PC	PC (per hour)
PB1 (#1)	30	7	14
PB2 (#1)	30	3	6
PB3 (#1)	30	5	10
PB4 (#1)	30	2	4
PB5 (#2)	30	5	10
PB6 (#2)	30	4	8
PB7 (#2)	30	3	6
PB8 (#3)	30	6	12
PB9 (#3)	30	5	10
PB10 (#3)	30	4	8
PB11 (#3)	30	4	8
PB12 (#4)	45	26	34
PB13 (#4)	45	18	24
PB14 (#4)	45	25	33
PB15 (#4)	45	8	11
PB16 (#5)	45	10	14
PB17 (#5)	45	3	4
PB18 (#5)	45	4	6
PB19 (#5)	45	9	12

PositionPeak meeting room			
Participant (#group)	Duration (min)	PC	PC (per hour)
P1 (#1)	20	19	57
P2 (#1)	20	29	87
P3 (#1)	20	16	48
P4 (#2)	34	25	43
P5 (#2)	34	21	36
P6 (#2)	34	38	65
P7 (#2)	34	23	39
P8 (#2)	34	17	29
P9 (#2)	34	22	38
P10 (#3)	30	15	30
P11 (#3)	30	11	22
P12 (#4)	20	11	33
P13 (#4)	20	10	30
P14 (#5)	35	37	63
P15 (#5)	35	29	50
P16 (#5)	35	20	34

**Table 1:** Number of position change (PC) per participant during observed meetings

*Pre- and post-questionnaires.* The pre-questionnaire enquired about the type of meeting and included 3 Likert scales (from 1 'not at all' to 7 'very') about how efficient and energetic the meetings usually are with this group and how comfortable users rate furniture in ordinary meeting rooms. The post-questionnaire had similar questions yet focused on the PositionPeak room.

*Baseline Test.* To understand the effect of PositionPeak on position changes, we first conducted a baseline test in an ordinary meeting room (with chairs, tables and a screen). We observed 5 groups of participants (N=19, different than PositionPeak participants) and coded the number of position change during their meetings.

## Results

### *Interaction with the PositionPeak Artefacts*

During their meetings, 3 groups decided to rearrange objects. For example (Figure 4), The Stairs was turned 90 degrees, with the back on the ground. The Lounger was placed vertically and used as a pillar or turned around with the highest end towards the center of the room. The Slope was placed horizontally. Also, subtle changes were done by dragging objects across the room. Participants had different ways of interacting with the objects. The Stairs was mostly used as a laptop stand or for sitting, especially on the upper level. The Lounger was sometimes used by two people, each sitting on a different level. The Lounger also served as a chair or a chair with a table stand. The Slope was mostly used for leaning, yet two participants sat on top of it.

### *Position Change*

During our baseline test in an ordinary meeting room (Table 1), participants changed position on average 12 times per hour (Min=4, Max=34) and walked in the

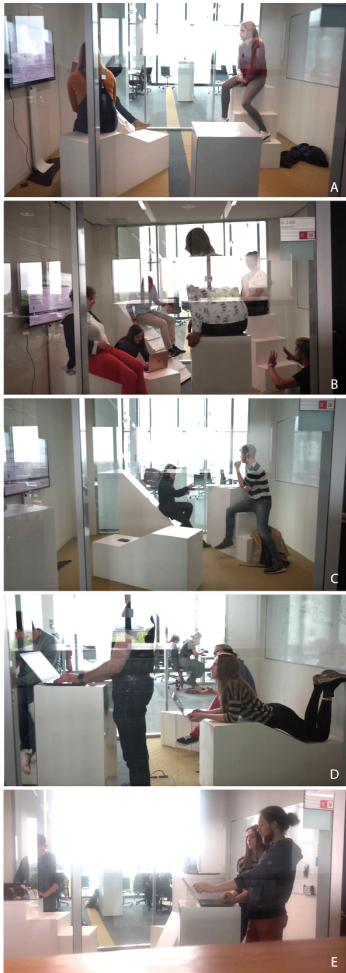
room only 0.13 times per meeting. In the PositionPeak room, participants changed their position 44 times per hour (Min=22, Max=87) on average, 3.7 times more than in the ordinary room. They walked in the room, usually between objects, 3.5 times per meeting on average. Users sometimes went back and forth between positions or took the same posture multiple times.

### *Pre- and Post-Questionnaires*

Fifteen participants (one missing data) filled in the pre- and post-questionnaire. On average, users rated the comfort of an ordinary meeting room as M=4.73 out of 7 (SD=1.49) and the PositionPeak room as M=3.8 (SD=1.41), 19% less comfortable. The average efficiency of the group meetings was M=4.47 (SD=1.19) in the pre-questionnaire, and assessed as M=5.38 (SD=1.04) using PositionPeak. Users rated the meeting energy level slightly higher in PositionPeak (M= 5.31, SD=1.11 vs. M=4.87, SD=1.64 in an ordinary room).

### *General Experience and Comfort*

Overall, the groups acknowledged the fact of moving more than in an ordinary room: "*Everybody here is already moving more than at a table* [P9]". However, in most of the interviews, some participants mentioned that they experienced postural discomfort: "*I did move more than often because I was not always sitting comfortably, but I switched places.*" [P8]. This is in line with the questionnaire data, with PositionPeak being rated as less comfortable than a normal room. On the positive side, participants appreciated the freedom offered by the space, allowing them to freely stand up or change positions whereas it would not feel appropriate in a normal meeting: "*I think the room encourages you to communicate more with your group because there is no table between you*" [P13]. Some participants also felt



**Figure 4:** Video recordings of the PositionPeak meetings through the glass window

that the setting was more fun and exciting and acted as a discussion point between teammates and became an ice breaker. Participants indicated having favorite artefacts and/or positions: *"This is my favorite! Then I thought, if I can't go to my favorite, so where do I go?"* [P4]. Some objects were perceived as more usable than others, the Slope being the less favorite: *"The triangular 'henhouse' piece, I didn't really know what to do with; I couldn't sit on it comfortably. That was also the only piece that didn't have a spot to put a laptop, which I liked about the others".* [P1]

#### *Efficiency of the Meeting and Energy Level*

Efficiency level in the PositionPeak room was usually described as good: *"it was actually quite effective, quick"* [P1] and *"very efficient, good"* [P8] *"It is nice to explore and play a bit more, I felt more active during the meeting."* Two participants did not experience changes in efficiency, and some mentioned a distracting effect: *"there were distractions which influenced somehow the meeting"* [P7]. Efficiency was often related to an increase in creativity: *"I liked the sort of informal character the meeting had because of the alternative furniture. Also, it may have helped us to be more creative. Looking forward to more variations"* [P2]. Some participants stated that PositionPeak did not influence their energy level, others found the question hard to answer *"it's difficult, it depends on the meeting and every meeting even in the same room with the same people can have a high or low energy level"* [P5]. Some teams felt their meeting was more interesting and hypothesized that they could be more energetic should they use PositionPeak more often *"I think it would be more energetic because it's less dull"* [P2]. The majority of groups saw PositionPeak as more suitable for short meetings or brainstorm sessions rather than long

meetings where focus is required: *"It is fine for short meetings for only speaking/standing, but not writing or calculations"* [P10] *"For brainstorms it is perfect"* [P12] *"If it's something unstructured, creative energy flows"* [P2] The use of laptops was mentioned as a concern: *"It's good for presentations or discussions but not for working with laptops"* [P15] *"There is a practical issue that you always have to carry your laptop"* [P11].

#### *Social Conventions*

A common theme was the way PositionPeak changed established social conventions. As P8 stated, *"I accepted it [that P9 was moving a lot], that's also a thing the furniture actually allows, because they are dynamic, you understand that people are moving, and the conversation just goes on."* *"In a room with chairs, when a person stands up, you think what is she doing? [..] Everyone turns their attention to her as it seems she will say something, but perhaps she just wants to stretch her legs, but it's not accepted in a normal meeting."* [P9] In group #2, one person decided to sit on the floor and admitted that, while he likes to do it, he would not have done it in a 'normal' room [P6]. A participant however expressed a notable concern about credibility *"I don't see it as a room for meeting with a client"* [P15]. Group #1 explained that they did not share artefacts to "respect personal space" whereas other groups were comfortable and open to sharing. The number of pieces of furniture had according to users a huge impact on the dynamics: *"it might have been easier to change because you see a free object and you switch to it"* [P14]

#### **Discussion and Future Recommendations**

We designed and tested PositionPeak, a modular meeting environment to encourage the acceptance of physical activity in the office and fit into daily work



### **Recommendations for the design of modular furniture for active meeting spaces**

- 1.** The meeting space entails more objects than the number of users, to encourage them to switch between objects without having to “push someone else to move”. It supports a smooth flow of movement, less likely to disturb the meeting activity
- 2.** The meeting space should be spacious enough to allow users to rearrange objects as well as to move freely in the space
- 3.** Affordances of artefacts should be carefully considered, and can be pretested to ensure that it supports at least one comfortable position
- 4.** Combination of pieces of furniture should allow a balanced mix of postures and meeting opportunities
- 5.** Several objects should encompass flat surfaces for laptops or documents.
- 6.** Sensors can be used to monitor the long-term use of artefacts in a non-intrusive way, eventually leading to adapt the space to users’ needs
- 7.** The use of different material and textures should be explored in order to provide more comfort and variety.

routine. PositionPeak triggered participants to adopt a variety of postures, while increasing the feeling of efficiency and the energy level. Findings showed that participants changed position about 3.7 times more often than in a conventional setting. Participants changed postures between objects, but also frequently on the same object. Possible motivations for people to change position were postural discomfort, seeing other participants move (thus emptying a spot) or being interested in another object. The difference in the amount of position change in ‘ordinary meetings’ and with PositionPeak seems large but could have been positively influenced by several factors. First, the participants were aware of being recorded (i.e. Hawthorne effect). Second, all were experiencing the PositionPeak meeting room for the first time which could lead to more curiosity to try out all the objects. Similarly, to [2], some objects were preferred, and others hardly used (or not by choice). Participants used the objects differently than expected and moved them throughout the room. Social conventions were also modified by the setup, which positively contributed to ‘normalizing movement’ during meetings. As recommended by [6], it is essential that these new forms of meetings are accepted as part of the work culture, which can be achieved by embedding them into the existing infrastructure. In the questionnaires, the energy level and efficiency were rated slightly higher when using PositionPeak. The higher energy level could be explained by the freedom of space and movement. However, in the rather similar End of Sitting study [2], employees reported feeling more energetic only after working in the new design for the first time. It would thus be relevant to investigate performance- and mood-related factors in the long term. To that end, we equipped the artefacts with pressure sensors to collect

data on the postures adopted by the PositionPeak meeting room users in a more ecological setting in the absence of researchers. Further studies with the pressure sensors will be conducted in order to evaluate long term use of PositionPeak. Qualitative feedback will be collected via online surveys and user interviews can be planned using the room booking data. We also intend to combine the data of pressure sensors with additional contextual data (e.g. use of the screen), following a data-enabled design approach [16].

Our findings also provide insights into how to design these type of active meetings rooms (see sidebar). The notion of availability of an object seems important in order to encourage users to switch between objects. We thus recommend such meeting rooms to entail 1-2 objects more than the number of meeting participants. However, there should be enough space in the room to allow for rearranging objects as well as walking and moving around freely. The topic of postural discomfort, often discussed by our users and aligned with previous studies [2], also needs to be addressed. Some objects were considered less comfortable or usable than others, and it is thus important to consider the affordances of each designed object. In a sense, it could push the participants to end the meeting faster, thus increasing efficiency, as experienced in standing meetings [8]. Of course, designing a balanced environment combining posture change and efficiency while being pleasurable to use is a more favorable endeavor. Lastly, the present study invites researchers and designers to rethink and discuss the way we can use technology to stimulate more physically active meetings. Where for instance laptop use in meetings often provoke static postures, the use of shared screens, tablets or other novel devices might bring the opportunity to challenge this status quo.

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