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Table of Contents

Table of Figures

Acronyms and Abbreviation

CDI	Crowd Dynamics International Limited
EC	European Commission
EMT	Executive Management team
FZJ	Forschungszentrum Julich Gmbh
GA	Grant Agreement
INRIA	Institut National De Recherche En Informatique Et Automatique
KPIs	Key Performance Indicators
ONH	Onhys
PO	Project Officer
UL	University of Leeds
ULM	Universität Ulm
URJC	Universidad Rey Juan Carlos
WP	Work-package

1. Introduction

This deliverable describes the efforts made in task T1.3 “Laboratory experiments in large groups”.

In period 1, in the framework of task T1.1 “Experimental design and scenarios” the consortium intensely discussed what the relevant gaps in existing datasets on crowd dynamics are and what they expect from the datasets which were to be acquired in WP1. The goal is to understand which features or dynamics can change the status of a crowd into a possible danger. We came to the conclusion that it is of utmost importance to learn about how people react to impulses and how impulses and information propagate through a crowd. The aim is to investigate on different levels of group size, i.e. from only one person being pushed in a controlled manner, over the study of how an impulse propagates through a small queue, up to dynamics in a crowd of more than 100 people. Another important aspect is the idea to connect dynamics on the macroscopic scale to movements on the limb scale. Therefore, besides the common video recordings, 3D full body motion capturing was used.

As a reminder, the objectives of WP1 are:

- To generate the required datasets to design models of local physical interactions.
- To establish the relations between the macroscopic features of a crowd motion with the microscopic features of physical interactions.
- To validate technologies resulting from the project.

2. Experiments conducted

All presented experiments have in common that they investigate the propagation of impulses or information within a crowd. They differ in size of the crowd and level of simplicity beginning with the first dataset in which the crowd is simplified to a row of only five persons up to the second dataset with a crowd of more than 100 persons.

During all presented experiments, video sequences were acquired by several overhead and sideview cameras. All participants were wearing colored hats with Aruco markers which are later used for the automatic detection of their individual head trajectories from the overhead video recordings.

The usage of inertial motion capturing (MoCap) of every person in combination with the absolute positioning from video data allows new insights into the 3D movement of every person not only individually but also relative to each other. It has to be pointed out that his is still a new kind of dataset which allows for novel analysis methods in the field of crowd dynamics.

In the following, experiments that belong to task T1.3 “Laboratory experiments on large groups” are described.

2.1. Large-scale Pushing Experiments in Wuppertal (FZJ)

2.1.1. Objective

From 10th to 12th May 2022, FZJ conducted experiments in the Foyer of a lecture hall of the Bergische University of Wuppertal, Germany. There, they were supported by partners from ULM, INRIA and UJRC.

The large-scale pushing experiments were an extension of the small-scale pushing experiments performed in 2021 (see deliverable D1.1). The experiments can be subdivided into experiments with and without external impulse (but with internal impulses).

In the experiment with external impulse, the objectives were to investigate the propagation of a push through a crowd, not only focusing on a forward direction but also analyzing the propagation to the side. Therefore, the number of participants was increased to up to 36 people and also the formation of the crowd was considered. Furthermore, we wanted to study how people recover balance inside the crowd, e.g., where feet are placed.

The experiments without external impulse focused on possible risks inside a pushing crowd. We wanted to observe phenomena, for example sideways movements, stumbling or people being lifted up, and identify factors that can lead to such situations. For this purpose, the participants were instructed to push against each other in different formations. To this end, we recorded head trajectories and 3D Motion capturing data, allowing us to get a detailed view inside a crowd.

2.1.2. Methods and types of data

For the experiment, volunteers between the ages of 19 and 36 were recruited. The experiments were performed in four blocks with new participants in every block. In every block, the main group of 20 participants was equipped with inertial MoCap suits by Xsens. In some trials, the group was enlarged up to 36 people by people who did not wear a MoCap suit. For safety reasons, the experimental area was laid out with judo mats. The experiments were recorded by overhead as well as sideview cameras. All participants wore orange hats with attached Aruco codes to automatically track the individual head trajectories. Then strength of the external impulse was measured by a pressure sensor from Xsensor (LX210:50.50.05) being attached to the front of the punching bag which was being used for the perturbation (see section 2.1.3).

2.1.3. Detailed description of experiments

With external impulse

As in the previous experiments (see deliverable D1.1), the impulse was given by pushing the group with a horizontally suspended punching bag which was pushed forward manually in a controlled manner by an experimenter. The participant standing directly in front of the punching bag was pushed forward at shoulder

height, colliding with the persons standing in front and so on. Like this, the impulse propagated through the small crowd.

The following variations of experimental parameters were applied:

- Strength of push: weak, medium, strong.
- Inter-person distance: elbow, no distance.
- Preparation: unprepared, prepared.
- Formation: see Table 1.

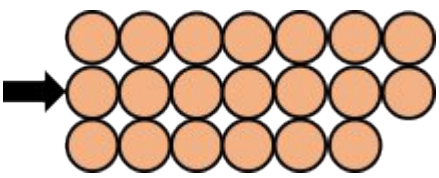
These variations were chosen because each of the parameters is expected to have an effect on the impulse propagation (e.g. velocity, distance, direction). Therefore the parameters were varied systematically in order to study their influence.

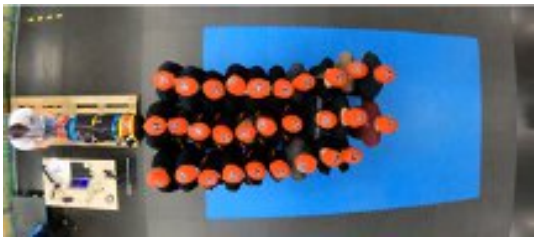
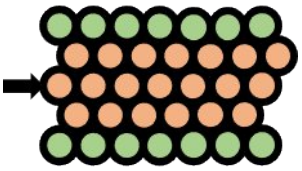
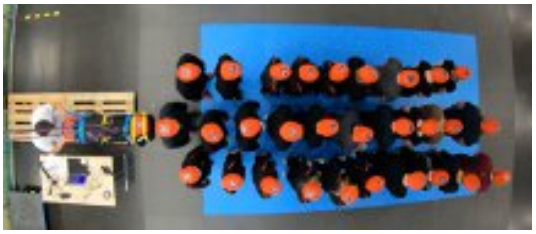
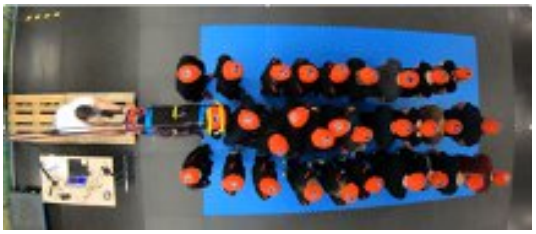
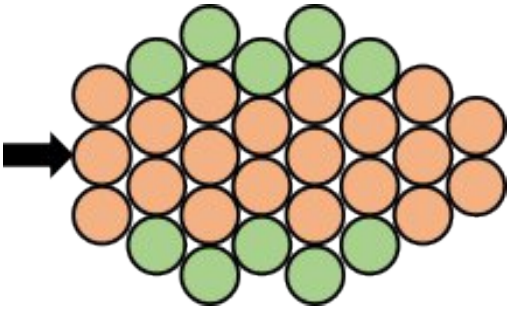
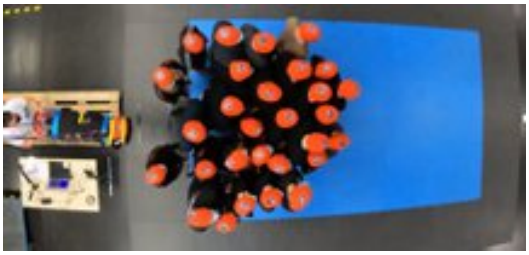
Different formation were chosen mainly to study their effects on the direction or the opening angle of the impulse propagation and on damping. E.g., in a formation in which each person is looking directly at the back of the person in front is expected to have a different direction/opening angle than a formation in which every person is looking at a gap between the shoulders of the two persons in the front.

To vary the preparation of the participants, the waiting time for the push to come was varied. In the case of the prepared condition, the push came immediately after the announcement "Please look to the front and get ready for the push that is about to come." For the unprepared condition, the participants had to wait for a random time (10 – 50 s), during which they got distracted by reciting the alphabet backwards. Here the announcement was "Please stand relaxed and look to the front. The push will come within the next minute. Now please recite the alphabet backwards silently."

In each experimental block, the participants were positioned in five different formations (A, B, C, D, G) as shown in Table 1. The total number of times a formation was conducted throughout the four experimental blocks is also listed in the table. For each group in each formation, 12 experimental trials with different experimental parameters were conducted. A detailed description of the performed variations is shown for one example formation in Table 2. A complete list of experimental trials is found in the Annex A.

Table 1. Overview and description of the crowd being pushed. In the sketches, orange circles indicate persons with a MoCap suit, green circles without MoCap.

Form	Description	Sketch, Photo
Pushing long row		
A (A11)	A single row of 10 or 20 people is pushed (**A11**). A11 with 10 people was conducted twice, A11 with 20 people 7 times.	
	 Before the push, elbow distance.	 After the push, elbow distance.
Pushing multiple rows, side by side		
B (B33) (B55)	Participants are standing in either three (**B33**, see sketch) or five (**B55**) rows with their shoulders side by side. The central row is being pushed. Both formations were carried out twice.	

	 Before the push, no distance.	 After the push, no distance.
Pushing multiple rows, shoulders in gap		
C (C33) (C55)	Either 3 (**C33**, see photos) or 5 (**C55**, see sketch) participants are standing side by side. The outer rows are shifted towards the front so that their shoulders are positioned at the gap between two people. The central row is being pushed. Both formations were carried out twice.	
	 Before the push, elbow distance.	 After the push, elbow distance.
Pushing a group		
D (D32) (D34)	Participants are standing shoulder by shoulder in rows of 3 and 2 (**D32**) or 3 and 4 (**D34**) persons. The rows are shifted sideways so that everyone faces a gap between two people in the front. The central person in the back row is being pushed. The size of the columns were varied. D32 was conducted twice, D34 and D-- were conducted once.	
	 Before the push, no distance.	 After the push, no distance.

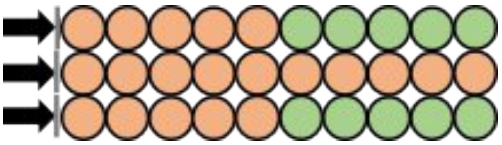
Pushing 3 people simultaneously		
G **(G33)** **(G34)**	Participants are standing in three rows next to each other (**G33**, see sketch) or as a Group (**G34**). Three persons are being pushed manually at the same time with a punching pad from behind. Both formations were carried out once.	
	 Before the push, no distance.	 After the push, no distance.

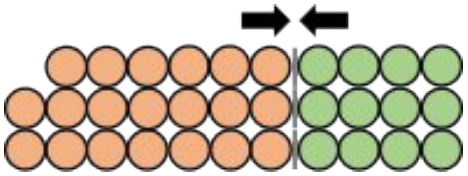
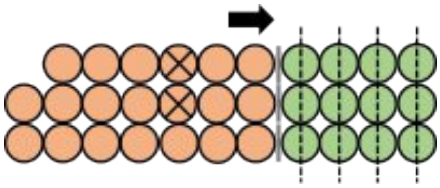
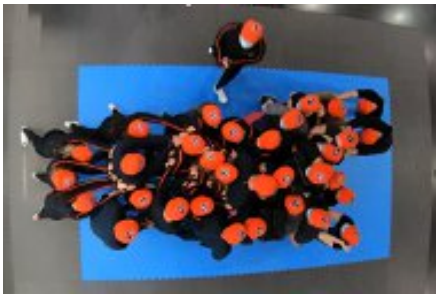
Table 2. Sequence of variations of the parameters “Impulse”, “Distance” and “Preparation” for an example formation (A11) with 20 participants. The column “Name” gives the according file and trial names. These variations of the three parameters were performed this way for all formations of the crowd following the naming convention. A complete list of experimental trials is listed in the Annex A.

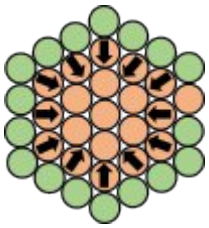
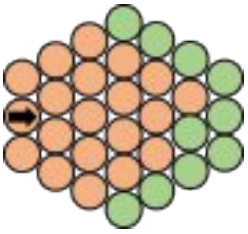
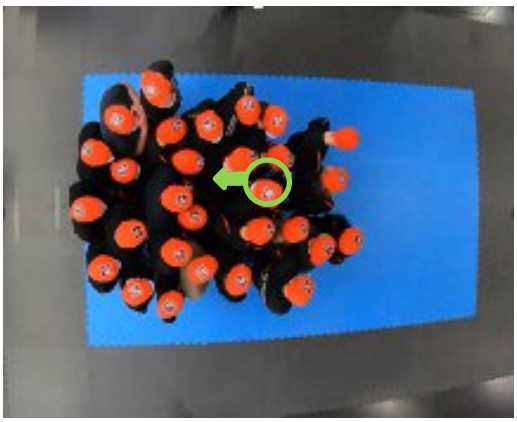
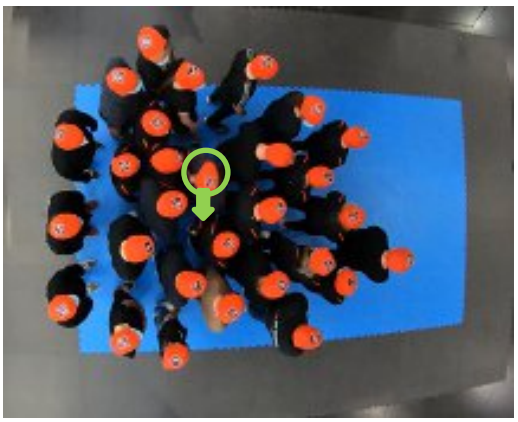
Block	Form	No of rows	No of persons	Impulse	Distance	Preparation	Name
2	A	11	20	Weak	Elbow	Unprepared	2A11_010_n20_fw_d1_p-
2	A	11	20	Medium	Elbow	Unprepared	2A11_020_n20_fm_d1_p-
2	A	11	20	Strong	Elbow	Unprepared	2A11_030_n20_fs_d1_p-
2	A	11	20	Weak	Elbow	Prepared	2A11_040_n20_fw_d1_p+
2	A	11	20	Medium	Elbow	Prepared	2A11_050_n20_fm_d1_p+
2	A	11	20	Strong	Elbow	Prepared	2A11_060_n20_fs_d1_p+
2	A	11	20	Weak	None	Unprepared	2A11_070_n20_fw_d0_p-
2	A	11	20	Medium	None	Unprepared	2A11_080_n20_fm_d0_p-
2	A	11	20	Strong	None	Unprepared	2A11_090_n20_fs_d0_p-
2	A	11	20	Weak	None	Prepared	2A11_100_n20_fw_d0_p+
2	A	11	20	Medium	None	Prepared	2A11_110_n20_fm_d0_p+
2	A	11	20	Strong	None	Prepared	2A11_120_n20_fs_d0_p+

Without external impulse

In the experiments without external impulse the participants are asked to actively push against each other either using large punching pads as a border or by using their hands. The performed formations are listed in Table 3. Each formation was conducted twice throughout the four experimental blocks. A complete list of experimental trials is found in the Annex A.

Table 3. Overview and description of the pushing experiments without external impulse. In the sketches, orange circles indicate persons with a MoCap suit, green circles without MoCap.

Form	Description	Sketch, Photo
Pushing in two groups		
E	Two groups face each other with 3 rows next to each other. On command, the pressure is slowly built up towards the front and held. Then on command the pressure is released again. The number of people pushing forward was varied. Which dynamics occur while pressure build-up and release?	
	 Pressure is being built up by all three rows.	 Pressure is being reduced, dynamics occur.
Pushing in two groups, creating a gap		
F	Similar to the preceding, but when the pressure is built up, one person creates a gap by stepping to the side. It was varied how many people pushed forward and at which place the gap was created. What is the effect on people in the row behind the gap?	
		 Person has stepped out of the row.

Pushing in a circle		
H	The participants form a filled circle facing inwards. On command everyone starts slowly pushing towards the center. It was varied how many people pushed forward. What effects can be observed?	
		
Passing through a standing crowd		
I	Participants are asked to stand relaxed but hold their position while one person is trying to cross the crowd from different directions. Variations include the inter-person distance of the standing crowd, the gender of the intruder as well as the direction of passing. Which dynamics occur in response to the intruder?	
	 Person moving from front to back, no distance.	 Person moving sideways, elbow distance.

2.1.4. Data processing applied and data storage

The data processing of all pushing experiments is largely completed, but it is still ongoing. The processing steps include detailed documentation, the automatic extraction of head trajectories from video recordings with the software PeTrack, the manual correction of trajectories, adjustments of software, time synchronization MoCap Preprocessing, Fusion of trajectory and MoCap data.
The head trajectories were exported as txt files.

The processing of the raw motion capturing data includes a calibration, time synchronization, cutting to the same times as the video sequences and an automatic reprocessing (ReprocessHD) with the software MVN Analyze. The MoCap data was exported in the mvnx and the c3d format containing information on orientation, position, velocity, acceleration, angular velocity and angular acceleration of every body segment in addition to the joint angles and the position of the center of mass. The head trajectories and the c3d motion capturing datasets will soon be combined. The pressure data is cut to each trial and saved as txt files, which include pressure values of each sensel, sensor information and an estimated load for all frames. Once the processing steps are finalised, the actual data analysis can start.
Currently, the data is stored on a local server and individual trials are available for the consortium on Alfresco. The data will be made publicly available via the Pedestrian Dynamics Data Archive of the FZJ as soon as a related journal article is published.

2.1.5. Related publications (if applicable)

There has been no publication about these experiments yet. It is planned to present results at the conference Pedestrian and Evacuation Dynamics 2023 (PED) and to publish at least one paper accordingly.

2.1.6. Data privacy and ethical approval

Ethical approval for this experiment was granted by the ethics board at the University of Wuppertal, Germany. Every person gave informed written consent before participation which included:

- Participating voluntarily in the study.
- Participation can be withdrawn at any time and without giving any reasons. It is also possible to omit individual trials without stopping the entire experiment.
- Minimum age of 18 years and a recommended maximum age of 60.
- Good knowledge of German language.
- Body height of 1.5 m to 2.0 m.
- Feeling physically fit enough, not being pregnant, affected by limited mobility or afraid of crowds.
- Agreeing to be filmed and the material to be published in a data repository or used for (social) media.
- Wearing dark clothes and not wearing large bag/backpacks.

At the time of the experiments, some Covid-19 regulations were still effective in Germany. Therefore, all participants had to wear masks. After the experiment, a reimbursement of 35 euros was paid for participation in the experiments.

2.2. Information propagation experiments (FZJ)

2.2.1. Objective

The information propagation experiments were carried out on the 10th and 12th of May 2022 in the foyer of a building of the University of Wuppertal, Germany. The purpose of this experiment was to investigate how a message propagates through a crowd, or in other words, who communicates with whom when passing on a message. We also wanted to examine which factors influence whether or not the message is passed on, and if so, how fast and in which direction it travels. Therefore, the following parameters were varied:

- The position of input (i.e., front, back, right, left).
- The relevance of the message for the participants.
- The type of message (i.e., information or instruction).
- If the participants knew that passing on the message it is part of the experiment or not.

For the analysis, we will further take the person density and, since we expect better performance in later runs (i.e. a training effect), the order of the runs into account.

2.2.2. Methods and types of data

In order to create a crowd with a rather high density that directed its focus in a certain direction, a small bottleneck experiment was set up. The participants were asked to pass through the bottleneck, but a few

seconds after the start they were interrupted and the bottleneck was closed. After a waiting period of 30-60 seconds, they were asked to walk "normally" through the bottleneck. During the waiting period, a message was given to them by an experimenter from a certain direction. The message could be in the form of an information or an instruction and was supposed to be passed on as in the widely known "telephone game". This procedure was repeated seven times within one block and in total there were five blocks involving 31-44 participants. The information about who received the message can be retrieved from the video recordings. The Aruco markers on the hats of the participants allow the connection between head trajectories (position, neighbourhood) and questionnaire answers that were collected after each run. The questionnaire data contains information on who received the message, how often it was received and if it was passed on. In runs with instruction, we also asked whether participants heard the instruction or only saw the execution in other people. After the second run per block, there was a longer questionnaire including additional questions about participants' well-being, their sense of belonging to the group and their perceived control over the experiment.

2.2.3. Detailed description of experiments

The procedure of each block was as follows: After giving informed consent and being equipped with orange hats, Acuro markers and a blue and green sticky dot for either shoulder, all participants were gathered in the middle of the experimental area and welcomed by an experimenter. They received some information about the experiment including their task to walk through the bottleneck in a hurry but without pushing or shoving and the filling in questionnaires after some runs. At this point, neither the interruption nor the input / propagation of messages were discussed. If there were no further questions, the group gathered directly in front of the bottleneck (as in Figure 1) and the experiment began. To make the crowd situation more realistic, sounds of a bigger crowd were played throughout the experiment.

Runs 1 and 2 (hidden purpose):

The first run had the purpose of getting the participants used to the setting and was carried out without any interruption or questionnaire. After the start signal, the group walked through the bottleneck, around the experimental area and gathered in front of the bottleneck again. The actual experiment began with the second run. A few seconds after the start, the participants were interrupted verbally by one experimenter and by blocking the bottleneck with the arm of another one (see Figure 1). Then, the participants waited for 60 seconds without any information before the experimenter standing at the left side of the crowd gave a message quietly to one person in the crowd and asked her/him to pass the word on. The relevance of this message was varied between the blocks and it was either "We've got a technical problem." (relevant information) or "The color is blue." (irrelevant information). After another 60 seconds, the bottleneck was reopened and the participants filled in the longer questionnaire.

Runs 3 to 8 (revealed purpose):

After everyone gathered in the experimental area again, the actual purpose of the experiment and the interruption was revealed. From now on, the participants knew that it is their task to pass a message on quietly ("telephone game"). Then, the whole procedure of the second run was repeated six times. However, participants did not have to wait for 60 seconds before the message was given in but only a few seconds. The position of the input (front, back, left, right) and whether the message was an information or an instruction was varied between the runs of one block (3x information, 3x instruction). Between the blocks, the messages were the same but their order was varied. An exemplary order and the names of the respective files can be found in Table 4. Depending on how quickly the message traveled through the crowd, the waiting time was adjusted and was between 30-60 seconds. After each run, participants had to fill in the short questionnaire.

Additional runs (regular bottleneck):

In order to exploit the experimental setting as much as possible, after the information experiment, three to four regular bottleneck runs were carried out. The participants had to walk either normally through the bottleneck or there were short interruptions of one second after each subject (i.e., ticket control) or one of the persons standing in front turned around and was instructed to walk backwards through the crowd (i.e., counterflow) or the group walked through the bottleneck three times in a row with a starting point at the back of the experimental area (i.e., flow). There were no questionnaires after any of these runs.

After the experiment was finished, the participants were thanked for their participation and received a reimbursement of 15€ for their time and effort.

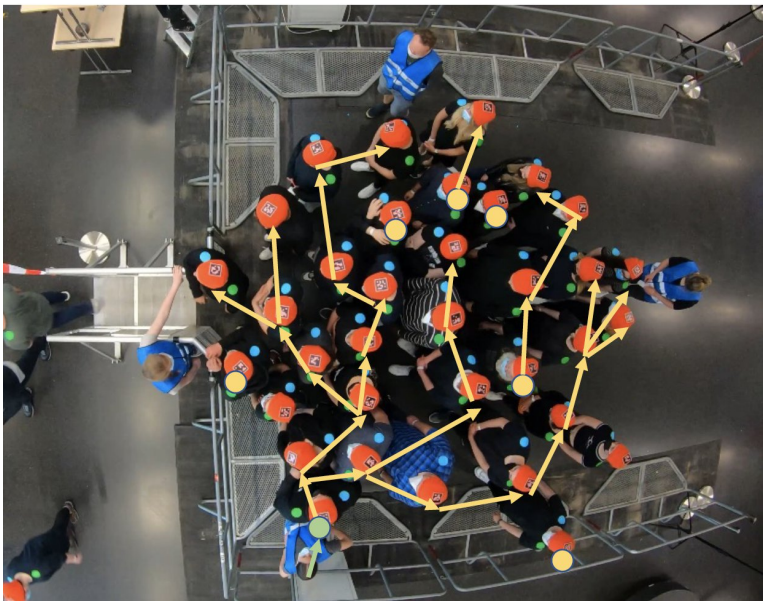


Figure 1. Overhead screenshot of an exemplary information propagation experiment. The bottleneck experiment has been interrupted and information has been given into the crowd (green arrow). The yellow arrows indicate the expected propagation of the information from person to person. The persons in blue vests standing at each side of the crowd are the experimenters who give the information in (only one at a time).

Table 4. Exemplary order of information propagation experiments of one group including experimental parameter and the naming of the respective file

Table . Run	**Type of run**	**Interruption?**	**Message**	**Position of input**	**Name of file**
1	Trial	No	-	-	Tue_01_010_noInt
2	Interruption (relevant)	Yes	We've got a technical problem.	Left	Tue_01_020_Surp+_l
3	Interruption (information)	Yes	The color is yellow.	Front	Tue_01_030_Info_f
4	Interruption (instruction)	Yes	Pull the green sticky dot off your shoulder.	Back	Tue_01_040_Com_b
5	Interruption (information)	Yes	The color is red.	Right	Tue_01_050_Info_r
6	Interruption (instruction)	Yes	Pull the blue sticky dot off your shoulder.	Left	Tue_01_060_Com_l
7	Interruption (information)	Yes	The color is purple.	Back	Tue_01_070_Info_b

8	Interruption (instruction)	Yes	Tap yourself on the shoulder for a second.	Front	Tue_01_080_Com_f
9	Regular bottleneck	No	-	-	Tue_01_090_Add_Normal
10	Ticket control	No	-	-	Tue_01_100_Add_Ticket
11	Counterflow	No	-	-	Tue_01_110_Add_Contraflow
12	Ticket control	No	-	-	Tue_01_120_Add_Ticket

2.2.4. Data processing applied and data storage

The data processing is still in progress. For the overhead video data, the head trajectories were extracted automatically by the software PeTrack and then manually corrected. The questionnaire data was digitized and stored as csv files. At the moment, the data is stored on an internal server in the research center in Jülich but it will be made publicly available via the Pedestrian Dynamics Data Archive of the FZJ as soon as a related journal article is published.

2.2.5. Related publications (if applicable)

The dataset was not part of a publication until now.

2.2.6. Data privacy and ethical approval

Ethical approval for this experiment was granted by the ethics board at the University of Wuppertal, Germany. Every person gave informed written consent before participation which included:

- Participating voluntary in the study.
- Minimum age of 18 years (no maximum age but being able to stand for 1.5 hours).
- Good knowledge of German language.
- Body height of 1.5 m to 2.0 m.
- Not being pregnant, affected by limited mobility or afraid of crowds.
- Agreeing to be filmed and the material to be published in a data repository or used for (social) media.
- Wearing dark clothes and not wearing large bag/backpacks.

The questionnaire data was collected anonymously and the connection between questionnaire answers and head trajectories (position, neighborhood) is realized through an individual number.

At the time of the experiments, some Covid-19 regulations were still effective in Germany. Therefore, all participants had to wear masks.

2.3. Bottleneck Experiments under high motivation (FZJ)

2.3.1. Objective

The bottleneck experiments were carried out in October 2021 in the Mitsubishi Electric Hall in Düsseldorf Germany. This series of experiments investigated different physical and social-psychological aspects in a bottleneck scenario. One aim is to investigate the dynamics in a crowd on different levels of detail (macroscopic, microscopic, limb scale). A special interest lies in dynamics during competitive states with in which the participants are in close contact leading, e.g., to involuntary swaying or to transversal waves of crowd motion. Therefore, a prerequisite of the experiments was to have a crowd with a common target and a high person density. To achieve this, a bottleneck structure was set up through which participants had to walk

under various controlled conditions. Furthermore, it was investigated how a message can travel through the dense crowd.

2.3.2. Methods and types of data

Figure 2. Front view of the bottleneck with the pressure sensors T1 and T2 attached to the front walls and bent 5 cm around the corner. The sideview video cameras are labelled with green circles.

A photograph of the bottleneck is shown in Figure 2 and sketches of the bottleneck construction can be found in Figure 3. The outer dimensions of the experimental area were 20m by 20 m. The bottleneck construction consisted of an 4 m x 2m x 1m aluminum frame with gray plastic panels, weighing 250 kg per side. They were each visually extended to be 6 m long by adding trade fair walls. Each side was secured against slipping with anti-slip mats and 750 kg concrete blocks which were bolted to the bottleneck construction. Participants were to maintain their motivation during the experiment until they crossed a finish line (goal) 8 m behind the bottleneck. The way to the finish line was marked with barrier tape. Beyond the finish line, participants could return to the line-up area by turning to either sides. Where questionnaires were to be completed, this was done after the respective runs in an area to the left of the experimental area.

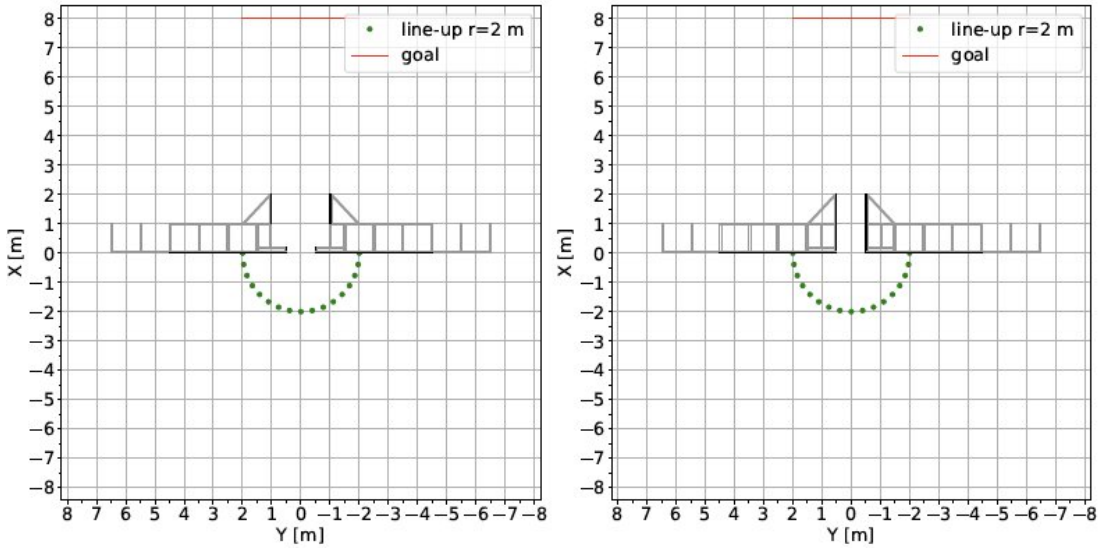


Figure 3. Schematics of a setup with a bottleneck length of 0.2 m (left) and 2 m (right).

The announcer and further observers were standing on a scissor lift that was parked behind the bottleneck construction and raised to a height of several meters to have a good overview. All announcements were made with a microphone connected to a portable loudspeaker. To increase the initial density, the participants in the

first row were asked to stay in place while everyone else was asked to take one step forward, before each run. The intended initial density was 1P/m^2. Whenever special targeted announcements were necessary to achieve the study objective, they were made via slips of paper or by the investigators directly addressing individuals.

To take safety precautions, a practiced crowd manager was present at the experiments equipped with an air pressure horn. The horn was activated whenever a participant indicated discomfort during an experiment by calling out 'stop' aloud or if the crowd manager himself identified a situation as critical or potentially harmful. At the beginning of the day, all participants were trained in what was to be done in the case of the horn being activated. The procedure included immediately stopping in the current position without further movement. Designated helpers that were close to the crowd at all times started tapping people at the shoulder once the crowd had come to a full stop. On the signal of "shoulder tapping" participants were allowed to turn around and move to the far back of the experimental site. The procedure was continued until every person was tapped at the shoulder. Apart from the test run where the horn was activated on purpose, two runs (4D250, 4D280) were aborted and resolved in the way described above.

A variety of technical means was employed to collect different data sets:

- Video sequences were acquired by several overhead and sideview cameras. The sideview cameras were mounted on the walls of the bottleneck structure (see Figure 2) and are mainly used to have a qualitative view on the crowd.
- All participant wore green hats with Aruco codes on top. These hats were used to automatically track the individual head trajectories from the sequences recorded from cameras that were mounted at the ceiling.
- Two pressure sensors Pressure Mapping Sensor 5400N from Tekscan (see Figure 2) with a size of 578 mm x 884 mm were attached on the walls of the bottleneck (to be able to derive the force of the crowd).
- 19 participants were equipped with 3D inertial motion capturing (MoCap) suits by Xsens. Up to 40 people were wearing sensors measuring the electrodermal activity (EDA). After some special trials, questionnaires were handed out.

2.3.3. Detailed description of experiments

The following experimental parameters were varied:

- Bottleneck width: 0.6 m, 0.7 m, 0.8 m, 1.0 m, 1.2 m, 1.6 m.
- Bottleneck length: 0.2 m, 2.0 m.
- Motivation: normal, hurry, full commitment.
- Number of participants
- Initial line-up: directly at the bottleneck, 2m semi-circle, special positions at 4m circle.
- Special announcement: none, active pushing / slowing, abort signal, interruption (with information passing on).

A detailed list of performed runs and combinations of parameters can be found in Table 5. Exemplary views from the overhead cameras for two exemplary experiments with different initial line-ups are shown in Figure 4.

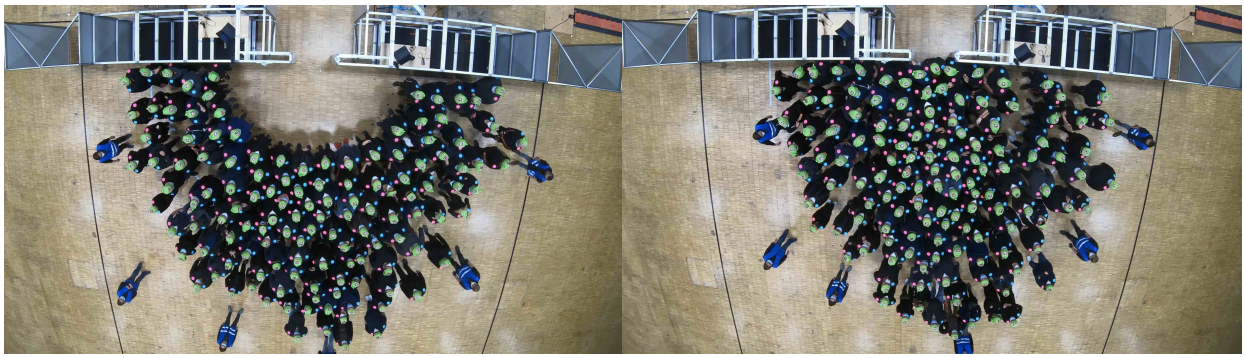


Figure 4. Snapshots of experiments with 0.2 m bottleneck length and an initial line-up being a 2 m semi-circle (left) and standing directly at the bottleneck (right)

The degree of motivation was varied by different announcements. In “normal” condition runs participants were instructed as follows: “You are in a crowd where people walk through a door at a normal pace. You yourself move purposefully, but without haste.” In “hurry” conditions the instructions were “You are in a crowd where people are in a hurry to pass a door. You yourself are also moving briskly”, and in “full commitment” conditions “You are in a crowd where everyone wants to pass through a door as quickly as possible and pushes their way through. You yourself do everything you can to get to the front and through quickly as well.”

Several trials were conducted to investigate the propagation of a message in a dense crowd. In this set of experiments, participants were interrupted while passing through the bottleneck. In the waiting crowd, a message was tried to be spread by the experimenters similar to the children’s game “telephone game”. The message was either an information about the reason for the interruption ("There is a technical problem") or an instruction ("Tap yourself briefly on the shoulder"). In the case of the instruction, it was added that this passing on is part of the experiment (“revealed purpose”), but not in the case of the information (“hidden purpose”). Video recording allowed for recording who received the message. For some runs, this assessment can also be validated through questionnaire data. All trials with message propagation are indicated in Table 5 by the special announcement “interruption”.

Further, there were two other trials with a special announcement that was only given to roughly 20% of the participants. While regathering in front of the bottleneck, experimenters chose randomly some participants and asked them to either push or be extra slow in the next trial. This instruction was given in secret so that none of the other participants knew about it. The IDs of the participants with the special task were noted down to make it easier to identify them in the video recordings. The two trials are indicated in Table 5 by the special announcement “20% actively pushing / slowing down”.

Table 5. Detailed list of performed runs of the bottleneck experiments including naming convention and combinations of parameters.

run name (short)	run name (descriptive) [width, length, motivation, addition]	no. of participants	width [m]	length [m]	motivation [h0: normal; h1: hurry; h2: full commitment; he: normal-hurry]	line-up	special announcement
4D000	test01	136	1.2	2.0	h0	2m semicircle	Explanation h0
4D001	test02	136	1.2	2.0	h1	2m semicircle	Explanation h1
4D002	test03	136	1.2	2.0	h2	Directly at bottleneck	Explanation h2, abort signal
4D010	w120_l200_h0	136	1.2	2.0	h0	2m semicircle	

4D020	w120_l200_h1	136	1.2	2.0	h1	2m semicircle	
4D030	w080_l200_h0	161	0.8	2.0	h0	2m semicircle	
4D040	w080_l200_h1	160	0.8	2.0	h1	2m semicircle	
4D050	w160_l021_h0	125	1.6	0.2	h0	2m semicircle	
4D060	w160_l021_h1	129	1.6	0.2	h1	2m semicircle	
4D070	w120_l021_h0	153	1.2	0.2	h0	2m semicircle	
4D080	w120_l021_h1	129	1.2	0.2	h1	2m semicircle	
4D090	w100_l021_h0	152	1.0	0.2	h0	2m semicircle	
4D100	w100_l021_h1	131	1.0	0.2	h1	2m semicircle	
4D110	w080_l021_h0	132	0.8	0.2	h0	2m semicircle	Mix up: first row queue behind
4D120	w080_l021_h1	132	0.8	0.2	h1	2m semicircle	
4D130	w080_l021_h2	129	0.8	0.2	h2	Directly at bottleneck	
4D180	w070_l021_h1_interrupt	150	0.7	0.2	h1	2m semicircle	interruption: technical,questionnaire
4D200	w070_l021_h0	168	0.7	0.2	h0	2m semicircle	
4D210	w070_l021_h1	169	0.7	0.2	h1	2m semicircle	questionnaire
4D181	w070_l021_h1_interrupt	164	0.7	0.2	h1	2m semicircle	Interruption: technical
4D220	w070_l021_h2_025	25	0.7	0.2	h2	Directly at bottleneck	
4D230	w070_l021_h2_050	51	0.7	0.2	h2	Directly at bottleneck	
4D240	w070_l021_h2_075	77	0.7	0.2	h2	Directly at bottleneck	
4D250	w070_l021_h2_100	94	0.7	0.2	h2	Directly at bottleneck	Abort signal
4D251	w070_l021_h2_100	96	0.7	0.2	h2	Directly at bottleneck	
4D280	w070_l021_h1_push	158	0.7	0.2	h1	2m semicircle	20% actively pushing,questionnaire, abort signal
4D281	w070_l021_h0	167	0.7	0.2	h0	-	no announced run /without “go” signal
4D290	w070_l021_he_slow	201	0.7	0.2	he	2m	20% actively slowing down

						semicircle	
4D291	w070_l021_he	168	0.7	0.2	he	2m semicircle	
4D300	w060_l021_h0	187	0.6	0.2	h0	2m semicircle	
4D310	w060_l021_he	191	0.6	0.2	he	2m semicircle	
4D320	w060_l021_he_interrupt	101	0.6	0.2	he	2m semicircle	interruption: information,questionnaire interruption: information,questionnaire
4D330	w060_l021_he_interrupt	91	0.6	0.2	he	2m semicircle	interruption: information,questionnaire
4D340	w060_l021_h2	53	0.6	0.2	h2	Directly at the bottleneck	

2.3.4. Data processing applied and data storage

The video sequences were synchronized, cut to the timing of the actual experiments and named according to Table 5. For all trials, the individual head trajectories were extracted from the overhead video sequences and corrected manually where necessary. To cover the complete experimental area, the trajectories of two cameras were combined to one dataset. The dataset is anonymized, but each trajectory is assigned with the Aruco code of the participant. This makes it possible to connect the experimental data with questionnaire data. Besides questionnaires that were filled out directly after some of the trials (see Table 5), a general questionnaire was filled out in the morning. This anonymized questionnaire includes personal information about the age, gender, height, weight and shoulder width, for example.

The processing of the raw motion capturing data includes a calibration, time synchronization, cutting to the same times as the video sequences and an automatic reprocessing (ReprocessHD) with the software MVN Analyze. The data was exported in the mvnx and the c3d format containing information on orientation, position, velocity, acceleration, angular velocity and angular acceleration of every body segment in addition to the joint angles and the position of the center of mass.

The head trajectories and the c3d motion capturing datasets will soon be combined.

The pressure data was also cut to each trial. They were exported as csv files, which include sensor and calibration information, the raw sum as well as pressure values for each sensel over time.

The questionnaire data was digitized and stored as csv files.

All datasets are currently stored on an internal server in the research center in Jülich and on Alfresco to share them among the consortium. They are currently being prepared to be made publicly available on the Pedestrian Dynamics Data Archive of the FZJ. The according website was already defined:

Forschungszentrum Jülich, Bergische Universität Wuppertal, Ruhr-Universität Bochum: Bottleneck Experiment. Pedestrian Dynamics Data Archive (2022). doi:10.34735/PED.2021.9. URL http://ped.fz-juelich.de/da/2021bottleneck.

2.3.5. Related publications

The bottleneck experiments were carried out among a large scale experimental series which is described in a data guidance paper (currently being under review):

Boomers, A. K., Boltes, M., Adrian, J., Beermann, M., Chraibi, M., Feldmann, S., ... & Üsten, E. (2023). Pedestrian Crowd Management Experiments: A Data Guidance Paper. arXiv preprint arXiv:2303.02319.

2.3.6. Data privacy and ethical approval

The application of ethical approval for the "Bottleneck" experiment was submitted to the ethical review committee of the University of Wuppertal (German: BergischeUniversität Wuppertal) by A. Seyfried and was approved in January 2020 (file referenceMS/BBL 191213 Seyfried).

Every participant has given informed written consent to the participation conditions which included the following points (among others):

- Minimum age of 18 years and recommended age of younger than 75 years.
- Body height of 1.5 m to 2.0 m.
- Not being affected by limited mobility or claustrophobia.
- Wearing dark clothes without lettering and not wearing large bag/backpacks.
- Agreeing to being filmed and the material to be published in a data repository.

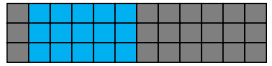
At the time of the experiments, Germany was at the beginning of a third Covid-19 wave. Due to the pandemic, a number of hygiene and safety precautions were taken which were approved by the crisis committee of Forschungszentrum Jülich and the competent regulatory authority of the city of Düsseldorf. These precautions included (among others) that all participants had to wear surgical masks and that they were either recovered, vaccinated or tested negative and additionally everyone had to show a current negative test result for Covid-19 upon arrival.

Conclusion

At the time of publication of this report, all experiments were performed as planned. We are confident that these data serve their purpose within the project. In particular, the experiments, in which an external impulse is given into a crowd will be useful for the design of models with local physical interaction. Both, the bottleneck experiment as well as the large-scale pushing experiment will reveal important insides into the relations between the macroscopic features of a crowd with microscopic features of individual reaction and physical interaction.

ANNEX A - Overview pushing experiments

Tuesday afternoon

SetUp	Form	File name	Run number	Number of persons	Impulse	Distance	Preparation	time until push [s]				notes	Layout of Judomats
		1A11_010_n10_fw_d1_p-	1	10	weak	elbow	unprepared	10--50					
		1A11_020_n10_fm_d1_p-	2	10	medium	elbow	unprepared	10--50					
		1A11_030_n10_fs_d1_p-	3	10	strong	elbow	unprepared	10--50					
									permute				
		1A11_040_n10_fw_d1_p+	4	10	weak	elbow	prepared	0					
		1A11_050_n10_fm_d1_p+	5	10	medium	elbow	prepared	0					
	1A11	1A11_060_n10_fs_d1_p+	6	10	strong	elbow	prepared	0					
									permute				
		1A11_070_n10_fw_d0_p-	7	10	weak	none	unprepared	10--50					
		1A11_080_n10_fm_d0_p-	8	10	medium	none	unprepared	10--50					
		1A11_090_n10_fs_d0_p-	9	10	strong	none	unprepared	10--50					
									permute				
		1A11_100_n10_fw_d0_p+	10	10	weak	none	prepared	0					
		1A11_110_n10_fm_d0_p+	11	10	medium	none	prepared	0					
		1A11_120_n10_fs_d0_p+	12	10	strong	none	prepared	0					
		1A11_130_n10_fw_d1_p-	1	10	weak	elbow	unprepared	10--50					
		1A11_140_n10_fm_d1_p-	2	10	medium	elbow	unprepared	10--50					
		1A11_150_n10_fs_d1_p-	3	10	strong	elbow	unprepared	10--50					
									permute				
		1A11_160_n10_fw_d1_p+	4	10	weak	elbow	prepared	0					
		1A11_170_n10_fm_d1_p+	5	10	medium	elbow	prepared	0					
	1A11	1A11_180_n10_fs_d1_p+	6	10	strong	elbow	prepared	0					
									permute				
		1A11_190_n10_fw_d0_p-	7	10	weak	none	unprepared	10--50					
		1A11_200_n10_fm_d0_p-	8	10	medium	none	unprepared	10--50					
		1A11_210_n10_fs_d0_p-	9	10	strong	none	unprepared	10--50					
									permute				
		1A11_220_n10_fw_d0_p+	10	10	weak	none	prepared	0					
		1A11_230_n10_fm_d0_p+	11	10	medium	none	prepared	0					
		1A11_240_n10_fs_d0_p+	12	10	strong	none	prepared	0					
		1A11_250_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50				pressure not recorded	
		1A11_260_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50				pressure not recorded	
		1A11_251_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		1A11_261_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		1A11_270_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		1A11_280_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		1A11_290_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
	1A11	1A11_300_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
									permute				
		1A11_310_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		1A11_320_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		1A11_330_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		1A11_340_n20_fw_d0_p+	10	20	weak	none	prepared	0					
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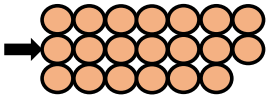
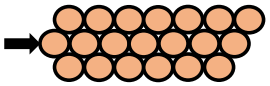
		1A11_360_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		1B33_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		1B33_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					



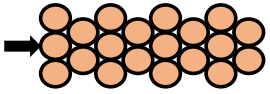
1B33

1B33_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50	
							permute
1B33_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0	
1B33_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0	
1B33_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0	
							permute
1B33_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50	
1B33_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50	
1B33_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50	
							permute
1B33_100_n20_fw_d0_p+	10	20	weak	none	prepared	0	
1B33_110_n20_fm_d0_p+	11	20	medium	none	prepared	0	
1B33_120_n20_fs_d0_p+	12	20	strong	none	prepared	0	



1C33

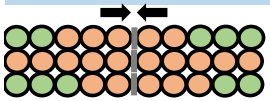
1C33_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50	
1C33_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50	
1C33_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50	
							permute
1C33_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0	
1C33_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0	
1C33_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0	
							permute
1C33_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50	
1C33_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50	
1C33_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50	
							permute
1C33_100_n20_fw_d0_p+	10	20	weak	none	prepared	0	
1C33_110_n20_fm_d0_p+	11	20	medium	none	prepared	0	
1C33_120_n20_fs_d0_p+	12	20	strong	none	prepared	0	



1D32

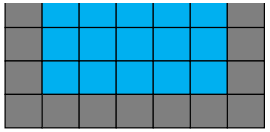
1D32_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50	
1D32_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50	
1D32_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50	
							permute
1D32_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0	
1D32_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0	
1D32_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0	
							permute
1D32_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50	
1D32_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50	
1D32_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50	
							permute
1D32_100_n20_fw_d0_p+	10	20	weak	none	prepared	0	
1D32_110_n20_fm_d0_p+	11	20	medium	none	prepared	0	
1D32_120_n20_fs_d0_p+	12	20	strong	none	prepared	0	

Break

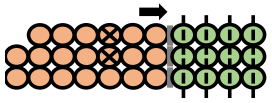


1E

						Instruction			step out
			Rows pushing	central	second	thrid	fourth	fifth (outer)	
1E_010_n30_a1_fs_fs	1	30	1	strong	strong	strong	strong	strong	
1E_020_n30_a3_fs_fs	2	30	3	strong	strong	strong	strong	strong	
1E_030_n30_a1_pa_fs	3	30	1	passive	passive	strong	strong	strong	
1E_040_n30_a3_pa_fs	4	30	3	passive	passive	strong	strong	strong	
1E_050_n30_a1_re_fs	5	30	1	resistant	resistant	strong	strong	strong	
1E_060_n30_a3_re_fs	6	30	3	resistant	resistant	strong	strong	strong	



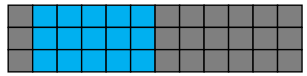
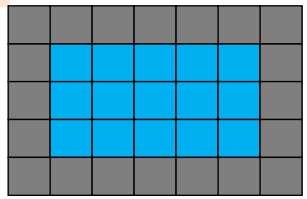
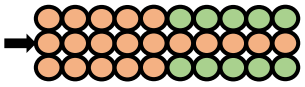
x

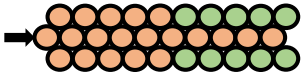
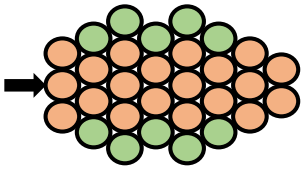
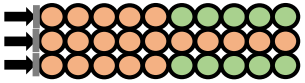


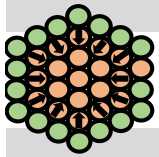
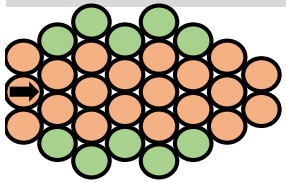
1F

1F_010_n30_a3_fs_fs_0l_0r	1	30	3	strong	strong	strong	strong	strong		keinen großen Ausfallschritt
1F_020_n30_a3_fs_fs_2l_0r	2	30	3	strong	strong	strong	strong	strong	2l	
1F_030_n30_a3_fs_fs_2l_2r	3	30	3	strong	strong	strong	strong	strong	2l, 2r	
1F_040_n30_a2_fs_fs_2l_2r	4	30	2	strong	strong	strong	strong	strong	2l, 2r	
1F_050_n30_a2_fs_fs_4l_3r	5	30	2	strong	strong	strong	strong	strong	4l, 3r	
1F_060_n30_h3_fs	6	30	semicircle	strong	strong	strong	strong	strong		
1F_061_n30_h3_fs	7	30	semicircle	strong	strong	strong	strong	strong		
1F_062_n30_h3_fs	8	30	semicircle	strong	strong	strong	strong	strong		

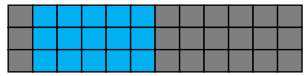
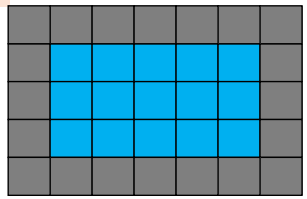
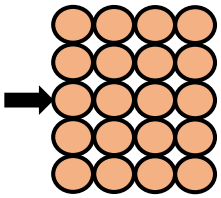
Wednesday morning

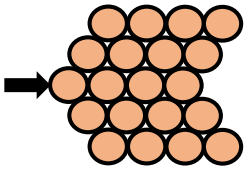
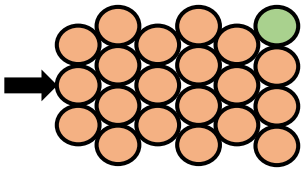
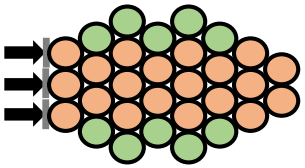
SetUp	Form	File name	Run number	Number of persons	Impulse	Distance	Preparation	time until push [s]				notes	Layout of Judomats
		2A11_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		2A11_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		2A11_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		2A11_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		2A11_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
		2A11_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
	2A11								permute				
		2A11_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		2A11_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		2A11_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		2A11_100_n20_fw_d0_p+	10	20	weak	none	prepared	0				pressure not recorded	
		2A11_101_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		2A11_110_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		2A11_120_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		2A11_130_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		2A11_140_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		2A11_150_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		2A11_160_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		2A11_170_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
		2A11_180_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
	2A11								permute				
		2A11_190_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		2A11_200_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		2A11_210_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		2A11_220_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		2A11_230_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		2A11_240_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		2B33_010_n29_fw_d1_p-	1	29	weak	elbow	unprepared	10--50					
		2B33_020_n29_fm_d1_p-	2	29	medium	elbow	unprepared	10--50					
		2B33_030_n29_fs_d1_p-	3	29	strong	elbow	unprepared	10--50					
									permute				
		2B33_040_n29_fw_d1_p+	4	29	weak	elbow	prepared	0					
		2B33_050_n29_fm_d1_p+	5	29	medium	elbow	prepared	0					
		2B33_060_n29_fs_d1_p+	6	29	strong	elbow	prepared	0					
	2B33								permute				
		2B33_070_n29_fw_d0_p-	7	29	weak	none	unprepared	10--50					
		2B33_080_n29_fm_d0_p-	8	29	medium	none	unprepared	10--50					
		2B33_090_n29_fs_d0_p-	9	29	strong	none	unprepared	10--50					
									permute				
		2B33_100_n29_fw_d0_p+	10	29	weak	none	prepared	0					

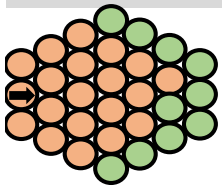
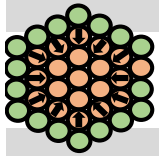
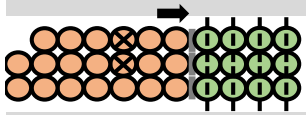
	2B33_110_n29_fm_d0_p+	11	29	medium	none	prepared	0		
	2B33_120_n29_fs_d0_p+	12	29	strong	none	prepared	0		
	2C33_010_n29_fw_d1_p-	1	29	weak	elbow	unprepared	10--50		
	2C33_020_n29_fm_d1_p-	2	29	medium	elbow	unprepared	10--50		
	2C33_030_n29_fs_d1_p-	3	29	strong	elbow	unprepared	10--50		
								permute	
	2C33_040_n29_fw_d1_p+	4	29	weak	elbow	prepared	0		
	2C33_050_n29_fm_d1_p+	5	29	medium	elbow	prepared	0		
 2C33	2C33_060_n29_fs_d1_p+	6	29	strong	elbow	prepared	0		
								permute	
	2C33_070_n29_fw_d0_p-	7	29	weak	none	unprepared	10--50		
	2C33_080_n29_fm_d0_p-	8	29	medium	none	unprepared	10--50		
	2C33_090_n29_fs_d0_p-	9	29	strong	none	unprepared	10--50		
								permute	
	2C33_100_n29_fw_d0_p+	10	29	weak	none	prepared	0		
	2C33_110_n29_fm_d0_p+	11	29	medium	none	prepared	0		
	2C33_120_n29_fs_d0_p+	12	29	strong	none	prepared	0		
	2D32_010_n29_fw_d1_p-	1	29	weak	elbow	unprepared	10--50		
	2D32_020_n29_fm_d1_p-	2	29	medium	elbow	unprepared	10--50		
	2D32_030_n29_fs_d1_p-	3	29	strong	elbow	unprepared	10--50		
								permute	
	2D32_040_n29_fw_d1_p+	4	29	weak	elbow	prepared	0		
	2D32_050_n29_fm_d1_p+	5	29	medium	elbow	prepared	0		
 2D32	2D32_060_n29_fs_d1_p+	6	29	strong	elbow	prepared	0		
								permute	
	2D32_070_n29_fw_d0_p-	7	29	weak	none	unprepared	10--50		pressure not recorded
	2D32_071_n29_fw_d0_p-	7	29	weak	none	unprepared	10--50		
	2D32_080_n29_fm_d0_p-	8	29	medium	none	unprepared	10--50		
	2D32_090_n29_fs_d0_p-	9	29	strong	none	unprepared	10--50		
								permute	
	2D32_100_n29_fw_d0_p+	10	29	weak	none	prepared	0		
	2D32_110_n29_fm_d0_p+	11	29	medium	none	prepared	0		
	2D32_120_n29_fs_d0_p+	12	29	strong	none	prepared	0		
Break									
	2G33_010_n26_fw_d1_p-	1	26	weak	elbow	unprepared	10--50		
	2G33_020_n26_fs_d1_p-	2	26	strong	elbow	unprepared	10--50		
								permute	
	2G33_030_n24_fw_d1_p+	3	24	weak	elbow	prepared	0		
 2G33	2G33_040_n24_fs_d1_p+	4	24	strong	elbow	prepared	0		
								permute	
	2G33_050_n24_fw_d0_p-	5	24	weak	none	unprepared	10--50		
	2G33_060_n24_fs_d0_p-	6	24	strong	none	unprepared	10--50		
								permute	

		2G33_070_n24_fw_d0_p+	7	24	weak	none	prepared	0
		2G33_080_n24_fs_d0_p+	8	24	strong	none	prepared	0
	2H	2H_010_n29_a1_fs	1	29	outer circle	strong		
		2H_020_n29_a3_fs	2	29	all	strong		
		2H_011_n29_a1_fs	3	29	outer circle	strong		
		2H_021_n29_a3_fs	4	29	all	strong		
	2I	2I_010_n29_gf_d1_pf	1	29	female	elbow	front	
		2I_020_n29_gf_d1_pb	2	29	female	elbow	back	
		2I_030_n29_gf_d1_pl	3	29	female	elbow	left	
		2I_040_n29_gf_d1_pr	4	29	female	elbow	right	
		2I_050_n29_gm_d0_pf	5	29	male	none	front	
		2I_060_n29_gm_d0_pb	6	29	male	none	back	
		2I_070_n29_gm_d0_pr	7	29	male	none	right	
		2I_080_n29_gm_d0_pl	8	29	male	none	left	

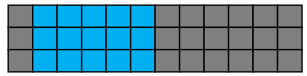
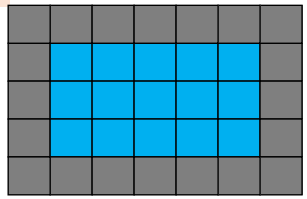
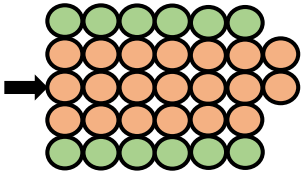
Wednesday afternoon

SetUp	Form	File name	Run number	Number of persons	Impulse	Distance	Preparation	time until push [s]				notes	Layout of Judomats
		3A11_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		3A11_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		3A11_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		3A11_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		3A11_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
		3A11_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
	3A11								permute				
		3A11_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50				pressure not recorded	
		3A11_071_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		3A11_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		3A11_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		3A11_100_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		3A11_110_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		3A11_120_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		3A11_130_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		3A11_140_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		3A11_150_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		3A11_160_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		3A11_170_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
		3A11_180_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
	3A11								permute				
		3A11_190_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		3A11_200_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		3A11_210_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		3A11_220_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		3A11_230_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		3A11_240_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		3B55_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		3B55_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		3B55_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		3B55_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		3B55_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
		3B55_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
	3B55								permute				
		3B55_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		3B55_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		3B55_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		3B55_100_n20_fw_d0_p+	10	20	weak	none	prepared	0					

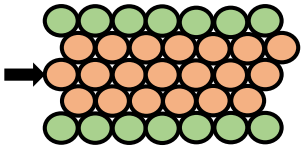
		3B55_110_n20_fm_d0_p+	11	20	medium	none	prepared	0	
		3B55_120_n20_fs_d0_p+	12	20	strong	none	prepared	0	
		3C55_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50	
		3C55_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50	
		3C55_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50	
								permute	
		3C55_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0	
		3C55_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0	
		3C55_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0	
	3C55							permute	
		3C55_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50	
		3C55_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50	
		3C55_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50	
								permute	
		3C55_100_n20_fw_d0_p+	10	20	weak	none	prepared	0	
		3C55_110_n20_fm_d0_p+	11	20	medium	none	prepared	0	
		3C55_120_n20_fs_d0_p+	12	20	strong	none	prepared	0	
		3D34_010_n21_fw_d1_p-	1	21	weak	elbow	unprepared	10--50	Olga fills up left position in last row
		3D34_020_n21_fm_d1_p-	2	21	medium	elbow	unprepared	10--50	
		3D34_030_n21_fs_d1_p-	3	21	strong	elbow	unprepared	10--50	
								permute	
		3D34_040_n21_fw_d1_p+	4	21	weak	elbow	prepared	0	
		3D34_050_n21_fm_d1_p+	5	21	medium	elbow	prepared	0	
		3D34_060_n21_fs_d1_p+	6	21	strong	elbow	prepared	0	
	3D34							permute	
		3D34_070_n21_fw_d0_p-	7	21	weak	none	unprepared	10--50	
		3D34_080_n21_fm_d0_p-	8	21	medium	none	unprepared	10--50	
		3D34_090_n21_fs_d0_p-	9	21	strong	none	unprepared	10--50	
								permute	
		3D34_100_n21_fw_d0_p+	10	21	weak	none	prepared	0	
		3D34_110_n21_fm_d0_p+	11	21	medium	none	prepared	0	
		3D34_120_n21_fs_d0_p+	12	21	strong	none	prepared	0	
Break									
		3G34_010_n31_fw_d1_p-	1	31	weak	elbow	unprepared	10--50	
		3G34_020_n31_fs_d1_p-	3	31	strong	elbow	unprepared	10--50	
								permute	
		3G34_030_n31_fw_d1_p+	4	31	weak	elbow	prepared	0	
		3G34_040_n31_fs_d1_p+	6	31	strong	elbow	prepared	0	
	3G34							permute	
		3G34_050_n31_fw_d0_p-	7	31	weak	none	unprepared	10--50	
		3G34_060_n31_fs_d0_p-	9	31	strong	none	unprepared	10--50	
								permute	
		3G34_070_n31_fw_d0_p+	10	31	weak	none	prepared	0	

		3G34_080_n31_fs_d0_p+	12	31	strong	none	prepared	0				
	3I	3I_010_n33_gm_d1_pb	1	33	male	elbow	back					
		3I_020_n33_gm_d1_pf	2	33	male	elbow	front					
		3I_030_n33_gm_d1_pr	3	33	male	elbow	right					
		3I_040_n33_gm_d1_pl	4	33	male	elbow	left					
		3I_050_n33_gf_d0_pb	5	33	female	none	back					
		3I_060_n33_gf_d0_pf	6	33	female	none	front					
		3I_070_n33_gf_d0_pr	7	33	female	none	right					
		3I_080_n33_gf_d0_pl	8	33	female	none	left					
	3H	3H_010_n33_a1_fs	1	33	outer circle	strong						
		3H_020_n33_a3_fs	2	33	all	strong						X-11 is lifted up
		3H_011_n33_a1_fs	3	33	outer circle	strong						
		3H_021_n33_a3_fs	4	33	all	strong						
	3F	3F_010_n33_a3_fs_0l_0r	1	33	3	strong	strong	strong	strong	strong		keinen gr Ausfallschritt, mittlere Reihe nach vorne anderen unterstützen
		3F_020_n33_a1_fs_0l_0r	2	33	1	strong	strong	strong	strong	strong		
		3F_030_n33_a3_fs_2l_2r	3	33	3	strong	strong	strong	strong	strong	2l, 2r	
		3F_021_n33_a1_fs_0l_0r	4	33	1	strong	strong	strong	strong	strong		

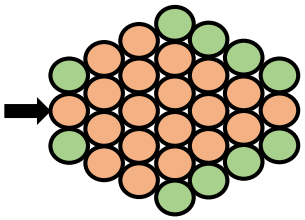
Thursday afternoon

SetUp	Form	File name	Run number	Number of persons	Impulse	Distance	Preparation	time until push [s]				notes	Layout of Judomats
		4A11_010_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		4A11_020_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		4A11_030_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		4A11_040_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		4A11_050_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
	4A11	4A11_060_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
									permute				
		4A11_070_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		4A11_080_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		4A11_090_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		4A11_100_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		4A11_110_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		4A11_120_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		4A11_130_n20_fw_d1_p-	1	20	weak	elbow	unprepared	10--50					
		4A11_140_n20_fm_d1_p-	2	20	medium	elbow	unprepared	10--50					
		4A11_150_n20_fs_d1_p-	3	20	strong	elbow	unprepared	10--50					
									permute				
		4A11_160_n20_fw_d1_p+	4	20	weak	elbow	prepared	0					
		4A11_170_n20_fm_d1_p+	5	20	medium	elbow	prepared	0					
	4A11	4A11_180_n20_fs_d1_p+	6	20	strong	elbow	prepared	0					
									permute				
		4A11_190_n20_fw_d0_p-	7	20	weak	none	unprepared	10--50					
		4A11_200_n20_fm_d0_p-	8	20	medium	none	unprepared	10--50					
		4A11_210_n20_fs_d0_p-	9	20	strong	none	unprepared	10--50					
									permute				
		4A11_220_n20_fw_d0_p+	10	20	weak	none	prepared	0					
		4A11_230_n20_fm_d0_p+	11	20	medium	none	prepared	0					
		4A11_240_n20_fs_d0_p+	12	20	strong	none	prepared	0					
		4B55_010_n36_fw_d1_p-	1	35	weak	elbow	unprepared	10--50					
		4B55_020_n36_fm_d1_p-	2	35	medium	elbow	unprepared	10--50					
		4B55_030_n36_fs_d1_p-	3	35	strong	elbow	unprepared	10--50					
									permute				
		4B55_040_n36_fw_d1_p+	4	36	weak	elbow	prepared	0					
		4B55_050_n36_fm_d1_p+	5	36	medium	elbow	prepared	0					
	4B55	4B55_060_n36_fs_d1_p+	6	36	strong	elbow	prepared	0					
									permute				
		4B55_070_n36_fw_d0_p-	7	36	weak	none	unprepared	10--50					
		4B55_080_n36_fm_d0_p-	8	36	medium	none	unprepared	10--50					
		4B55_090_n36_fs_d0_p-	9	36	strong	none	unprepared	10--50					
									permute				
		4B55_100_n36_fw_d0_p+	10	36	weak	none	prepared	0					
		4B55_110_n36_fm_d0_p+	11	36	medium	none	prepared	0					

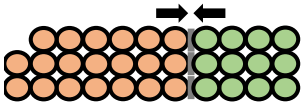
	4B55_120_n36_fs_d0_p+	12	36	strong	none	prepared	0				
	4C55_010_n36_fw_d1_p-	1	35	weak	elbow	unprepared	10--50				
	4C55_020_n36_fm_d1_p-	2	35	medium	elbow	unprepared	10--50				
	4C55_030_n36_fs_d1_p-	3	35	strong	elbow	unprepared	10--50				
								permute			
	4C55_040_n36_fw_d1_p+	4	36	weak	elbow	prepared	0				
	4C55_050_n36_fm_d1_p+	5	36	medium	elbow	prepared	0				
	4C55_060_n36_fs_d1_p+	6	36	strong	elbow	prepared	0				
								permute			
	4C55_070_n36_fw_d0_p-	7	36	weak	none	unprepared	10--50				
	4C55_080_n36_fm_d0_p-	8	36	medium	none	unprepared	10--50				
	4C55_090_n36_fs_d0_p-	9	36	strong	none	unprepared	10--50				
								permute			
	4C55_100_n36_fw_d0_p+	10	36	weak	none	prepared	0				
	4C55_110_n36_fm_d0_p+	11	36	medium	none	prepared	0				
	4C55_120_n36_fs_d0_p+	12	36	strong	none	prepared	0				
	4D--_010_n36_fw_d1_p-	1	30	weak	elbow	unprepared	10--50				
	4D--_020_n36_fm_d1_p-	2	30	medium	elbow	unprepared	10--50				
	4D--_030_n36_fs_d1_p-	3	30	strong	elbow	unprepared	10--50				
								permute			
	4D--_040_n36_fw_d1_p+	4	31	weak	elbow	prepared	0				
	4D--_050_n36_fm_d1_p+	5	31	medium	elbow	prepared	0				
	4D--_060_n36_fs_d1_p+	6	31	strong	elbow	prepared	0				
								permute			
	4D--_070_n36_fw_d0_p-	7	33	weak	none	unprepared	10--50				
	4D--_080_n36_fm_d0_p-	8	33	medium	none	unprepared	10--50				
	4D--_090_n36_fs_d0_p-	9	33	strong	none	unprepared	10--50				
								permute			
	4D--_100_n36_fw_d0_p+	10	33	weak	none	prepared	0				
	4D--_110_n36_fm_d0_p+	11	33	medium	none	prepared	0				
	4D--_120_n36_fs_d0_p+	12	33	strong	none	prepared	0				
Break											
			Number of persons	Rows pushing	Instruction central	second	thrid	fourth	fifth (outer)	step out	
	4E_010_n36_a1_fs_fs	1	36	1	strong	strong	strong	strong	strong		
	4E_011_n36_a1_fs_fs	2	36	1	strong	strong	strong	strong	strong		Ansage: an der Seite stabil stehen
	4E_020_n36_a3_fs_fs	3	36	3	strong	strong	strong	strong	strong		mittlere Reihe umgestellt
	4E_021_n36_a3_fs_fs	4	36	3	strong	strong	strong	strong	strong		
	4E_030_n36_a1_pa_fs	5	36	1	passive	passive	strong	strong	strong		
	4E_031_n36_a1_pa_fs	6	36	1	passive	passive	strong	strong	strong		
	4E_040_n36_a3_pa_fs	7	36	3	passive	passive	strong	strong	strong		
	4E_041_n36_a3_pa_fs	8	36	3	passive	passive	strong	strong	strong		
	4E_050_n36_a1_re_fs	9	36	1	resistant	resistant	strong	strong	strong		
	4E_051_n36_a1_re_fs	10	36	1	resistant	resistant	strong	strong	strong		
	4E_060_n36_a3_re_fs	11	36	3	resistant	resistant	strong	strong	strong		viele Leute hingefallen



4C55

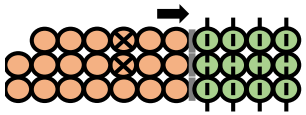


4D--

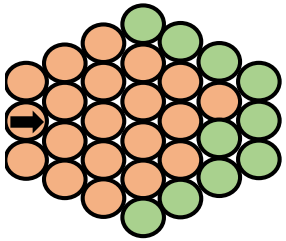


4E

	4E_061_n36_a3_re_fs	12	36	3	resistant	resistant	strong	strong	strong		
	4F_010_n36_a3_fs_fs_2l_0m	1	36	3	strong	strong	strong	strong	strong	2l	keinen großen Ausfallschritt
	4F_020_n36_a3_fs_fs_3r_0m	2	36	3	strong	strong	strong	strong	strong	3r	
	4F_030_n36_a3_pa_fs_3l_0m	3	36	3	passive	passive	strong	strong	strong	3l	
	4F_040_n36_a3_pa_fs_4r_0m	4	36	3	passive	passive	strong	strong	strong	4r	
	4F_050_n36_a3_re_fs_4l_0m	5	36	3	resistant	resistant	strong	strong	strong	4l	
	4F_060_n36_a3_re_fs_3r_0m	6	36	3	resistant	resistant	strong	strong	strong	3r	
	4F_070_n36_a3_fs_fs_2l_2m	7	36	3	strong	strong	strong	strong	strong	2l, 2m	
	4F_080_n36_a3_fs_fs_3r_3m	8	36	3	strong	strong	strong	strong	strong	3r, 3m	Mittlere Person ist nicht raus gekommen
	4F_090_n36_a3_pa_fs_3l_3m	9	36	3	passive	passive	strong	strong	strong	3l, 3m	
	4F_100_n36_a3_pa_fs_4r_4m	10	36	3	passive	passive	strong	strong	strong	4r, 4m	3r ist mit raus
	4F_110_n36_a3_re_fs_3l_3m	11	36	3	resistant	resistant	strong	strong	strong	3l, 3m	
	4F_120_n36_a3_re_fs_4r_4m	12	36	3	resistant	resistant	strong	strong	strong	4r, 4m	
	4F_130_n36_h3_fs	13	36	semicircle	strong	strong	strong	strong	strong		
	4F_131_n36_h3_fs	14	36	semicircle	strong	strong	strong	strong	strong		
	4I_010_n35_gm_d1_pb	1	35	male	elbow	back					
	4I_020_n35_gm_d1_pf	2	35	male	elbow	front					
	4I_030_n35_gm_d1_pr	3	35	male	elbow	right					
	4I_040_n35_gm_d1_pl	4	35	male	elbow	left					
	4I_050_n35_gf_d1_pf	5	35	female	elbow	front					
	4I_060_n35_gf_d1_pb	6	35	female	elbow	back					
	4I_070_n35_gf_d1_pl	7	35	female	elbow	left					
	4I_080_n35_gf_d1_pr	8	35	female	elbow	right					
	4I_090_n35_gm_d0_pb	9	35	male	none	back					
	4I_100_n35_gm_d0_pf	10	35	male	none	front					
	4I_110_n35_gm_d0_pl	11	35	male	none	left					
	4I_120_n35_gm_d0_pr	12	35	male	none	right					
	4I_130_n35_gf_d0_pb	13	35	female	none	back					
	4I_140_n35_gf_d0_pf	14	35	female	none	front					
	4I_150_n35_gf_d0_pr	15	35	female	none	right					
	4I_160_n35_gf_d0_pl	16	35	female	none	left					



4F



4I