AARHUS BSS

COGNITION AND BEHAVIOR LAB
AARHUS UNIVERSITY

AACSB ACCREDITED

ASSOCIATION AMBA ACCREDITED

EFMD EQUIS ACCREDITED

COGNITION AND BEHAVIOR LAB
State-of-the-art facilities for research

Contents

Interdisciplinary infrastructure for social science research

Per Baltzer Overgaard
Vice-Dean for Research and Talent

It is tremendous to watch how Cognition and Behavior Lab continue to provide researchers at Aarhus BSS and Aarhus University, in general, with state-of-the-art facilities for conducting modern experimental behavioural research. Controlled laboratory experiments are now an established and essential research tool in many branches of social science, and several research groups at Aarhus BSS were conducting such research prior to establishing the lab in 2013.

To an economist like myself, it was clearly sub-optimal to set up half a dozen smaller labs at Aarhus BSS, each one serving only one or two research groups. Aarhus BSS therefore decided to support the broad researcher driven initiative for a common lab infrastructure. The initiative was backed by research groups from several departments at Aarhus BSS, and also by researchers from the Faculty of Arts and from the Centre for Integrative Neuroscience (CFIN). CFIN is established as an excellent facility for neuroscience research and researchers there increasingly use behavioural studies as a complement to brain scanning studies. Having access to both a cutting-edge neuroscience research facility and a behavioural research lab enables Aarhus BSS to attract and retain top researchers applying these methods within a wide range of academic disciplines, and indeed across disciplines, in line with Aarhus University's general strategic emphasis on interdisciplinary research.

The seamless interaction of researchers across academic fields is a significant benefit of a shared research facility, as witnessed by the attendance to courses, workshops and meetings held at the lab. Lastly, I appreciate interacting with the scientific advisory board of the lab, which is made up of highly innovative and first-class researchers from several fields.

Controlled laboratory **experiments are now an established and essential tool** in many branches of social science

Nine benefits of doing research in COBE Lab

1 **FREE ACCESS TO LABS, EQUIPMENT AND SOFTWARE**

You have free access to our state-of-the-art facilities including two fully equipped computer interaction labs, seven lab rooms, equipment for eye tracking, virtual reality, psychophysiology and EEG.

2 **ETHICS EVALUATION OF YOUR RESEARCH PROJECT**

Research with human participants requires that you think carefully and critically about ethical matters. Your project proposal is evaluated by our Human Subjects Committee and they support you with advice on research ethics.

3 **HELPFUL PROCEDURES FOR YOUR EXPERIMENT**

There are a lot of practical issues to think of when running experiments. We have streamlined research procedures which help you through all stages of your research project from the early planning of your experiment to recruiting and paying participants.

4 **EASY RECRUITMENT OF PARTICIPANTS FOR YOUR STUDY**

You have the option to recruit participants through our participant pool. It is easy, convenient and our system manages both timeslots, prerequisites and restrictions based on prescreen responses.

5 **PARTICIPATE IN OUR WORKSHOPS AND COURSES**

Participate in our workshops and courses, which we continuously offer. We host workshops on use of equipment and software but also about other relevant topics such as data protection in research.

6 **PART OF A COMMUNITY OF RESEARCHERS**

You are part of an interdisciplinary network as associated researcher of COBE Lab. You get in touch with other researchers using the same research methods, equipment or software who are able to help you with potential struggles and new ideas.

7 **POOL OF RESEARCH ASSISTANTS**

An experienced research assistant is a great help when you need to manage and run your sessions in COBE Lab. We have a pool of assistants you are free to recruit. They are familiar with COBE Lab procedures and policies.

8 **DISSEMINATE YOUR RESEARCH TO THE PUBLIC**

We continuously arrange and engage in research events to showcase experiments in social science and demonstrate how we use technologies in research at Aarhus University. You are always welcome to join us and support public engagement in science.

9 **TEACH YOUR STUDENTS IN COBE LAB**

Would you like your students to learn about experiments and technologies in social science? You are always welcome to bring your students to COBE Lab, arrange a workshop and demonstrate equipment. We help you out with the practical details.
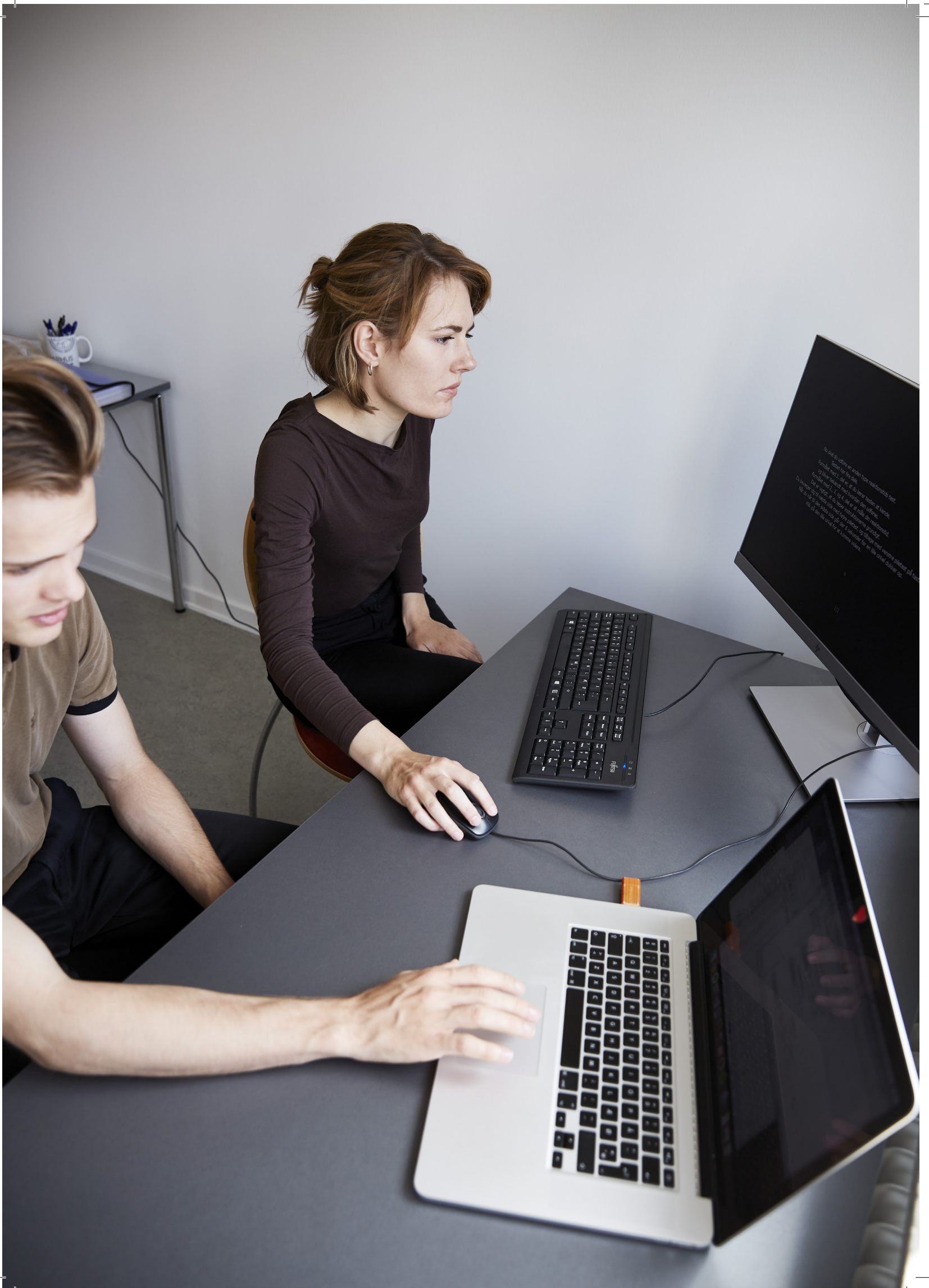
Spread over two floors —
spanning all departments

Cognition and Behavior Lab is located at Campus Fuglesangs Allé with more than 250 m² laboratory facilities situated on two floors. Here you are able to conduct your studies with research participants in a controlled environment. The facilities are open to all departments at Aarhus University for research studying social science and behaviour.

Floor 1

Meeting room   Kitchen   Lab 2F   Toilets   Entrance   Research Assistant Office

Waiting area

Storage room

Lab Manager Office   Lab Manager Office   Lab 2E   Lab 2D   Lab 2C   Lab 2B   Lab 2A

Floor 0

Lab 1A   Control room   Waiting area   Toilets   Entrance hall

Lab 1B   Lab 1F   Kitchen

Find us on Campus Fuglesangs Allé
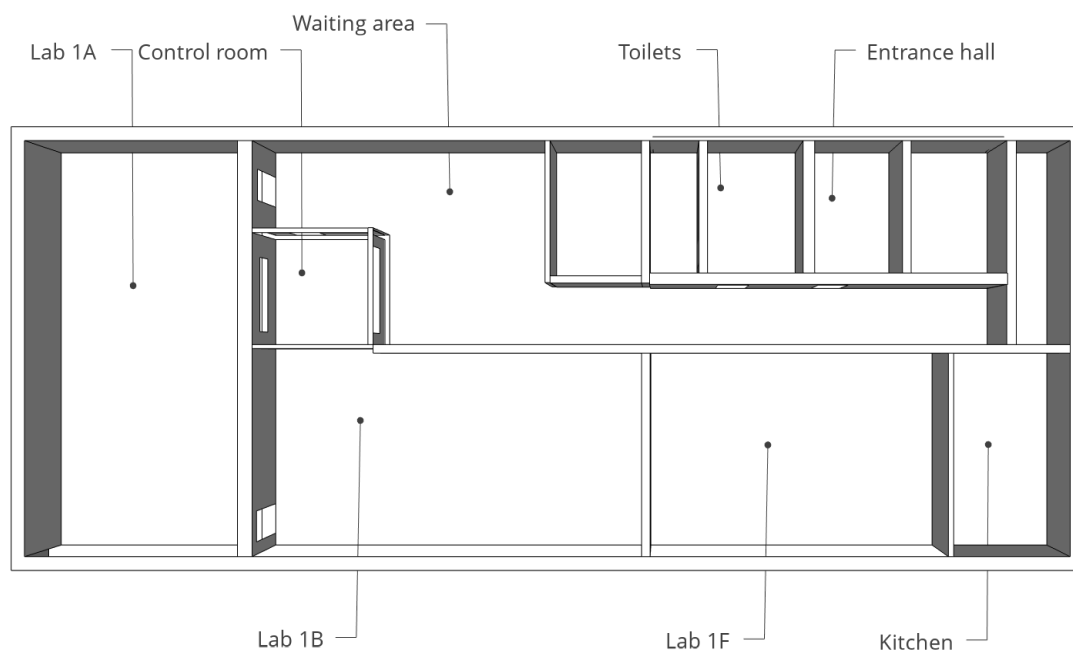
COBE Lab
Building 2635
Fuglesangs Allé 20
8210 Aarhus V.

Computer interaction labs

Large computer interaction labs
COBE Lab has two computer interaction labs and a control room situated between the two lab rooms. Each lab features 16 desktop computers. This arrangement allows you to conduct experiments with up to 32 participants at a time.

Control room
In the control room you have a view to the two labs. From the two admin computers you have full control over the 32 lab computers and are able to power on, power off, remote view, remote control, open websites and run programs on all or a selected group of computers.

Web-based studies
The computer interaction labs are suitable for web-based studies with many particpants at a time and for studies in which you need to connect participants in pairs or groups to solve a task together.

Small lab rooms

Six small neutral labs
Labs 2A–2F are small lab rooms suitable for experiments with 1–2 participants at a time. They all feature black-out curtains and soundproof doors.

Eyetracking labs
Lab 2A and 2B are primarily reserved for eyetracking experiments and feature the EyeLink 1000 and Tobii T60 XL. Lab 2C and 2D are suited for simple computer-based studies.

EEG lab
Lab 2E is designed to alleviate electromagnetic interference by routing wiring away from the room and employing 12 V DC lighting.

Virtual reality lab
Lab 2F is a flexible room suitable for virtual reality set-ups. Base stations are placed in each corner of the room which allows for a quick set up of virtual reality experiments.
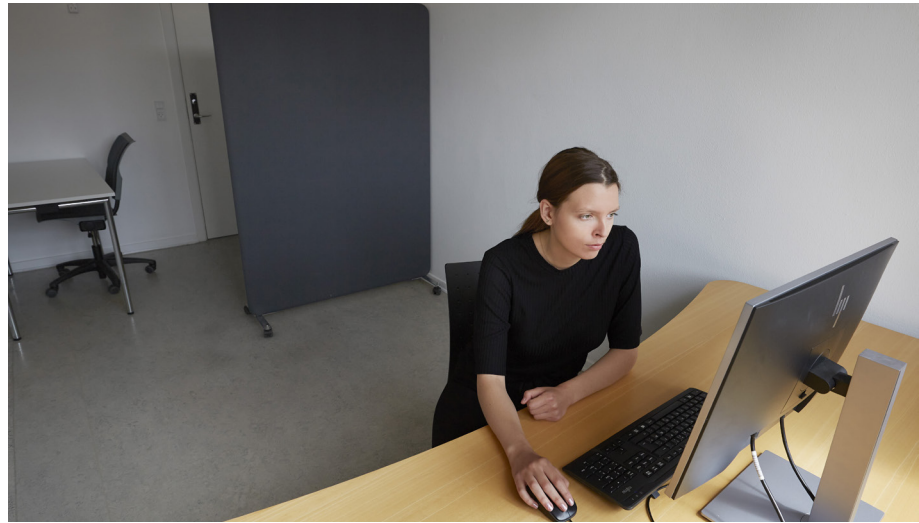
Flexible labs and other rooms

Two flexible labs
Lab 1F is a larger, flexible room which can be rearranged as needed. It is suitable for small workshops, virtual reality set-ups and teaching in smaller groups.

The room features chairs, folding tables, a movable 75" monitor and a projector.

Lab 2F is another smaller flexible room. It is a bit larger than labs 2A–2E and is also flexible for experiments that need more space.

Meeting room
The meeting room may be booked for meetings or experiments, if you coordinate this with lab management.

The room is suitable for smaller groups with up to 5–6 people.

Lab kitchen
A kitchen with a fridge is available for experiments that involve foodstuff. Here, it is possible to prepare and store food samples.

Technologies and equipment

Eye-tracking

Eye-tracking equipment allows you to measure eye movements and fixations. With our screen-based eye-tracking equipment, you are able to collect data in controlled lab environments and gain an understanding of the participants' visual attention.

> One EyeLink 1000 eye-tracker with remote option
> One Tobii T60 XL eye-tracker
> One Pupil Labs HTC Vive bionocular add-on (for VR)
> Five Smart Eye Aurora eyetracking bars

EEG

Electroencephalography is the neurophysiological measurement of electrical activity in the brain as recorded by electrodes placed on the scalp. The resulting traces are known as an electroencephalogram (EEG) and represent a summation of post-synaptic potentials from a large number of neurons.

Two Brain Products ActiCap Xpress Bundles each containing:
> A 16 channel V-Amp amplifier
> Two caps (L/XL)
> 16 signal plus 1 reference and 1 ground electrodes
> 38 QuickBits in different lengths and accessories
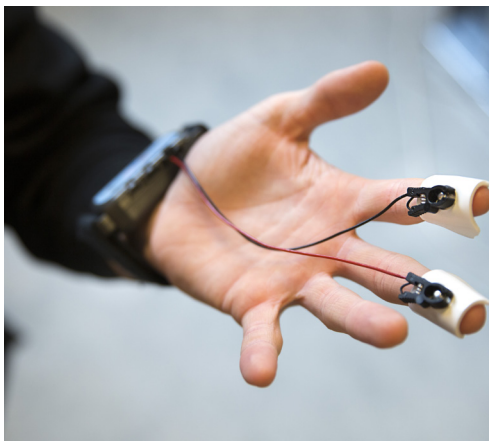
Psychophysiology

Psychophysiological measures are used to assess the connection between psychological and physical states. The lab has equipment that allows you to measure some of the common psychophysiological signals, such as electrodermal activity (EDA), electrocardiography (ECG), respiration and electromyography (EMG).

> Two BIOPAC MP150 systems
> PPGED, RSPEC, EMG100C, ECG100C, GSR-100C, STP100C modules

Virtual reality

Our virtual reality equipment uses room scale tracking technology to track the participants' movement in 3D space. Handheld motion-tracked controllers are used to interact with the environment.

> Two HTC Vive head-sets with accessories
> Two VR suitable computers
> One VR eye tracking add-on

Computers, monitors & audiovisual

We have a number of spare desktop computers, laptops and iPads available to equip the lab rooms with what you need.

A range of audiovisual equipment such as cameras, microphones and head-sets are available if you need to record video or audio in your experiment.

Software and licenses

Several software options are available for recording and analysing data:

> TOBII Studio (for use with Tobii T60 XL)
> BIOPAC Acknowledge 4 (for use with BIOPAC equipment)
> iMotions core module + screen-based eye tracking module (for use with eyetracking bars)
> OpenViBE (for use with EEG)
> Experiment Builder (for use with EyeLink 1000)

Helpful procedures
throughout your research project

This guide for research projects in COBE Lab is developed to help you and your research assistants. There are a lot of practical issues to think of when you run experiments. That is why we have streamlined procedures to help you through all the stages of your research project.

At any one time, your research project at COBE Lab will be categorised in one of three stages:

> Planning
> Active
> Completed

The planning stage
In this stage, the researcher is asked to submit documents that necessiate diligent planning of the study protocol. The research plans are reviewed by our Human Subjects Committee together with lab management to ensure that COBE Lab's ethical policy is followed.

The active stage
When the research plans are reviewed and approved by the Human Subjects Committee, the research project moves to the active stage. In this stage, data collection is ongoing. This involves booking labs and equipment, recruiting and reimbursing participants.

The completed stage
After data collection is finished, the research project is complete. This means that all data must be anonymised and payment receipts must be destroyed. Remember also to notify lab management and return all keys and equipment to COBE Lab.

For more information, go to
cobelab.au.dk/forms

Planning	Active	Completed
1 Introduction and tour of the lab	**1** Pick up keys, equipment and recruitment material	**1** Anonymise data and remove files from lab computers
2 Submit pre-study form	**2** Run a pilot study and adjust changes	**2** Destroy payment information
3 Register project with jurists at AU if you collect personal data	**3** Book resources	**3** Tidy up lab room, turn back keys and equipment
4 Submit research ethics checklist and consent form	**4** Recruit participants	**4** Inform lab management of completion
5 Submit project account information form	**5** Pay participants continually	**5** Inform legal support of completion
6 Submit ethics certificates	**6** Store consent forms and payment information safely	**6** Store consent forms

Ethics in COBE Lab:
Protecting human participants

Research with human participants requires that you think carefully and critically about ethical matters. Ethical guidelines are necessary to ensure a respect for human dignity, scientific validity and the rights and interests of the research participants.

Research in COBE Lab is guided by the ethical principles regarding research involving human participants as set out in the Declaration of Helsinki and the Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research. Researchers will minimize harm and maximize benefits pertaining to their research by implementing ethical research procedures. The principles are:

1. Respect for the participant
2. Informed consent
3. Provide appropriate information
4. Privacy and data protection measures

HUMAN SUBJECT COMMITTEE
The purpose of Cognition and Behavior Lab's Human Subjects Committee is to ensure that the research that takes place in COBE Lab follows the Lab's ethics policy. This is to protect the participants as well as the Lab's reputation. The Human Subjects Committee will also comment on issues regarding data protection, and they can recommend or require that AU's Technology Transfer Office (TTO) is involved to ensure that personal data is properly handled.

RESEARCH ETHICS CHECKLIST
It is mandatory to submit a research ethics checklist for your project in COBE Lab. The checklist will undergo evaluation by three members of our Human Subjects Committee. They will help you with advice and guidance on research ethics issues in your project and hence grant you access to COBE Lab's facilities.

NO-DECEPTION POLICY
With regard to the COBE Lab subject pool, COBE Lab has an explicit no-deception policy, which means that deception may not be used in any studies for which participants will be recruited from the pool. Studies involving deception may however gain access to other COBE Lab resources such as computer rooms and equipment under certain conditions.

ETHICS CERTIFICATION
Ethics certification is mandatory for all researchers and research assistants involved in data collection. The ethics training will help you recognise ethical issues, resolve ethical dilemmas and in general promote ethical behaviour.

OTHER COMMITTEES
The Central Jutland Regional Committee governs Health Research Ethics. All health research projects must be submitted to this committtee.

Aarhus University's Research Ethics Committee is the institutional review board of AU. You need approval from this committee if it is necessary for you to have formal ethics approval and your project is not eligible to be reviewed by the regional or national committee under the rules of the Committee Act.

For more information, go to
cobelab.au.dk/ethics
staff.au.dk
en.nvk.dk

Recruiting participants
for your research

PARTICIPANT POOL
Our participant pool system allows COBE Lab researchers to attract and recruit participants and subsequently manage experimental sessions effectively.

You can set prerequisite characteristics (e.g. Danish language proficiency) and specify previous studies as qualifiers/disqualifiers for subsequent participation.

From a participant perspective, study information including description, duration, payment information and location are clearly displayed. There is also an app for smartphones/tablets, making it convenient to sign up for studies whilst away from a computer.

HELP RECRUIT PARTICIPANTS
The participant pool is a common good for all researchers at COBE Lab. When you spread the word about COBE Lab to students and other individuals, you help maintain an active and larger participant pool to recruit from.

We encourage all researchers to tell their students, friends and colleagues about the pool and by doing this help to recruit new participants for the pool.

PAYMENT FOR PARTICIPATION
Payment of participants is a requirement if using our participant pool. We advise payment of around 100 – 110 DKK per hour, which corresponds to a student wage.

IS THE POOL WEIRD?
Over 3000 individuals are registered in the participant pool. The majority of participants are Danish students in their early to mid 20's. Hence yes, the sample is Western, Educated, Industrialised, Rich and Democratic (WEIRD).

The main advantages of using our pool is the ease of access, low cost and that it is practical and convenient. The pool is certainly not completely homogenous and has variations in for example ethnical background, study direction and 38% of the pool are not students. Moreover, the participants are used to the university settings and following task instructions.

RECRUITING PARTICIPANTS THROUGH COBE LAB

3354 PARTICIPANTS
ARE ACTIVELY REGISTERED IN OUR POOL

77%
ARE DANISH

91%
SPEAK ENGLISH

72%
ARE AU STUDENTS

58%
ARE FEMALE

89%
ARE RIGHT HANDED

71%
ARE BETWEEN 18–24 YEARS

Source: Statistics from Sona participation system, 2020

Nine dos and don'ts when recruiting participants

DO KEEP IT SHORT, DESCRIPTIVE AND FUN

The study description in Sona is what motivates participants to sign up for your study. Relatively short headlines and descriptions are easier to grasp and get more attention. Do not be afraid to be creative and make your study stand out by using catchy headlines and an interesting description. Just do not get carried away and promise more than you can deliver. The description must be exact about the task in the study and give the participants an idea about what is expected of them.

DO HIRE A RESEARCH ASSISTANT

Planning and managing timeslots and participants can be time-consuming. Luckily you can hire a qualified research assistant to take on these tasks and make sure it is all running smoothly. The research assistant will carry out sessions following your instructions. If you want contact information on research assistants that have experience from COBE Lab, do not hesitate to ask the lab managers.

DON'T MISS THE PAYMENT DEADLINE

This cannot be stressed enough. It is important to pay your participants as soon as possible. The administrative process at Aarhus University takes 2–4 weeks, and if you stall the payments, it will take even longer for the participants to receive their earnings. Late payments give us unhappy participants which negatively affect the lab's reputation and future recruitment of participants. Payments must be processed every two weeks to keep up with the payment deadlines. Please. Do. Not. Forget.

DO OVERBOOK IF YOU NEED AN EXACT NUMBER OF PARTICIPANTS

Some people forget to show up for their appointments. So if you need exactly 8 participants to go through with your experiment and only 7 show up, you may need to send 7 participants home with a show-up fee. This is a waste of everyone's time and resources. It is better to recruit a couple of participants more than you need to be sure that you can go through with your session. If you suddenly have too many participants for your session, you can prepare another condition for the rest or voluntarily send the extra participants home with a show-up fee and ask them to sign up for another day.

DO REACH OUT AND COMMUNICATE WITH PARTICIPANTS

Sometimes you need to cancel a timeslot or rearrange a participant group. These changes are better received by the participants if you reach out to them and give them a reason that you have to change or cancel their appointment. Write to them via email or text message and sign the message with your name. Let them know that you are sorry for the inconvenience and that it is possible to sign up for another timeslot. Good communication makes it more likely that they will sign up to another one of your sessions. This also applies to any other contact with participants.

DON'T OPEN ALL TIMESLOTS AT ONCE

It is tempting to open all your timeslots at once and wait for them to be filled in. This is not always the most effective way to manage your sessions. You will risk empty sessions on more days than necessary with long breaks between participants.

Keep your timeslots bundled, and open a couple of sessions at a time. Then add more sessions as they get filled.

DO ADVERTISE
YOUR STUDY

Spread the word about the lab! Let your network know that you are looking for participants for your study. Share a post on social media, promote your study in your lectures, and ask your colleagues to do the same. This will help you find new participants to recruit. COBE Lab's participant pool is a common good for researchers at AU, and we maintain it together. We do have many participants, but there is always room for more.

DO SEND TEXTS
INSTEAD OF EMAILS

As a researcher you have access to see the participants' phone numbers to get in contact with them. Participants do not always check emails, and sometimes our emails from the Sona Systems hit their spam filter. For this reason it is much more effective, if you or your research assistant send a text message as a reminder of the appointment the night before. Other communication such as rescheduling an appointment or cancelling a session is also possible to do via text messages.

DO ASK LAB MANAGERS
FOR PUBLICITY

COBE Lab has its own Facebook page and Instagram account for us to post stories about new studies. On Instagram we write short stories about the researchers and the research they are doing at the moment. This is a great way to promote your research as well as the lab. Lab managers will also assist in sending out mass emails to the participant pool to invite participants to sign up for your study.

Research in the lab

Mind over body:
How you talk to yourself when you are exercising

Johanne Sofie Krog Nedergård, School of Communication and Culture, Aarhus University
Mikkel Wallentin, School of Communication and Culture, Aarhus University

Your inner voice is your ally when you are exercising. At least that is what Johanne puts forward as a hypothesis in her PhD project. In her study she prevents participants from talking to themselves while bicycling to see if this has a detrimental effect on their physical performance.

A participant has just arrived at the lab. She is wearing training clothes and carries a towel. Johanne meets her at the door and follows her to the lab room. They enter a big neutral room with an exercise bike placed in the middle. Johanne quickly graps some papers and introduces the participant to the study. She asks the participant to read the consent form carefully before she signs it. Before the participant gets on the bike, she is asked to fill in a short questionnaire. The questions are about how the participant generally talks to herself while she is exercising.

After the questionnaire is filled in, it is time for biking. A computer screen is placed in front of the bike. It shows a grid with letters and numbers. The participant is either asked to remember which letters and numbers appeared on the screen or where they appeared. She starts biking. She bikes for one minute and rests for one minute. During the trials she solves the memory tasks. This routine is repeated 12 times.

Johanne is sitting behind the exercise bike with a small computer in her hand while the participant is biking. The computer is used to measure the speed and distance. The participant's pulse is also measured during the exercise. This information, combined with the results of the tasks,

is used to measure the participant's performance. After all 12 trials the participant is a little bit exhausted from the exercising. Johanne gives her a debriefing, and the participant leaves to take a shower nearby, and the session is finished.

"COME ON ME, YOU CAN DO IT"
Most people think in words and have an inner dialogue, which they use in their day-to-day thinking. Last time you were exercising you may have carried out a discussion with yourself. When am I allowed to quit? I really have to beat my time from yesterday! Or maybe you did not really talk that much to yourself.

"Studies have shown that inner speech is ubiquitous in the mental lives of people, and that we use it for a range of cognitive processes to control our behaviour. This is for example when we inhibit a certain behaviour, solve problems, use the ability to remember, and navigate in different environments. I am interested in investigating whether we need to talk to ourselves to perform well on a physically demanding task," Johanne says about her project. This is why she diverts people from talking to themselves by giving them a range of memory tasks to see if this has an effect on their physical performance. The participants invited to the lab exercise at least two times a week normally to make sure they have good physical fitness.

Johanne hopes the results will contribute to new insights in the literature, but as the experiment is ongoing, we do not have information about the results yet. Until then — keep talking to yourself to boost your workout!

Click on the letters and numbers you can remember. It doesn't have to be all of them. Press ENTER when you're done.
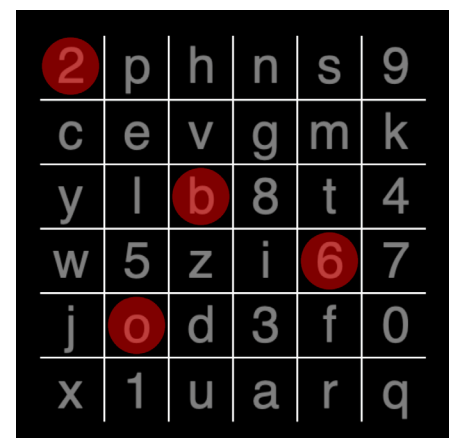
Click on the locations you can remember. It doesn't have to be all of them. Press ENTER when you're done.
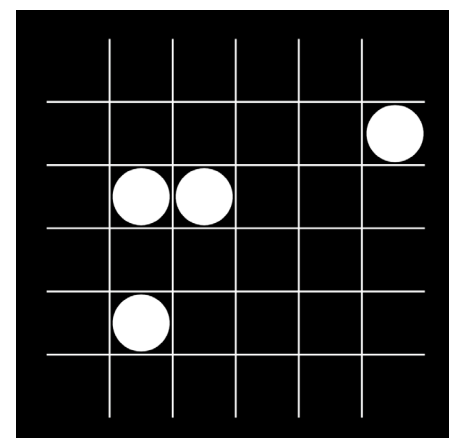
Research in the lab

Working in social networks
to find solutions

Andrea Baronchelli, School of Mathemathics, Computer Science and Engineering, University of London
Dan Mønster, School of Business and Social Sciences, Aarhus University
Kristian Tylén, School of Communication and Culture, Aarhus University
Riccardo Fusaroli, School of Communication and Culture, Aarhus University

Aliens have arrived on planet Earth. There's only one way to handle this situation: you and a partner must work together to compose a musical tune that will please the extra-terrestrial visitors. In doing so, you're going to help researchers answer questions about how people come up with optimal solutions to complex problems together.

Pairs
16 nodes
8 edges

Lattice
16 nodes
32 edges (8x4)

Full
16 nodes
120 edges (32x3,75)
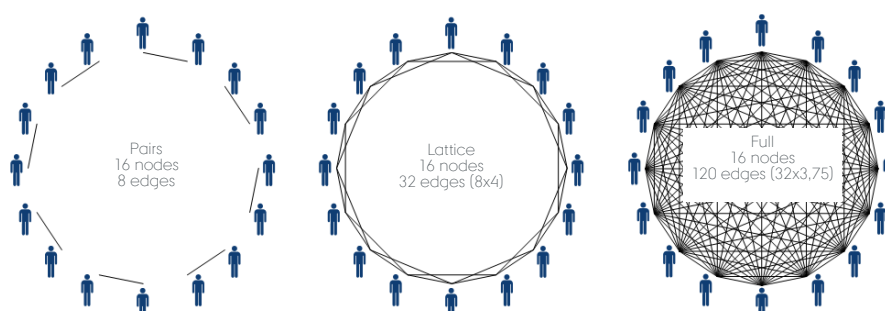
Here is what happened in the study "Close Encounters of the Third Kind": participants joined the study in sessions of exactly 16 people each. After signing a consent form, everyone was seated at individual stations in a computer lab, upon which the researcher started to give instructions: "Space ships are approaching Earth, and their intentions are unknown. Apparently, they only communicate through musical melodies."

On their computers, participants were shown a screen with an image of the approaching spaceships, a few piano keys and a chat interface. They were paired with another player and, using the chat-function only, they had two minutes to figure out what melody to compose as a message to the aliens. Once the message was composed and sent, participants were presented with feedback, consisting of a score between –25 and +40 and the image of an alien who was either pleased or — if the score was sufficiently low — mortally offended. Then a new round began. With five possible notes to choose from, and the melody itself being four notes long, there is a total of 625 possible outcomes. Only one of them would get the maximum score of 40 points.

THE IMPACT OF SOCIAL NETWORK PATTERNS ON FINDING SOLUTIONS
The researchers investigated how performance was affected by the type of network the participants worked in. They considered three patterns: pairs, lattice and fully connected networks. In the first pattern, participants worked with the same partner throughout the experiment. In the second, they worked with four different partners, meaning that each round they were randomly paired with one of their four partners. Finally in the last pattern, participants were randomly paired in each round with another person from the entire group of 16 people in the experiment.

One purpose of this investigation was to see if there is an optimal social structure for finding solutions. The researchers had two hypotheses: 1) that repeated interaction with the same partner improves performance, and 2) that more connections give access to more information and improves performance. Few connections — i.e. working with the same partner the entire time — is opposite to working with many connections — i.e. multiple partners. The two hypotheses represent a fundamental trade off. Preliminary observations suggested that pairs performed worse than both lattice and fully connected networks.

Another variable the researchers looked at was what happened if participants knew the maximum possible score. Consider that you — by pure luck — got a 40 point score in the first try. If you did not know this was the maximum score possible, you would continue to search for a better solution. However, if you knew it was the maximum score, you would not need to explore your options further. Thus, having knowledge can be expected to influence how participants search for solutions. This was supported by preliminary results, which suggested that participants did more to explore their options when the maximum possible score was unknown. The researchers also saw indications that if participants did not know the maximum possible score the lattice pattern with the highest connectivity gave the best overall performance.

WHAT WAS THE POINT OF ALIENS?
No point — except to make the experiment interesting and motivating for participants. There is no reason experiments should be dull. To the contrary, if people are bored, then this can negatively affect their effort. But if they are composing music to make alien invaders happy, they might have fun while helping researchers get new insights into collaboration and complex problem-solving.

Research in the lab

Training new skills
in virtual reality

Koumaditis Konstantinos, Department of Business Development and Technology, School of Business and Social Sciences, Aarhus University
Francesco Chinello, Department of Business Development and Technology, Schoole of Business and Social Sciences, Aarhus University
Panagiotis Mitkidis, Department of Management, School of Business and Social Sciences, Aarhus University
Simon Tobias Karg, Department of Management, School of Business and Social Sciences, Aarhus University

Virtual immersive training is being used more widely in industries to train people in a specific task or skill. A clear-cut example of this is a surgeon who is able to interact directly with a virtual body and train how to perform complicated surgery. This method is sold as being both inexpensive and effective. But how effective is virtual training really compared to training in 'the real world'?

Fortunately, this experiment involves no dead bodies with surgical cuts. The training task simply consisted of assembling a motion-based 3D cube. The 3D cube consisted of 45 parts and the assembly process of nine sequential steps. The researchers of the study wanted to compare how well and fast the participants solved the task after undergoing either virtual or physical training, with and without a trainer's assistance. Hence, they wanted to see the effectiveness of virtual vs. physical training.

TRAINING CONDITIONS
Following a between-subjects experimental design, the participants were trained to assemble the 3D cube based on one of the four conditions they were assigned. In the first condition, components were available in physical form, and the training was provided through text, pictures and animation without trainer assistance. In the second condition, the same features were present as in the first condition, but with the support of a trainer's verbal assistance. In the third condition, only the virtual blocks were available, and the training was provided through text, pictures and animation, without trainer's assistance. Finally, in the last condition, the same setup as in the third condition was applied, but with the support of trainer assistance.

Following the training and after a short break, the participants were asked to assemble a 3D-printed physical version of the corresponding 3D cube within a given time. The success rate and completion time were measured. The sessions were complemented by a series of questionnaires about the participants' profile and a debriefing interview.

VIRTUAL TRAINING PROVEN TO BE EFFECTIVE BUT NOT AS MUCH AS PHYSICAL TRAINING
One thing the researchers expected was that physical training was more effective than virtual training with and without a trainer. In line with this, the completion success was higher in the physical conditions than in the virtual conditions.

Only one participant failed to assemble the 3D cube in the physical conditions, while 15 participants failed in the virtual conditions.

Another thing the researchers expected was that the presence of a trainer would improve the number of participants who were able to succesfully assemble the cube. However, the results showed no evidence for this. An interaction between trainer presence and the training type was also not supported in the analysis.

ASSEMBLY TIME
More participants successfully assembled the 3D cube when they went through the physical training. But were they also faster? Yes! Participants who succesfully completed the assembly task in the virtual conditions were 37% slower than other participants.

The researchers' results show that a virtual training system can be utilized to train assembly workers, yet they still are not as effective if physical objects are not incorporated in the training. The findings also demonstrated that the trainer's verbal guidance played no significant role during the training.
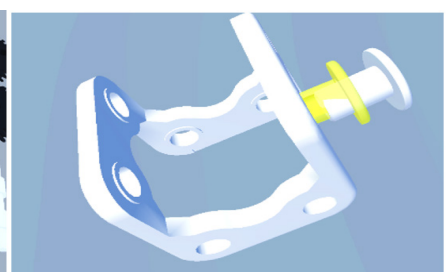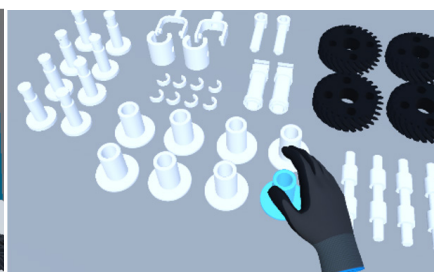
What researchers say about the lab:
What have you used the lab for in your research? What are the benefits?

Jacob Orquin
Department of Management
I almost exclusively use COBE Lab for my research. With the exception of collaborative projects completed in other labs or online, my research relies mainly on the eye-tracking equipment, participant pool and the controlled lab environment.

When I began my career at Aarhus University, our lab consisted of a single eye tracker in a spare room. Later COBE Lab was funded with its many obvious advantages: multiple types of equipment, full time staff for support, training, administration of resources, an internal review board for approving studies, multiple rooms for testing, training and meetings and a participant pool for fast and convenient recruiting and payment of study participants. The benefit of having access to a large and excellent testing environment like COBE Lab is beyond comparison for experimental researchers.

Lene Aarøe
Department of Political Science
My research field is political communication and public opinion formation in modern democracies. I have used COBE Lab to run various types of experiments on how political and evolutionary psychology shape citizens' political attitude formation in modern mass politics.

COBE Lab offers an excellent research infrastructure. The setup is highly professional, the rooms are welcoming to participants and the equipment is state-of-the art. Importantly, the lab is the centre of a creative and open interdisciplinary research environment where researchers across disciplines have unique opportunity to learn from each other and exchange knowledge.

Kristian Tylén
School of Communication and Culture
I have conducted almost all my recent research relying on the COBE Lab facilities, which include experimental studies on decision-making in networks and cultural transmission using the computer lab, perception-action studies with customised setups in the flexible rooms and psycholinguistic experiments using virtual reality and eye-tracking.

COBE Lab is an invaluable ressource for this kind of experimental research. And on top of this, the participant pool makes the recruitment procedure very simple and effective, which means that you can easily contact and collect data from a full batch of experimental participants within a week.

Malene Damholdt
Department of Psychology and Behavioural Science

We have used COBE Lab quite a lot. We have especially utilised the facilities, participant pool, the excellent help of the staff and got excellent feedback from Human Subjects Committee on how to make our research claim stronger and ethically robust when we originally submitted our application to use the lab.

When we showcased the lab to our international collaborators, they were very impressed by the facilities. They do not have similar facilities at their home universities. Here, you have everything in one location and there are loads of different technologies you, as an indpendent researcher, are not able to afford yourself. There is a lot of flexibility if you need something custom, and the staff do whatever they can to help. When you work in the lab, you meet other researchers from other disciplines, and there is a lot of knowledge sharing that you cannot pick up in any book.

Alexander Koch
Department of Economics and Business Economics

I have used the computer labs to collect data with many participants at once, the smaller rooms for data collection with individual participants and drawn on the subject pool for online studies or combined lab and online studies. The latter ran over several dates, offering interesting possibilities for research on the time aspects of decision making or to prepare stimulus materials.

A perhaps lesser known offering of COBE Lab is that you can borrow equipment that you may not have thought existed — this goes from laptops for running smaller studies "off site" to more exotic things like, for example, a device for measuring hand grip strength — so do check out what is on offer. I have benefited from the feedback and advice of the Human Subject Committee and the experience of lab management to fine tune procedures in my experiments or to sort out practical problems.

Camile Correa
Department of Clinical Medicine

We used COBE Lab to run the biggest experiment made on human metacognition inside a lab. We used rooms 1A and 1B (each with 16 parallel computers), and in one month we had collected our full dataset, with a sample big enough to ensure a good statistical power.

COBE Lab helped us with the practicalities of setting the experiment, software installation and data storing. We will definitely continue running our experiments here.

Students in the lab:
Highlighted experiments in student projects

Can you react as a patient with a brain injury?
Natascha Jensen, Georgij Svadkovskil and Thomas Lamm
Master students in Psychology, Aarhus University
Supervisor: Mimi Mehlsen, Department of Psychology and Behavioural Sciences

The three students of psychology investigated whether it was possible for healthy people to perform as people who have a brain injury in a range of neuropsychological tasks. The participants were asked to complete two different reaction time tests and a memory test. They were divided into two groups, an experimental group and a control group. The control group was asked to do their best on the reaction time task. The experimental group was asked to complete the same task, but also to simulate as if they had a brain injury. Afterwards, both groups were presented with extra information: the reaction time average for a typical person with brain injury.

It is a known problem from neuropsychological practice that patients try to make up or exaggerate symptoms in order to receive financial compensation. The purpose of this study was to shed light on whether participants were able to react as a patient with a brain injury and help develop a reaction time test that cannot be rigged. The results are not processed yet, as the experiment is ongoing.

The students had access to lab rooms, computer equipment and recruited 111 participants in COBE Lab.

Navigating in urban spaces in virtual reality

Astrid Iversen, Amalie Andersen and Annamaya Halskov-Jensen
Bachelor students in Cognitive Science, Aarhus University
Supervisors: Kristian Tylén and Cordula Vesper, School of Communication and Culture

Astrid, Amalie and Annamaya investigated how people navigate in urban spaces in virtual realities. The participants had to find an object hidden in the streets of two very different cities. One city had vivid colours and narrow, winded streets. The other city had bland colours with broad, straight streets. When participants came to the lab, they were equipped with VR-headset and remote and moved into the streets of both cities to find the object. Once the object was located, the participants were asked to write route instructions for the next participant. The next participant received these instructions before he or she entered the cities.

The purpose of this study was to see how the participants experienced their journeys through the cities differently. The expectation was that peoples' perception of their surroundings were shaped by both the physical environment, such as the urban space, and social interactions, such as the instructions from other participants. Astrid, Amalie and Annamaya analysed the route descriptions to look at the words the participants used to describe the route and how often they occured. More specifically, they had two expectations. Firstly, that participants used more words related to colours in the colourful city, and secondly, that participants used more words similar to the words in the instructions they received from another participant. The results of the analysis showed evidence for the first expectation but only little evidence for the second expectation.

For their study they had access to a lab room, VR equipment and recruited 72 participants through the participant pool in COBE Lab.

The creative game

Kathrine Bredahl and Signe Iversen
Bachelor students in Cognitive Science, Aarhus University
Supervisor: Kristian Tylén, School of Communication and Culture

Are we more creative as individuals or when we work together? This question was asked by Signe and Kathrine when they conducted their experiment. Participants arrived at the lab, either individually or randomly paired, and were asked to stand in front of a black touch screen with 10 green squares displayed in a horizontal line. The task was to create figures of the squares they found interesting or original. When they created a figure they were satisfied with, they had the option to save it to a gallery, creating their own personal gallery of figures as the experiment progressed. An originality score was presented to the participants. The score was calculated based on a corpus of figures saved from a different run of The Figure Exploration Game. A perfect originality score of 100 was obtained if the corpus did not contain the saved figure. Thus, the originality score indicated the frequency of each figure in the corpus. The score was updated every 30 seconds, presenting the participants with an accumulated score of the figures saved within the past 30 seconds. During the second part of the experiment, participants were shown their saved figures, one by one. The participants were asked to rate each figure on three different parameters on a scale ranging from: concrete versus abstract, do not like versus like a lot and not creative versus very creative. The rating process was performed by moving an arrow across a horizontal bar, using the touch screen.

Kathrine and Signe expected that participants who worked together were more creative than participants who worked individually. In this experiment this would be expressed as creating more divergent figures. However, this did not seem to be the case as they found no evidence supporting that being in pairs compared to working individually influenced the originality of the figure creation.

Kathrine and Signe had access to a lab room and recruited 108 participants for their study.

Language skills and sexual selection

Nanna Vittrup
Master student in Biology, Aarhus University
Supervisors: Trine Bilde, Department of Biology and Fabio Trecca, School of Communication and Culture

Nanna used eye-tracking to investigate how acquired traits such as language skills had an effect on how attractive a person is to another person. It is known that initial attraction to potential sexual partners builds primarily on looks. More specifically, people assess body traits as indicators of mate quality, which is for example the eyes or facial symmetry of a person. In this study, Nanna wanted to shed light on another trait as a marker of attractiveness — namely foreign language skills in non-native speakers of Danish.

Participants were presented with 80 pictures of same-sex and opposite-sex faces that had been stripped of both facial hair, make-up, jewelry, and glasses in the eye-tracking experiment. The participants could freely look at the faces on the screen for a pre-defined amount of time while their eye movements were recorded. In the experiment the participant were exposed to two conditions. Firstly, simply 40 faces presented individually on the screen. Secondly, 40 new faces presented on the screen, but this time they were presented together with short audio-clips of voice actors introducing themselves. Half of them were Danish native speakers, the other half had Danish as a foreign language. For each face the participants were asked how attractive they found that specific face and how interested they would be in having that person as sexual/romantic partner. Nanna expected to see a difference in perceived attractiveness by comparing the self-reported measures with the eye gaze patterns. The results are not processed yet.

Nanna had access to the lab room, one of our eye-trackers and recruited 173 participants.

ACCESS TO COBE LAB AS A STUDENT

• The student must be enrolled at Aarhus University.
• The supervisor must be employed at Aarhus University.

Students who would like to collect behavioural data with advanced equipment or develop an experimental design that requires controlled environments are welcome to use the facilities at COBE Lab. They will follow the same procedures as other researchers and get access to all labs, equipment and participants on equal terms. This also means that they will have to pay participants and find funding for this. Alternatively, they may recruit their own participants outside the COBE Lab pool.

The supervisor is expected to take on an active role in the application process, which includes reading and approving of the application before it is submitted and taking part in conversation about necessary changes.

A talk with Bo: What is it like to be **a participant?**

How did you first hear about COBE Lab?
I was at a student fair at Aarhus University, and COBE Lab had a virtual reality stand, which I had to try. It was the first time I tried virtual reality. I signed up as a participant in the lab, and now I have participated in about 30 studies.

Why do you participate in studies at COBE Lab?
In the beginning, it was primarily because of the money. It was a fast, convenient, and fun way to earn a bit extra in addition to my SU. Now, I have a student job but continue to participate in studies I find interesting. Just because it is fun, and not because of the money anymore. As an academic, you also buy in on the idea that research is important, and here you actually have the opportunity to contribute to research at your own university. That makes me willing to spend an hour in COBE Lab from time to time.

What kind of studies, do you find most interesting?
COBE Lab has a lot of gear, and I really like to participate in the studies that use some kind of technology, for example virtual reality, eye-tracking, or something similar. It is not every day you have the possibilities to try such things out, but in COBE Lab you do.

How do you feel that you learn something from participating in studies?
Many of the studies I have participated in use some kind of game theory, and I can recognise some of the elements from my studies. Besides that, the studies are so varied, and there are a lot of new things to get to understand. You also learn something about yourself and others and, for example, how willing other people are to help or 'cheat' each other in order to earn more in studies with payments based on performance.

What are the benefits of participating in studies?
Besides the money, I like that you contribute to research and to PhD and master projects at the university. It is cool to help out with their research projects, and maybe I will also need that help some day, when I get to it.

Is there a particular piece of advise you would like to pass on to the researchers on how to make participants sign up for their study?
I notice that you post more about studies on social media — that is a good way! I think you need to tell the participants why it is interesting and what you get out of the study as participant. It is most likely always interesting for the researchers, but you also need to tell why it is interesting as participant.

A talk with Clara: What is it like to be **a research assistant?**

**Why did you apply
to be a research assistant?**
I have a deep fascination of behavioural experiments. I have studied some of the classical experiments in the literature, as for example, Milgram's famous shock experiment. That gave me insights in the possibilities, challenges, and ethical considerations of experiments. I also participated in a couple of studies in COBE Lab before I was hired as a research assistant. In one experiment I was asked to blow up balloons. It left me with a lot of curiosity about the academic perspectives and research questions behind the study.

**What kind of studies
have you been employed in?**
I have primarily worked with computer-based studies. The participants were asked to collaborate to solve tasks or to make decisions that had an impact on the other participants' decisions. In both studies the behaviour of one participant affected the other participants' behaviour. I have also run an analogue experiment in which participants solved cognitive tasks individually.

**What do you do as RA?
What are your typical tasks?**
I take care of the administrative tasks, such as booking lab rooms, recruiting participants, preparing rooms, and setting up equipment. Then I, of course, instruct and run the sessions.

What do you learn from being RA?
I learn a lot about the transition from theory to practice — how research ideas go from theoretical concepts to computer games, virtual reality, negotiations, and math tasks. And then I am constantly reminded how people behave differently in the same situation.

**What do you like the most
about the job?**
I really like to get insights in the researchers perspective and how they design their experiments on the basis of a research question. As research assistant I get to know about the purpose of the study, and I get knowledge about research topics I otherwise would not get. And then it is fun to see how the participants react to the tasks they are asked to solve.

What is your study background and how does it relate to your job as RA?
I study political science and psychology at AU and have a special interest in perception and behaviour — two disciplines that relate closely to COBE Lab experiments. For this reason, working in the lab has been quite relatable for me. Recently, I even read an article from the syllabus in which I was one of the participants.

Is there a particular recommendation you would like to pass on to other RAs — Something you wish you had known before or just a useful trick?
A useful tip: Expect the unexpected! You think an instruction or a task is so straight forward that it can only be understood in one way, but other people do not see the world in the same way as you do, and suddenly there are a thousand ways to understand or solve the task.

Skill up in our workshops

OPEN AND FREE WORKSHOPS
COBE Lab's workshops and seminars are open to all researchers at Aarhus University. Our events are primarily relevant to research in COBE Lab and center around use of equipment and software, programming and new technologies.

EQUIPMENT AND SOFTWARE
The aim of these workshops is to help you become familiar with relevant technologies and tools for your research. The workshops introduce you to software and equipment that is useful when designing behavioural experiments.

This could be an introduction to using eye-tracking in research, designing interactive games in oTree software, demonstration of Virtual Reality equipment and the like. The workshops are taught by researchers at Aarhus University or by external experts.

CARPENTRIES WORKSHOPS
COBE Lab works with Center for Humanities Computing (CHCAA) at Aarhus University to organise and teach programming courses for researchers. The Carpentries develops and teaches in-person, interactive, hands-on, two-day workshops for learning core data

science and coding skills. Carpentries workshops are taught by volunteer instructors, who focus on creating a motivating and engaging environment for learners.

Visit our webpage and sign up for our newsletter to be updated on new events.

For more information, go to
cobelab.au.dk
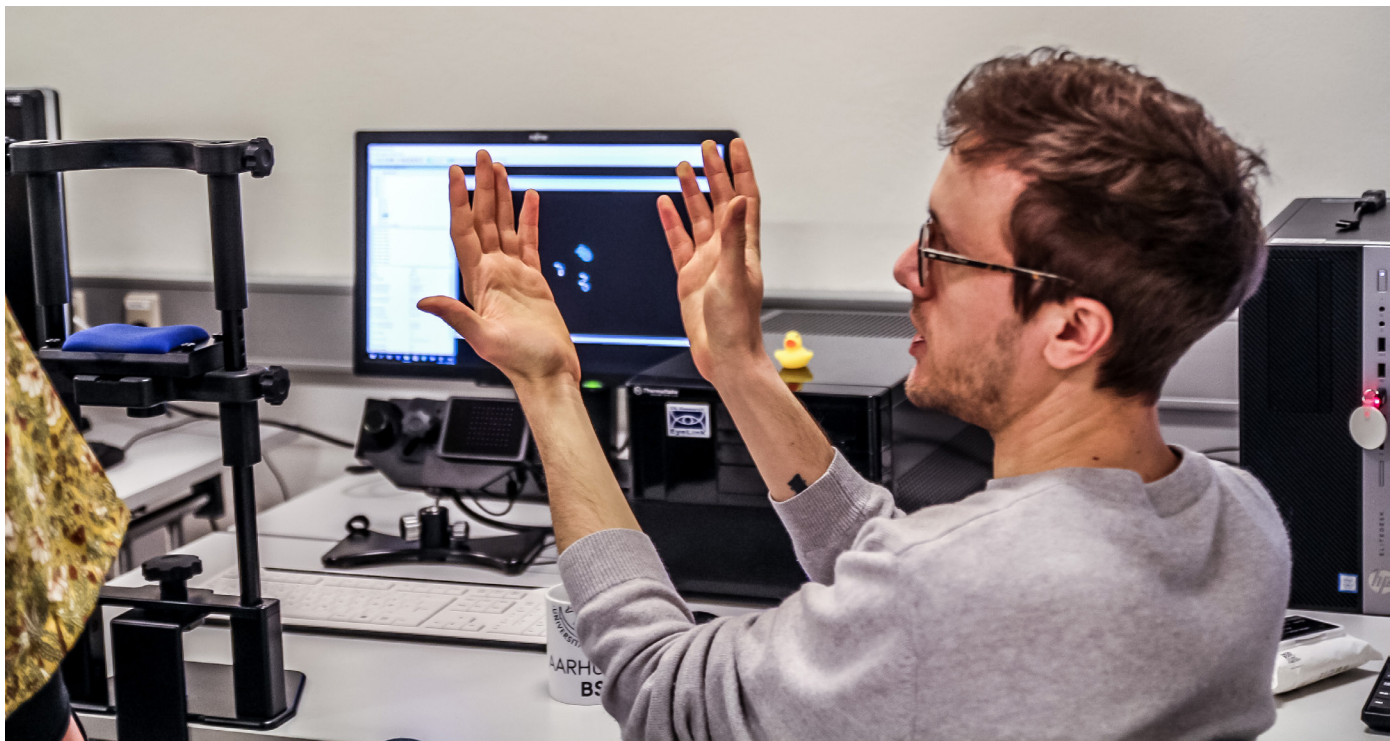
Teach your students in COBE Lab

Research is the top priority of the lab, but teaching and training students in experimental methods is also important. This contributes both to education and to recruiting talented students to pursue research careers in experimental behavioural science.

COBE Lab's facilities are open to be used in teaching activities, demonstrations of equipment and technologies and touring students for an introduction to behavioural research.

For more information, contact lab managers **cobelab@au.dk**

Reach out to the public

We appreciate public engagement in research and participate in events that support the relationship between researchers and the general public.

At the Danish Science Festival we have a stand with exciting activities on human cognition and behaviour. Here, our associated researchers are able to showcase their experiments and demonstrate equipment. The visitors engage in fun games and activities to learn how researchers study their conscious and unconscious behaviour.

At the Science Museums at Aarhus University we have participated in exhibitions in the winter and fall breaks. The visitors were invited to play a 3-player game, where they had to cooperate to survive as astronauts on the planet Mars by exchanging vital resources. The researchers used the data from the visitors' gaming behaviour to study which strategies they used, and how the strategies developed during the game.

Associated researchers

ASSOCIATED WITH THE LAB
COBE Lab's facilities are open to all researchers at Aarhus University. When you conduct your research here, you are invited to be part of the associated researchers list.

Being an associated researcher involves putting your name on our website, receiving newsletters and invitations to events, displaying your publications on our publication list and participating in the lab's activities as desired.

NEWSLETTERS
Our newsletter is sent out approximately once a month. The newsletter will keep you updated on events, administrative procedures, lab staff, events and much more. Here you also find our researcher spotlight feature: A short informal interview with one of our associated researchers.

PUBLICATIONS
On our website you find a list of COBE Lab related publications. Browse the list and you may discover researchers who work in research areas or experimental designs similar to yours.