Dear Pinja and Jana,

Thank you for submitting an Ethics Checklist and regional ethics approval in relation to your research project *Quantum Minds - Flow* (project ID 0156). Your Ethics Checklist has been reviewed by members of the Lab's Ethics Advisory Group.

I am pleased to inform that your Ethics Checklist has been approved.

We take this opportunity to remind you that we have both of your ethics certificates on file, in addition to the Pre-study Form. However, if you choose to pay participants via automatic bank transfer we require the Project Account Information Form. Please visit the 'For Researchers' section of our website for further information regarding our research procedures.

In the Pre-study Form it is stated that you intend to use the Lab's participant pool, and therefore researcher accounts on our participant system will be created for you in the near future. We require that in return for access to the pool, you help recruit more participants, for the benefit of other researchers. We have bookmarks and flyers available for distribution, and we recommend that you hand out these materials in busy areas such as canteens, Friday bars, cafés and lectures.

Supplementary advice

This section contains advisory information that we think may be useful to you, but is not mandatory to follow this advice.

1. We refer you to the act on personal information (persondataloven) regarding storing personal data. We recommend that you produce a data set without personal information, that could be shared with other researchers.
2. We recommend that—in future applications to the Ethics Advisory Group—you forward the consent information (which is strongly recommended to be in writing) to the Ethics Advisory Group.

The Ethics Advisory Group's aims, scope and role are described on the following page.

Regards,

Joshua Brain

Cognition and Behavior Lab

Joshua Brain

Assistant Lab Manager

Date: 8 November 2016

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Ethics Advisory Group

The aims of the group

The Ethics Advisory Group aims to promote the conduct of ethical research at Cognition and Behavior Lab, by advising on ethical issues surrounding specific studies, and by preventing use of the lab's subject pool or lab facilities in certain rare cases where the interests of the lab or the participant pool are deemed to be placed at risk. The group has three specific aims: 1) to advise associated researchers with ethical issues pertaining to the design of their studies; 2) to promote the rights, interests, and well-being of individuals in the subject pool; and 3) to ensure that the lab maintains a reputation in line with best practices of the disciplines with which associated researchers are affiliated.

The role of the group

To meet these aims, the lab requires that all research activities are registered with the Ethics Advisory Group as part of the project initiation process. This is done by filling in the Advisory Group's checklist. Submitted checklists will be read by at least two members of the group, who will provide initial feedback to researchers as quickly as possible (usually within a week).

In typical cases, the group members will function in an advisory capacity. Their feedback may highlight ethical issues raised by the study design, or offer suggestions for improving the ethical standards of the research. In rare cases, where there exist concerns that the rights, interests, or well-being of subject pool members are at risk, or where there are concerns that research may not be in line with the best practices of associated researchers' disciplines, the group may call a meeting to discuss changes that must be made before the proposed research can proceed. In all cases the group acts on the principles laid out in the NIH course "Protecting Human Research Participants", which all associated researchers and their research assistants are required to complete.

The scope of the group

The Ethics Advisory Group is not a formal review committee. The group does not govern research outside of the lab and its subject pool, and feedback from the group does not constitute formal ethical approval for the purpose of Danish or international law, funding agencies, or research publication. The legal body governing human subjects research conducted in Aarhus is De Videnskabsetiske Komitéer for Region Midtjylland (The Scientific Ethics Committee for the Central Jutland Region). It is the responsibility of associated researchers to themselves contact the regional committee to determine whether their protocol requires or is exempt from regional review under Danish laws governing ethics in biomedical research. The Ethics Advisory Group assumes that all research designs submitted to Cognition and Behavior Lab have either undergone the full regional review process, or have been deemed exempt from review by the Region.

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Pre-study Form

Thanks for your interest in running research at Cognition and Behavior Lab (COBE Lab).

This form should take no more than 10 minutes to complete and will help us to better organise studies at the Lab.

Please email the completed document to cobelab@au.dk

Thanks, Dan and Josh

Date submitted (DD/MM/YY): 25/10/2016

1. Research Group Information

1.1 Name(s) of researcher(s)
Pinja Haikka
Jana Jarecki

1.2 Contact email for all researchers.
pinja@phys.au.dk
jana.jarecki@unibas.ch

1.3 What Department is the principal investigator (researcher) primarily associated with?
Department of Physics

1.4 Name of study for the internal system, cobelab.au.dk (this is not seen by participants).
Quantum Minds - Flow

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2. Ethics & Sensitive Information

2.1 COBE Lab requires ethics certification for all researchers and their assistants. Have all research members completed this?

☒ Yes
☐ No
☐ Other

2.2 Does the study conform to the ethical requirements mandated by the Lab? For instance, there is a no deception policy.

If "No": (i) You will not be able to use our participant pool; (ii) You will only be permitted to use the physical facilities, and not allowed to use the COBE Lab brand; (iii) You will insert the following text into your participant information and consent form: "This research is not conducted by Cognition and Behavior Lab itself, and is not covered by its policies. For specific questions about the study, please contact the researcher in charge: Name of principal investigator: Department Street address: "

Yes (no deception)

2.3 Is regional ethics approval required for your study?

Please note this is different to approval from the Lab's Ethics Advisory Group

☐ Yes—approval obtained
☐ Yes—approval pending
☒ No—not required
☐ Not sure

2.4 Will your study include the collection of personal/ sensitive information?

☐ Yes
☐ No
☒ Not sure

2.4.1 If 'Yes' or 'Not sure' to the above question, please provide more detail.

We collect measurements of IQ

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3. Equipment, Participant and Session Information

3.1 Ideally, what room(s) would you require?

- ☐ Lab 1a (upto nine laptops
- ☒ Lab 1b (upto 24 desktop computers)
- ☒ Lab 2a, 2b or 2c (smaller lab room)
- ☐ Lab 2m
- ☐ Lab 2f
- ☐ Office space in COBE Lab office (H9)
- ☐ Kitchen

Other (please write)

3.2 What equipment do you require? Mark all that apply

- ☐ EyeLink 1000 eye tracker
- ☐ Tobii T60XL eye tracker
- ☐ BIOPAC system
- ☐ Cortrium C3 device (n=2)
- ☐ Brain Products EEG equipment
- ☐ iPad (n=2)
- ☐ Video camera
- ☐ GoPro camera
- ☐ Camera (Canon)
- ☐ Dynamometer (n=2)
- ☐ PST response boxes (n=4)
- ☐ Headphones with detachable mic (n=32)
- ☐ Smartboard projector (in Lab 2f)
- ☐ 60 inch monitor (in Lab 2m)
- ☐ Centrifuge
- ☐ -80 degree C freezer

3.3 Ideally when do you plan to run the study? Include preferred start date and expected duration of study.

November 2016 - January 2017

3.4 Will you be using the COBE Lab participant pool (Sona system) to recruit participants?

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☒ Yes
☐ No
☐ Not sure
☒ Other recruitment method

Other (please write): we hope to be able to re-recruit participants from an earlier study, namely "The Alien Game. Hierarchical Problem solving, part 2" with PIs carsten Bergenholt and Oana Vuculescu).

3.4.1 If ' Yes' to the above, please write the name of study as seen by potential participants (in the Sona system)

Quantum Minds

3.5 How many participants are you looking to recruit?

By using the participant pool you agree to help advertise the Lab to prospective participants, typically via disturbing promotional material at canteens and in busy student areas.

100

A first batch would ideally be re-invited participants having taken part in the study "The Alien Game. Hierarchical Problem solving, part 2"

3.6 How many participants per session?

10 to 20

3.7 How long will one session take (in minutes)?

60-70 minutes

3.8 How are participants rewarded?

☒ Automatic bank transfer via NemKonto
☐ Cash
☐ Anonymous cash payment
☐ Cinema ticket
☐ Gift voucher
☐ Item: e.g., bottle of wine
☐ Anonymous bank transfer

Other (please write):

Any questions or comments, please write in below

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Please email the completed document to cobelab@au.dk

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Research Ethics Checklist

We thank you for your interest in conducing research at Cognition and Behavior Lab.

Before conducting research at Cognition and Behavior Lab, **the principal investigator is required to fill out the checklist below.** The checklist is **not** an application for formal ethics approval for your study.

We have developed the checklist to support researchers to carefully and critically think about ethical and data protection issues pertaining to their research. Two or more members of the Lab's Ethics Advisory Group will review the Checklist.

After undergoing review, you will be contacted by Lab management with the comments from the Ethics Advisory Group. Issues will be discussed between the three parties—namely the research team, the Ethics Advisory Group and Lab management.

If the issues cannot be resolved, the research project under review may not take place at Cognition and Behavior Lab. Please note that Lab management and the Scientific Advisory Board make the final decision about whether a study can be conducted at the Lab.

Please complete the below form and mail it to cobelab@au.dk

Date (dd/mm/yyyy): 25/10/2016

Research Centre:
Where will the research be conducted: ☒ COBE Lab ☐ TrygFonden's Centre for Child Research ☐ Other. Please specify:

About the Project:			
Project title:	Quantum Minds - Flow		
Project start-date:	November 2016	Anticipated end-date:	January 2016
Principal Investigator(s):	Pinja Haikka Jana Jarecki	Email address(es):	pinja@phys.au.dk jana.jarecki@unibas.ch
Supervisor (if PI is a student):		Email address(es):	
Project description:	**Please describe or attach research proposal:** The project "Quantum Minds - Flow" investigates which cognitive or motivational processes relate to human problem solving, namey solving a complex computational quantum challenge. The quantum challenge consists of moving an atom in a computer game and is computationally hard. We investigate three constructs hypothesized to facilitate performance based on the gaming literature and the cognitive science: successful players may enter a flow state during game play (flow hypothesis), or they may have comparatively high general cognitive capacities such as working memory or IQ (cognitive capacity hypothesis), or successful players may be more motivated to solve complex tasks, e.g. score high on need for cognition measures (motivational hypothesis). To test these three accounts we use a one-factorial between subjects design. Our study utilizes a computerized trial-by-trial gamified learning paradigm. In this paradigm participants repeatedly attempt to solve a computer game that is derived from a quantum challenge. Participants' game play constitutes our dependent variable. As explanatory variables we will manipulate the instructions in order to achieve a flow state or a more analytice state (independent variable: flow). We will measure subjective flow using standardized questionnaires. Furtrher we will measure the aforementioned psychological constructs (cognitive capacity, motivation) using validated psychological scales and tests (see data collection procedure below). ☐ **Research proposal is attached**		

Funding body:	Department of Physics and Astronomy, AU
Financial disclosure:	**Please tick the box if the following statement is correct:** ☒ "The funders will have no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript." **If this statement is not correct, you must describe the role of any sponsors or funders and amend the aforementioned sentence as needed:**
Data collection method:	**Data collection:** (please tick at least one box. If you tick "other", please explain your data collection in details) ☐Interviews ☒Questionnaire ☒ Experiment ☐Secondary data ☐Observation ☐ Other (please specify): _____
Data collection procedure:	**Please describe:** **1. Introduction: Manipulation "Flow"** **2. Game Play: Levels 1 - 4 of the game, fixed number of trials per game: 100 trials** **3. Measurement of psychological correlates** **3.1. Flow scale** **3.2. Need for cognition scale (Cacioppo, Petty, Feinstein, & Jarvis, 1996)** **3.3. Cognitive Capacities (*)** **4. Demographics** **(5.) Only for re-recruited participants: Input anonymous individual code (month of birth, first letter of parent's name, middle initial of own name, etc.) for linking participants across studies** **(*) W.r.t. the cognitive capacities we hope to be able to re-recruit participants from an earlier study, namely "The Alien Game. Hierarchical Problem solving, part 2" with Pls carsten Bergenholt and Oana Vuculescu). In this study participants filled out a battery of cognitive tests. If re-recruitment fails we will measuer hand-eye coordination and fluid intelligence**

About the Participants:
Characteristics of the participants (age, gender, ethnic origin, or people who are in custody or care) **Please describe:** **No special restrictions, except for that we will reach out to participants of a prior COBE Lab study**
If your sample includes children (aged 18 and below), mentally incapacitated persons, patients[1], your own students, members of ethnic minorities, individuals who are in custody or care arrangement such as pupils or students at school or in a professional or client relationship with the researcher, please explain below why it is necessary to use these particular groups. If subjects are minors or mentally incompetent, please describe how and by whom permission will be granted? If you are including children under the age of 18 and are not getting parental consent, please explain why you believe that their parents would consent if it was possible to contact them. Further describe any specific risks of the study for such vulnerable groups and whether the value of information to be gained outweighs these risks. **Please describe**: NA ☒ **Not applicable**
If your research is being conducted within a specific organisation (e.g., schools, voluntary organisation, care institution), please state how organisational permission has been obtained: **Please describe**: ☒ **Not applicable**

[1] A **patient** is any recipient of health care services. The patient is most often ill or injured and in need of treatment by a physician, physician assistant, advanced practice registered nurse, veterinarian, or other health care provider.

Risk of Harm: Section 1/7

Describe in detail the nature and extent of the general risk the study might impose on the participants (does the study cause harm or negative consequences beyond the risks encountered in normal life?) and provide the rationale for the necessity of such risks.

NA

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Risk of Harm: Section 2/7

Does the proposed research involve any drugs, placebos or other substances (e.g., food substances, vitamins) to be administered to the study participants or does the study involve any invasive, intrusive or potentially harmful procedures of any kind?

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks.

NA

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Risk of Harm: Section 3/7

Will it be necessary for participants to take part in the study without their knowledge and informed consent at the time? (e.g., “natural field experiments”, covert observation of people in non-public places, people not able to give their consent).

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Describe why it is necessary to not ask the participants for informed consent.

NA

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Do you think participants would give their consent if they knew about the purpose of the study? Explain why:

Risk of Harm: Section 4/7

Does the proposed research involve tracking the location or observation of people?

Please select:

☐ Yes ☒ No

If yes, answer the following questions (*please note that any tracking of individuals or locations should be specifically mentioned in the consent form*):

Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks

NA

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Risk of Harm: Section 5/7

Does the proposed research involve human biological samples, human genetic material (e.g. will tissue samples such as blood or saliva, be obtained from participants)?

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks

Does the value of information to be gained outweighs the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Risk of Harm: Section 6/7

Does the proposed research involve processing of sensitive data (e.g., health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks.

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Risk of Harm: Section 7/7

Does the proposed research involve imposing pain, more than mild discomfort, or induce psychological stress or anxiety on the participants?

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks.

Does the value of information to be gained outweigh the risks?
Please select:

☐ Yes ☐ No ☒ Not applicable

Use of deception:

Does the proposed research involve deception?

Please select:

☐ Yes ☒ No

If yes, answer the following questions:

Is the use of deceptive techniques justified by the study's significant prospective scientific, educational, or applied value?

Please select:

☐ Yes ☐ No

Have non-deceptive alternative procedures been considered?

Please select:

☐ Yes ☐ No

At what stage in the proposed research will participants be informed about the use of deception?

Please select:

☐ Immediately after their participation
☐ Immediately after the conclusion of data collection
☐ Other (please specify):

Is the revelation of the intended deception likely to lead to discomfort, anger or objections from the participants?

Please select:

☐ Yes ☐ No

Handling of data:

What precautions will be taken to safeguard identifiable records of individuals? Please describe specific procedures to be used to provide confidentiality of data by you and others, in both the short and long run. This question also applies if you are using secondary sources of data that is not anonymous and to datasets where photos, descriptions of the individual's physical appearance, location of residence or institutional membership can pose a risk to the individual being identified by a third party.

Please describe:

All participants will be assigned a user ID which is individually generated based on year of birth, first letters of name and shoe size and this will serve as the user ID that can be used across studies without loss of confidentiality.

☐ **Not applicable**

Please describe any usage of an internet platform where respondents' data may be monitored by a third party (such as Amazon Turk, eBay, …) or is any information from the study likely to be passed on to external companies or organizations in the course of the research? Has such exposure been clearly stated in the consent form?

Please describe:

☒ **Not applicable**

How will you store data? This is of particular relevance if CPR numbers or other personal information are collected.

Please describe:

data is stored on password protected servers.

Informed Consent:
What type of consent will be obtained from study participants? ☐ Oral consent ☒ Written consent ☐ Anonymous questionnaire (cover letter required, no consent form needed) ☐ Other (please specify):
If you are making use of oral consent, please explain by written consent is not an option:
How and where will consent/permission be recorded? **Participants will be informed at the beginning of the study and need to consent in order to proceed to the study.**

Aarhus University's Data Protection Registry

Data Protection internal report form

The following form will be sent to the Rector's Office—Secretariat and Legal Support (e-mail: legal@au.dk)

Faculty	**Science and Technology**
Department	**Department of Physics and Astronomy**
Contact person (data responsible) *Name, position, work address, phone number, AU e-mail address.* *This is the person responsible for complying with demands of the Danish Data Protection Agency regarding security and processing of data.*	**Pinja Haikka** **Postdoc** **Ny Munkegade 120** **Building 1522, 314** **8000 Aarhus C** **pinja@phys.au.dk** **Phone: +4587155672**
Project title	**Quantum Minds - Flow**
Purpose of the project	**Investigate which cognitive or motivational factors underly peoples' success in solving computationally hard problems**
Project start date	**1. Nov 2016**
Number of persons registered *If exact number is unknown approximate or expected number*	**50**
If storing biological material: type of material	**NA**
Date where data will be deleted, archived or anonymised.	**Data collection is anonymous** **Archive 1. Nov 2018** **Anonymized non-personal data may be submitted to an open science repository upon publication**
Data processor's (databehandlers) name, address, e-mail address and phone number (if data are stored and/or processed outside of Aarhus University) *NOT the same as the data responsible*	**NA**
Aarhus Universitets sagsnummer *[Filled out by AU, Rector's Office, Secretariat and Legal Support]*	
Aarhus Universitets løbenummer/Unikt AU-id *[Filled out by AU, Rector's Office, Secretariat and Legal Support]*	

The Next Steps

Thank you for completing the Research Ethics Checklist.

Please send your completed Checklist to cobelab@au.dk. The Lab will then send the relevant information to the Lab's Ethics Advisory Group and to Aarhus University's data protection registry personnel.

The Lab's Ethics Advisory Group will review your Checklist and Lab management will contact you with the Committee's advice within five–seven working days.

Before conducting the experiment we encourage you to reflect upon:
1) Your hypotheses
2) How you intend to test your hypothesis
3) What sample size you intend to collect, why you intend to collect the stated sample size and what sampling method you intend to use