

Title: Intelligent games for assessing cognitive, social, and physical capabilities of elderly and children

Submitters & Research team (The full name, expertise, linkedin profile, and email address of each applicant, team member)

Students of DKE Honours Programme:

Bujnarowski, Kamil (Student DKE) k.bujnarowski@student.maastrichtuniversity.nl;

Calsius, Frederik (Student DKE) f.calsius@student.maastrichtuniversity.nl;

Dàvila Mateu, Marta (Student DKE) d.marta@student.maastrichtuniversity.nl;

Gaßner, Martin (Student DKE) m.gassner@student.maastrichtuniversity.nl;

Meyers, Marion (Student DKE) marion.meyers@student.maastrichtuniversity.nl;

Negura, Albert (Student DKE) a.negura@student.maastrichtuniversity.nl;

Ritter, Hermann (Student DKE) hermann.ritter@student.maastrichtuniversity.nl;

Yared, Ryan (Student DKE) r.yared@student.maastrichtuniversity.nl

Researchers Maastricht University:

Christopher, Seethu (DKE) seethu.christopher@maastrichtuniversity.nl

Dahl, Lucas (DKE) lucas.dahl@maastrichtuniversity.nl

Corresponding author: Möckel, Rico (DKE) <https://www.linkedin.com/in/rico-m%C3%B6ckel-27857177/>
rico.mockel@maastrichtuniversity.nl

Tumanov, Kirill (DKE) k.tumanov@maastrichtuniversity.nl

Weiss, Gerhard (DKE) <https://www.linkedin.com/in/weissg/> gerhard.weiss@maastrichtuniversity.nl

Urlings, Corrie (SBE) c.urlings@maastrichtuniversity.nl

Borghans, Lex (SBE) <https://www.linkedin.com/in/borghans/> lex.borghans@maastrichtuniversity.nl

Coppens, Karien (SBE) <https://www.linkedin.com/in/kariencoppens/> k.coppens@maastrichtuniversity.nl

Hamers, Huub (Engineer at PSYCHOLOGY) h.hamers@maastrichtuniversity.nl

Hurks, Petra (PSYCHOLOGY) <https://www.linkedin.com/in/petra-hurks-675b324/pm.hurks@maastrichtuniversity.nl>

Goanta, Catalina (LAW) <https://www.linkedin.com/in/catalina-goanta-b9898017/>
catalina.goanta@maastrichtuniversity.nl

Theme: improving health care and well-being

An executive summary (max 200 words)

Testing of elderly and children is important to assess their health, their cognitive and physical capabilities. However, testing of elderly and children is not easy, time consuming, and often leads to subjective results. We are a team of Honours students from the Department of Data Science and Knowledge Engineering and multidisciplinary researchers of Maastricht University. Together we develop novel assessment tools that are fun for elderly and children and that free caregivers and teachers from tedious work. For this we combine algorithms from data science and artificial intelligence with robotic technology, psychological and physical tests.

The main objective of proposed research (what is the research problem?) The significance of the problem (why is the problem worth solving?)

The problem at hand: (1) high documentation load for caregivers and teachers while there is a lack of caregivers and teachers and the population keeps growing older. The proportion of people of working age in the EU-28 has been and keeps shrinking. The relative number of people estimated to be aged 65 or older and thus being retired or expected to be retired soon has been expanding by 2.4 % over the past 10 years. As a greater proportion of the post-war baby-boom generation reaches retirement in the coming years and due to the consistency of fewer births in the past year, professional projections predict that people aged 65 years or over will account for 29.1 % of the EU-28's population by 2080, compared with 19.2 % in 2016 leading to a continuously growing demand for more caregivers.

Already now there is a lack of available caregivers. At the same time, the demand for documentation and quality management increases and thus reduces the time caregivers can spend on the work they love: providing care for elderly and children. Instead facilities for elderly and children report that caregivers must spend up to 50 % and more of their time for documentation and management tasks. This results in frustration for caregivers and high costs for the caregiving facilities, health insurances, and society.

Schools in the Netherlands face a lack of teachers. In June 2017, a shortfall of some 900 primary school teachers has been reported with the prediction that these numbers will further be increasing in the future. The number of people qualifying as a primary school teacher has fallen from some 7,300 in 2005 to around 3,800 in 2015. Similarly as caregivers, teachers suffer from a high amount of documentation responsibilities that reduce the time teachers can spend with children.

(2) Testing is stressful for elderly and children, artificial test environments, testing is not objective but depends on experimentalist. The execution of psychological and physical tests is typically stressful for the elderly and children who are being tested. To avoid uncontrollable influences elderly and children often are being separated from their natural environment. Still the test results are not objective and have the risk of being depended on the skills of the experimentalist. Continuous testing becomes difficult and there is a risk that elderly or children are not tested at all for deficits that are not already sufficiently expressed with the risk that treatments come too late.

The research plan (how will you address the problem?)

The proposed solution: intelligent game devices for automated assessments to reduce documentation load of caregivers and teachers



To reduce the amount of required documentation load, our research focusses on providing technologies that allow for automated assessments of cognitive, physical, and social capabilities of elderly and children in natural environments. For this, elderly and children play games with game devices specifically developed by us for this application.

These game devices are equipped with intelligent sensor technology. While they play, intelligent algorithms developed by us automatically assess the elderly's and children's capabilities based on the sensor outputs and provide the necessary documentation for caregivers, teachers, doctors, and nurses. For the development and testing of our technologies, we work closely together with schools, kindergartens, and facilities for elderly in the Netherlands and Germany where we test elderly and children. We perform acceptability, psychological, and physical test. So far two devices, an intelligent dice and an intelligent maze, have been developed. First test data has been obtained. To prove the value of our developments we compare the outputs of our assessments against standard psychological and physical tests and questionnaires. We develop statistical models as well as parametric models that we train with machine learning methods to predict the output of the standard tests with our automatic game assessments. Colleagues from the law faculty research about liability aspects of our game devices and the application of artificial intelligence for elderly and children.

The innovation in the proposed research (what new methodology is being developed)

The project aims at innovation at a variety of disciplines: (1) The development of novel algorithms from data science and artificial intelligence that animate elderly and children to play and process the sensor outputs of our game devices to correctly predict the cognitive, social, and physical capabilities of elderly and children. (2) The development of novel physical game devices that are fun for elderly and children and facilitate professional assessments of cognitive, social, and physical capabilities. (3) The development of novel psychological, cognitive, and biophysical models that describe the cognitive, social, and physical capabilities of elderly and children. (4) The exploration of the legal aspects of such novel assessment devices.

The anticipated results along with short and long term benefits

Benefits for elderly and children (1) By playing games continuously, it is possible to obtain objective data on the capabilities of elderly and children continuously, over a long time, and more often per day than it would be possible if caregivers or teachers had to provide the information through observation. As a result, there is higher quality and more objective data to support a better choice of treatment or therapy. The need for treatments or therapies can be detected earlier. Unnecessary treatments can be avoided. The quality of life for elderly and children can be improved. (2) Elderly and children have fun using our games and do not realize that they are being tested. In contrast to normal artificial standardized tests our games cause less stress for elderly and children – leading to more realistic higher quality assessments in natural environments.

Benefits for caregivers and teachers (1) Through the application of automated assessments, caregivers and teachers get unloaded of paper work and can focus again on the work they like to perform: providing care and education. This leads to happier caregivers and teachers, and possibly better performance of these caregivers and teachers. (2) Caregivers and teachers also gain time since elderly and children can have fun playing the games together without the necessity of a continuous supervision by a caregiver or teacher.

Benefits for caregiving facilities, schools, health insurances, and ministry of education (1) Caregiving facilities and schools imposing less documentation load are more attractive employers and gain an advantage on the job market. (2) Continuous and objective quality assessments allow for better quality control through the management. (3) Caregivers and teachers having more time for elderly and children leads to a higher efficiency and lower costs for the facilities, health insurance, and the ministry of education. (4) Earlier and better detection of required treatments reduces costs in caregiving facilities and for health insurances. (5) By providing objective, long-term data, health insurances obtain better information about the effectiveness of the applied therapies and treatments.

Benefits for society (1) By making the jobs of caregivers and teachers more attractive and efficient, shortage of caregivers and teachers can be reduced. (2) Increasing the efficiency of caregivers and teachers effectively helps to fight their shortage in caregiving facilities and schools. (3) Under the impression of an aging population more efficient caregiving contributes to a reduction of economic load faced by the society. (4) More objective assessments of elderly and children lead to fairer assessments.