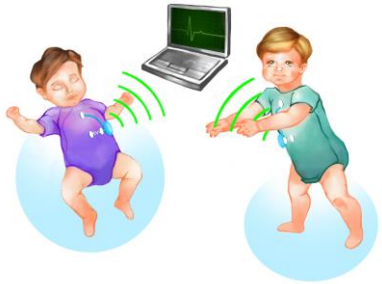
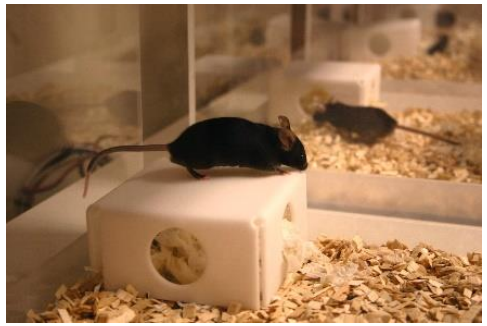




Of Mice and Men, Healthy Brain and Healthy Business

Prof. dr. Lucas P.J.J. Noldus

Science Meets Business meeting “Healthy Brain”, 3 December 2020

NOLDUS INFORMATION TECHNOLOGY

Radboud University

Speaker bio

Lucas Noldus

- Founder & CEO, Noldus Information Technology BV, Wageningen
- Professor of Behavior, Information Technology and Innovation,
  Donders Institute for Brain, Cognition and Behavior, Radboud University, Nijmegen
- Research Associate, Food & Biobased Research, Wageningen University & Research
- Secretary for International Affairs, Netherlands Academy of Technology and Innovation
- Chairman, ICT for Brain, Body & Behavior Foundation
- Secretary, Man-Machine Interaction Platform
- Member, Board of Supervisors, Foundation “Wageningen Werkt Duurzaam”
- Chairman, Board of Supervisors, Belmonte Arboretum Foundation
- Member, Wageningen Ambassadors

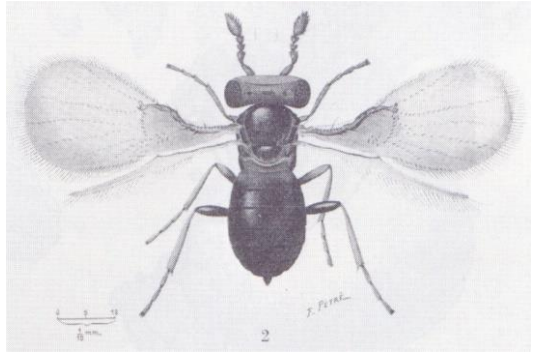
Science & technology

Innovation

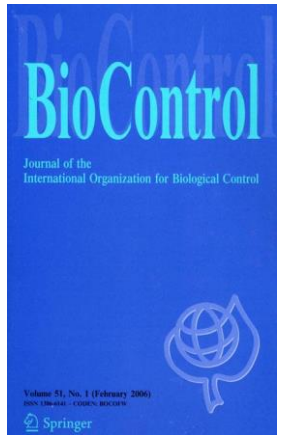
Sustainability

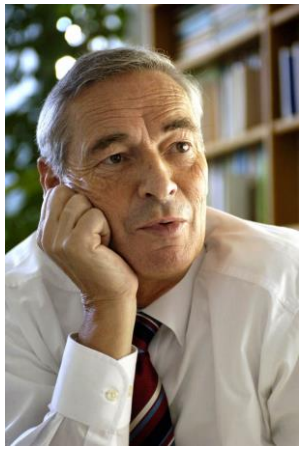
Ph.D. research

Biological Pest Control using Natural Enemies

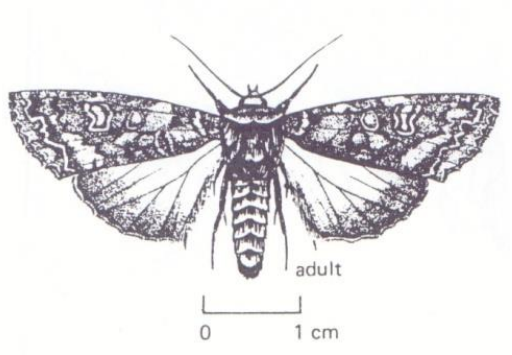


Trichogramma evanescens





Joop van Lenteren



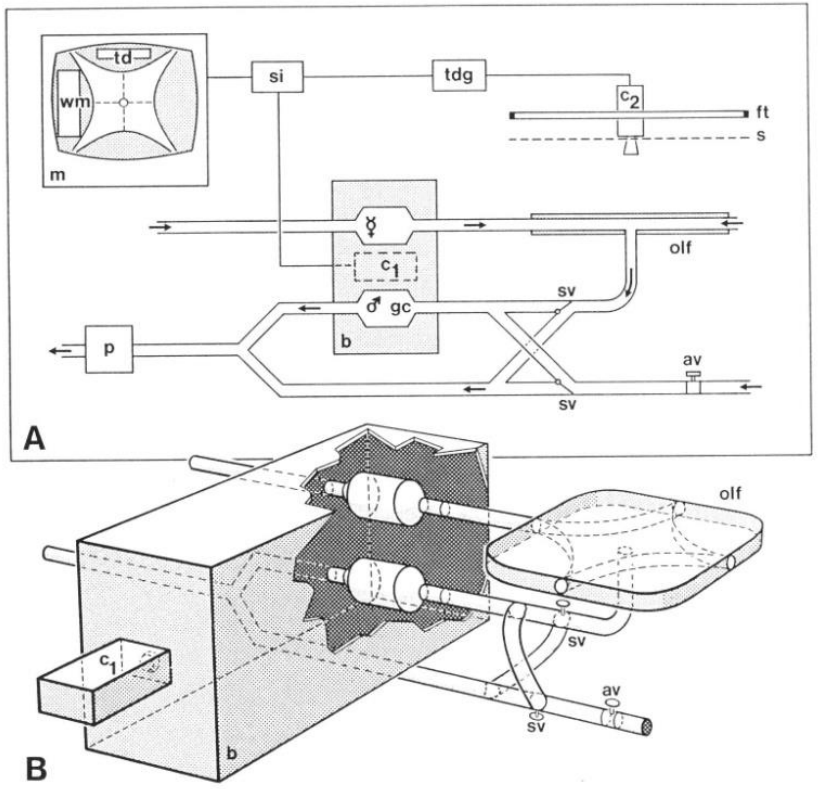
Mamestra brassicae

Fascinating questions

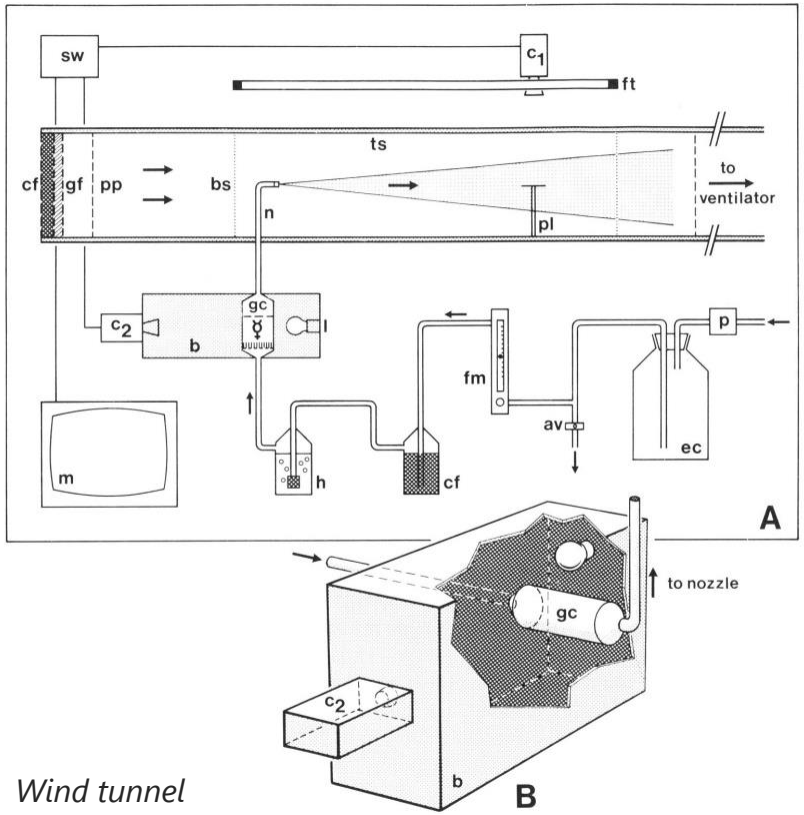
- How can tiny wasp find moth eggs in giant cabbage field?
- Do they use smell or taste?
- Wasps are diurnal, moths are nocturnal…

Ph.D. research

Designing hardware instruments



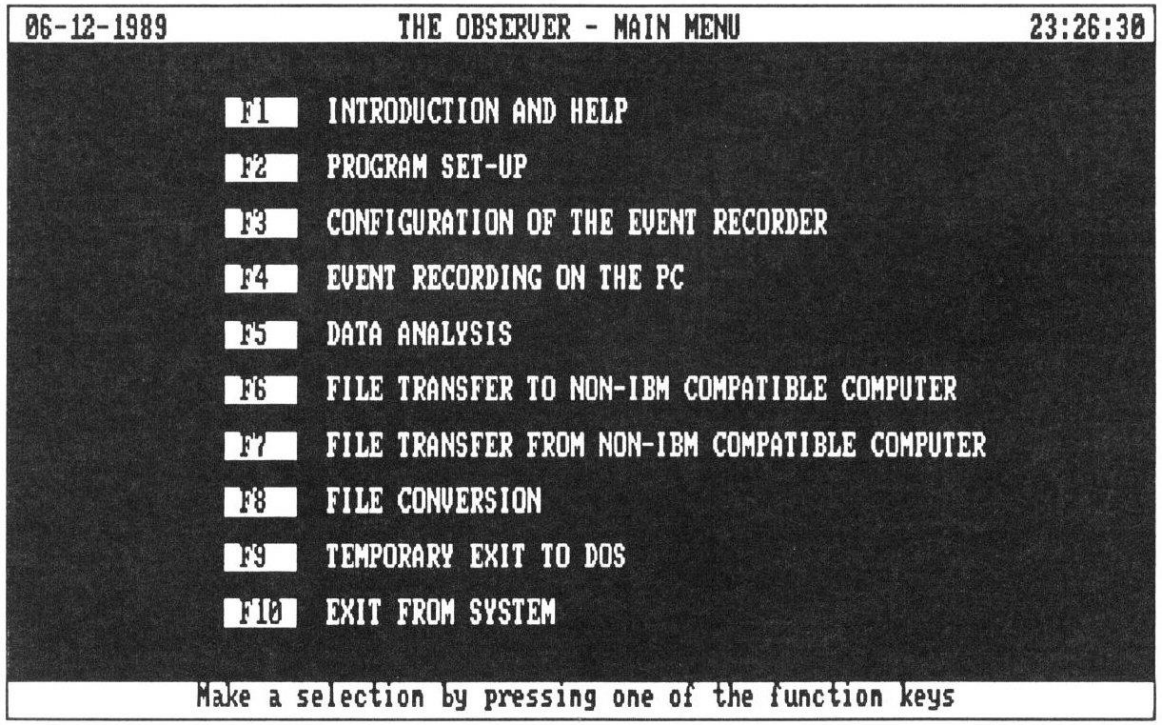
Olfactometer



Wind tunnel

Ph.D. research

Writing software



The Observer version 1

TRS-80 Model 100 portable computer

Observation, recording and analysis

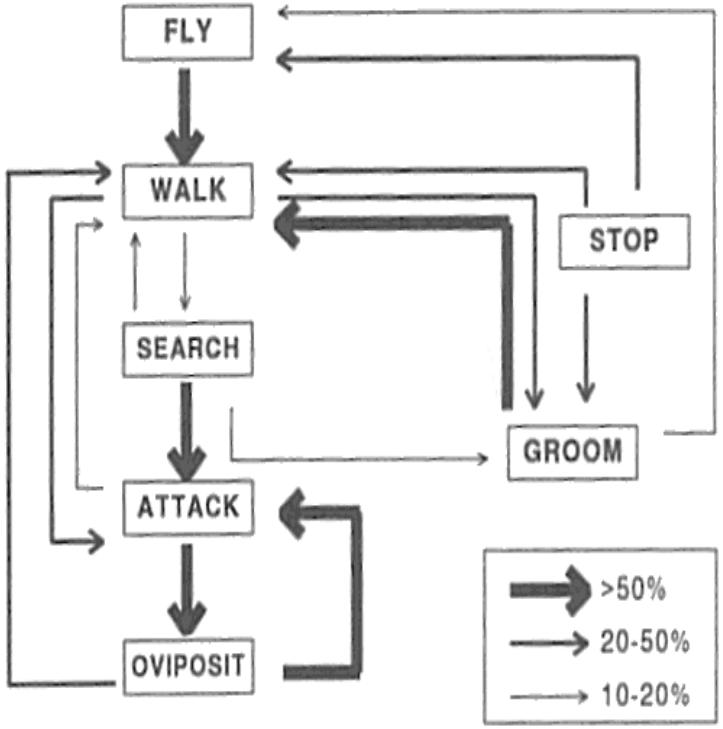
Insect behavior

Wasp
Cotesia glomerata

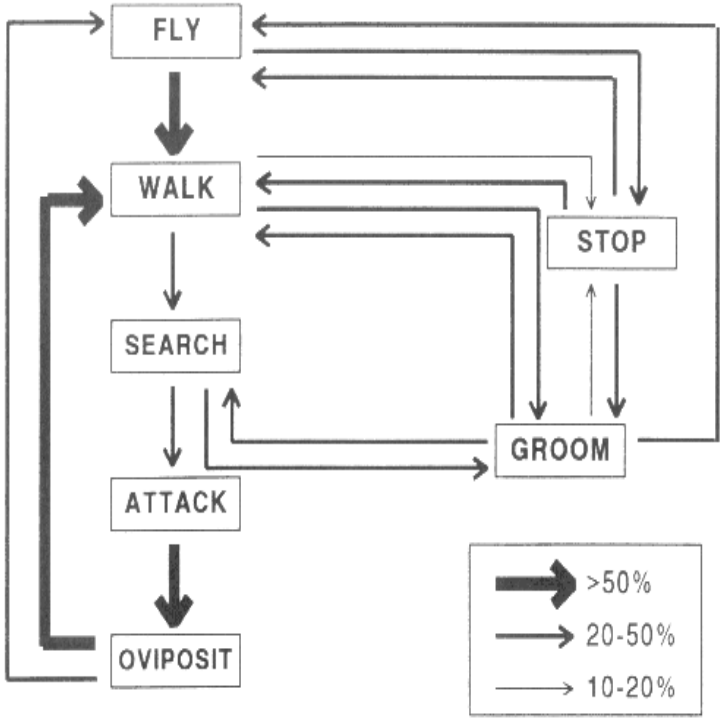
Caterpillar
Pieris brassicae

Sequential analysis: universal method to analyze behavior

Behavior described as sequence of events



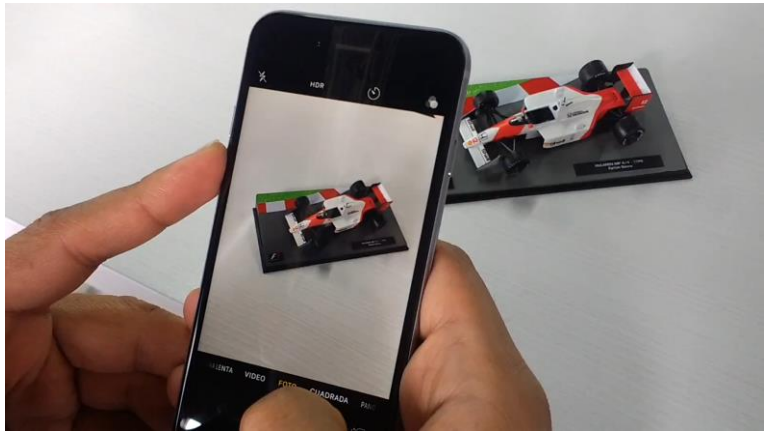
Wasp: Cotesia glomerata
Caterpillar: Pieris brassicae

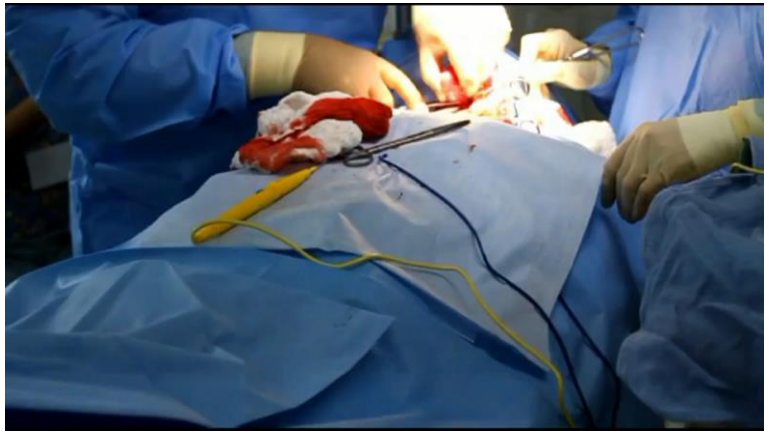


Wasp: Cotesia rubecola
Caterpillar: Pieris rapae

One concept for many applications

Goal-oriented behavior





Measuring behavior

Individual behavior

- Activity
- Movement
- Body posture
- Gestures
- Facial expression
- Vocalizations & speech

Interaction

- Social behavior: human-human, animal-animal
- Human-animal interaction
- Human-system interaction

Plenty of measurement challenges
Needed: tools!

Start of the company

The first ingredients for growth

Method of describing behavior independent of organism

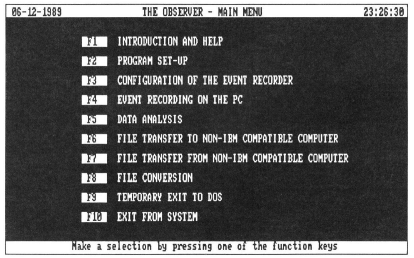
- Systematic observation
- Event recording
- Sequential analysis

Tools suitable for many applications

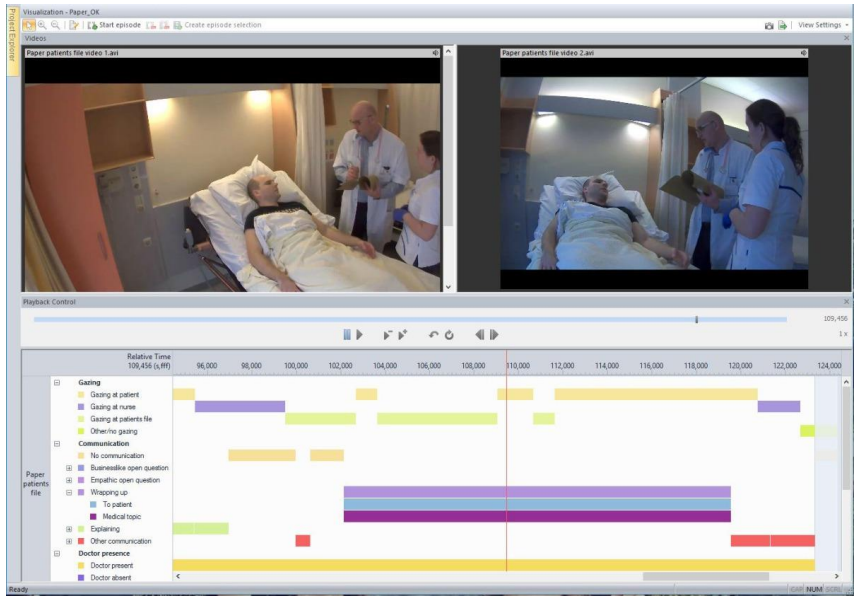
The Observer and supported computer models, early 90's

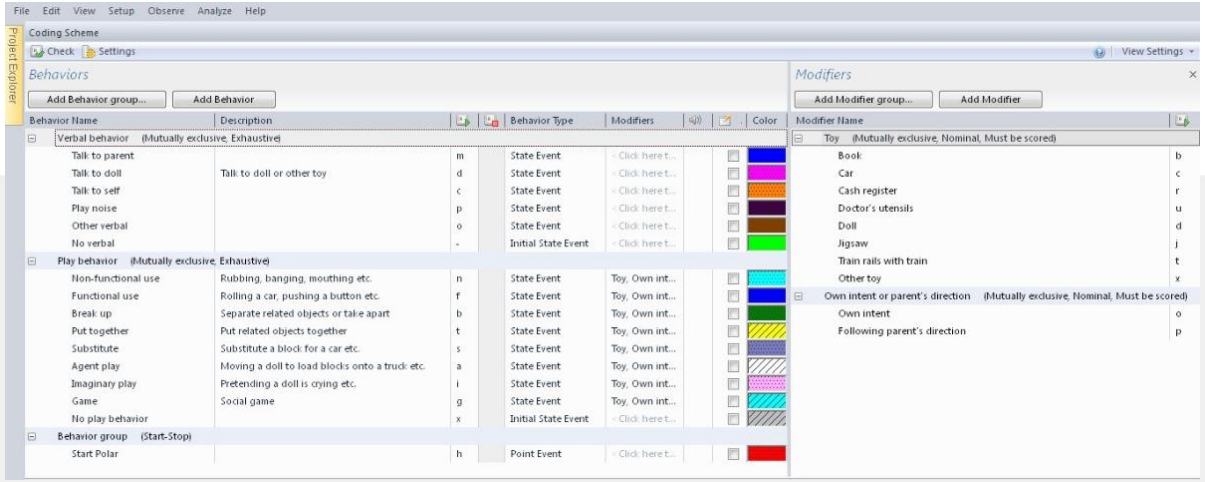
30 years later

The Observer XT

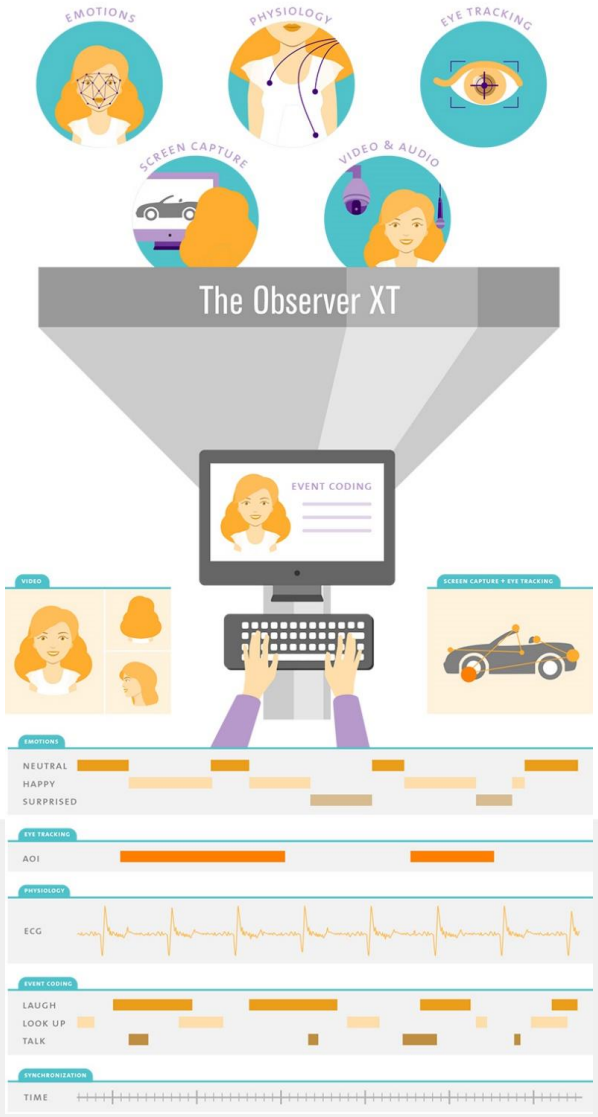


The Observer 1





The Observer XT 15



The Observer XT Data Integration Platform

- 6,000 licenses
- 30,000 users
- 12,000 publications

Our offering 2020

Tools for human and animal behavior research

Noldus

APPLICATIONS PRODUCTS CUSTOMER STORIES ABOUT NOLDUS MYNOLDUS CONTACT BLOG

HUMAN BEHAVIOR RESEARCH

Advance your behavioral research

Save time & obtain high quality data

SOFTWARE

SERVICES

LABS

SYSTEMS

ANIMAL BEHAVIOR RESEARCH

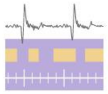
Product portfolio 2020

Products and integrated solutions

INNOVATIVE SOLUTIONS FOR HUMAN BEHAVIOR RESEARCH


AV recording & evaluation

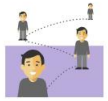

Behavioral coding & analysis


Data integration & visualization


Emotion analysis


Eye tracking & physiology


Lab set-ups


Spatial behavior


UX research

INNOVATIVE SOLUTIONS FOR ANIMAL BEHAVIOR RESEARCH


Zebrafish video tracking


Rodent video tracking


Home cage & welfare


Anxiety / fear / depression


Rodent gait analysis


Animal behavior observation


Cognition & memory


Behavior, welfare & health tracking

Automated behavioral observation

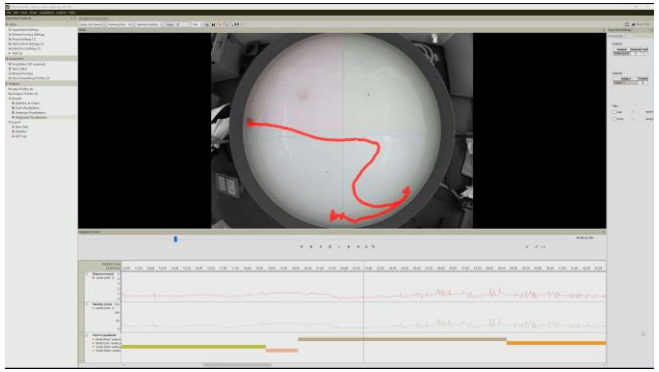
EthoVision® XT

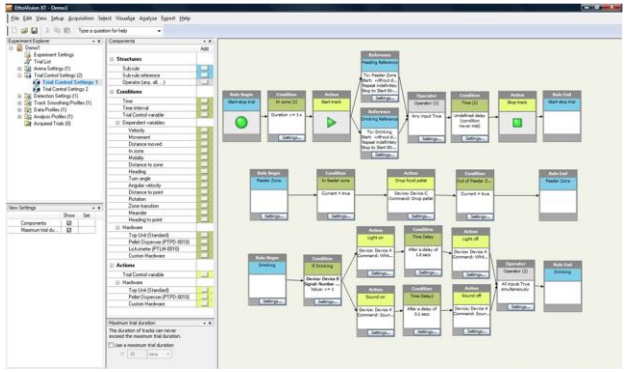
Video tracking software for automating behavioral experiments

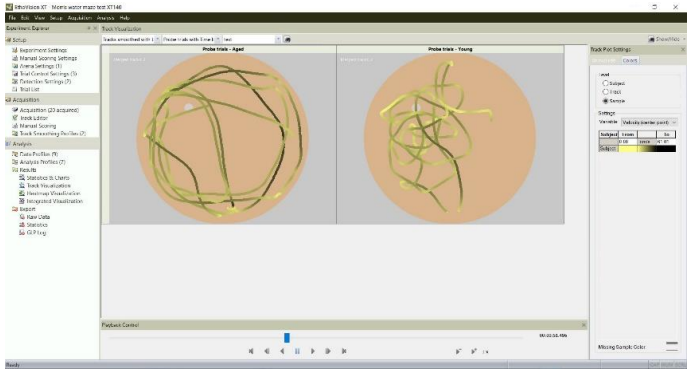
- Robust and reliable tracking of any kind of animal
- For high-throughput and high-content testing
- Automatic behavior recognition for rats and mice
- Trial and hardware control for automated of stimulus delivery
- Comprehensive analysis of individual and social behavior

Movement
Distance moved
Velocity
Movement
Acceleration
Acceleration state
Location
In zone
Distance to zone
Distance to point
Path
Meander
Target visits and errors
Zone alternation
Zone transition

Direction
Heading
Heading to point
Head direction
Head directed to zone
Turn angle
Angular velocity
Body
Body elongation
Body elongation state
Body angle
Body angle state
Mobility
Mobility state
Rotation







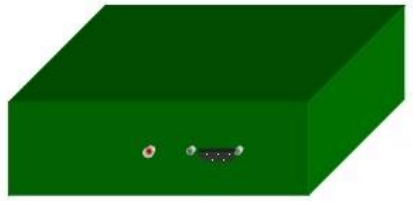
EthoVision XT design principles

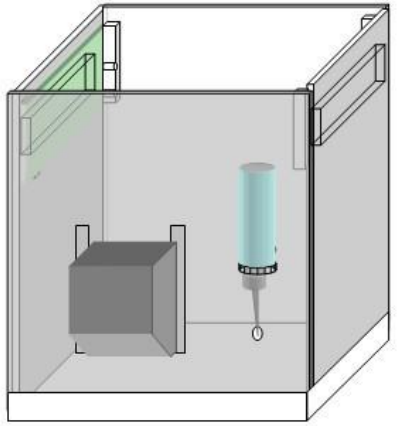
- One software application for many different applications
- Open interface to third-party hardware
- Modular design: low-cost base package, optional add-on modules

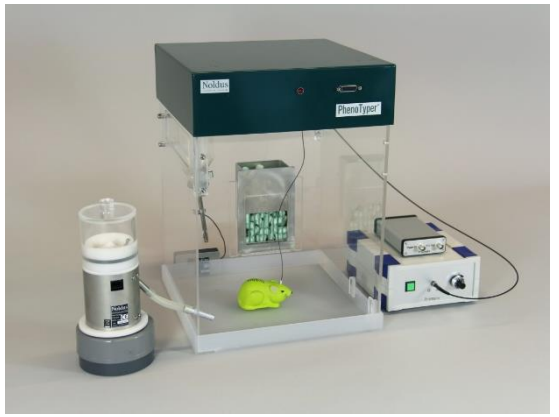
Observation in home cage
PhenoTyper®

Instrumented cage for automated behavioral testing

- Highly flexible, modular test environment, from basic test arena to enriched home cage
- Top unit with camera, LEDs, audio and visual stimuli
- Supports 24/7 continuous operation
- Wide range of components and add-on devices available for operant conditioning, optogenetics, electrophysiology, in-vivo brain imaging, etc.
- Applications: sleep/wake studies, anxiety, eating disorders, learning & memory, etc.
- Powered by EthoVision software





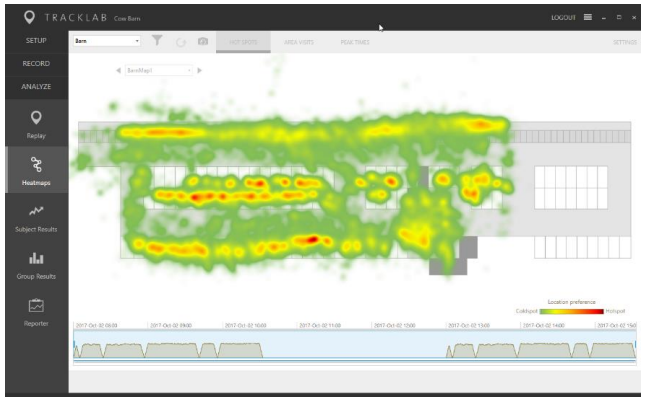


From mice to men

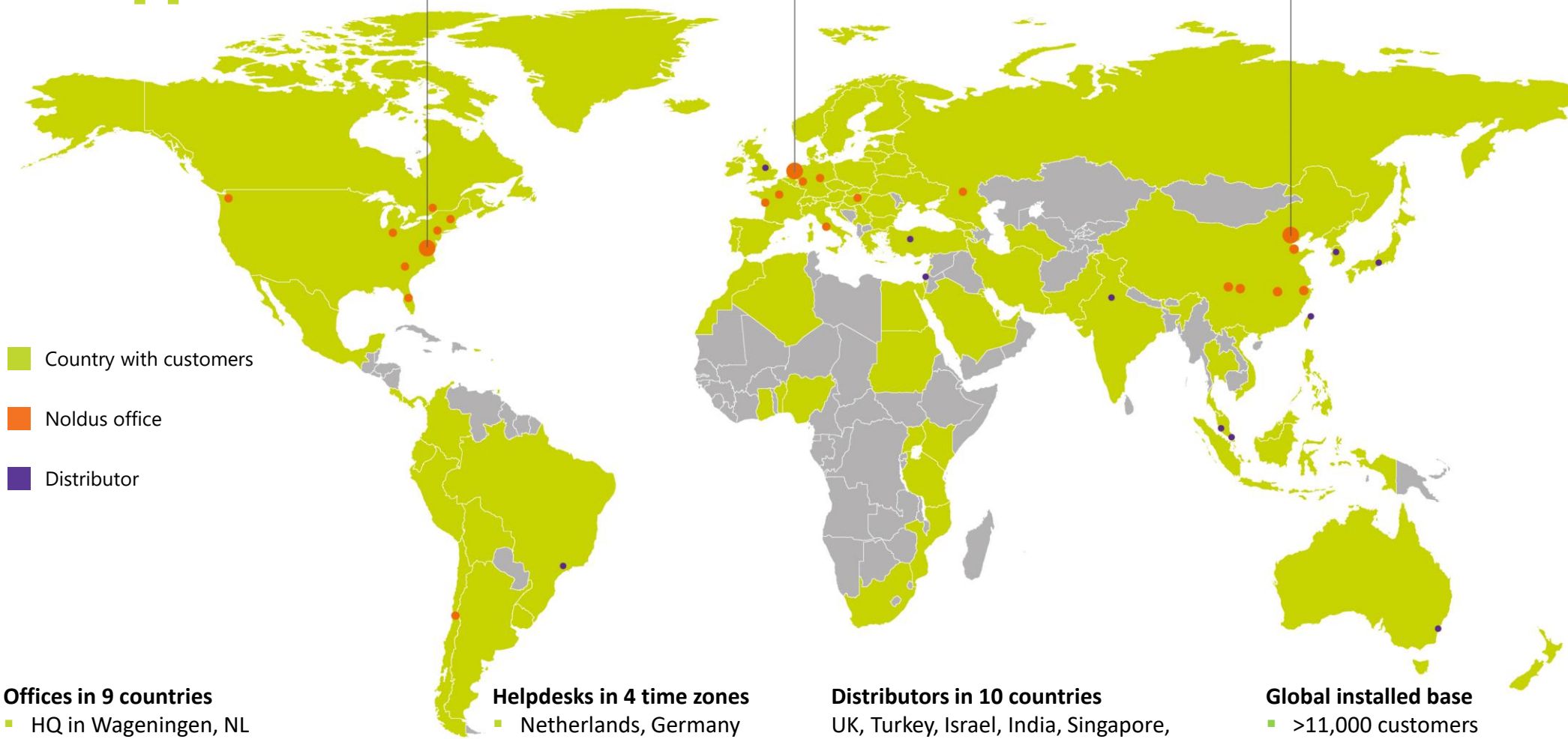
TrackLab™

Software for tracking and analysis of spatial behavior

- Gain insight into spatial behavior, both indoor and outdoor
- Work with any number and type of subjects (animal or human), any space
- Supports different positioning systems: ultra wideband, GPS
- Visualize and analyze tracking data by subject, group, time bin
- Quantify locomotion parameters, social behavior



Global Presence, Local Support



Offices in 9 countries
- HQ in Wageningen, NL
- Branch offices in France, Germany, Italy, Hungary, USA, Canada, China, Chile
- 160 employees

Helpdesks in 4 time zones
- Netherlands, Germany
- US West Coast
- US East Coast
- China

Distributors in 10 countries

UK, Turkey, Israel, India, Singapore, Japan, Korea, Taiwan, Australia, Brazil

Global installed base
- >11,000 customers
- 94 countries

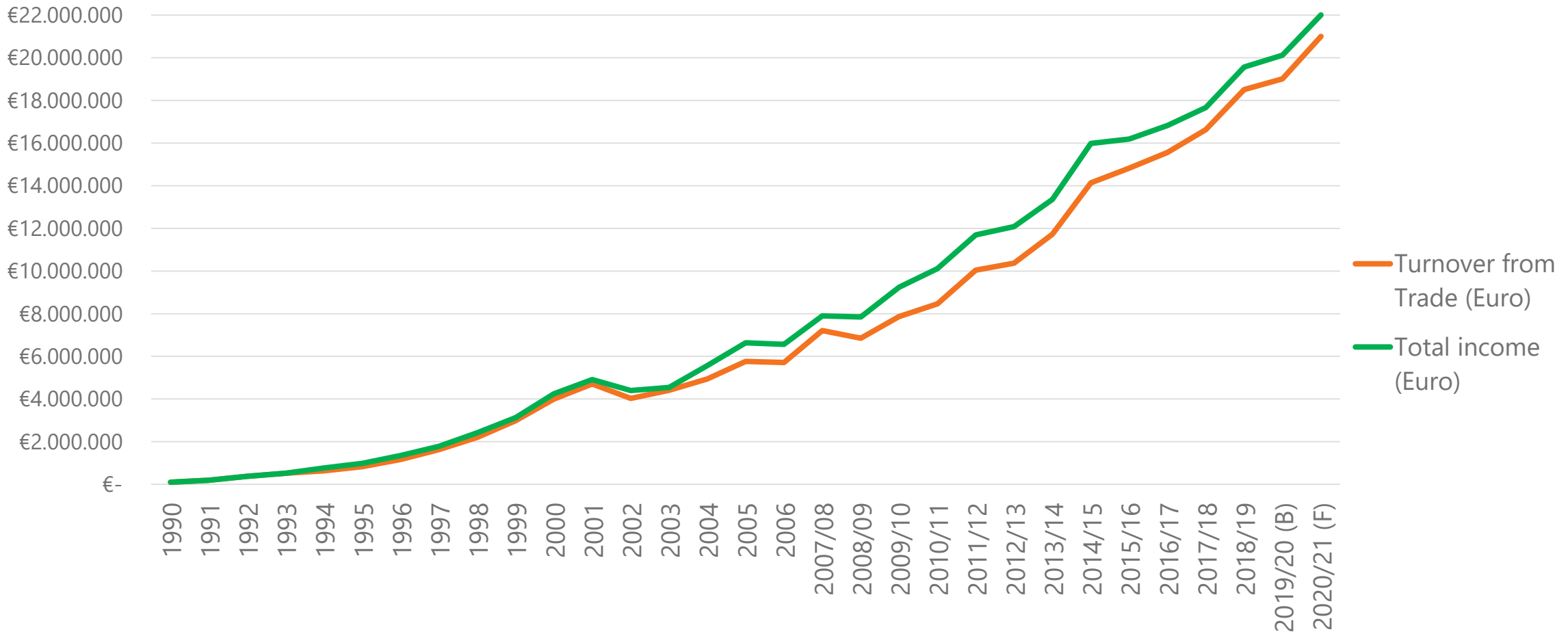
Our clients
Universities

Our clients

Pharmaceutical industry

Healthy business

Revenue growth



The future of health

Market trends and opportunities

- Researchers of human behavior are increasingly asking for **automated data collection**.
- Human behavior studies move from the lab to more naturalistic context, asking for **non-invasive sensors** and **automated remote monitoring**.
- Multimodal measurement asks for **sensor fusion** and **smart data integration**.
- Increasing interest in animal models of social behavior asks for robust identification and advanced analysis tools.
- Big data resulting from automated measurement needs **AI-based analytics**, video highlights, insightful graphs and dashboards.
- Scientists expect **access to data** anytime and anywhere, device-independent and OS-independent software tools.
- Research moves **from the clinic to the field**, from a handful of test participants to hundreds of patients participating remotely.
- Research tools for thousands of scientists can be embedded in **teaching** programs, reaching millions of students.

The future of health

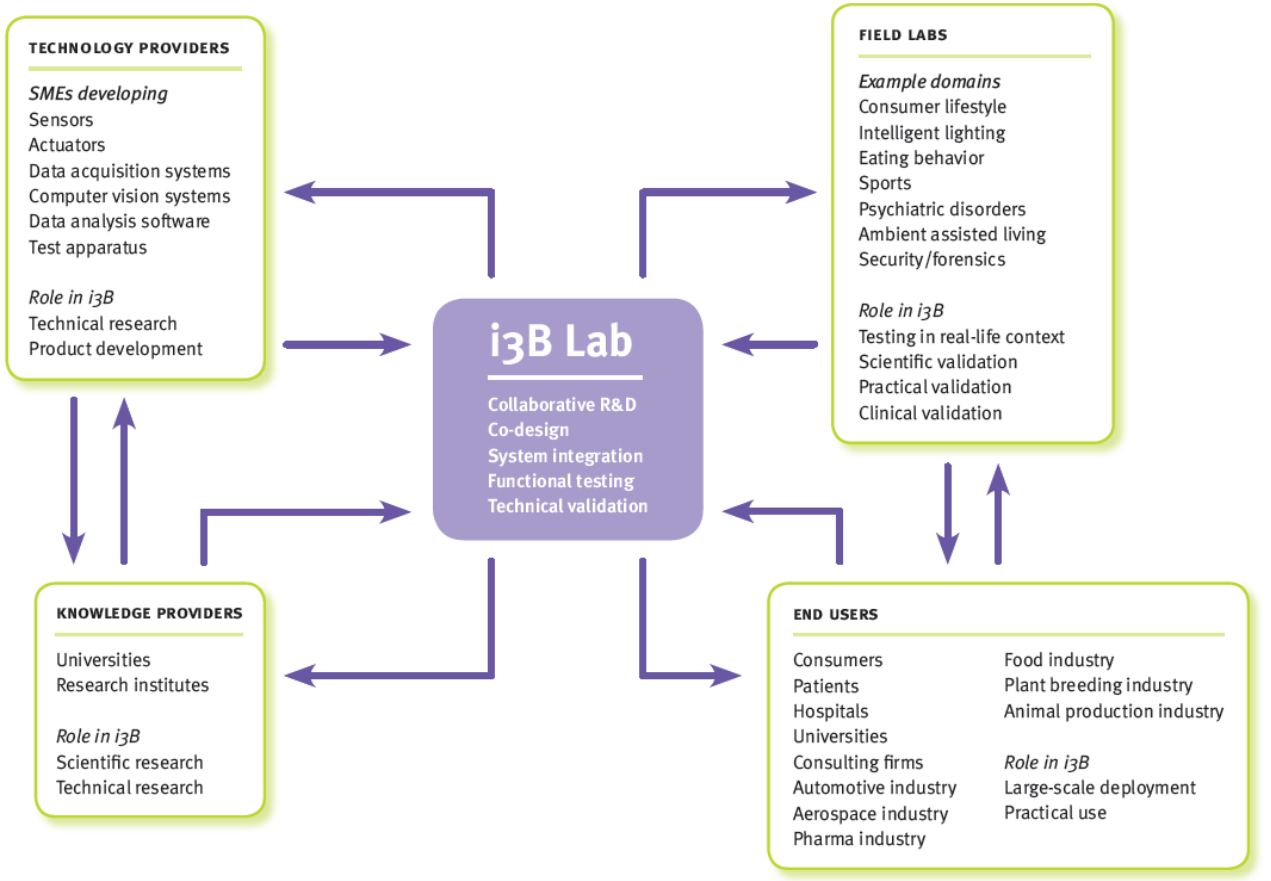
Technical developments and enablers

Ongoing developments in computer science, microelectronics and data communication enable breakthrough innovations:

- **Sensor technology**: wider choice of sensors, more sensitive, smaller, cheaper.
- **Computing power**: low-cost processing power allows real-time massive number crunching.
- **Internet**: our customers are always online, everywhere.
- **Artificial Intelligence**: software libraries for computer vision, deep learning, pattern recognition are freely available.

Innovation through collaboration

Our innovation ecosystem



Comorbid Analysis of Neurodevelopmental Disorders and Epilepsy

CANDY

The problem

- Neurodevelopmental conditions (e.g. autism, ADHD) affect ~15% of the European population.
- Often associated with somatic illnesses (e.g. epilepsy, autoimmune disease) which can have a strong impact on quality of life.
- No effective treatments
- Why do they co-exist?

Project objectives

- Understand interaction between genetic and environmental factors
- Elucidate causal mechanisms
- Develop new strategies for prevention and treatment

Target group

Animal model

Radboud umc · King's College London · Institut Pasteur · Uni Basel
University of Groningen · Ghent University · Karolinska Institutet · Assistance Publique Hôpitaux de Paris
Inserm · Ulm University · CEA Paris-Saclay · ADDISS
Autism Europe · Noldus · ARTTIC · Birkbeck

HORIZON 2020

AIMS-2-TRIALS

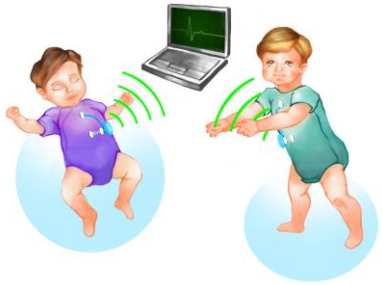
Smart Baby Suit

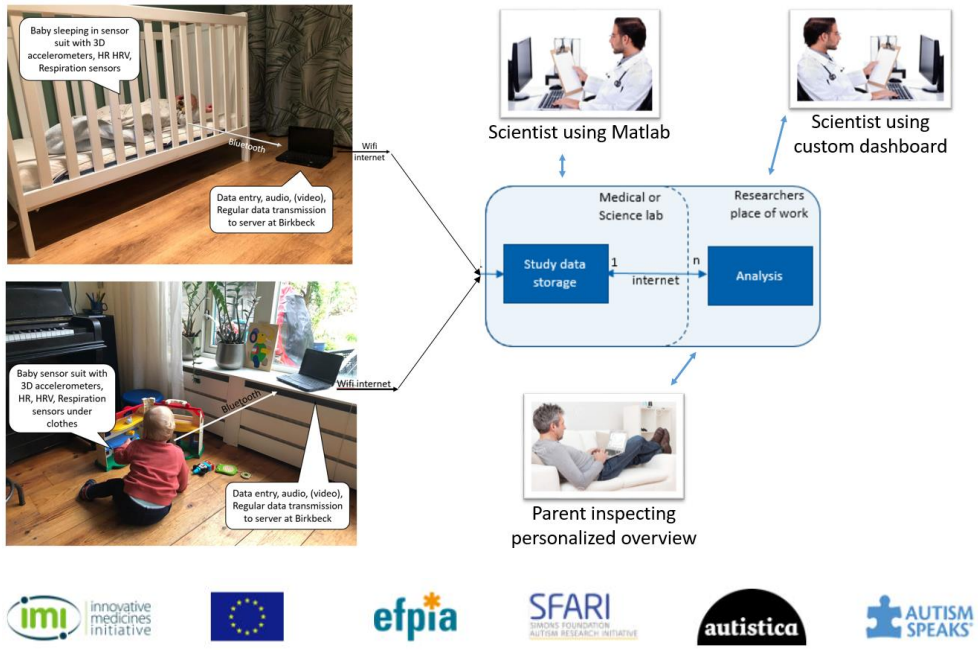
Objectives

- Development of system for continuous automated monitoring of body motion, posture, heart rate and breathing rate in babies and toddlers for home use
- Integration of sensors in garment, no discomfort
- Machine learning, pattern recognition
- Distributed data architecture using low-cost hardware and web interface
- Easy for use for parents, clinicians and researchers

Project partners

- Radboud University (Biophysics, Artificial Intelligence, Baby & Child Research Center)
- Noldus Information Technology
- Demcon
- AIMS-2-TRIALS consortium





Innovaties voor Gedrag en Gezondheid in Gelderland

Objectives

- Development of integrated monitoring solutions for early risk detection and personalized lifestyle/behavior interventions
- Main product: multi-sensor wristband for continuous measurement of activity, motion and physiological parameters, real-time display and capture of user response
- Provide insight into risk factors, efficacy of behavioral interventions, and mental wellbeing
- Data accessible for healthy volunteers, patients, healthcare professionals and researchers
- Distributed data architecture for remote monitoring and support
- Privacy by design, AVG and GDPR compliant

Europese Unie

Europees Fonds voor Regionale Ontwikkeling

Thank you for your attention

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