

In this June 2018 issue...

- [Autonomic Adapters](#)
- [Actions and Autonomic Adapters](#)
- [Machine learning in GRaCE-AGE](#)
- [GRaCE-AGE partners](#)
- [Whats next ...](#)

GRaCE-AGE mid-term report

In the first six months of the year, we have gained new organisations using the GRiST technology, firmed up our commercialisation plans, and rolled out training programmes for both mental health practitioners and members of the public. Our main achievements can be summarised as:

Finalised and validated machine learning algorithms that exploit mental-health expertise to evaluate suicide risk and provide appropriate advice on reducing it.

Autonomic adapters that can be embedded within the mental-health expertise and “listen out” for situations requiring an intervention. An overall “policy” determines how to respond to the events in the context of inputs coming from other adapters. The system provides great flexibility in adapting GRaCE-AGE to individual contexts.

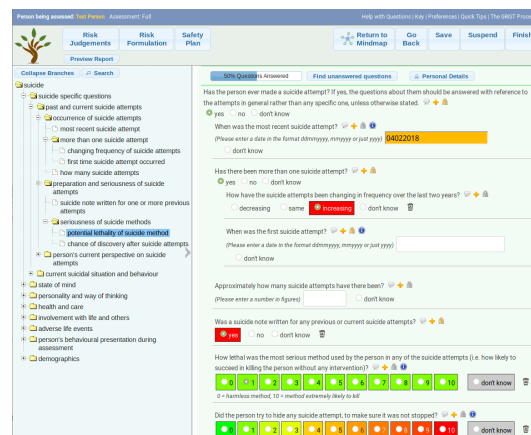
Business and commercialisation activities that are building collaborations and strategies for sustaining GRaCE and GRaCE-AGE beyond the EIT Health funding.

Training for mental health professionals based on the way GRaCE models clinical decision making, from risk evaluations through formulations to management plans and interventions.

Research and development that underpins the GRiST technology and has led to many research publications, including PhD theses.

Autonomic Adapters for planning care

One of the most exciting aspects of the GRaCE-AGE project has been linking risk evaluations to plans for mitigating the risks. The knowledge underpinning GRaCE-AGE is structured into high level concepts that break down into lower-level concepts and eventually to specific items of information that are collected by the assessment questions. For example, suicide risk has subconcepts of previous history, current intention, and depression as contributors, amongst many other issues.



The screenshot shows a web-based assessment form for suicide risk. It includes a navigation menu at the top with options like 'Risk Judgements', 'Risk Formulation', and 'Safety Plan'. The main content area is divided into a left-hand panel with a tree view of assessment categories (e.g., 'suicide specific questions', 'preparation and seriousness of suicide attempts') and a right-hand panel with specific questions and a risk contribution scale. The scale uses colored circles from green (0) to red (10) to indicate risk levels. Questions include 'Has the person ever made a suicide attempt?', 'When was the most recent suicide attempt?', and 'How many suicide attempts have there been?'. The interface also includes a search bar and various navigation buttons.

The illustration shows how the knowledge is structured in the left-hand panel and the questions for collecting data in the right-hand panel for a small part of the suicide risk hierarchy. Each answer generates a risk contribution of between 0 (green) to 1 (red) that helps show where the risk is accumulating. But please note that a maximum contribution is not necessarily creating high risk because the influence of each answer varies: some are very

important, others are more to do with managing risks rather than predicting them

Actions and Autonomic Adapters

Each GRaCE-AGE question and concept can be associated with an action or intervention, depending on the level of risk associated with it. For example, if the depression concept has a high risk level, then an action can be triggered for a referral to the [IAPT primary-care service](#). Or if the answer to the angry emotion question is 10 (maximum risk), an action could point people to resources for anger management.



Autonomic Adapters (AAs) are a way of implementing the actions associated with a question or concept. An AA can be attached to a question or concept and be configured to react whenever the level of risk is within a particular range. When it is, the AA sends a signal to the central policy rule base, which decides whether the action associated with the AA should be executed, depending on what other AAs have been

activated at the same time. The rule-base learns the most appropriate risk levels and combinations of actions that produce the most effective improvement plans and “adapts” the AAs accordingly.

The research on autonomous adapters was presented at the [The International Conference on Intelligent Systems and Computer Vision 2018](#) in April and received the best paper award.

Machine learning in GRaCE-AGE

The GRiST decision support system is used by experienced mental-health practitioners to collect information about a person and produce a risk assessment for them. The practitioners provide their own expert judgements about the level of risks associated with the person's information profile. There are over one million of these judgements and the GRaCE-AGE team has been working on machine-learning algorithms that can use them to predict risks.

Risk Score	Accuracy	Shifted accuracy	Shifted Scores	Freq
0	64	95	0,1	21172
1	52	96	0, 1, 2	27567
2	40	95	1,2,3	21735
3	36	93	2,3,4	14375
4	37	89	3,4,5	7313
5	31	85	4,5,6	5456
6	33	82	5,6,7	2475
7	32	79	6,7,8	2216
8	36	77	7,8,9	1579
9	47	81	8,9,10	513
10	65	80	9,10	155

In June, a PhD student at Aston, Nawal Zaher, completed her thesis and demonstrated extremely accurate predictions of practitioners' risk judgements. GRiST uses an 11-point scale, from 0 (minimum risk) to 10 (maximum risk), which provides a high-level of discrimination compared to the three-point low, medium, high risk that other scales often use.

The challenge is to predict a clinical risk judgement to within plus or minus one of the actual number given. We call this our "shifted accuracy";

the "shifted scores" column shows the predicted judgements that are deemed to be correct for the given clinical (actual) judgement. We are able to meet this target around 80% of the time for all risk levels and illustrates how reliably mental-health practitioners assess mental health.

Although predicting risk judgements is not the same as predicting a risk event itself, our analyses have indicated a link between judgements and outcomes. If a practitioner's judgement is more than two points lower than the prediction, the risk of a repeat suicide attempt increases by up to a third. This is why we will be monitoring for such eventualities and bringing it to the attention of practitioners just in case they want to reconsider their assessment.

[Back to Contents](#)

1. *West Midlands Academic Health Science Network*, which includes Aston University, the lead organisation and responsible for developing the software.
2. *University of Leuven* is researching new sensors and contributing to the GRaCE-AGE interface design as well as being responsible for the Belgian pilots.
3. *BeWell Innovations* has expertise in diagnostic testing and tele-monitoring as well as providing software platforms that share information between providers and patients, as is the intention of GRaCE-AGE.
4. *Maastricht Instruments* has a more hardware orientation, with expertise in helping researchers design and deliver their ideas within products that can be commercialised.
5. *ExtraCare* is a charity running residential villages for older adults in the community. It has suitable pilot sites and will help develop and deliver training.
6. *Evolyst* is a software development company specialising in healthcare apps. It will provide advice and technical help, especially for the evolving mobile GRaCE-AGE versions.
7. *Galassify* is a small, new company that will use its experience with end users and the current GRiST system to develop the requirements and support the pilots for GRaCE-AGE.

[Back to Contents](#)

Coming up in the next six months



1. We are very excited to be trialling a new ambient sensor created by RedGear that collects multiple types of data within a single box. This will be tested by ExtraCare and we are confident that it will greatly improve their ability to assess the care requirements of new residents.
2. Commercialisation activities will continue apace, with joint ventures being drawn up with Evolyst and BeWell Innovations.
3. The machine learning algorithms will now be implemented within GRaCE-AGE so that they can disseminate expertise and advice to older adults and their care network.
4. Flexible pathways are being developed for more focused assessments that improve accessibility to my-GRaCE.
5. Migration to new servers and from Drupal 6 to Drupal 8 will be completed and greatly improve both security and functionality of GRiST.
6. The new responsive website and themes will enable mobile versions of my-GRaCE.
7. GRaCE will be set up as a new limited company and start trading by the end of the year.
8. We hope to run a third ATHENS course at KU Leuven for students across Europe. It provides a week of teaching and active learning on the subject of healthcare in the community using sensors.

[Back to Contents](#)

Contact Information:

Dr Christopher Buckingham
c.d.buckingham@aston.ac.uk
www.egrist.com/grace-age