Managing the Mental Health of the Armed Forces
The role of digital health technologies and personalised healthcare

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• **Aim:** to produce high quality research which has a positive impact on the health & wellbeing of the armed forces community.

• **Multi-disciplinary team in:** computer science, psychiatry, epidemiology, military history, psychology, public health.

• Over 1000+ refereed articles published to-date on military health.

• Co-located with ADMMH (Academic Department of Military Mental Health) – composed of members of the British Armed Forces.

Established in 2003
Identifying probable PTSD using machine learning
PTSD compared to other disorders

The prevalence of alcohol misuse has decreased from 2004/06, whereas the prevalence of PTSD has increased from 4% to 6%

Machine learning as an aid... *for now*

- The risks:
  - **Perception**: Deep Mind and Greenwich hospital
  - **Understanding**: ‘Black box’
  - **Accountability**: ‘Blame’
  - **Human factor**: ‘Loss of jobs’

Work on-going to mitigate these risks
Approach

Self-report questionnaire data

13,690 completed PCL-C
22 variables

Classical machine learning
Support Vector Machines
Random Forests
Artificial Neural Network
Bagging

80% retained for training
20% used for testing

Prediction
Induction of probable PTSD
No indication PTSD

Features contributing to a prediction

## Approach

80% retained for training  
20% used for testing

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>MCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Vector Machines</td>
<td>0.91</td>
<td>0.70</td>
<td>0.92</td>
<td>0.74</td>
</tr>
<tr>
<td>Random Forests</td>
<td>0.97</td>
<td>0.60</td>
<td>0.98</td>
<td>0.64</td>
</tr>
<tr>
<td>Artificial Neural Networks</td>
<td>0.89</td>
<td>0.61</td>
<td>0.92</td>
<td>0.45</td>
</tr>
<tr>
<td>Bagging</td>
<td>0.95</td>
<td>0.69</td>
<td>0.96</td>
<td>0.55</td>
</tr>
</tbody>
</table>


13,690 completed PCL-C
**Approach**

**Machine learning analysis is helping us to determine WHICH variables are most important**

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Rank 1</th>
<th>Rank 2</th>
<th>Rank 3</th>
<th>Rank 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support Vector Machines</td>
<td>AUDIT Score</td>
<td>GHQ-12 score</td>
<td>Age (years)</td>
<td>Consumes alcohol (y/n)</td>
</tr>
<tr>
<td>Random Forests</td>
<td>Gender</td>
<td>AUDIT Score</td>
<td>GHQ-12 score</td>
<td>Service type</td>
</tr>
<tr>
<td>Artificial Neural Networks</td>
<td>GHQ-12 score</td>
<td>AUDIT case (y/n)</td>
<td>AUDIT Score</td>
<td>Consumes alcohol (y/n)</td>
</tr>
<tr>
<td>Bagging</td>
<td>Age</td>
<td>Consumes alcohol (y/n)</td>
<td>Smoking</td>
<td>GHQ-12 score</td>
</tr>
</tbody>
</table>


Drinks:Ration - an Android and iOS app for Armed Forces personnel

FEEL BETTER AND SAVE MONEY BY DRINKING LESS ALCOHOL
Is there a problem with drinking in the UK military?

ALCOHOL USAGE IN THE UK ARMED FORCES
1 June 2016 - 31 May 2017

ALCOHOL SCREENING TOOL
74% (n = 109,459) of Regular UK Armed Forces personnel had completed a questionnaire (AUDIT-C). (1% declined)

This is the first large scale use of the AUDIT-C questionnaire in a military population

RISK CATEGORIES
61% scored 5+ indicating that they may potentially be at increasing risk or above of alcohol related harm (ranging from poor mood, accidents and reduced fitness, to possible long-term illness)

You would score in this category if you drank:
- 3 glasses of wine twice a week
- 4 pints of beer on one occasion in the month

2% scored 10+ indicating that they may potentially be at increasing or higher risk and should be advised to see their GP

You would score in this category if you drank:
- 3 pints of beer 5 times a week

ALCOHOL ADVICE
80% of personnel who scored 1+ had been given an alcohol advice leaflet

63% of personnel who scored 5+ had been given advice about reducing their drinking (alcohol brief intervention)
The story so far...

Evaluating the efficacy of a mobile app (Drinks:Ration) to reduce alcohol consumption in a help-seeking military veteran population: Randomised Controlled Trial. Daniel Leightley, Charlotte Williamson, Roberto Rona, Ewan Carr, James Shearer, Jordan D. Davis, Amos Simms, Nicola T. Fear, Laura Goodwin and Dominic Murphy. *Journal of Internet Medical Research: mHealth & uHealth*, 2022.


How is *Drinks*:Ration different to others?

- Focused on binge drinking and problematic behaviours
- Focused on **shorter term outcomes** e.g. impact on relationship
- Use **implementation intentions** goal setting
- Daily **personalised** text messages and/or push notifications
- Weekly **assessments** of mood and drinking behaviours to inform personalisation
- Content **tailored** to target veterans

Behavioural Change Theory underpins all *Drinks*:Ration components

**Machine Learning (semi-supervised)**
- User behaviours (insights)
- Stage transition (progress)
- Messaging (adherence)

Note: Users do not directly interface with MLaaS

Data problem: user persona data (synthetic)

Signal problem: what is ‘meaningful’
DrinksRation Data

- Socio-demographics
- Self-reported mental and physical health (weekly)
- Drinking behavior (location, time, type)
- Goals (and barriers to goals)
- Physical activity (Google Fit/Apple Health)
- Notification interactions
- App usage
Personalising the ‘message’

*IndEx (v1) + Cohort*
- Socio-demographic
- Alcohol-use
- Mental health
- Alcohol behaviours
- Message impact

Feature selection (predictive performance to outcome)
Personalising the ‘message’

Policy-based Reinforcement Learning

Probability based predictions: 1) message type 2) context 3) behaviour to focus

Threshold value manually specified
Personalising the ‘message’

User summary generated: drinking behaviour (eg. daily aggregates, when, where, who with, triggers)

JSON payload – per user
Personalising the ‘message’

Message constructed with personal greeting and message. Determine when to send the message and channel.
Evening Dan, if you’re off out tonight – maybe you should think about singles instead of doubles? It would have saved you £16.70 last week.
Evening Dan, if you’re off out tonight — maybe you should think about singles instead of doubles? It would have saved you £16.70 last week.

Using ANN via MLaaS constrained rules.
Does it actually work?

<table>
<thead>
<tr>
<th>Reported alcohol consumption</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking days</td>
<td>4.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Drink free days</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Units per drinking day</td>
<td>5.6</td>
<td>6.5</td>
<td>4.54</td>
<td>4.7</td>
</tr>
<tr>
<td>Units consumed</td>
<td>22.9</td>
<td>20.4</td>
<td>18.1</td>
<td>15.9</td>
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<tr>
<td>Alcoholic drinks per drinking day</td>
<td>2.0</td>
<td>3.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Binge drinking days per week</td>
<td>2.0</td>
<td>2.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Median.

Previous study
MAVERICK app

MAVERICK
Please select an option to continue...
Scan QR code or enter token?
By creating an account you agree to our Privacy Policy
App: v1.0 (0x10000012)

Permission
MAVERICK needs your permission to function properly. Please read each of the next screens carefully. You can change your choice at any time via the 'settings' tab

Questionnaire
Please tell us a bit about yourself.
Recognizing that sexual orientation is complex, which of these terms best describes your sexual orientation?

- Straight/heterosexual
- Gay
- Lesbian
- Bisexual
- Questioning
- Asexual
- Other

iOS

Google Play
Legalisation of cannabis in California

- Legal for medical use since 1996, and for recreational use since 2016.
  - Heavy taxation.

- Can be purchased from any recreational cannabis dispensary. ID required.

- Can purchase a maximum of 28.5 grams.

- You do not need to justify your use of cannabis.
MAVERICK study

Focus: Recently discharged veterans with a history of PTSD and cannabis use who are not under treatment for either condition.

1. Use machine learning algorithms to determine whether passive data, alone and/or in conjunction with active data collection, can accurately predict clinically significant increases in PTSD symptoms and cannabis use.

2. Assess interplay between PTSD and problematic cannabis use.

3. Understand the feasibility and acceptability of monitoring symptoms using passive vs. active data collection in clinical practice to non-treatment-seeking veterans.
Participant journey

App
Download MAVERICK app

Questionnaires
Complete daily questionnaires

Wearable
Obtain physical activity data

Interview
Interview on cannabis use

Participants take part for 84 days
MAVERICK app
Thank You

Do you have any questions?

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