The non-existent average individual
Blaauw, Frank

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Chapter 11

Conclusion and Future Perspectives

Every now and then a man’s mind is stretched by a new idea or sensation, and never shrinks back to its former dimensions (a quote from Holmes, 1858). We commenced this dissertation with an epistle pertaining to dimensionality. The dimensionality surrounding individuals is high and as such, every individual can be considered unique. We set out to explore different methods and approaches to signify the uniqueness of the individual in e-mental health and psychopathology research, and how this can be accelerated using data science. We divided this quest for personalization into two parts: one part in which we collected data about the individual on a large scale, and one part where we focused on means to provide personalized advice on these data.

The importance of data in data science cannot be overstated. Ever richer data sets can shed light on the infinite dimensional natural systems that underlie the individual. To better understand these complex and individual systems, high resolution time series data sources, such as sensor data and ecological momentary assessment (EMA) data, should be incorporated, like we showed in the previous chapters. Apart from these two sources of data, we also envision the importance of other data sources, mainly data that people are eager to provide as part of their social life. People are currently generating vast amounts of personal data on numerous social media platforms, and such platforms have been shown to share important information about various psychological traits (e.g., personality; Golbeck, Robles, & Turner, 2011; Quercia, Kosinski, Stillwell, & Crowcroft, 2011). Another source of data could be the various messaging applications one uses (such as email and chat applications), or data collected by one’s smartphone (e.g., location). Including data from such platforms could be an unobtrusive way to collect data, and could offer a heterophenomenological perspective on the individual.

A promising direction for psychopathology research is a dimensional, dynamic, and individual perspective that acknowledges the role of the interactions between mental context, symptoms, and strengths (Lee Duckworth et al., 2005). The field of psychopathology research is one in which personalization has the potential to have a major impact, as the heterogeneity of both the individual and the disorder have been shown to result in a highly variable effectiveness of treatments. As an
effect of such heterogeneity, one-size-fits-all methods that might be effective in other fields of medicine are often sub-optimal in the treatment of psychopathology. Still, current clinical practice strongly relies on the normative categories provided by the Diagnostic and Statistical Manual of Mental Disorders (DSM). Although categorization into discrete mental disorders may be helpful in clinical practice to communicate and to reach treatment decisions, this procedure may be supplemented with a patient-tailored approach via the introduction of diary studies focusing on the level of symptoms and personalized models of feedback. The acceptance and application of such individualized assessment and feedback methods is intrinsically linked to computer science. Applying diary methods on a large scale is undesirable or even impossible without the use of information and communication technology (ICT), and for such methods to become mainstream and accepted in clinical practice, the use of automated analyses is inevitable. Our platforms for EMA studies, the use of Physiqual, and our implementations of Automated Impulse Response Analysis (AIRA) and the Online SuperLearner (OSL) could aid the implementation of such automation in practice. As such, these implementations could serve as a basis for future research.

We envision that automated analysis techniques, in particular those based on machine learning, can become a major asset in medicine, especially in precision and personalized medicine. On the one hand, machine learning could serve for the development of person-tailored decision support systems using parameters derived from empirical data, and provide insight into the probable effects that treatments will have for the individual patient.

On the other hand, machine learning could serve as an early warning system in which it would be used to analyze real-time and high dimensional data related to symptoms, strengths and context of individual patients, and automatically provide feedback whenever help is needed. This does not necessarily mean that it is used for preventive medical care; it might also serve as a self-management tool for people that prefer to self-monitor their health.

To conclude, we explored methods and applications that could aid psychopathology research and improve the general well-being. We designed and implemented several platforms that aim to increase personalization in psychopathology research. And we did this all with a single goal: to move away from the non-existent average individual.
## Appendix A

**HowNutsAreTheDutch and Leefplezier — Supplement**

### A.1 HowNutsAreTheDutch

Table A.1: Modules, instruments, and contents of the cross-sectional study of HowNutsAreTheDutch.

<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>Description</th>
<th>Items</th>
<th>Response range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>N/A</td>
<td>Gender, birth year, postal code area, relationship status, number of children, education level, and occupational situation.</td>
<td>8</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Living situation</td>
<td>N/A</td>
<td>Country of origin (also for both parents), family income, living arrangement, family members, pets, religion, time spent on television/internet/sports, length and weight, and hand preference.</td>
<td>17</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Affect / Mood</td>
<td>Positive And Negative Affect Schedule (PANAS)</td>
<td>PANAS Flemish version, assesses 10 positive and 10 negative emotions over the past week. Mood over the past week and is sensitive to subthreshold symptoms.</td>
<td>20</td>
<td>1 to 5</td>
<td>Peeters et al. (1996); Raes et al. (2010)</td>
</tr>
<tr>
<td></td>
<td>Quick Inventory of Depressive Symptoms (QIDS)</td>
<td>The QIDS assesses and classifies Diagnostic and Statistical Manual of Mental Disorders (DSM) major depression with 9 domains, sad mood, concentration, self-criticism, suicidal ideation, interest, energy/fatigue, sleep, change in appetite/weight, psychomotor, over the past week.</td>
<td>16</td>
<td>0 to 3</td>
<td>A. Rush et al. (2003); A. J. Rush et al. (2006)</td>
</tr>
<tr>
<td></td>
<td>Depression Anxiety Stress Scales (DASS)</td>
<td>The DASS measures mood over the past week and is sensitive to subthreshold symptoms.</td>
<td>42</td>
<td>0 to 3</td>
<td>De Beurs, van Dyck, Marquenie, Lange, and Blonk (2001); Lovibond and Lovibond (1995)</td>
</tr>
</tbody>
</table>

*Continued on next page.*
<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>Description</th>
<th>Items</th>
<th>Response range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellbeing</td>
<td>Manchester Short Assessment of quality of life (MANSA)</td>
<td>The MANSA measures quality of life on multiple domains, with 12 items for a sum score, and 4 additional yes/no items.</td>
<td>16</td>
<td>1 to 7</td>
<td>Priebe, Huxley, Knight, and Evans (1999); Priebe et al. (2010)</td>
</tr>
<tr>
<td></td>
<td>Happiness index</td>
<td>The Happiness index assesses the degree to which one judges the quality of one’s life in a single item: Do you feel happy in general?</td>
<td>1</td>
<td>0 to 10</td>
<td>Abdel-Khalek (2006); Fordyce (1988); Veenhoven (1994)</td>
</tr>
<tr>
<td></td>
<td>Social Production Functions for the Level of well-being (SPF-II)</td>
<td>The SPF-II measures the five universal primary goals affection, behavioral confirmation, status, comfort, and stimulation, which, according to SPF theory, underlay individual wellbeing.</td>
<td>15</td>
<td>0 to 3</td>
<td>Nieboer, Lindenberg, Boomsma, and Bruggen (2005)</td>
</tr>
<tr>
<td></td>
<td>Ryff scales</td>
<td>The Ryff scales of psychological wellbeing measure self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth.</td>
<td>39</td>
<td>1 to 6</td>
<td>Van Dierendonck (2004)</td>
</tr>
<tr>
<td>Personality</td>
<td>Neuroticism-Extraversion-Openness Five-Factor Inventory updated and revised version (NEO-FFI-3)</td>
<td>The NEO-FFI-3 personality inventory assesses the Big Five personality domains Neuroticism, Extraversion, Openness to experience, Agreeableness, and Conscientiousness with 60 items. This instrument was extended with 36 neuroticism items from the Neuroticism-Extraversion-Openness Personality Inventory updated and revised version (NEO-FFI-3) to derive all facet traits for the neuroticism domain.</td>
<td>96</td>
<td>1 to 5</td>
<td>De Fruyt and Hoekstra (2014)</td>
</tr>
<tr>
<td></td>
<td>Dark Triad</td>
<td>The Dark Triad assesses tendencies towards Narcissism, Machiavellianism, and Psychopathy.</td>
<td>12</td>
<td>1 to 9</td>
<td>Klimstra, Sijtsema, Herricks, and Cima (2014); Paulhus and Williams (2002)</td>
</tr>
<tr>
<td></td>
<td>Doing, Feeling, Thinking</td>
<td>Doing, Feeling, Thinking assesses tendencies towards the behavioural styles Doing (practically-oriented), Feeling (relational-oriented), and Thinking (content-logic-oriented).</td>
<td>9</td>
<td>1 to 3</td>
<td>De Klerk, van Yperen, Postma, and Kamsma (2003)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>Patient Health Questionnaire 15 item version (PHQ-15)</td>
<td>The PHQ-15 is a screening and diagnostic tool to assess somatic symptoms associated with mental health disorders.</td>
<td>15</td>
<td>1 to 3</td>
<td>Kroenke, Spitzer, and Williams (2002)</td>
</tr>
</tbody>
</table>

Continued on next page.
<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>Description</th>
<th>Items</th>
<th>Response range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosmalen Somatic items scale (Rosi)</td>
<td>A composite of five items from the Symptom Checklist (SCL) somatic scale and eight 13 items derived from an expert committee supervised by J. Rosmalen.</td>
<td>13</td>
<td>0 to 2</td>
<td>Arrindell and Ettema (1986)</td>
<td></td>
</tr>
<tr>
<td>Whiteley index</td>
<td>The Whiteley index measures tendencies towards hypochondria.</td>
<td>14</td>
<td>0 to 1</td>
<td>Speckens, Spinhowen, Slokers, Bolk, and van Hemert (1996)</td>
<td></td>
</tr>
<tr>
<td>Psychotic experiences</td>
<td>Community Assessment of Psychic Experiences (CAFE)</td>
<td>34</td>
<td>0 to 3</td>
<td>Konings, Bak, Hanssen, van Os, and Krabbendam (2006)</td>
<td></td>
</tr>
<tr>
<td>Optimism</td>
<td>Life Orientation Test-Revised (LOT-R)</td>
<td>The LOT-R assesses dispositional optimism (and pessimism).</td>
<td>10</td>
<td>0 to 4</td>
<td>Glaesmer et al. (2012)</td>
</tr>
<tr>
<td>Empathy</td>
<td>Empathy Quotient (EQ)</td>
<td>The EQ questionnaire measures both affective empathy via shared emotions and cognitive empathy or theory of mind.</td>
<td>40</td>
<td>0 to 2</td>
<td>Baron-Cohen and Wheelwright (2004)</td>
</tr>
<tr>
<td>Childhood adversity</td>
<td>Childhood Trauma Questionnaire-Short Form (CTQ-SF)</td>
<td>The CTQ-SF is a retrospective self-report questionnaire designed to assess five dimensions of childhood maltreatment: physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect.</td>
<td>28</td>
<td>1 to 5</td>
<td>Thombs, Bernstein, Lobbestael, and Arntz (2009)</td>
</tr>
<tr>
<td>Intelligence</td>
<td>International Cognitive Ability Resource Base (ICAR)</td>
<td>We selected 11 items measuring inductive reasoning and 24 items measuring 3D rotation abilities from the ICAR cognitive item pool.</td>
<td>35</td>
<td>1 to 6, 1 to 8</td>
<td>Condon and Revelle (2014)</td>
</tr>
<tr>
<td>Evaluation</td>
<td>The evaluation questionnaire was designed to evaluate the HowNutsAreTheDutch (HND) website, the cross-sectional questionnaire modules, the feedback upon completed modules, and the impact of participation.</td>
<td>7</td>
<td>1 to 10</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
Table A.2: Items of the HND diary study.

<table>
<thead>
<tr>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hoe gaat het op dit moment met u?</td>
<td>How are you doing right now?</td>
<td>'Very bad' to 'Very good'</td>
<td>0 to 100</td>
<td>Moment-to-moment quality of life</td>
</tr>
<tr>
<td>2</td>
<td>Heeft u sinds het vorige meetmoment geslapen?</td>
<td>Did you sleep since the last measure?</td>
<td>(1) No, (2) Yes</td>
<td>1 to 2</td>
<td>Sleep (check boxes). If yes, go to 3 and 4</td>
</tr>
<tr>
<td>3</td>
<td>Heeft u goed geslapen?</td>
<td>Did you sleep well?</td>
<td>'Not at all' to 'Very well'</td>
<td>0 to 100</td>
<td>Quality of sleep</td>
</tr>
<tr>
<td>4</td>
<td>Heeft u lang genoeg geslapen?</td>
<td>Did you sleep long enough?</td>
<td>'Too short' to 'Too long'</td>
<td>0 to 100</td>
<td>Duration of sleep</td>
</tr>
<tr>
<td>5</td>
<td>Ik voel me ontspannen</td>
<td>I feel relaxed</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td>6</td>
<td>Ik voel me somber</td>
<td>I feel gloomy</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td>7</td>
<td>Ik voel me energiek</td>
<td>I feel energetic</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Activation</td>
</tr>
<tr>
<td>8</td>
<td>Ik voel me angstig</td>
<td>I feel anxious</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
<tr>
<td>9</td>
<td>Ik voel me enthousiast</td>
<td>I feel enthusiastic</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Activation</td>
</tr>
<tr>
<td>10</td>
<td>Ik voel me onrustig</td>
<td>I feel nervous</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
<tr>
<td>11</td>
<td>Ik voel me tevreden</td>
<td>I feel content</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td>12</td>
<td>Ik voel me prikkelbaar</td>
<td>I feel irritable</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
<tr>
<td>13</td>
<td>Ik voel me kalen</td>
<td>I feel calm</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td>14</td>
<td>Ik voel me lusteloos</td>
<td>I feel dull</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td>15</td>
<td>Ik voel me opgewekt</td>
<td>I feel cheerful</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Activation</td>
</tr>
<tr>
<td>16</td>
<td>Ik voel me moe</td>
<td>I feel tired</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td>17</td>
<td>Ik ervaar lichamelijk ongemak</td>
<td>I experience physical discomfort</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Somatic symptoms</td>
</tr>
<tr>
<td>18</td>
<td>Ik voel me gewaardeerd</td>
<td>I feel valued</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Self-esteem</td>
</tr>
<tr>
<td>19</td>
<td>Ik voel me eenzaam</td>
<td>I feel lonely</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Loneliness</td>
</tr>
<tr>
<td>20</td>
<td>Ik heb het gevoel tekort te schieten</td>
<td>I feel I fall short</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Worthlessness</td>
</tr>
<tr>
<td>21</td>
<td>Ik voel me zelfverzekerd</td>
<td>I feel confident</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Self-esteem</td>
</tr>
<tr>
<td>22</td>
<td>Ik pieker veel</td>
<td>I worry a lot</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Worrying</td>
</tr>
<tr>
<td>23</td>
<td>Ik ben snel afgeleid</td>
<td>I am easily distracted</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Concentration / Mindfulness</td>
</tr>
<tr>
<td>24</td>
<td>Ik vind mijn leven de moeite waard</td>
<td>I feel my life is worth living</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Worthlessness / Suicidal ideation</td>
</tr>
<tr>
<td>25</td>
<td>Ik ben van slag</td>
<td>I am unbalanced</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Stress reactivity</td>
</tr>
<tr>
<td>26</td>
<td>Ik leef in het hier en nu</td>
<td>I am in the here and now</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Mindfulness</td>
</tr>
<tr>
<td>27</td>
<td>Mijn eetlust is</td>
<td>My appetite is</td>
<td>'Much smaller than usual' to 'Much larger than usual'</td>
<td>0 to 100</td>
<td>Appetite</td>
</tr>
</tbody>
</table>

Continued on next page.
Table A.2 – continued from previous page.

<table>
<thead>
<tr>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Hoe druk heb ik het?</td>
<td>How busy am I?</td>
<td>(1) Much too busy, (2) Pleasantly busy, (3) Neutral, (4) Pleasantly quiet, (5) Much too quiet</td>
<td>1 to 5</td>
<td>Time pressure</td>
</tr>
<tr>
<td>29</td>
<td>Waar was ik het afgelopen dagdeel de meeste tijd?</td>
<td>Where have I spent most of my time since the last measurement?</td>
<td>(1) At home, (2) At work / school, (3) With family / friends, (4) On the way, (5) Vacation home / hotel / camping, (6) Hospital / health facility, (7) Restaurant / beaverly, (8) In nature, (9) Somewhere else</td>
<td>1 to 9</td>
<td>Location (check boxes; only one location could be checked)</td>
</tr>
<tr>
<td>30</td>
<td>Wat deed ik het afgelopen dagdeel de meeste tijd?</td>
<td>How did I spend most of my time since the last measurement?</td>
<td>(1) Resting / sleeping, (2) Household / groceries, (3) Working / studying / volunteering, (4) Exercising / walking / cycling, (5) Yoga / meditation / sauna visit etc., (6) Reading, (7) Hobby (e.g., gardening, making music), (8) Trip (e.g., leisure park, concert), (9) Watching tv, (10) Websurfing / gaming / social media, (11) Conversing, (12) Something intimate (e.g., cuddling, sex), (13) Something else / all kinds of things</td>
<td>1 to 13</td>
<td>Activities (check boxes; only one activity could be checked)</td>
</tr>
<tr>
<td>31</td>
<td>Ik ervoer deze activiteit overwegend als</td>
<td>I experienced this activity mainly as</td>
<td>‘Very unpleasant’, via ‘Neutral’, to ‘Very pleasant’</td>
<td>0 to 100</td>
<td>Appraisal of activity</td>
</tr>
<tr>
<td>32</td>
<td>Is er het afgelopen dagdeel iets bijzonders gebeurd?</td>
<td>Did something special happen since the last measurement?</td>
<td>(1) No, nothing, (2) Yes, something positive, (3) Yes, something neutral, (4) Yes, something negative</td>
<td>1 to 4</td>
<td>Special event (check boxes; only one box could be checked). If nothing, jump to 34, otherwise 33.</td>
</tr>
<tr>
<td>33</td>
<td>Waar had dit mee te maken?</td>
<td>This was related to</td>
<td>(1) Myself, (2) Home situation / close family / significant others, (3) Friends / other family / acquaintances, (4) Work / school, (5) Society / news, (6) Public space / strangers, (7) Other</td>
<td>1 to 7</td>
<td>Context of special event (check boxes; only one box could be checked).</td>
</tr>
<tr>
<td>34</td>
<td>Ik was het afgelopen dagdeel grotendeels</td>
<td>Most of the time since the last measurement I was</td>
<td>(1) Alone, (2) In company</td>
<td>1 to 2</td>
<td>Social company (check boxes; only one box could be checked). If alone, go to 35, followed by 38. If in company, go to 36 and 37. Continued on next page.</td>
</tr>
<tr>
<td>Q</td>
<td>Dutch</td>
<td>Translation</td>
<td>Response range</td>
<td>Range</td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>35</td>
<td>Ik was liever in gezelschap ge-weest</td>
<td>I would rather have been with others</td>
<td>'No, preferably not' to 'Yes, certainly'</td>
<td>0 to 100</td>
<td>Appraisal of being alone</td>
</tr>
<tr>
<td>36</td>
<td>Ik zou liever alleen zijn geweest</td>
<td>I would rather have been alone</td>
<td>'No, preferably not' to 'Yes, certainly'</td>
<td>0 to 100</td>
<td>Appraisal of social company</td>
</tr>
<tr>
<td>37</td>
<td>Ik vond dit gezelschap overwe-gend</td>
<td>I found my company predominantly</td>
<td>'Very unpleasant', via 'Neutral', to 'Very pleasant'</td>
<td>0 to 100</td>
<td>Appraisal of social company</td>
</tr>
<tr>
<td>38</td>
<td>Ik heb in het afgelopen dagdeel gelachen</td>
<td>Since the last measurement I had a laugh</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Laughing</td>
</tr>
<tr>
<td>39</td>
<td>Ik heb in het afgelopen dagdeel iets voor iemand kunnen beteke- nen</td>
<td>Since the last measurement I was able to make a difference</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Making a difference</td>
</tr>
<tr>
<td>40</td>
<td>Ik ben het afgelopen dagdeel buiten geweest</td>
<td>Since the last measurement I have been outside</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Being outside</td>
</tr>
<tr>
<td>41</td>
<td>Hoe lichamelijk actief was ik het afgelopen dagdeel?</td>
<td>Since the last measurement I was physically active</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Physical activity</td>
</tr>
<tr>
<td>42</td>
<td>Ik deed dingen 'op de automatische piloot', zonder me bewust te zijn van wat ik deed</td>
<td>I did jobs or tasks automatically without being aware of what I was doing</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Mindfulness</td>
</tr>
<tr>
<td>43</td>
<td>Mijn eigen belangrijke factor</td>
<td>My personal important factor</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Personal item</td>
</tr>
</tbody>
</table>
A.1. HowNutsAreTheDutch

This bar shows your score relative to the maximum score of the questionnaire:

Low  High

This bar shows your score relative to the scores of the other participants of the HowNutsAreTheDutch project:

Low  High

(a) Bar chart showing a comparison between the participant and the population.

(b) Spider chart showing a comparison between the participant and the population.

Figure A.1: Examples of provided feedback on cross-sectional modules in HowNutsAreTheDutch.

(a) Negative affect in the personal results of the diary study.

(b) The pleasantness of activities in the personal results of the diary study.

Figure A.2: Examples of provided feedback on cross-sectional modules in HowNutsAreTheDutch.
Table A.3: Population proportions and post-stratification weight factors Strata.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Age</th>
<th>Gender</th>
<th>Education</th>
<th>Dutch Population</th>
<th>HowNutsAreTheDutch</th>
<th>Truncated Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>n (± 1,000)</td>
<td>Percentage</td>
<td>n²</td>
</tr>
<tr>
<td>1</td>
<td>18 to 25</td>
<td>Men</td>
<td>Middle</td>
<td>531</td>
<td>4,045</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>Low</td>
<td>160</td>
<td>1,364</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Low</td>
<td>455</td>
<td>3,672</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>Middle</td>
<td>416</td>
<td>3,057</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>Middle</td>
<td>108</td>
<td>0.871</td>
<td>451</td>
</tr>
<tr>
<td>6</td>
<td>25 to 35</td>
<td>Men</td>
<td>Low</td>
<td>169</td>
<td>1.364</td>
<td>35</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Low</td>
<td>442</td>
<td>3,567</td>
<td>119</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Low</td>
<td>383</td>
<td>3,091</td>
<td>462</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>Low</td>
<td>128</td>
<td>1,033</td>
<td>37</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Low</td>
<td>335</td>
<td>3,188</td>
<td>186</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>Low</td>
<td>468</td>
<td>3,777</td>
<td>1,503</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>Low</td>
<td>222</td>
<td>1.792</td>
<td>47</td>
</tr>
<tr>
<td>13</td>
<td>35 to 45</td>
<td>Men</td>
<td>Low</td>
<td>483</td>
<td>3,898</td>
<td>153</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>Low</td>
<td>403</td>
<td>3,252</td>
<td>486</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>Low</td>
<td>201</td>
<td>1.622</td>
<td>49</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>Low</td>
<td>504</td>
<td>4,067</td>
<td>204</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td>Low</td>
<td>409</td>
<td>3,301</td>
<td>1,069</td>
</tr>
<tr>
<td>18</td>
<td>45 to 55</td>
<td>Men</td>
<td>Low</td>
<td>306</td>
<td>2,469</td>
<td>68</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td>Low</td>
<td>531</td>
<td>4,285</td>
<td>168</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>Low</td>
<td>406</td>
<td>3,277</td>
<td>688</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td>Low</td>
<td>336</td>
<td>2,712</td>
<td>93</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td>Low</td>
<td>562</td>
<td>4,536</td>
<td>334</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>Low</td>
<td>534</td>
<td>4,086</td>
<td>1,549</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td>Low</td>
<td>297</td>
<td>2,397</td>
<td>60</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>Low</td>
<td>425</td>
<td>3,429</td>
<td>150</td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td>Low</td>
<td>340</td>
<td>2,744</td>
<td>894</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td>Low</td>
<td>440</td>
<td>3,551</td>
<td>136</td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td>Low</td>
<td>380</td>
<td>3,067</td>
<td>296</td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td>Low</td>
<td>218</td>
<td>1.921</td>
<td>1,248</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td>Low</td>
<td>276</td>
<td>2,227</td>
<td>46</td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td>Low</td>
<td>298</td>
<td>2,405</td>
<td>98</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td>Low</td>
<td>208</td>
<td>1.679</td>
<td>412</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td>Low</td>
<td>470</td>
<td>3,793</td>
<td>69</td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td>Low</td>
<td>241</td>
<td>1,943</td>
<td>92</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td>Low</td>
<td>164</td>
<td>0.839</td>
<td>310</td>
</tr>
</tbody>
</table>

Note: Population scores were derived from the Dutch Governmental Agency for Statistics; Centraal Bureau voor de Statistiek (CBS).  

- Highest level of achieved education: Low refers to elementary school and vocational training (VMBO); Middle refers to the first three years of preparatory middle-level applied education (MBO) and higher general education (HAVO / VWO); High refers to higher education (HBO) and university degree.  
- The total sample of HND participants in this table is 12,189 because 314 participants (2.5%) did not provide their education level correctly.  
- Post-stratification weights were calculated with formula \( \text{W}_{\text{str}} = \frac{\text{N}_{\text{str}}}{\bar{N}} \), in which \( \text{W}_{\text{str}} \) refers to the weighting factor for persons in HND with age \( \alpha \), sex \( s \), and education level \( e \); \( \bar{N} \) refers to the average number of persons in the Netherlands with age \( \alpha \), sex \( s \), and education level \( e \); \( \text{N}_{\text{str}} \) refers to the number of persons in HND with age \( \alpha \), sex \( s \), and education level \( e \); \( \bar{N} \) refers to the total number of respondents in HND while \( \bar{N} \) refers to the total population in the Netherlands.  
- We truncated the highest post-stratification weights at 7 (or twice the average weight of 3.44), which reduced the weights for the two low educated youngest strata (strata 1 and 4).
### Table A.4: Questionnaire completion percentage of HowNutsAreTheDutch.

<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td></td>
<td>12,190</td>
<td>97.5</td>
</tr>
<tr>
<td>Living situation</td>
<td></td>
<td>5,568</td>
<td>44.5</td>
</tr>
<tr>
<td>(socio-demography)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affect / Mood</td>
<td>PANAS</td>
<td>8,032</td>
<td>64.2</td>
</tr>
<tr>
<td></td>
<td>QIDS</td>
<td>8,003</td>
<td>64.0</td>
</tr>
<tr>
<td></td>
<td>DASS</td>
<td>7,972</td>
<td>63.8</td>
</tr>
<tr>
<td>Wellbeing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MANSA</td>
<td>10,181</td>
<td>81.4</td>
</tr>
<tr>
<td></td>
<td>Happiness index</td>
<td>10,152</td>
<td>81.2</td>
</tr>
<tr>
<td></td>
<td>SPF-IL</td>
<td>10,137</td>
<td>81.1</td>
</tr>
<tr>
<td></td>
<td>Ryff scales</td>
<td>10,033</td>
<td>80.2</td>
</tr>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NEO-FFI-3</td>
<td>4,334</td>
<td>34.7</td>
</tr>
<tr>
<td></td>
<td>Dark Triad</td>
<td>878</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>Doing, Feeling, Thinking</td>
<td>850</td>
<td>6.8</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>PHQ-15</td>
<td>3,357</td>
<td>26.8</td>
</tr>
<tr>
<td></td>
<td>Rosi</td>
<td>3,358</td>
<td>26.9</td>
</tr>
<tr>
<td></td>
<td>Whiteley Index</td>
<td>3,354</td>
<td>26.8</td>
</tr>
<tr>
<td>Psychotic experiences</td>
<td>CAPE</td>
<td>2,911</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>HSQ</td>
<td>3,078</td>
<td>24.6</td>
</tr>
<tr>
<td>Humor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOT-R</td>
<td>2,680</td>
<td>21.4</td>
</tr>
<tr>
<td>Optimism</td>
<td>EQ</td>
<td>2,836</td>
<td>22.7</td>
</tr>
<tr>
<td>Empathy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood adversity</td>
<td>CTQ-SF</td>
<td>788</td>
<td>6.3</td>
</tr>
<tr>
<td>Intelligence</td>
<td>ICAR</td>
<td>37</td>
<td>0.2</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Evaluation</td>
<td>3,093</td>
<td>24.7</td>
</tr>
</tbody>
</table>

*Note:* The column *percentage* contains the percentage of our sample of $n = 12,503$ who filled out this specific questionnaire.
Table A.5: HowNutsAreTheDutch differences between male and female

<table>
<thead>
<tr>
<th>Participants</th>
<th>Mean</th>
<th>Mean</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>7.95</td>
<td>4.21</td>
<td>3.73</td>
</tr>
<tr>
<td>Education</td>
<td>7.95</td>
<td>4.21</td>
<td>3.73</td>
</tr>
<tr>
<td>PANAS positive affect (PA)</td>
<td>5.45</td>
<td>2.61</td>
<td>2.83</td>
</tr>
<tr>
<td>PANAS negative affect (NA)</td>
<td>5.45</td>
<td>2.61</td>
<td>2.83</td>
</tr>
<tr>
<td>QIDS depression</td>
<td>5.40</td>
<td>2.61</td>
<td>2.83</td>
</tr>
<tr>
<td>DASS depression</td>
<td>5.38</td>
<td>2.59</td>
<td>2.79</td>
</tr>
<tr>
<td>DASS anxiety</td>
<td>5.38</td>
<td>2.59</td>
<td>2.79</td>
</tr>
<tr>
<td>DASS stress</td>
<td>5.38</td>
<td>2.59</td>
<td>2.79</td>
</tr>
<tr>
<td>MANSA quality of life</td>
<td>6.60</td>
<td>3.51</td>
<td>3.09</td>
</tr>
<tr>
<td>Happiness</td>
<td>6.63</td>
<td>3.51</td>
<td>3.12</td>
</tr>
<tr>
<td>SPF</td>
<td>6.62</td>
<td>3.50</td>
<td>3.12</td>
</tr>
<tr>
<td>Bryll total</td>
<td>6.60</td>
<td>3.45</td>
<td>3.15</td>
</tr>
<tr>
<td>Bryll self-acceptance</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
<tr>
<td>Bryll positive social relations</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
<tr>
<td>Bryll autonomy</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
<tr>
<td>Bryll environmental mastery</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
<tr>
<td>Bryll purpose in life</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
<tr>
<td>Bryll personal growth</td>
<td>6.70</td>
<td>3.45</td>
<td>3.25</td>
</tr>
</tbody>
</table>

Note: Men is reference category. All tests were bootstrapped (k = 1000).

* The degrees of freedom (df) for the t-tests differ between (i) analyses in which equal variances could be assumed (df = (N1 + N2) - 2) and (ii) analyses in which the assumption of homogeneity of variances for both genders was violated (df = N1 - 1, in which N1 refers to the smallest group), according to Levene test (p-value < 0.05)

Table A.6: Descriptive statistics of predictor and outcome variables among the 629 diary participants

<table>
<thead>
<tr>
<th>n</th>
<th>Min-max</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>629</td>
<td>18 to 75</td>
<td>40.2</td>
<td>13.3</td>
<td>-0.23</td>
</tr>
<tr>
<td>Education</td>
<td>589</td>
<td>2 to 8</td>
<td>7.1</td>
<td>1.1</td>
<td>-1.65</td>
</tr>
<tr>
<td>Affect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive affect</td>
<td>459</td>
<td>10 to 48</td>
<td>33.7</td>
<td>6.8</td>
<td>-0.63</td>
</tr>
<tr>
<td>Negative affect</td>
<td>459</td>
<td>10 to 40</td>
<td>20.3</td>
<td>7.9</td>
<td>0.84</td>
</tr>
<tr>
<td>Mood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>459</td>
<td>0 to 42</td>
<td>7.4</td>
<td>8.0</td>
<td>1.58</td>
</tr>
<tr>
<td>Anxiety</td>
<td>459</td>
<td>0 to 35</td>
<td>4.1</td>
<td>5.1</td>
<td>2.16</td>
</tr>
<tr>
<td>Stress</td>
<td>459</td>
<td>0 to 40</td>
<td>9.1</td>
<td>6.9</td>
<td>0.99</td>
</tr>
<tr>
<td>Well-being</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ryff</td>
<td>529</td>
<td>87 to 228</td>
<td>163.0</td>
<td>27.2</td>
<td>-0.40</td>
</tr>
<tr>
<td>Happiness</td>
<td>532</td>
<td>1 to 10</td>
<td>6.7</td>
<td>1.6</td>
<td>-1.01</td>
</tr>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>356</td>
<td>12 to 57</td>
<td>34.7</td>
<td>9.3</td>
<td>-0.10</td>
</tr>
<tr>
<td>Extraversion</td>
<td>356</td>
<td>19 to 60</td>
<td>38.9</td>
<td>6.8</td>
<td>-0.17</td>
</tr>
<tr>
<td>Openness</td>
<td>356</td>
<td>25 to 58</td>
<td>44.3</td>
<td>6.5</td>
<td>-0.27</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>356</td>
<td>25 to 57</td>
<td>44.2</td>
<td>5.4</td>
<td>0.20</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>356</td>
<td>24 to 57</td>
<td>43.3</td>
<td>6.1</td>
<td>-0.52</td>
</tr>
</tbody>
</table>

Note: Of the 629 participants 517 were women (82.2%, mean age = 39, standard deviation (SD) = 13) and 112 men (17.8%, mean age = 49, SD = 13). The skewness and kurtosis scores above z > 1.96 are significant at p-value < 0.05, from z > 2.58 at p-value < 0.01, and from z > 3.29 at p-value < 0.001 (all values significant from p-value < 0.01 are marked with an asterisk).
Table A.7: Differences between diary participants ($n \leq 629$) versus those who did not participate ($n \leq 11,874$).

<table>
<thead>
<tr>
<th></th>
<th>Diary $n$</th>
<th>Non-diary $n$</th>
<th>Mean diary (SD)</th>
<th>Mean non-diary (SD)</th>
<th>KS</th>
<th>T-test</th>
<th>$D_f$</th>
<th>P-value</th>
<th>Mean diff.</th>
<th>95% CI</th>
<th>Cohen's $d^v$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>629</td>
<td>11,874</td>
<td>40.2 (13.3)</td>
<td>46.6 (14.7)</td>
<td>0.001</td>
<td>9.78</td>
<td>711</td>
<td>0.004</td>
<td>5.35</td>
<td>4.06 to 6.60</td>
<td>0.40</td>
</tr>
<tr>
<td>Education</td>
<td>589</td>
<td>11,600</td>
<td>7.1 (1.1)</td>
<td>6.9 (1.2)</td>
<td>0.001</td>
<td>-5.67</td>
<td>609</td>
<td>0.001</td>
<td>-0.26</td>
<td>-0.34 to -0.17</td>
<td>0.24</td>
</tr>
<tr>
<td>Positive affect</td>
<td>459</td>
<td>7,569</td>
<td>33.7 (6.8)</td>
<td>34.2 (6.9)</td>
<td>0.456</td>
<td>1.49</td>
<td>8,025</td>
<td>0.125</td>
<td>0.49</td>
<td>-0.14 to 1.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Negative affect</td>
<td>459</td>
<td>7,569</td>
<td>19.7 (7.2)</td>
<td>20.3 (7.0)</td>
<td>0.212</td>
<td>-1.71</td>
<td>8,025</td>
<td>0.079</td>
<td>-0.59</td>
<td>-1.29 to 0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>Depression</td>
<td>459</td>
<td>7,511</td>
<td>7.4 (8.0)</td>
<td>6.7 (7.8)</td>
<td>0.059</td>
<td>-1.71</td>
<td>7,968</td>
<td>0.104</td>
<td>-0.64</td>
<td>-1.49 to 0.13</td>
<td>0.08</td>
</tr>
<tr>
<td>Anxiety</td>
<td>459</td>
<td>7,511</td>
<td>4.1 (5.1)</td>
<td>3.6 (4.9)</td>
<td>0.053</td>
<td>-1.90</td>
<td>7,968</td>
<td>0.070</td>
<td>-0.45</td>
<td>-0.97 to 0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Stress</td>
<td>459</td>
<td>7,511</td>
<td>9.1 (6.9)</td>
<td>8.6 (7.0)</td>
<td>0.222</td>
<td>-1.61</td>
<td>7,968</td>
<td>0.110</td>
<td>-0.54</td>
<td>-1.20 to 0.13</td>
<td>0.09</td>
</tr>
<tr>
<td>Ryff wellbeing</td>
<td>529</td>
<td>9,504</td>
<td>163.0 (27.2)</td>
<td>166.8 (26.5)</td>
<td>0.002</td>
<td>3.23</td>
<td>10,031</td>
<td>0.001</td>
<td>3.83</td>
<td>1.66 to 6.20</td>
<td>0.14</td>
</tr>
<tr>
<td>Happiness</td>
<td>532</td>
<td>9,620</td>
<td>6.7 (1.6)</td>
<td>6.9 (1.6)</td>
<td>0.006</td>
<td>3.28</td>
<td>10,150</td>
<td>0.001</td>
<td>0.23</td>
<td>0.09 to 0.37</td>
<td>0.15</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>356</td>
<td>3,975</td>
<td>34.7 (9.3)</td>
<td>32.4 (9.4)</td>
<td>0.001</td>
<td>-4.47</td>
<td>4,302</td>
<td>0.001</td>
<td>-2.34</td>
<td>-3.22 to -1.35</td>
<td>0.25</td>
</tr>
<tr>
<td>Extraversion</td>
<td>356</td>
<td>3,978</td>
<td>38.9 (6.8)</td>
<td>38.4 (7.2)</td>
<td>0.240</td>
<td>-1.27</td>
<td>4,302</td>
<td>0.193</td>
<td>-0.50</td>
<td>-1.30 to 0.31</td>
<td>0.07</td>
</tr>
<tr>
<td>Openness</td>
<td>356</td>
<td>3,978</td>
<td>44.3 (6.5)</td>
<td>44.0 (6.2)</td>
<td>0.383</td>
<td>-0.70</td>
<td>4,302</td>
<td>0.519</td>
<td>-0.24</td>
<td>-0.92 to 0.47</td>
<td>0.04</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>356</td>
<td>3,978</td>
<td>44.2 (5.4)</td>
<td>43.0 (5.5)</td>
<td>0.020</td>
<td>-4.07</td>
<td>4,302</td>
<td>0.001</td>
<td>-1.23</td>
<td>-1.88 to -0.61</td>
<td>0.23</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>356</td>
<td>3,978</td>
<td>43.3 (6.1)</td>
<td>43.7 (6.3)</td>
<td>0.821</td>
<td>1.25</td>
<td>4,302</td>
<td>0.201</td>
<td>0.43</td>
<td>-0.19 to 1.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Note: Diary is reference. Gender 0 = women.

---

1 We used a $\chi^2$ to test for gender differences, bootstrapped $k = 1000$, which showed that diary participants were more often women ($\chi^2 = 84.51, p-value < .001, d = 0.28$).
2 Cohen’s $d$ for independent samples t-test can be derived as $\frac{\text{Mean}}{\text{SD}}$.
3 KS stands for the Kolmogorov-Smirnov test statistic.
## A.2 Leefplezier

### Table A.8: Modules, instruments, and contents of the cross-sectional study of Leefplezier.

<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>Description</th>
<th>Items</th>
<th>Response range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feelings</td>
<td>Happiness index</td>
<td>The Happiness index assesses the degree to which one judges the quality of one’s life in a single item: Do you feel happy in general?</td>
<td>1</td>
<td>0 to 100</td>
<td>Abdel-Khalek (2006); Fordyce (1988); Veenhoven (1994)</td>
</tr>
<tr>
<td>Feelings</td>
<td>PANAS</td>
<td>PANAS Flemish version, assesses 10 positive and 10 negative emotions over the past week. mood over the past week and is sensitive to subthreshold symptoms.</td>
<td>20</td>
<td>0 to 100</td>
<td>Raes et al. (2010); Watson et al. (1988)</td>
</tr>
<tr>
<td>Personal life (socio-demography)</td>
<td>N/A</td>
<td>Marital status, family members, social network, contentness with leisure activities, living arrangement, work, use of assistance / care, activities, level of independence, chronic conditions, medication use, financial situation, religion / connectedness</td>
<td>41</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>Ryff scales</td>
<td>The Ryff scales of psychological wellbeing measure self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth.</td>
<td>39</td>
<td>1 to 6</td>
<td>Van Dierendonck (2004)</td>
</tr>
<tr>
<td>Affect / mood</td>
<td>DASS</td>
<td>The DASS measures mood over the past week and is sensitive to subthreshold symptoms.</td>
<td>42</td>
<td>0 to 3</td>
<td>De Beurs et al. (2001); Lovibond and Lovibond (1995)</td>
</tr>
<tr>
<td>Personality</td>
<td>NEO-FFI-3</td>
<td>The NEO-FFI-3 personality inventory assesses the Big Five personality domains Neuroticism, Extraversion, Openness to experience, Agreeableness, and Conscientiousness with 60 items.</td>
<td>60</td>
<td>1 to 5</td>
<td>De Fruyt and Hoekstra (2014)</td>
</tr>
</tbody>
</table>

### Table A.9: Items of the Leefplezier diary study.

<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>1</td>
<td>Hoe gaat het op dit moment met u?</td>
<td>How are you doing right now?</td>
<td>‘Very bad’ to ‘Very good’</td>
<td>0 to 100</td>
<td>Moment-to-moment quality of life</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ik voel me ontspannen</td>
<td>I feel relaxed</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ik voel me somber</td>
<td>I feel gloomy</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ik voel me energiek</td>
<td>I feel energetic</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Positive affect Activation</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ik voel me angstig</td>
<td>I feel anxious</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Ik voel me onrustig</td>
<td>I feel nervous</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
</tbody>
</table>

*Continued on next page.*
Table A.9 – continued from previous page.

<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td>Ik voel me tevreden</td>
<td>I feel content</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Ik voel me prikkelbaar</td>
<td>I feel irritable</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Activation</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Ik voel me kalm</td>
<td>I feel calm</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Deactivation</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Ik voel me lusteloos</td>
<td>I feel dull</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Ik voel me opgewekt</td>
<td>I feel cheerful</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive affect Activation</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Ik voel me moe</td>
<td>I feel tired</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative affect Deactivation</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Ik voel me gelukkig</td>
<td>I feel happy</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Happiness</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Wat deed ik het afgelopen dagdeel de meeste tijd?</td>
<td>How did I spend most of my time since the last measurement?</td>
<td>(1) Resting / sleeping, (2) Household / groceries, (3) Working / studying / volunteering, (4) Exercising / walking / cycling, (5) Yoga / meditation / sauna visit etc., (6) Reading, (7) Hobby (e.g., gardening, making music), (8) Trip (e.g., leisure park, concert), (9) Watching tv, (10) Web-surfing / gaming / social media, (11) Conversing, (12) Something intimate (e.g., cuddling, sex), (13) Something else / all kinds of things</td>
<td>1 to 13</td>
<td>Activities (check boxes; only one activity could be checked)</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Ik ervoer deze activiteit overwegend als</td>
<td>I experienced this activity mainly as</td>
<td>'Very unpleasant' to 'Very pleasant'</td>
<td>0 to 100</td>
<td>Appraisal of activity</td>
</tr>
<tr>
<td>Sleep</td>
<td>1</td>
<td>Heeft u sinds het vorige meetmoment geslapen?</td>
<td>Did you sleep since the last measurement?</td>
<td>(1) No, (2) Yes</td>
<td>1 to 2</td>
<td>Sleep (check boxes). If yes, go to Sleep questions 2 to 5</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Heeft u goed geslapen?</td>
<td>Did you sleep well?</td>
<td>'Not at all' to 'Very well'</td>
<td>0 to 100</td>
<td>Quality of sleep</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Heeft u lang genoeg geslapen?</td>
<td>Did you sleep long enough?</td>
<td>'Too short' to 'too long'</td>
<td>0 to 100</td>
<td>Duration of sleep</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ik ben snel en makkelijk in slaap gevallen</td>
<td>I fell asleep easily</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Ease of falling asleep</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ik heb vanochtend slaapmedicatie gebruikt</td>
<td>I used sleep medication last night</td>
<td>(1) No, (2) Yes</td>
<td>1 to 2</td>
<td>Use of sleep medication</td>
</tr>
<tr>
<td>Activity</td>
<td>1</td>
<td>In het afgelopen dagdeel... Was ik lichamelijk actief</td>
<td>Since the last measurement... I was physically active</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Physical activity</td>
</tr>
</tbody>
</table>

Continued on next page.
<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Ervoer ik mijn lichamelijke activiteit overwegend als</td>
<td>I experienced this physical activity mainly as</td>
<td>'Very unpleasant' to 'Very pleasant'</td>
<td>0 to 100</td>
<td>Appraisal of physical activity</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Was ik tevreden over hoe ik mijn inspanning heb uitgevoerd</td>
<td>I was content about how I performed my activity</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Appraisal of performing the physical activity</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Was ik tijdens het bewegen / sporten overwegend</td>
<td>I was during the activity mostly</td>
<td>(1) Alone, (2) In company</td>
<td>1 to 2</td>
<td>Social company</td>
</tr>
<tr>
<td>Body</td>
<td>1</td>
<td>In het afgelopen dagdeel... Ervoer ik lichamelijk ongemak (hoofdpijn, diarree, zware benen, etc.)</td>
<td>Since the last measurement... I experienced physical discomfort (headaches, diarrhea, heavy legs, etc.)</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Physical discomfort</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Lette ik erg op pijnjes in mijn lichaam</td>
<td>I was paying attention to little pains in my body</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Being aware of physical discomfort</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Maakte ik mij zorgen om mijn gezondheid</td>
<td>I was worried about my health</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Health anxiety</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Heb ik lichamelijk contact gehad (intimiteit / knuffel met persoon of huisdier)</td>
<td>I had physical interaction (intimacy / hugging a person or pet)</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Physical contact</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Heb ik gezond gegeten (zowel voedingswaarde / hoeveelheid)</td>
<td>I ate enough (both nutritional value and quantity)</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Food consumption</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Heb ik voldoende gedronken (&gt; 1.5 liter per dag, alcoholvrij)</td>
<td>I drank enough (&gt; 1.5 liters a day, non-alcoholic)</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Liquid consumption</td>
</tr>
<tr>
<td>Mind</td>
<td>1</td>
<td>In het afgelopen dagdeel... Gingen er veel negatieve gedachten door mijn hoofd</td>
<td>Since the last measurement... many negative thoughts passed my mind</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Negative thoughts</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Gingen er veel positieve gedachten door mijn hoofd</td>
<td>Many positive thoughts passed my mind</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Positive thoughts</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Was ik veel en snel afgeleid</td>
<td>I was often and easily distracted</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Distraction</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Piekerde ik veel</td>
<td>I was ruminating a lot</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Rumination</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Heb ik gelachen</td>
<td>I had a laugh</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Laughing</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Voelde ik me geestelijk uitgedaagd</td>
<td>I felt challenged (mentally)</td>
<td>'Not at all' to 'Very much'</td>
<td>0 to 100</td>
<td>Mental challenges</td>
</tr>
</tbody>
</table>

Continued on next page.
Table A.9 – continued from previous page.

<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>1</td>
<td>Ik was het afgelopen dagdeel grotendeels</td>
<td>Most of the time since the last measurement I was</td>
<td>(1) Alone, (2) In company</td>
<td>1 to 2</td>
<td>Social company (check boxes; only one box could be checked). If alone, go to Social 2, followed by social 5. If in company, go to 3 to 5.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ik was liever in gezelschap geweest</td>
<td>I would rather have been with others</td>
<td>‘No, preferably not’ to ‘Yes, certainly’</td>
<td>0 to 100</td>
<td>Appraisal of being alone</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ik zou liever alleen zijn geweest</td>
<td>I would rather have been alone</td>
<td>‘No, preferably not’ to ‘Yes, certainly’</td>
<td>0 to 100</td>
<td>Appraisal of social company</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ik vond dit gezelschap overwegend</td>
<td>I found my company predominantly</td>
<td>‘Very unpleasant’, via ‘Neutral’, to ‘Very pleasant’</td>
<td>0 to 100</td>
<td>Appraisal of social company</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ik voel me eenzaam</td>
<td>I feel lonely</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Loneliness</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Ik voel me gewaardeerd</td>
<td>I feel valued</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Self-esteem</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Anderen vragen veel van mij</td>
<td>Others are asking a lot of me</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Experiencing excessive demand</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Ik heb gesproken over zaken die er voor mij te doen</td>
<td>I talked about things that matter to me</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Talking about subjects one cares about</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Ik heb in het afgelopen dagdeel iets voor iemand kunnen betekenen</td>
<td>Since the last measurement I was able to make a difference</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Making a difference</td>
</tr>
<tr>
<td>Environment</td>
<td>1</td>
<td>Hoe rustig / druk heb ik het?</td>
<td>How pieceful / busy am I?</td>
<td>‘Very pieceful’ to ‘Very busy’</td>
<td>0 to 100</td>
<td>Time pressure</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ik ervaar deze rust / druk als</td>
<td>I experienced this piecefulness / busyness as</td>
<td>‘Very unpleasant’ to ‘Very pleasant’</td>
<td>Range</td>
<td>Appraisal of piecefulness / busyness</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Ik heb genoten van mijn bezigheden</td>
<td>I enjoyed my activities</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Apraisal of piecefulness / busyness</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Ik ben het afgelopen dagdeel buiten geweest</td>
<td>Since the last measurement I have been outside</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Being outside</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Is er het afgelopen dagdeel iets bijzonders gebeurd?</td>
<td>Did something special happen since the last measurement?</td>
<td>(1) No, nothing, (2) Yes, something positive, (3) Yes, something neutral, (4) Yes, something negative</td>
<td>1 to 4</td>
<td>Special event (check boxes; only one box could be checked). If nothing, jump to environment 7, otherwise environment 6.</td>
</tr>
</tbody>
</table>

Continued on next page.
<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Waar had dit mee te maken?</td>
<td>This was related to (1) Myself, (2) Home situation / close family / significant others, (3) Friends / other family / acquaintances, (4) Work / school, (5) Society / news, (6) Public space / strangers, (7) Other</td>
<td>1 to 7</td>
<td>Context of special event (check boxes; only one box could be checked).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Waar was ik het afgelopen dagdeel de meeste tijd?</td>
<td>Where have I spent most of my time since the last measurement?</td>
<td>1 to 9</td>
<td>Location (check boxes; only one location could be checked)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mindfulness

1. In het afgelopen dagdeel... Leefde ik in het hier en nu Since the last measurement... I lived in the here and now
   - Not at all' to 'Very much'
   - 0 to 100
   - Experiencing the here and now

2. Accepteerde ik de dingen zoals ze zijn I accepted things the way they are
   - Not at all' to 'Very much'
   - 0 to 100
   - Acceptance

3. Was ik mild voor mezelf als dingen fout liepen I was mild to myself whenever things went wrong
   - Not at all' to 'Very much'
   - 0 to 100
   - Approval

4. Kon ik genieten van kleine dingen I enjoyed the small things in life
   - Not at all' to 'Very much'
   - 0 to 100
   - Appraisal of small things in life

5. Accepteerde ik mijzelf zoals ik ben I accepted myself the way I am
   - Not at all' to 'Very much'
   - 0 to 100
   - Self-acceptence

6. Heb ik een momentje voor mijzelf genomen I took some time for myself
   - Not at all' to 'Very much'
   - 0 to 100
   - Taking time for oneself

Meaning / connectedness

1. In het afgelopen dagdeel... Had ik grip op mijn omgeving Since the last measurement... I was in control of my environment
   - Not at all' to 'Very much'
   - 0 to 100
   - Control

2. Voelde ik mij zelfverzekerd I felt confident
   - Not at all' to 'Very much'
   - 0 to 100
   - Confidence

3. Voelde ik mij verbonden I felt connected
   - Not at all' to 'Very much'
   - 0 to 100
   - Connectedness

4. Voelde ik mij geïnspireerd I felt inspired
   - Not at all' to 'Very much'
   - 0 to 100
   - Inspiration

5. Heb ik tijd besteed aan dingen die voor mij van belang zijn I spent time on things that matter to me
   - Not at all' to 'Very much'
   - 0 to 100
   - Spending time on things that matter

Continued on next page.
<table>
<thead>
<tr>
<th>Module</th>
<th>Q</th>
<th>Dutch</th>
<th>Translation</th>
<th>Response range</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td>Heb ik mij verwonderd</td>
<td>I was amazed</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Astonishment</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Had ik het gevoel dat mijn leven betekenis heeft</td>
<td>I had the feeling my life had a purpose</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Purpose</td>
</tr>
<tr>
<td>General</td>
<td>16</td>
<td>Persoonlijke vraag</td>
<td>My personal factor</td>
<td>‘Not at all’ to ‘Very much’</td>
<td>0 to 100</td>
<td>Personal item</td>
</tr>
</tbody>
</table>
Table A.10: Questionnaire completion percentage of Leefplezier.

<table>
<thead>
<tr>
<th>Module</th>
<th>Instrument</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feelings</td>
<td>Happiness index</td>
<td>949</td>
<td>94.33</td>
</tr>
<tr>
<td></td>
<td>PANAS</td>
<td>949</td>
<td>94.33</td>
</tr>
<tr>
<td>Personal life (socio-demography)</td>
<td>N/A</td>
<td>880</td>
<td>87.48</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>Ryff scales</td>
<td>819</td>
<td>81.41</td>
</tr>
<tr>
<td>Affect / mood</td>
<td>DASS</td>
<td>788</td>
<td>78.33</td>
</tr>
<tr>
<td>Personality</td>
<td>NEO-FFI-3</td>
<td>749</td>
<td>74.45</td>
</tr>
</tbody>
</table>

Note: The column percentage contains the percentage of our sample of $n = 1006$ who filled out this specific questionnaire. Data exported on August 15, 2017.
Appendix B

Automated Impulse Response Analysis —
Supplement

B.1 Impulse response calculation

Automated Impulse Response Analysis (AIRA) first converts vector autoregression (VAR) models into the vector moving average (VMA) representation of the model. Algorithm B.1 shows the pseudo code for determining the VMA coefficients. In this (and the other) examples, $m$ denotes the number of variables in the model and $p$ the number of lags. The R version of AIRA uses the vars package to calculate these models (Pfaff, 2008). The JavaScript version of AIRA uses an implementation specially crafted for the present work. This JavaScript implementation for calculating the VMA models and running the impulse response function (IRF) analysis is described in this appendix.

Firstly, the VAR coefficient matrix (of size $m \times mp$) in the VAR model is partitioned in separate matrices based on the lag, generating $p$ matrices of size $m \times m$, as shown in Lines 4 to 8 of Algorithm B.1. This allows for reusing them when determining the VMA coefficients. Secondly, AIRA performs the transformation from VAR coefficients (the $B$ matrices in the VAR equation) to the VMA coefficients (the $C$ coefficient matrix in VMA representation), as shown in Lines 9 to 17. Note that only the first $k$ rows of $C$ are converted, that is, the specified horizon.

The $\delta$ function used in this algorithm checks whether a coefficient matrix is available for the provided lag (i.e., a model with two lags has two coefficient matrices, one for each lag). This function is created as

$$\delta(B,j) = \begin{cases} m \times m \text{ zero matrix} & \text{if } j \geq B.length \\ B_j & \text{otherwise.} \end{cases}$$

(B.1)

The algorithm for the VMA coefficients is based on the work of Brandt and Williams (2007) and on the work of Lütkepohl (2005).

After AIRA has calculated the vector moving average model, it performs the IRF analysis. Algorithm B.2 lists the pseudo code used for running this analysis. The algorithm starts by defining an output matrix in Line 2. In the case of orthogonalized
Algorithm B.1 Finds the VMA coefficients of the VAR model.

1: function CALCULATEVMA(var_coef, p, k)
   arguments var_coef is the coefficient matrix from the VAR model (of size $m \times mp$), $p$ is the number of lags, and $k$ is the number of steps to forecast (the horizon).
2:     $B \leftarrow$ empty list of size $p$
3:     $C \leftarrow$ matrix of all zeroes of size $(k \times k)$ \hspace{1em} $\Rightarrow$ the VMA coefficient matrix
4:     for $l \leftarrow 1, l \leq p$ do
5:         $x \leftarrow m \cdot (l - 1) + 1$
6:         $B_l \leftarrow \text{var_coef}_{(1...m),(x...x+m-1)}$ \hspace{1em} $\Rightarrow$ $B$ is a list of matrices, each matrix being the coefficients for a different lag
7:         $l \leftarrow l + 1$
8:     end for
9:     $C_{1,1} \leftarrow \delta(B, 1)$
10:    for $i \leftarrow 2, i \leq k$ do
11:        for $j \leftarrow 1, j < i$ do
12:           $C_{i,j} \leftarrow \delta(B, j) \cdot (\sum_{x=1}^{i-j} C_{i-j,x})$
13:           $j \leftarrow j + 1$
14:        end for
15:     $C_{i,i} \leftarrow \delta(B, i)$
16:     $i \leftarrow i + 1$
17: end for
18: return $C$
19: end function

IRF, the identity matrix used in Line 3 ($I_m$) should be replaced by the contemporaneous coefficient matrix. Orthogonalized IRF is currently only supported in the R version of AIRA. The actual impulse responses are defined in Lines 4 to 11. The shocks are multiplied with each of the VMA coefficients to determine the response and are calculated for each moment on the horizon.

B.2 Time complexity

Algorithm B.1 describes the conversion of VAR coefficients to VMA coefficients. In order to determine these VMA coefficients, the algorithm iterates over $k$ (the used horizon). In each iteration, the algorithm retrieves all previously created VMA coefficients $k$ times. This is done for all entries and therefore bounded by $k$. Each of the entries retrieved requires a matrix summation for each $m \times m$ matrix. Finally, this
Algorithm B.2 Algorithm for calculating the IRF from shocks in $\vec{s}$ for $k$ steps in the future.

1: function CALCULATEIRF($\vec{s}, C, k$)
   arguments $\vec{s}$ vector of length $m$ containing the shocks, $C$ are the VMA coefficients as returned by Algorithm B.1, and $k$ is the number of steps (horizon) to forecast.
2:   $Y \leftarrow \text{empty matrix of size } (k \times m)$
3:   $Y_1 = I_m \cdot \vec{s}$
4:   for $t \leftarrow 2, t \leq k$ do
5:     $Y_t \leftarrow [0_1, \ldots, 0_m]^T$
6:     for $i \leftarrow 1, i < t$ do
7:       $Y_t \leftarrow Y_t + (C_{t-1,i} \cdot \vec{s})$
8:       $i \leftarrow i + 1$
9:     end for
10:    $t \leftarrow t + 1$
11: end for
12: return $Y^T$
13: end function

The time complexity of the IRF calculation as shown in Algorithm B.2 depends on the horizon and the number of variables in the model. The algorithm iterates over the horizon ($k$ steps). For each step on the horizon, it determines an effect at most $k$ times, where each effect calculation is a matrix-vector multiplication of at most $m \times m$ steps (the size of matrix $C_{t-1,i}$). Finally, each element of the resulting $m \times 1$ vector is added to the $Y_t$ vector. The total upper bound of the calculation of the IRF is therefore $O(k^2 m^2)$. 
Appendix C

Machine Learning for Precision Medicine — Supplement

Table C.1: All questionnaire questions used in the feature selection module.

<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender of respondent</td>
<td>(1) male, (2) female</td>
</tr>
<tr>
<td>2</td>
<td>Age at baseline</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>3</td>
<td>Respondent sampling frame first</td>
<td>(1) Primary care, (2) Specialized mental health care, (3) Netherlands Mental Health Survey and Incidence Study (NEMESIS), (4) Ariadne</td>
</tr>
<tr>
<td>4</td>
<td>Respondent sampling frame second</td>
<td>(1) Primary care, (2) Specialized mental health care, (3) general population</td>
</tr>
<tr>
<td>5</td>
<td>Interviewed by researchers from</td>
<td>(1) Amsterdam, (2) Leiden, (3) Groningen</td>
</tr>
<tr>
<td>6</td>
<td>What is the highest level of education that you completed (i.e. received a diploma)?</td>
<td>(1) No diploma or several years of primary education, (2) Elementary education, (3) VSO (proceeded special education), (4) General intermediate / lower vocational education: HBO / HBO (household-, craft-, technical school, of in company training), MBO-short, (5) Modern apprenticeship, ULO, (6) General secondary education: MAVO, MULO, VMBO, (7) Intermediate vocational education: MBO-long, or in company training on MBO level 8. Higher secondary education: HAVO, VWO, Gymnasium, HIS, MMS, (9) Higher vocational education: HBO or in company training on HBO-level, (10) College / University education, (11) Different, (12) Don’t know, (13) Not applicable</td>
</tr>
<tr>
<td>7</td>
<td>Education level attained (years)</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>8</td>
<td>Level of education</td>
<td>(0) Not clear (see Question 6), (1) Basic, (2) Intermediate, (3) high</td>
</tr>
<tr>
<td>9</td>
<td>Birthcountry of respondent</td>
<td>(1) The Netherlands, (2) Other European country, (3) Morocco, (4) Turkey, (5) Suriname, (6) Dutch Antilles, (7) Indonesia, (8) Other non-European country.</td>
</tr>
<tr>
<td>10</td>
<td>Number of different nationalities</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>11</td>
<td>First nationality of the respondent</td>
<td>(1) Dutch, (2) Turkish, (3) Moroccan, (4) Surinamese, (5) Antillean / Aruban (6) Indonesian, (7) Other.</td>
</tr>
</tbody>
</table>

Continued on next page.
Table C.1 – continued from previous page.

<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Respondent: North-european ancestry?</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>13</td>
<td>Poly drugs use: number of different drugs used</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>14</td>
<td>Sum Score</td>
<td>(0) Respondent does not drink, (8) hazardous drinking, (13) alcohol dependence likely (women), (15) alcohol dependence likely (men)</td>
</tr>
<tr>
<td>15</td>
<td>Medical advise</td>
<td>(0) No advice, (1) Simple advice on reduction, (2) Brief counseling and monitoring, (3) Further diagnostic evaluation</td>
</tr>
<tr>
<td>16</td>
<td>Positive affect</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>17</td>
<td>Negative affect</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>18</td>
<td>Somatization</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>19</td>
<td>Total score of Mood Disorder Questionnaire (MDQ) items 1 to 13</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>20</td>
<td>Total distress score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>21</td>
<td>Severity score</td>
<td>(0) No, (1) Moderately increased, (3) Severely increased</td>
</tr>
<tr>
<td>22</td>
<td>During the past week, did you suffer from feeling down or depressed?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>23</td>
<td>During the past week, did you suffer from worry?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>24</td>
<td>During the past week, did you suffer from disturbed sleep?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>25</td>
<td>During the past week, did you suffer from a lack of energy?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>26</td>
<td>During the past week, did you feel tense?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>27</td>
<td>During the past week, did you feel easily irritated?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>28</td>
<td>During the past week, did you feel that you just can’t do anything anymore?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>29</td>
<td>During the past week, did you feel that you can no longer take any interest in the people and things around you?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>30</td>
<td>During the past week, did you feel that you can’t cope anymore?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>31</td>
<td>During the past week, did you feel that you can’t face it anymore?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>32</td>
<td>During the past week, did you no longer feel like doing anything?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>33</td>
<td>During the past week, did you have difficulty in thinking clearly?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
</tbody>
</table>

Continued on next page.
<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>During the past week, did you have difficulty in getting to sleep?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>35</td>
<td>During the past week, did you easily become emotional?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>36</td>
<td>During the past week, did you ever have fleeting images of any upsetting event(s) that you have experienced?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>37</td>
<td>During the past week, did you ever have to do your best to put aside thoughts about any upsetting event(s)?</td>
<td>(1) No, (2) Sometimes, (3) Regularly, (4) Often, (5) Very often or constantly.</td>
</tr>
<tr>
<td>38</td>
<td>Somatization 5 point sum score</td>
<td>Discrete value, $\geq 0$</td>
</tr>
<tr>
<td>39</td>
<td>Somatization trychotomization of item scores for clinical purposes</td>
<td>Discrete value, $\geq 0$</td>
</tr>
<tr>
<td>40</td>
<td>Dichotomization based on trychotomization variable $\geq 11$</td>
<td>(0) No somatization, (1) Somatization</td>
</tr>
<tr>
<td>41</td>
<td>Falling Asleep</td>
<td>(1) I never take longer than 30 minutes to fall asleep, (2) I take at least 30 minutes to fall asleep, less than half the time, (3) I take at least 30 minutes to fall asleep, more than half the time, (4) I take more than 60 minutes to fall asleep, more than half the time.</td>
</tr>
<tr>
<td>42</td>
<td>Sleep During the Night</td>
<td>(1) I do not wake up at night, (2) I have a restless, light sleep with a few brief awakenings each night, (3) I wake up at least once a night, but I go back to sleep easily, (4) I awaken more than once a night and stay awake for 20 minutes or more, more than half the time.</td>
</tr>
<tr>
<td>43</td>
<td>Waking Up Too Early</td>
<td>(1) Most of the time, I awaken no more than 30 minutes before I need to get up, (2) More than half the time, I awaken more than 30 minutes before I need to get up, (3) I almost always awaken at least one hour or so before I need to, but I go back to sleep eventually, (4) I awaken at least one hour before I need to, and can’t go back to sleep.</td>
</tr>
<tr>
<td>44</td>
<td>Sleeping Too Much</td>
<td>(1) I sleep no longer than 7 to 8 hours/night, without napping during the day, (2) I sleep no longer than 10 hours in a 24-hour period including naps, (3) I sleep no longer than 12 hours in a 24-hour period including naps, (4) I sleep longer than 12 hours in a 24-hour period including naps.</td>
</tr>
<tr>
<td>45</td>
<td>Feeling Sad</td>
<td>(1) I do not feel sad, (2) I feel sad less than half the time, (3) I feel sad more than half the time, (4) I feel sad nearly all of the time.</td>
</tr>
<tr>
<td>46</td>
<td>Feeling Irritable</td>
<td>(1) I do not feel irritable, (2) I feel irritable less than half the time, (3) I feel irritable more than half the time, (4) I feel extremely irritable nearly all of the time.</td>
</tr>
</tbody>
</table>

Continued on next page.
<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>Feeling Anxious or Tense</td>
<td>(1) I do not feel anxious or tense, (2) I feel anxious (tense) less than half the time, (3) I feel anxious (tense) more than half the time, (4) I feel extremely anxious (tense) nearly all of the time.</td>
</tr>
<tr>
<td>48</td>
<td>Response of Your Mood to Good or Desired Events</td>
<td>(1) My mood brightens to a normal level which lasts for several hours when good events occur, (2) My mood brightens but I do not feel like my normal self when good events occur, (3) My mood brightens only somewhat to a rather limited range of desired events, (4) My mood does not brighten at all, even when very good or desired events occur in my life.</td>
</tr>
<tr>
<td>49</td>
<td>The Quality of Your Mood</td>
<td>(1) The mood (internal feelings) that I experience is very much a normal mood, (2) My mood is sad, but this sadness is pretty much like the sad mood I would feel if someone close to me died or left, (3) My mood is sad, but this sadness has a rather different quality to it than the sadness I would feel if someone close to, (4) My mood is sad, but this sadness is different from the type of sadness associated with grief or loss.</td>
</tr>
<tr>
<td>50</td>
<td>Change in Appetite</td>
<td>(1) There is no change from my usual appetite, (2) I eat somewhat less often or lesser amounts of food than usual, (3) I eat much less than usual and only with personal effort, (4) I rarely eat within a 24-hour period, and only with extreme personal effort or when others persuade me to eat, (5) I feel a need to eat more frequently than usual, (6) I regularly eat more often and/or greater amounts of food than usual, (7) I feel driven to overeat both at mealtime and between meals.</td>
</tr>
<tr>
<td>51</td>
<td>Weightchange (Within the Last Two Weeks)</td>
<td>(1) I have not had a change in my weight, (2) I feel as if I’ve had a slight weight loss, (3) I have lost 3 pounds or more, (4) I have lost 5 pounds or more, (5) I feel as if I’ve had a slight weight gain, (6) I have gained 3 pounds or more, (7) I have gained 5 pounds or more.</td>
</tr>
<tr>
<td>52</td>
<td>Concentration/Decision Making</td>
<td>(1) There is no change in my usual capacity to concentrate or make decisions, (2) I occasionally feel indecisive or find that my attention wanders, (3) Most of the time, I struggle to focus my attention or to make decisions, (4) I cannot concentrate well enough to read or cannot make even minor decisions.</td>
</tr>
<tr>
<td>53</td>
<td>View of Myself</td>
<td>(1) I see myself as equally worthwhile and deserving as other people, (2) I am more self-blaming than usual, (3) I largely believe that I cause problems for others, (4) I think almost constantly about major and minor defects in myself.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>View of My Future</td>
<td>(1) I have an optimistic view of my future, (2) I am occasionally pessimistic about my future, but for the most part I believe things will get better, (3) I'm pretty certain that my immediate future (2 to 3 months) does not hold much promise of good things for me, (4) I see no hope of anything good happening to me anytime in the future.</td>
</tr>
<tr>
<td>55</td>
<td>Thoughts of Death or Suicide</td>
<td>(1) I do not think of suicide or death, (2) I feel that life is empty or wonder if it’s worth living, (3) I think of suicide or death several times a week for several minutes, (4) I think of suicide or death several times a day in some detail, or I have made specific plans for suicide or have actual.</td>
</tr>
<tr>
<td>56</td>
<td>General Interest</td>
<td>(1) There is no change from usual in how interested I am in other people or activities, (2) I notice that I am less interested in people or activities, (3) I find I have interest in only one or two of my formerly pursued activities, (4) I have virtually no interest in formerly pursued activities.</td>
</tr>
<tr>
<td>57</td>
<td>Energy Level</td>
<td>(1) There is no change in my usual level of energy, (2) I get tired more easily than usual, (3) I have to make a big effort to start or finish my usual daily activities (for example, shopping, homework, cooking or go, (4) I really cannot carry out most of my usual daily activities because I just don’t have the energy.</td>
</tr>
<tr>
<td>58</td>
<td>Capacity for Pleasure or Enjoyment (excluding sex)</td>
<td>(1) I enjoy pleasurable activities just as much as usual, (2) I do not feel my usual sense of enjoyment from pleasurable activities, (3) I rarely get a feeling of pleasure from any activity, (4) I am unable to get any pleasure or enjoyment from anything.</td>
</tr>
<tr>
<td>59</td>
<td>Interest in Sex (Please Rate Interest, not Activity)</td>
<td>(1) I’m just as interested in sex as usual, (2) My interest in sex is somewhat less than usual or I do not get the same pleasure from sex as I used to, (3) I have little desire for or rarely derive pleasure from sex, (4) I have absolutely no interest in or derive no pleasure from sex.</td>
</tr>
<tr>
<td>60</td>
<td>Feeling slowed down</td>
<td>(1) I think, speak, and move at my usual rate of speed, (2) I find that my thinking is slowed down or my voice sounds dull or flat, (3) It takes me several seconds to respond to most questions and I’m sure my thinking is slowed, (4) I am often unable to respond to questions without extreme effort.</td>
</tr>
<tr>
<td>61</td>
<td>Feeling restless</td>
<td>(1) I do not feel restless, (2) I’m often fidgety, wringing my hands, or need to shift how I am sitting, (3) I have impulses to move about and am quite restless, (4) At times, I am unable to stay seated and need to pace around.</td>
</tr>
</tbody>
</table>

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Table C.1 – continued from previous page.

<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>Aches and pains</td>
<td>(1) I don’t have any feeling of heaviness in my arms or legs and don’t have any aches or pains, (2) Sometimes I get headaches or pains in my stomach, back or joints but these pains are only sometime present and they don’t stop me from doing what I need to do, (3) I have these sorts of pains most of the time, (4) These pains are so bad they force me to stop what I am doing.</td>
</tr>
<tr>
<td>63</td>
<td>Other bodily symptoms</td>
<td>(1) I don’t have any of these symptoms: heart pounding fast, blurred vision, sweating, hot and cold flashes, chest pain, hea, (2) I have some of these symptoms but they are mild and are present only sometimes, (3) I have several of these symptoms and they bother me quite a bit, (4) I have several of these symptoms and when they occur I have to stop doing whatever I am doing.</td>
</tr>
<tr>
<td>64</td>
<td>Panic / Phobic symptoms</td>
<td>(1) I have no spells of panic or specific fears (phobia) (such as animals or heights), (2) I have mild panic episodes or fears that do not usually change my behavior or stop me from functioning, (3) I have significant panic episodes or fears that force me to change my behavior but do not stop me from functioning, (4) I have panic episodes at least once a week or severe fears that stop me from carrying on my daily activities.</td>
</tr>
<tr>
<td>65</td>
<td>Constipation / diarrhea</td>
<td>(1) There is no change in my usual bowel habits, (2) I have intermittent constipation or diarrhea which is mild, (3) I have diarrhea or constipation most of the time but it does not interfere with my day-to-day functioning, (4) I have constipation or diarrhea for which I take medicine or which interferes with my day-to-day activities.</td>
</tr>
<tr>
<td>66</td>
<td>Interpersonal Sensitivity</td>
<td>(1) I have not felt easily rejected, slighted, criticized or hurt by others at all, (2) I have occasionally felt rejected, slighted, criticized or hurt by others, (3) I have often felt rejected, slighted, criticized or hurt by others, but these feelings have had only slight effects on me, (4) I have often felt rejected, slighted, criticized or hurt by others and these feelings have impaired my relationships and.</td>
</tr>
<tr>
<td>67</td>
<td>Leaden Paralysis / Physical Energy</td>
<td>(1) I have not experienced the physical sensation of feeling weighted down and without physical energy, (2) I have occasionally experienced periods of feeling physically weighted down and without physical energy, but without a n, (3) I feel physically weighted down (without physical energy) more than half the time, (4) I feel physically weighted down (without physical energy) most of the time, several hours per day, several days per week.</td>
</tr>
<tr>
<td>68</td>
<td>Total scale score</td>
<td>Discrete value, ≥ 0</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>Severity categorisation - Kabacoff</td>
<td>(0) Normal (0 to 9), (1) mild (10 to 18), (2) Moderate (18 to 29), (3) Severe (≥ 29)</td>
</tr>
<tr>
<td>70</td>
<td>Somatic scale score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>71</td>
<td>Subjective scale score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>72</td>
<td>Neuroticism - total score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>73</td>
<td>Neuroticism - negative affect</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>74</td>
<td>Neuroticism - self reproach</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>75</td>
<td>Neuroticism - anxiety alternative rationally derived decomposition of neuroticism domain</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>76</td>
<td>Neuroticism - depression alternative rationally derived decomposition of neuroticism domain</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>77</td>
<td>Neuroticism - selfreproach alternative rationally derived decomposition of neuroticism domain</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>78</td>
<td>Extraversion - total score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>79</td>
<td>Extraversion - positive affect</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>80</td>
<td>Extraversion - sociability</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>81</td>
<td>Extraversion - activity</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>82</td>
<td>Openness - total score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>83</td>
<td>Openness - aesthetic interest</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>84</td>
<td>Openness - intellectual interest</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>85</td>
<td>Openness - unconventionality</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>86</td>
<td>Agreeableness - total score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>87</td>
<td>Agreeableness - nonantagonistic orientation</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>88</td>
<td>Agreeableness - prosocial orientation</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>89</td>
<td>Conscientiousness - total score</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>90</td>
<td>Conscientiousness - orderliness</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>91</td>
<td>Conscientiousness - goal striving</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>92</td>
<td>Conscientiousness - dependability</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>93</td>
<td>Number of chronic disease</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>94</td>
<td>Number of chronic diseases under treatment</td>
<td>Discrete value, ≥ 0</td>
</tr>
<tr>
<td>95</td>
<td>Minor depression - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>96</td>
<td>Major Depression - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>97</td>
<td>Major Depression - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>98</td>
<td>Major Depression - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>99</td>
<td>Major Depression - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>100</td>
<td>Dysthymia - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
</tbody>
</table>

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Table C.1 – continued from previous page.

<table>
<thead>
<tr>
<th>Q</th>
<th>Feature / question</th>
<th>Response range</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Dysthymia - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>102</td>
<td>Dysthymia - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>103</td>
<td>Dysthymia - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>104</td>
<td>Number of current depression diagnoses (past six months)</td>
<td>Discrete value, $&gt;0$</td>
</tr>
<tr>
<td>105</td>
<td>Lifetime depression diagnoses present</td>
<td>(0) No lifetime diagnosis, (1) Lifetime diagnosis</td>
</tr>
<tr>
<td>106</td>
<td>Categories for lifetime depression diagnoses</td>
<td>(0) No lifetime dysthymia and no lifetime MDD, (1) Lifetime dysthymia, no lifetime MDD, (2) Lifetime MDD, no dysthymia, (3) Both lifetime MDD and lifetime dysthymia</td>
</tr>
<tr>
<td>107</td>
<td>Social Fobia - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>108</td>
<td>Social Fobia - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>109</td>
<td>Social Fobia - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>110</td>
<td>Social Fobia - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>111</td>
<td>Panic with agorafobia - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>112</td>
<td>Panic with agorafobia - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>113</td>
<td>Panic with agorafobia - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>114</td>
<td>Panic with agorafobia - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>115</td>
<td>Panic without agorafobia - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>116</td>
<td>Panic without agorafobia - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>117</td>
<td>Panic without agorafobia - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>118</td>
<td>Panic without agorafobia - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>119</td>
<td>Agorafobia - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>120</td>
<td>Agorafobia - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>121</td>
<td>Agorafobia - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>122</td>
<td>Agorafobia - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>123</td>
<td>GAD - past month</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>124</td>
<td>GAD - past six months</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>125</td>
<td>GAD - past year</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>126</td>
<td>GAD - in lifetime</td>
<td>(0) No, (1) Yes</td>
</tr>
<tr>
<td>127</td>
<td>Number of current anxiety diagnoses (past 6 months)</td>
<td>Discrete value, $&gt;0$</td>
</tr>
<tr>
<td>128</td>
<td>Lifetime anxiety diagnoses present</td>
<td>(0) No lifetime diagnosis, (1) Lifetime diagnosis</td>
</tr>
</tbody>
</table>

Note:

* We used a combination of raw questionnaire items and computed, derived variables, such as sum scores and average scores.
* The original questions and answers were in Dutch. In this table we only show the translations.
* Translations used from the Four-Dimensional Symptom Questionnaire (4DSQ).
Appendix D

Online Super Learner — Supplement

D.1 The questionnaire items

The ten questions of the Positive And Negative Affect Schedule (PANAS) query the level of feeling (i) interested, (ii) excited, (iii) strong, (iv) enthusiastic, (v) proud, (vi) alert, (vii) inspired, (viii) determined, (ix) attentive, and (x) active. We weight each variable equally and average them in order to have a scalar measure for positive affect (range 0 to 100, where 0 is no positive affect and 100 is the maximum level of positive affect). In order to determine which activity has the greatest influence on positive affect, we intervene on the activity a person carried out during the previous measurement period. We determine the most influential activity of the past measurement period using the question: ‘How did I spend most of my time since the last measurement?’ This categorical question can take one of the following thirteen categories: (0) something else / all kinds of things, (i) resting / sleeping, (ii) household / groceries, (iii) working / studying / volunteering, (iv) exercising / walking / cycling, (v) yoga / meditation / sauna visit etc., (vi) reading, (vii) hobby (e.g., gardening, making music), (viii) trip (e.g., leisure park, concert), (ix) watching television, (x) web surfing / gaming / social media, (xi) conversing, and (xii) something intimate (e.g., cuddling, sex). Other measured questions in the ecological momentary assessment (EMA) study are combined with general demographical data and are included as covariates.

D.2 Relevant source code

We translated the mathematical procedures as described in Chapter 8 into a proof-of-concept R-package\(^1\). Some vital parts of this code have been transformed and are described in the following subsections.

\(^1\)Source available at http://github.com/frbl/onlinesuperlearner.
D.2.1 The conditional density estimation algorithm

In Algorithm D.1 we provide a high-level overview of the conditional density estimation algorithm and the steps it takes to estimate these densities. The algorithm is initiated with three arguments: (i) the number of bins used for the discretization (one number of bins for each random variable), (ii) the observations that need to be discretized, and (iii) the particular machine learning algorithm used to perform the estimation. Note that the Online SuperLearner (OSL) calls this procedure for each candidate learners. The algorithm proceeds as follows. First it defines an empty list in which each of the estimators will be stored once fitted on the data (Line 2). Then, in Lines 3 to 11, the algorithm fits a conditional density for each of the random variables provided. To do so, it first grabs all data of a certain random variable from $\mathcal{O}^N$, and divides it over the number of $l_{rv}$ bins (the number of bins specified for the random variable $rv$) using the SPLITINTOBINS function (Line 4). This function determines the distribution of a random variable, and divides the data according to a splitting strategy over all bins (e.g., find the min and max, and divide equally over all bins). After this step, $\mathcal{O}_{rv,l}$ contains $l$ subsets of the data, in which each entry is a random variable in combination with the relevant covariates. Then, the algorithm trains an estimator for each of these $l_{rv}$ bins (Lines 6 to 9). We train $l_{rv}$ copies of $\Phi$, where each estimator is trained to predict the probability of being in a certain bin given an instance of a random variable and its covariates. Finally, we store these estimators (Line 10) and return the list of estimators per random variable (Line 12).

D.2.2 Conditional density sampling

An important procedure used for OSL and online one-step estimator (OOS) is sampling from the conditional densities of each of the random variables. The algorithm for sampling from these densities is provided in Algorithm D.2. The algorithm starts (after initialization on Line 2) with predicting the probability of the block $\mathcal{O}^N(t)$ being in each of the bins $1 \leq l < l_{rv}$ (Lines 3 to 7). For this prediction it uses the current block\(^2\) and its relevant history $Z(t)$ (Line 4). Note that this pseudo code internally takes care of ensuring enough historical observations are available for this relevant history. After the algorithm found the probability for the specific bin $i$, it will sample a value from a binomial distribution given the predicted probability (Line 5). The values for each bin (after sampling from the binomial distribution) are summed, yielding the final bin the value is expected to be in (Line 6). After the prediction classifies the block to belong to $b$, it will start the procedure to sample a value from that specific bin (Lines 8 to 14).

\(^2\)Note that the block might be incomplete. However, it always contains enough information to sample the next random variable.
The density estimation algorithm.

**Input:** \( l \) is a vector with the number of bins for each random variable (indexed by the name of the random variable), \( O^N \) is the observation to be discretized, and \( \Phi \) is a learner.

**Output:** a list of \( l \) estimators for each random variable \( \in \{W, A, Y\} \), one for each bin.

```python
1: function DENSITYESTIMATION(\( l, O^N, \Phi \))
2: \( E \leftarrow \) list of dimension equal to the number of random variables for which the conditional densities should be fitted.
3: for \( rv \in \{W, A, Y\} \) do
4: \( O_{rv,l} \leftarrow \) SPLITINTOBINS(\( O^N, rv, l_{rv} \))
5: \( \phi_l \leftarrow \) empty list of dimension \( l_{rv} \)
6: for \( i \leftarrow 1, i \leq l_{rv} \) do
7: \( \phi_{l,i} \leftarrow \) TRAIN(\( \Phi, O_{rv,A_{rv,i}} \))
8: \( i \leftarrow i + 1 \)
9: end for
10: \( E_{rv} \leftarrow \phi_l \)
11: end for
12: return \( E \)
13: end function
```

The sampling procedure is as follows. In the regular case, that is when the length of \( b \) is finite, the algorithm samples from a uniform distribution over the bin (Line 13). Otherwise, the algorithm samples a value from an exponential distribution, and either subtracts this sampled value from the left-hand side of the bin located to its right (if we are in the first bin, Line 9), or adds this sampled value to the right-hand side of the bin to its left (if we are in the last bin, Line 11). By sampling from the exponential distribution we make sure that the values found stay close to the tails of the distribution, but are also still continuous. Finally, we return the sampled value on Line 15.

### D.2.3 Monte-Carlo sampling algorithm

In this section we describe the Monte-Carlo sampling algorithm used to approximate our target parameter. The algorithm is listed in Algorithm D.3. After initialization the \( y_{r,a} \) on Line 2, the Monte-Carlo sampling procedure starts by sampling a large number of \( B \) values from the conditional densities found using \( \text{OSL} \). We initialize each of these \( B \) iterations using the first available block in Lines 4 to 6 (i.e., a block that has enough history for the summary measures). Then, sequentially, we
Algorithm D.2 The sampling step in the density estimation algorithm.

**Input:** \( l_{rv} \) is the number of bins, \( \phi_t \) is a list of estimators trained for each bin for a specific random variable (one entry from \( E \) as retrieved from \( DENSITYESTIMATION \)), and \( O^N(t) \) is one block from observation \( O^N \) for which the outcome needs to be found, \( Z(t) \) the relevant history for this block, and \( \iota \) is the start of the interval for each bin (on the extremes, it is \(-\infty \) and \( \infty \)).

**Output:** a value \( \hat{P} \) from the conditional distribution.

1: function \( CONDITIONAL\_SAMPLING(l_{rv}, \phi_t, O^N(t), Z(t), \iota) \)
2: \( b \leftarrow 1 \)
3: for \( i \leftarrow 1, i \leq l_{rv} \) do
4: \( p \leftarrow \phi_{i,t}(O^N(t), Z(t)) \)
5: \( b \leftarrow b + (x \sim BINOMIAL(p)) \)
6: \( i \leftarrow i + 1 \)
7: end for
8: if \( b = 1 \) then
9: \( \hat{P} \leftarrow \iota_{b+1} - (x \sim EXPONENTIAL(1)) \)
10: else if \( b = l_{rv} \) then
11: \( \hat{P} \leftarrow \iota_{b} + (x \sim EXPONENTIAL(1)) \)
12: else
13: \( \hat{P} \leftarrow (x \sim U(\iota_{b}, \iota_{b+1})) \)
14: end if
15: return \( \hat{P} \)
16: end function

Sample new data conditional on these summary measures. First we sample \( w(t) \) conditionally on \( c_w(t) \) (Line 8), then conditionally on this newly sampled value and the available \( c_a(t) \), we sample \( a(t) \) (Line 12). Note that we only sample \( a(t) \) if \( s \neq t \) (i.e., the current iteration is not an intervention iteration). If \( a = t \) we set \( a(t) \) to a specified activity \( a^* \) (Line 10). Lastly we sample \( y(t) \) conditionally on the previously sampled \( w(t) \) and \( a(t) \), and the summary measures from \( c_y(t) \) (Line 14). In order to have all relevant history available for the next iteration, we generate new summary measures based on the values sampled in this iteration and the previous iteration (Line 16). We repeat this procedure until we reach our variable of interest, \( y(\tau) \), where \( \tau = s + 1 \) in the present work. We save this value and repeat the sampling \( B \) times (Lines 3 to 22), after we calculate our result; the mean of all outcomes, \( B^{-1} \times y_{\tau,a^*} \) (Line 23).
**Algorithm D.3** The Monte-Carlo procedure of approximating the target parameter.
Function to approximate the intervention effect at a certain time $\tau$ for an intervention $a^*$. 

**Input:** $q_w, q_g, q_y$ are the conditional densities of resp. $W(t)$, $A(t)$, and $Y(t)$, $\tau$ is the moment at time at which we want to determine the effect of the intervention, $O(1)$ is the first block available from which the sampling starts, $s$ is the time at which we impose an intervention, $a^*$ is an intervention from $A$ we impose at $t$, $B$ is a large number (e.g., $10^5$), $l$ is a vector with the number of bins for each random variable (indexed by the name of the random variable), and $\iota$ is the start of the interval for each bin (on the extremes, it is $-\infty$ and $\infty$).

**Output:** Monte-Carlo approximation of the expected value of the outcome.

1: function $\textsc{MonteCarloProcedure}(q_w, q_g, q_y, \tau, O(1), s, a^*, B, l, \iota)$
2: $y_{\tau,a^*} \leftarrow 0$
3: for $b \leftarrow 1, b \leq B$ do
4: \hspace{1em} $c_w(1) \leftarrow \gamma_w(t(W^-(1)))$
5: \hspace{1em} $c_a(1) \leftarrow \gamma_a(t(A^-(1)))$
6: \hspace{1em} $c_y(1) \leftarrow \gamma_y(t(Y^-(1)))$
7: for $t \leftarrow 1, t \leq \tau$ do
8: \hspace{2em} $w(t) \leftarrow \textsc{ConditionalSampling}(l_w, \bar{q}_w(t), \emptyset, w(t), \iota)$
9: \hspace{2em} $\Rightarrow E_{q_w(t)}[w(t) | c_w(t)]$
10: \hspace{1em} if $s = t$ then
11: \hspace{2em} $a(t) = a^*$
12: \hspace{1em} else
13: \hspace{2em} $a(t) \leftarrow \textsc{ConditionalSampling}(l_a, \bar{q}_a(t), w(t), c_a(t), \iota)$
14: \hspace{2em} $\Rightarrow E_{q_a(t)}[a(t) | c_a(t), w(t)]$
15: end if
16: \hspace{2em} $y(t) \leftarrow \textsc{ConditionalSampling}(l_y, \bar{q}_y(t), [w(t), a(t)], c_y(t), \iota)$
17: \hspace{2em} $\Rightarrow E_{q_y(t)}[y(t) | c_y(t), w(t), a(t)]$
18: \hspace{1em} if $(t + 1) \leq \tau$ then
19: \hspace{2em} $c_w(t + 1), c_a(t + 1), c_y(t + 1) \leftarrow$
20: \hspace{2em} $\textsc{NextSummary}(w(t), a(t), y(t), c_w(t), c_a(t), c_y(t))$
21: \hspace{1em} end if
22: \hspace{2em} $t \leftarrow t + 1$
23: end for
24: $y_{\tau,a^*} \leftarrow y_{\tau,a^*} y(\tau)$
25: $b \leftarrow b + 1$
26: end for
27: return $B^{-1} \times y_{\tau,a^*}$
28: end function
Acronyms

*df*  degrees of freedom 69, 205, 209

**4DKL** VierDimensionale KlachtenLijst 115, 117

**4DSQ** Four-Dimensional Symptom Questionnaire 221

**AIC** Akaike information criterion 42

**AIRA** Automated Impulse Response Analysis 13, 77, 79–81, 84–90, 92, 94–99, 102, 108, 110, 187–190, 197, 217, 292, 293

**API** application programming interface 50, 59, 172, 175, 179, 183, 195

**ARCH** autoregressive conditional heteroskedasticity 23

**ARIMA** autoregressive integrated moving average 23

**ARMA** autoregressive moving average 23

**AR** autoregression 22, 23

**ATE** average treatment effect 135

**AUC** area under the curve 85, 86, 123, 125, 127, 191

**AUDIT** Alcohol Use Disorder Identification Test 115

**BAI** Beck Anxiety Inventory 115

**CAPE** Community Assessment of Psychic Experiences 199, 205

**CBS** Dutch Governmental Agency for Statistics; Centraal Bureau voor de Statistiek 61, 62, 67, 205
CIDI Composite International Depression Interview 115
CI confidence interval 69, 85, 96, 163, 205, 209
CMS content management system 48, 51, 54, 56, 58
CSV comma separated values 170, 175, 180
CTQ-SF Childhood Trauma Questionnaire-Short Form 199, 205
CV cross-validation 120, 121, 125, 143, 145, 150, 159, 191, 192, 194, 293
D/S/A Deletion / Substitution / Addition algorithm 192
D3 data-driven documents 53
DAG directed acyclic graph 156, 157
DASS Depression Anxiety Stress Scales 62, 64, 199, 205, 210, 216
DOM document object model 89
DSM Diagnostic and Statistical Manual of Mental Disorders xi, 4–7, 33, 46, 66, 98, 100, 116, 186, 197, 199, 289, 291
ECG electrocardiogram 167, 168
EHR electronic health record 28
ENN Edited Nearest Neighbors 123
EQ Empathy Quotient 199, 205
ESM experience sampling method 8, 19, 20, 99, 109, 165, 167
FN false negative 123, 124
FP false positive 123–125
GAD generalized anxiety disorder 227
GC group cumulative 104
HMAC keyed-hash message authentication code 48, 50
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<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>HND</td>
<td>How Nuts Are the Dutch</td>
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<td>HSQ</td>
<td>Humor Styles Questionnaire</td>
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<td>HTML</td>
<td>Hypertext Markup Language</td>
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<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
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<tr>
<td>ICAR</td>
<td>International Cognitive Ability Resource Base</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>IDS</td>
<td>Inventory of Depressive Symptomatology</td>
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<td>IRF</td>
<td>Impulse Response Function</td>
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<td>JSON</td>
<td>JavaScript Object Notation</td>
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<td>KDE</td>
<td>Kernel Density Estimation</td>
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<td>KS</td>
<td>Kolmogorov-Smirnov</td>
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<td>LOT-R</td>
<td>Life Orientation Test-Revised</td>
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<td>MANSA</td>
<td>Manchester Short Assessment of Quality of Life</td>
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<tr>
<td>MARS</td>
<td>Multivariate Adaptive Regression Splines</td>
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<tr>
<td>MASQ</td>
<td>Mood and Anxiety Symptom Questionnaire</td>
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<tr>
<td>MA</td>
<td>Moving Average</td>
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<tr>
<td>MDD</td>
<td>Major Depressive Disorder</td>
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<tr>
<td>MDQ</td>
<td>Mood Disorder Questionnaire</td>
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<tr>
<td>MINI</td>
<td>Mini International Neuropsychiatric Interview</td>
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<td>MSSD</td>
<td>Mean Squared Successive Difference</td>
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<td>NA</td>
<td>Negative Affect</td>
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<tr>
<td>NEMESIS</td>
<td>Netherlands Mental Health Survey and Incidence Study</td>
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NEO-FFI-3  Neuroticism-Extraversion-Openness Five-Factor Inventory updated and revised version 199, 205, 210, 216

NEO-FFI  Neuroticism-Extraversion-Openness Five-Factor Inventory 115, 117

NEO-PI-3  Neuroticism-Extraversion-Openness Peronality Inventory updated and revised version 199

NESDA  Nederlandse Studie naar Depressie en Angst 72, 115, 118, 120, 127, 293

NPSEM  nonparametric structural equation model 137, 138

OCD  obsessive compulsive disorder 28

OER  online emotion recognition 167

OIRF  orthogonalized impulse response function 25, 84

OOS  online one-step estimator 13, 154, 156, 158–160, 163, 193, 194, 230, 293

OSL  Online SuperLearner 13, 151, 152, 156, 158–160, 162–164, 193–195, 197, 229–231, 293

PANAS  Positive And Negative Affect Schedule 38, 62, 132, 199, 205, 210, 216, 229

PA  positive affect 62, 69, 98, 100–104, 106–110, 162, 189, 205

PHQ-15  Patient Health Questionnaire 15 item version 199, 205

PTSD  post-traumatic stress disorder 28

QIDS  Quick Inventory of Depressive Symptoms 38, 66, 100, 103, 107, 108, 199, 205

QS  Quantified Self 21, 165, 195

RCT  randomized controlled trial 28

REST  representational state transfer 46, 50, 52, 53

ROC  receiver operating characteristic 123, 125

RosSi  Rosmalen Somatic items scale 199, 205

SCL  Symptom Checklist 199

SD  standard deviation 62, 64, 67, 68, 70, 73, 83, 84, 88, 89, 92, 103, 117, 179, 205, 209

SE  standard error 62
SMOTE Synthetic Minority Over-sampling Technique 123
SOA service-oriented architecture 12, 45, 46, 50, 59, 60, 170
SOC service-oriented computing 45–48, 50, 51, 55, 56, 59
SPF-IL Social Production Functions for the Level of well-being 199, 205
SPOC single point of contact 46, 55
SSL secure socket layer 50
SSO single sign-on 48, 50, 52
TMLE Targeted Minimum Loss Estimation 128
TN true negative 123, 124
TP true positive 123–125
VAS visual analogue scale 40
VMA vector moving average 81, 83, 90, 217, 218
OAuth open authorization 50, 170