Behaviour Change Taxonomy (Ontology)

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@SusanMichie
This talk

1. What is an Ontology and where do taxonomies fit in?
2. Why do we need them for behavioural trials?
3. Where have we got to?
4. Next steps
Current state of play

- Behavioural trials
  - estimated 100s published each day
- Considerable investment
- Most have modest and variable effects
  - e.g. reviews from Cochrane, NICE

How can we improve this situation?
Behavioural interventions

• Most are complex
  • Made up of many interacting components
• To design more effective interventions, need to
  • know what the components are and why they work
  • unpack the “black box” of interventions

• What is in the black box? [content]
• Why do components have their effect? [theory]
• How do they vary across contexts? [theory]
Room for improvement ...

- Taken as a whole, our trial reporting and published literature is chaotic
  - Different terms for same concept
  - Same term for different concepts
  - Relationships between concepts either not or poorly specified
- Problem for science and for implementation
Example: varying terminology in specifying intervention content

<table>
<thead>
<tr>
<th>Title of journal article</th>
<th>Description of “behavioural counseling”</th>
</tr>
</thead>
<tbody>
<tr>
<td>The impact of <em>behavioral counseling</em> on stage of change fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease</td>
<td>“educating patients about the benefits of lifestyle change, encouraging them, and suggesting what changes could be made” (Steptoe et al. AJPH 2001)</td>
</tr>
<tr>
<td>Effects of internet <em>behavioral counseling</em> on weight loss in adults at risk for Type 2 diabetes</td>
<td>“feedback on self-monitoring record, reinforcement, recommendations for change, answers to questions, and general support” (Tate et al. JAMA 2003)</td>
</tr>
</tbody>
</table>
Methodological advances needed to ...

• **Accumulate** evidence efficiently
  1. **Replicate** for incremental advance
     • Explicitly build on past work rather than start anew or present as ‘new’
  2. **Minimise waste** in research
     • Improve **reporting, fidelity** of delivery and use of **theory**
       ... for replication and evidence synthesis
  3. **Co-ordinate vs fragment**
     • To maximise effectiveness and efficiency of building evidence and advancing theory
     • **Ontologies** useful for this purpose
What is an ontology?

• An ontology = systematic method for specifying concepts and the relationships between them using a “controlled vocabulary”
  • e.g. behaviour change techniques, theoretical constructs, behaviours

• An ontology of behaviour change interventions
  • Includes taxonomies of the key concepts e.g.
    • behaviour change techniques, mechanisms of action, behaviour
The Behaviour Change Intervention Ontology

West & Michie, 2016

“What works how well, for whom in what setting for what behaviours and why?”

Unorganised world literature
Describing content using a shared language

• Behaviour change techniques (BCTs)
  • The smallest components that on their own have the potential to bring about change
  • The ‘active ingredients’ of an intervention
  • Observable and replicable
  • Can be used alone or in combination with other BCTs
“Taxonomies” of BCTs

- Physical activity/healthy eating/mixed: 26 BCTs, Abraham & Michie, 2008
- Physical activity & healthy eating: 40 BCTs, Michie et al, Psychology & Health, 2011
- Smoking cessation: 53 BCTs, Michie et al, Annals Behavioral Medicine, 2010
- Reducing excessive alcohol use: 42 BCTs, Michie et al, Addiction, 2012
- Condom use: 47 BCTs, Abraham et al, 2012
- Competence framework: 89 BCTs, Dixon & Johnston, 2011

Fragmentation rather than integration
Bringing the taxonomies together, 2010-13

Michie, Johnston, Abraham, Francis, Hardeman, Eccles, Wood, Cane, Richardson

To develop a unified taxonomy using literature and expert consensus

• 400 participants from 12 countries across a range of disciplines
Results

• 93 clearly labelled, well defined, distinct, precise BCTs
• Hierarchically organised into 16 groupings to improve ease of use

Cane et al, BJHP, 2014
## BCT Taxonomy v1: 93 items in 16 groupings

<table>
<thead>
<tr>
<th>Page</th>
<th>Grouping and BCTs</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Goals and planning</td>
<td>8</td>
<td>6. Comparison of behaviour</td>
<td>16</td>
<td>12. Antecedents</td>
</tr>
<tr>
<td>1.1</td>
<td>Goal setting (behavior)</td>
<td>6.1</td>
<td>Demonstration of the behavior</td>
<td>12.1</td>
<td>Restructuring the physical environment</td>
</tr>
<tr>
<td>1.2</td>
<td>Problem solving</td>
<td>6.2</td>
<td>Social comparison</td>
<td>12.2</td>
<td>Restructuring the social environment</td>
</tr>
<tr>
<td>1.3</td>
<td>Goal setting (outcome)</td>
<td>6.3</td>
<td>Information about others’ approval</td>
<td>12.3</td>
<td>Avoidance/reducing exposure to cues for the behavior</td>
</tr>
<tr>
<td>1.4</td>
<td>Action planning</td>
<td>12.4</td>
<td>Distraction</td>
<td>12.5</td>
<td>Adding objects to the</td>
</tr>
<tr>
<td>1.5</td>
<td>Review behavior goal(s)</td>
<td>7. Associations</td>
<td>7.1</td>
<td>Prompts/cues</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>Discrepancy between current behavior and goal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>Review outcome goal(s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### No. Label Definition Examples

<table>
<thead>
<tr>
<th>No.</th>
<th>Label</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Goals and planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Goal setting (behavior)</td>
<td>Set or agree on a goal defined in terms of the behavior to be achieved. <em>Note: only code goal-setting if there is sufficient evidence that goal set as part of intervention; if goal unspecified or a behavioral outcome, code 1.3, Goal setting (outcome); if the goal defines a specific context, frequency, duration or intensity for the behavior, also code 1.4, Action planning.</em></td>
<td>Agree on a daily walking goal (e.g. 3 miles) with the person and reach agreement about the goal. Set the goal of eating 5 pieces of fruit per day as specified in public health guidelines.</td>
</tr>
</tbody>
</table>
BCTTv1 smartphone app

- Search by BCT label, BCT grouping or alphabetically

Find by search term: BCTs
Welcome

The Behaviour Change Technique Taxonomy — a resource for intervention designers, researchers, practitioners, systematic reviews and all those wishing to communicate the content of behaviour change interventions.

Login

New User?

email

password

login

"Tasks and session materials made a great combination"

Tutorial trainee, Cambridge UK

www.bct-taxonomy.com
BCT methodology provides an agreed, standard method to ...

- **Describe** interventions as accurately as possible
  - **Replicate** interventions to generate evidence
  - **Assess** fidelity
  - **Implement** effective interventions
- **Evaluate** e.g. in reviews or factorial designs
  - **Identify** active ingredients *(what)*
  - **Investigate** mechanisms of action *(how)*
- **Design** interventions
  - **BCTs** linked to broader intervention frameworks
Feedback and plans for developing BCTTv2

Please click here for the BCTTv1 online feedback form.

http://www.ucl.ac.uk/behaviour-change-techniques/BCTTv1Feedback

BCTTv1 was developed with the understanding that, in a few years, feedback from international users would lead to the development of BCTTv2.

In order to inform this development, we encourage users of BCTTv1 to submit information about their experiences within this portal. We would be grateful for any feedback and suggestions you have, including:

- Additional BCTs not in BCTTv1
- Amendments to labels or definitions of specific BCTs
- BCTs found to be difficult to use
- Adaptations or translations of BCTTv1
- Reliability data
- General suggestions for improvement

With many thanks for your contribution. All those submitting information considered by the future reviewing consortium will be acknowledged. We anticipate data will be formally reviewed in 2017.

Best wishes,

The BCTTv1 Team.
Building the Behaviour Change Intervention Ontology
Health Psychology Review
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rhpr20

Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review
Rachel Davis\textsuperscript{a}, Rona Campbell\textsuperscript{b}, Zoe Hildon\textsuperscript{a}, Lorna Hobbs\textsuperscript{a} & Susan Michie\textsuperscript{a}

Cross-disciplinary literature review with Advisory group from psychology, sociology, anthropology and economics
Results

• 83 theories
  • Summary of original description
  • List of constructs
    • 1725; mean 21, range 5-84
  • Integrating theoretical constructs (‘mechanisms’) into a taxonomy
• Future: Searchable website

Identifying hypothesised links between BCTs and mechanisms, 2014-17

1. Systematic review: what does the literature (280 articles) tell us?
2. Expert consensus: what do >100 experts from 18 countries think?
3. Triangulation

- International Advisory Board
  42 experts from 11 countries
Building the BCI Ontology: Behaviours

- Led by Kai Larsen, University of Colorado
  - with Robert West, University College London
- 5,461 articles from 3 leading journals in
  - Psychology, Education, Behavioral Medicine, Business, Management, Marketing, Information Systems, Nursing
- 2,375 behavioural variables
  - Extending WHO’s International Classification of Functioning, Disability and Health (ICF)
  - We have created 6 levels of hierarchy
The Behaviour Change Intervention Ontology
Building the BCI Ontology: Modes of delivery

• Categories inductively generated from published research
• A reliable taxonomy with 4 levels

With
Rachel Carey,
Robert West,
Fiona Evans (UCL)
Marie Johnston (Aberdeen)
The Human Behaviour-Change Project, 2016-2020: Building the science of behaviour change for complex intervention development
The Collaboration

• **Behavioural Science**
  - Susan Michie (PI)
  - Marie Johnston
  - Robert West
  - Mike Kelly

• **Information Science**
  - James Thomas

• **Computer Science**
  - John Shaw-Taylor
  - Pol Mac Aonghusa
The Project

To address the key question in behavioural science:

- What works
  - how well, for whom, in what setting
  - for what behaviours and why?

We require

1. an ‘Ontology’ of behaviour change interventions
2. A computational model, using Artificial Intelligence, to organise the evidence
   - extract information from the vast and rapidly accelerating world scientific literature, using Natural Language Processing, organised into this Ontology
   - generate new behavioural insights by synthesising this evidence
3. A user interface to allow scientists and policy-makers to draw on evidence in real-time to address the key question
The process of collaboration of three sciences
Evaluating the Ontology and AI System

• Pilot the ability of the system to maintain updated syntheses of the literature in 4 case studies:
  • Smoking, alcohol consumption, diet, physical activity
    • Start with smoking which has the most extensive & definitive evidence base

• Evaluation criteria include:
  • The adequacy of the new system in comparison with traditional evidence synthesis to provide information that is ..
    • more accurate, extensive, useable and timely
  • The utility of the system as assessed by users
Conclusion

• The aim of this programme of research is to:
  1. Efficiently and rapidly make progress in advancing our understanding of behaviour change
  2. Harness and develop the powers of AI for effectively synthesising research evidence
  3. Make accessible the world literature on behavioural interventions in real-time

• For the benefit of:
  1. All scientists
  2. Policy-makers and intervention designers
Thanks to ....

• Funders

• The many who have contributed to my thinking and work
  • especially ...Robert West and Marie Johnston

• My research team
CBC Summer School 2016

Behaviour Change – Principles and Practice
8th – 12th August 2016
University College London

Course format
• Monday to Friday, 9.30 – 17.00
• Highly participatory, with short presentations, discussions and small group work
• End-of-day mentoring sessions to work on own project, guided by an expert
• Lunch and refreshments provided
• Networking reception on the first and penultimate evenings

Additional week added due to high demand!

Registration opening soon!

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@UCLBehaveChange
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For more information

- UCL Centre for Behaviour Change
  - [www.ucl.ac.uk/behaviour-change](http://www.ucl.ac.uk/behaviour-change)
- Susan Michie, [s.michie@ucl.ac.uk](mailto:s.michie@ucl.ac.uk)

All proceeds from CBC teaching, training, books and products go to further development
ADDITIONAL SLIDES
The White House
Office of the Press Secretary

For Immediate Release
September 15, 2015

Executive Order -- Using Behavioral Science Insights to Better Serve the American People

EXECUTIVE ORDER

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USING BEHAVIORAL SCIENCE INSIGHTS TO
BETTER SERVE THE AMERICAN PEOPLE

A growing body of evidence demonstrates that behavioral science insights -- research findings from fields such as behavioral economics and psychology about how people make decisions and act on them -- can be used to design government policies to better serve the American people.
85% of Biomedical Research Funding ($210 Billion) Is Being Avoidably Wasted

Several stages of research production may lead to waste (Moher 2015)

1 Questions relevant to users of research?
   - Low priority questions addressed
   - Important outcomes are not assessed
   - Over 50% of studies are designed without reference to systematic reviews of existing evidence

2 Appropriate research design, conduct, and analysis?
   - Over 50% of studies do not take adequate steps to reduce biases
   - Inadequate statistical power
   - Inadequate replication of initial observations

3 Efficient research regulation and management?
   - Hyper-regulation of research
   - Inefficient delivery of research
   - Poor reuse of data
   - Do not promote evaluative research as an integral element of good clinical practice

4 Accessible, full research reports?
   - More than 50% of studies are never published in full
   - Biased under-reporting of studies with disappointing results
   - Biased reporting of data within studies

5 Unbiased and useable reports?
   - More than 30% of trial interventions are not sufficiently well described
   - More than 50% of planned study outcomes are not reported
   - Most new research not interpreted in the context of systematic assessment of other relevant evidence

Research waste
What is an intervention?

- The *action* of intervening, “stepping in” or interfering in any affair, so as to affect its *course or issue*  
  (Oxford English Dictionary)

- The *act* or fact of becoming involved intentionally  
  (Cambridge English Dictionary)

- The *act* or … a method of interfering with the *outcome or course* especially of a condition or process  
  (Merriam-Webster Dictionary)

- An *action* that aims to bring about identifiable *outcomes*  
  (Rychetnik et al., 2004; A glossary for evidence-based public health. JECH; 2004;58:538-545)

- Intentional change strategies (delivered at different levels)  
  (Fraser M et al., Intervention Research. 2009. Oxford University Press)
Complex Interventions: UK MRC Framework

• Number of and *interactions between components* within the experimental and control interventions

• Number and *difficulty of behaviours* required by those delivering or receiving the interventions

• Number of *groups or organisational levels targeted* by the intervention

• Degree of *flexibility or tailoring of the intervention* permitted