The Human Behaviour-Change Project:
Digitising the knowledge base on effectiveness of behaviour change interventions

HB CP
Human Behaviour-Change Project

Participating organisations

UCL

University of Aberdeen

University of Cambridge

IBM Research

www.humanbehaviourchange.org

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A Collaborative Award funded by the

wellcome trust

The collaboration

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	Behavioural science	Information science	Computer science
Grant-holders	Susan Michie (PI; UCL) Robert West (UCL) Marie Johnston (Aberdeen) Mike Kelly (Cambridge)	James Thomas (UCL)	John Shawe-Taylor (UCL) Pol MacAonghusa (IBM)
Researchers	Ailbhe Finnerty (UCL) Marta Marques (UCL) Emma Norris (UCL) *Researcher: tba*	Alison O'Mara-Eves (UCL) *Software developer: tba*	Lea Deleris (IBM) Debasis Ganguly (IBM)
Project manager	Niccola Hutchinson Pascal		

The Human Behaviour Change Project

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The need	Urgent need for more effective behaviour change interventions to improve health & wellbeing
The challenge	High volume of noisy data on effectiveness of interventions with large number of potential factors interacting to influence outcomes
The solution	An AI system that can extract relevant information from intervention evaluations, build a knowledge base that can be interrogated, and continually improve as new information becomes available

The problem

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Volume of research

- Estimated >200 evaluations of behavioural interventions published each day

Reporting variability

- Studies are reported very variably so difficult to synthesise or to draw theoretical conclusions about mediation and moderation of effects

Context sensitivity

- Much literature not directly relevant to specific contexts of users

Need for timeliness

- Typical time for study results to be included in systematic reviews 2.5-6.5 years

Building the science of behaviour change

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- The HBCP aims to revolutionise the ways in which we
  - Build knowledge and understanding about behaviour change
  - Use that knowledge to answer real-world questions

'What works, compared with what, how well, with what exposure, with what behaviours, for how long, for whom, in what settings and why?'

The 4-year plan

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1. A Behaviour Change Intervention Ontology for organising relevant information from research reports
2. An automated feature extraction system to find and extract that information
3. Machine Learning and Reasoning Systems that integrate and extrapolate from that information to generate new knowledge and hypotheses about behaviour change
4. A User Interface that answers questions about behaviour change interventions and explains its conclusions

The Behaviour Change Intervention Ontology

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A systematic method for defining agreed-upon terms and their inter-relationships

Three core elements:

1. a controlled vocabulary specifying and defining existing entities,
2. specification of the inter-relationships between entities, and
3. codification in a computer-readable format to enable knowledge generation, organisation, re-use, integration, and analysis

Larsen, Michie, Hekler et al (2016). Behavior change interventions: The potential of ontologies for advancing science and practice. *Journal of Behavioral Medicine.*

The Preliminary Ontology of Behaviour Change Interventions

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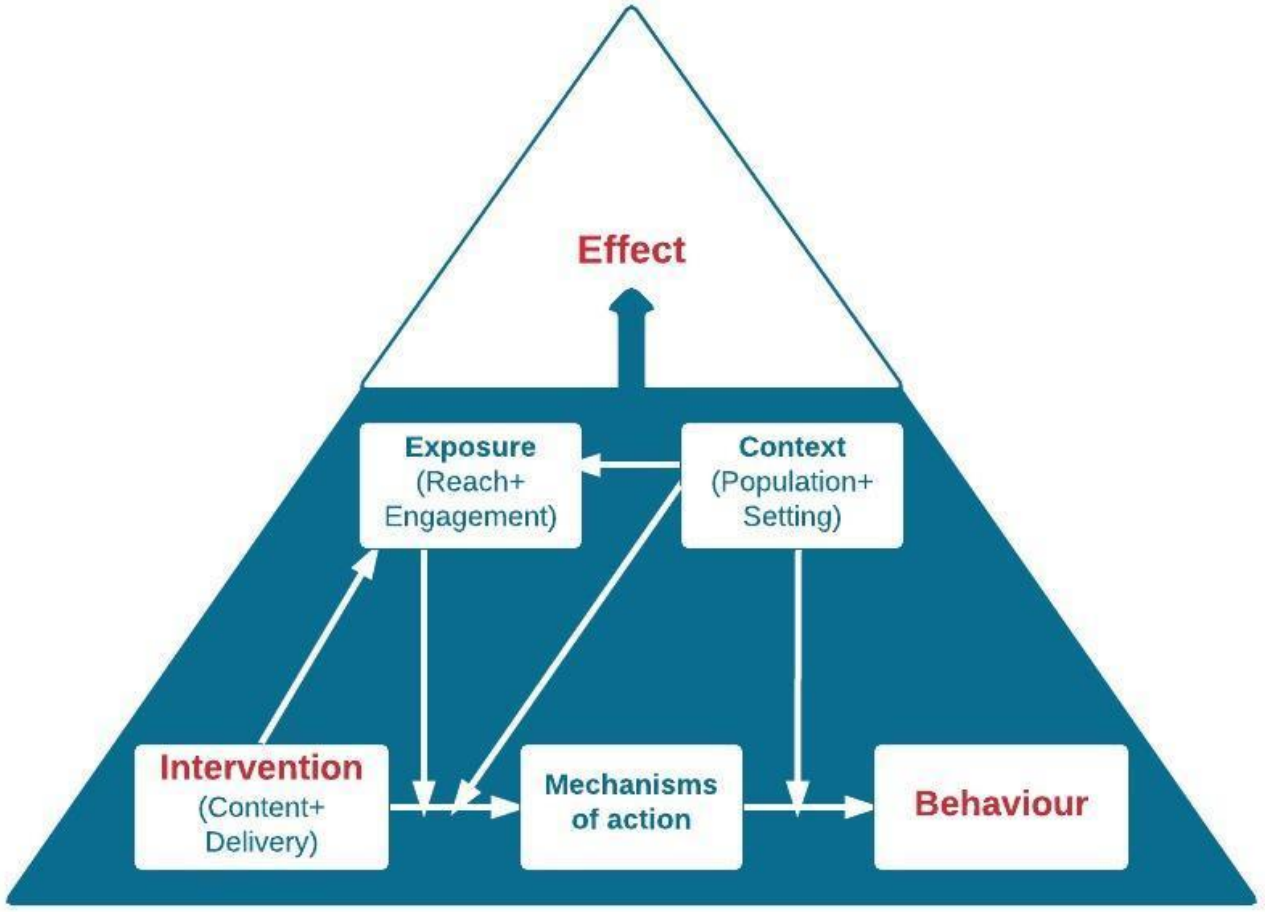

The task

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1. Behavioural scientists annotate published reports using the BCI Ontology to train an Artificial Intelligence system to …
2. Systematically identify connections and patterns in data
   - Using Natural Language Processing and other feature extraction tools
3. Interpret evidence many times faster than a human
   - Using Machine Learning and automated reasoning
4. Generate reusable knowledge that both humans and machine can interpret
   - Accessed via a User Interface

Agents and Activities

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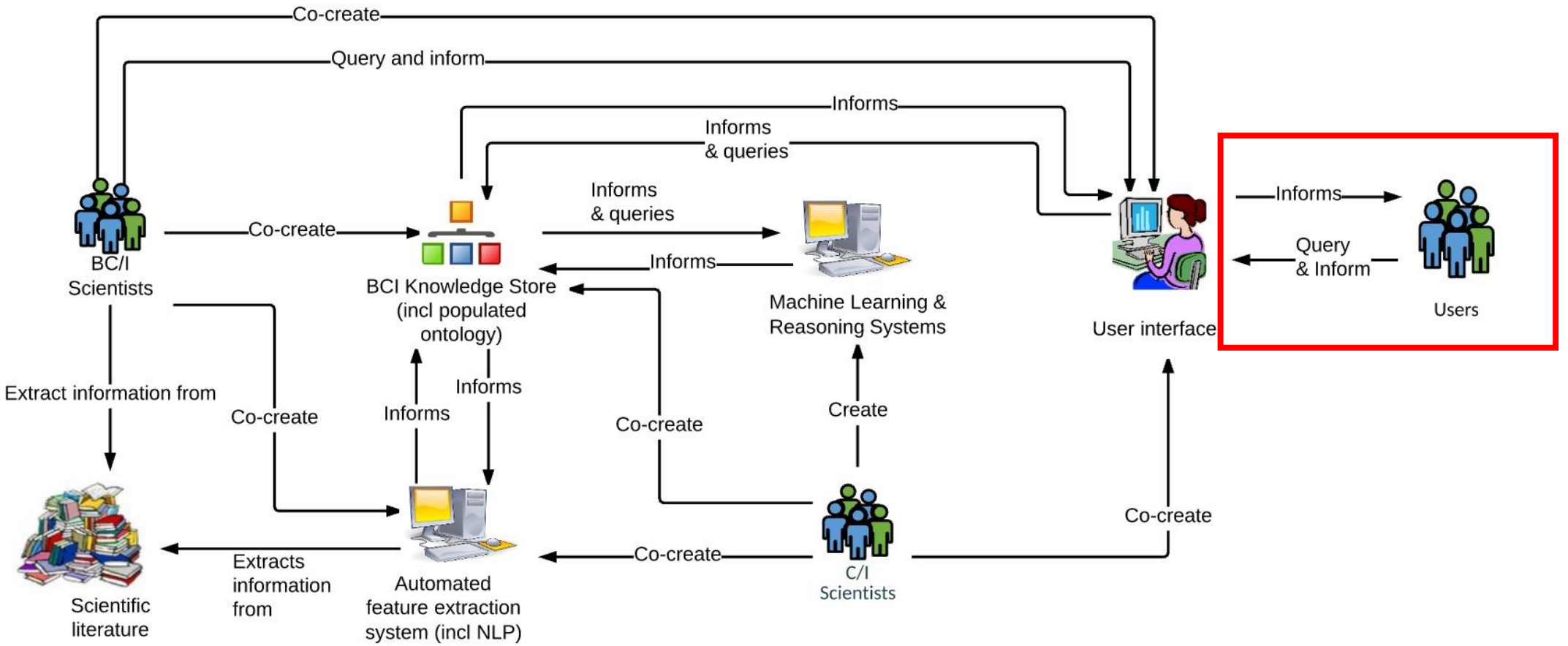

Examples of Users and Uses

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Inform

Query & Inform

Users

Behavioural scientist

E.g. what mechanisms of action are likely to account for the effect of x on y?

Public health policy-maker

E.g. what do I need to do to bring about this change in this population?

Detects patterns, makes inferences

The AI System

The Promise

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1. Remarkable success stories such as IBM Watson (playing Jeopardy), DeepMind (playing Atari games and Go) etc.
2. HBCP will leverage such approaches to teach the AI system to populate ontologies and suggest improvements to the structures
3. The AI system will be able to generate new insights and testable hypotheses about behaviour change

Challenges

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1. Join knowledge from many sources
   - significant effort to identify connections
2. De-noise relevant knowledge
   - useful information represents small proportion of total content
3. Resolve content ambiguity
   - for precise semantics of ontology
4. Assign confidence to learned knowledge
   - assess evidence vs opinion
5. Connect rich semantic knowledge source to Machine Learning & AI
   - without combinatorial meltdown

The user interface

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- Develop and evaluate an online open-access interface to
  - enable widespread use of the knowledge generated
  - provide users with an easy method for intelligent searching of the behaviour change intervention literature and the inferences made from it
  - interrogate and provide feedback from a wide perspective of views into the AI system – and the ontology developed by the AI System

Implementation

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- Establish
  - Scientific Advisory Board
    - International, interdisciplinary
  - Users and Stakeholders Board
    - Co-design User Interface
  - Partners e.g.
    - Cochrane and Campbell Collaborations
    - Public sector and commercial users

Future collaborative projects

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- HBCP will provide an infrastructure and tools that can enable collaborative projects e.g.
  - Include cost-effectiveness evidence
  - Examine ethical aspects of how the HBCP can maximise social benefit and minimise harm
  - Apply to individual-level datasets rather than aggregate-level data as in published evaluation reports
  - Etc …

Conclusion

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We need this research to:

1. make rapid and efficient progress in advancing our understanding of behaviour
2. harness and develop the powers of AI for effectively synthesising research evidence and generating new knowledge and hypotheses
3. make accessible up-to-date world literature on behavioural interventions ….
4. For the benefit of:
   - Scientists
   - Policy-makers, practitioners and intervention designers
   - Public and commercial sectors, NGOs etc.

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Questions and discussion

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