From single to multiple behaviour change approaches in implementation science

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• No industry funding
Ottawa – Canada
Implementation Science in Ottawa: Centre for Implementation Research

13 faculty and their teams focused on advancing research into developing and applying Implementation Science in health settings to improve health-care and health.

Multidisciplinary Fields

- Cognitive psychology
- Epidemiology
- Health economics
- Health psychology
- Health services research
- Knowledge translation science
- Medical sociology
- Medicine
- Nursing
- Population health
- Statistics
- Other health and behavioural sciences
My research program

Evidence synthesis
- Chronic Disease
  - Chronic Pain
- Blood and Tissue
  - Transfusion guideline implementation
  - Organ donation and registration
  - Plasma donation
  - Living organ donation
  - Blood donation
- Infectious Disease
  - HCV screening and treatment
- Personalized health and AI
  - End of life care
- Conceptual innovation
  - Trust
  - Implementation intentions
  - Misinformation
  - Maintenance of change
  - Multiple behavior change and prioritization
- Expert Research Service
  - Government rapid reviews
  - Barrier assessments

Barriers/enablers assessment
- Intervention Development
- Intervention Evaluation
- Equity
- Engagement
Overview

• Behaviour as a foundational unit of interest in implementation science

• Build a case for moving from single behaviour to multiple behaviour paradigm in implementation science with insight from our work in:
  1. Methods for specifying behaviour
  2. Interventions to change >1 behaviour
  3. Exploring how behaviours are inter-connected
  4. Trying to advance theory

• Open questions and future directions
Behaviour as a fundamental unit of analysis in ImplSci
Behaviour as a fundamental unit of analysis in ImplSci

Someone in the healthcare system’s behaviour need(s) to change

Implementation can be viewed through the lens of behaviours of those who need to change

- The question can then become: who, at what level, needs to change what they do
- My interest: exploring interface between behavioural science and implementation science
Behaviour underpins gaps between research evidence and routine care

Research  ▼ Health services

Inappropriate use of clinical practices in Canada: a systematic review

Janet E. Squires RN PhD, Danielle Cho-Young RN MScN, Laura D. Aloisio RN MScN, Robert Bell MD, Stephen Bornstein PhD, Susan E. Brien PhD, Simon Decary PT PhD, Melissa Demery Varin RN MScN, Mark Dobrow PhD, Carole A. Estabrooks RN PhD, Ian D. Graham PhD, Megan Greenough RN MScN, Doris Grinspun RN PhD, Michael Hillmer PhD, Tanya Horsley PhD, Jiale Hu RN PhD, Alan Katz MBChB MSc, Christina Krause MSc, John Lavis MD PhD, Wendy Levinson MD, Adrian Levy PhD, Michelina Mancuso PT MSc, Steve Morgan PhD, Letitia Nadjalin-Penno RN PhD, Andrew Neuner MBA, Tamara Rader MLIS, Wilmer J. Santos RN MScN, Gary Teare DVM PhD, Joshua Tepper MD eMBA, Amanda Vandyk RN PhD, Michael Wilson PhD, Jeremy M. Grimshaw MBChB PhD

Median proportion of inappropriate care: 30% (IQR 12-57%)

Underuse: 44% (IQR 24-66%)
Overuse: 14% (IQR 3-31%)

Overuse of outdated practice and underuse of evidenced in Canada
174 studies representing 228 clinical practices and covering 2.9m patients

Squires et al 2022 CMAJ
Gaps between research evidence and routine care involve behaviour

Types of underused and overused clinical practices
- Lab tests
- Referrals
- Assessments
- Screening
- Blood tests
- Imaging
- Acute procedures
- Biophysical therapy
- Psychosocial therapy
- Medication

Diseases/conditions
- Diabetes
- Chronic kidney disease
- COPD
- Cancers (breast, prostate, colorectal, cervical, skin, bladder, bone, oral)
- CVD
- Asthma
- Osteoporosis
- Hypertension

Squires et al 2022 CMAJ
The Behaviour System: whose behaviour, at what level?

People, at every level, are making decisions and engaging in behaviours that impact themselves and those around them now and into the future.

Rather than system/organization vs individual, my approach:

**Who needs to do what, differently, where and when?**
My toolkit: Theories, Models, and Frameworks of behavioural approaches to ImplSci

Who needs to do what differently?

Identifying theory-informed barriers and enablers to address

Codevelop interventions to address modifiable barriers/enablers

Evaluate process and outcomes

Tools

- AACTT\(^1\) Process Mapping\(^2\)
- TDF\(^3,4,5\) Dual process models\(^6\)
- BCTTv1\(^7\)
- BCTO\(^8\)
- BCW\(^9\)
- RCTs Quasi experiments Process Evals\(^10\)

\(^1\)Presseau et al 2019; \(^2\)Best et al 2023 \(^3\)Michie et al., 2005; \(^4\)Cane et al., 2012; \(^5\)Atkins et al 2017; \(^6\)Potthoff et al 2022; \(^7\)Michie et al. 2013; \(^8\)Marques et al 2023; \(^9\)Michie et al 2011; \(^10\)Wolfenden et al. 2021
A case to move from single to multiple behaviour approaches
A typical approach

Who needs to do what differently?

Identifying theory-informed barriers and enablers to address

Codevelop interventions to address modifiable barriers/enablers

Evaluate process and outcomes

Gap in care identified (e.g., hand hygiene suboptimal); a target behaviour specified in detail

Theory-informed barrier/enabler study (qual or survey) + synthesis of existing barrier/enabler studies: identifies clear targets for intervention development to improve hand hygiene behaviour

Map implementation/behaviour change strategies to barriers/enablers; bring together healthcare professionals to co-develop intervention content

Pilot for feasibility and acceptability then run cluster randomized trial with theory-based process evaluation focused on hand hygiene behaviour
Everyday life is characterised by multiple behaviours competing for our limited resources.
Manage infections without antibiotics
Exercise advice
Referring to nurse
Ask about stress
Answer patient questions
Update history
Adjust meds to achieve <140/80 mmHg
Hand hygiene
Check A1c
Adjust meds if Hb1c is >8%
Provide self-management advice
Provide weight advice
Examine feet
Discuss prescribing options
Shared decision about treatment
Exercise advice
Nutrition advice
Ask about stress
Refer for eye screening
Maintain rapport
See next patient
Attend CPD event
Limits of single behaviour approaches

- **Questionable ecological validity**: the contexts in which we aim to change behaviour are characterized by a range of behaviours vying for our limited motivation.

- **Insufficient theory**: Predominant behavioural models, theories and frameworks applied in ImplSci (and HSR more generally) focus on one behaviour on which to understand, develop interventions and evaluation change.

- **Whack-A-Mole risk (spillover effects)**: a given intervention that successfully improves one behaviour may do so at the expense of other existing behaviours.

- **Missed opportunity for synergy (knock-on effects and tipping points)**: a given intervention that successfully improves one behaviour also has potential to positively impact on other behaviours.

Moving to a multiple behaviour paradigm can address each of these limitations.
Insights gleaned by moving to a multiple behaviour perspectives

1. Ways of specifying behaviour(s)
2. Interventions to change >1 behaviour
3. Investigating how behaviours are interconnected
4. Integrating multiple behaviour perspectives in existing theories/models/frameworks
Specifying a target behaviour
Identifying who needs to do what, differently: a multiple behaviour approach

- Proposed a framework to enhance the specificity of description of a target behaviour

**METHODOLOGY**

<table>
<thead>
<tr>
<th>Action</th>
<th>Behaviour(s) that needs to change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor</td>
<td>Person/people that do/could do the Action</td>
</tr>
<tr>
<td>Context</td>
<td>Physical location or social setting of Action</td>
</tr>
<tr>
<td>Target</td>
<td>Person/people for whom Action is performed</td>
</tr>
<tr>
<td>Time</td>
<td>When the Action is performed (time/date/freq)</td>
</tr>
</tbody>
</table>

Designed to be helpful to:
- Identify who needs to do what, differently, when and where
- Inform a more specific barrier/enabler assessment and tighter measures
- Select implementation intervention components
- Measure change in the AACTT-specified behaviour
Specifying the AACTT: a multiple behaviour approach

Often used to specify a single AACTT – but designed to with multiple behaviour specification in mind too!

1. **Single behaviour AACTT**
   - **Action**: Specify the behaviour that needs to change, in terms that can be observed or measured
     - Use alcohol-based hand gel
   - **Actor**: Specify the person/people that do(es) or could do the action targeted
     - Staff physicians, nurses and residents
   - **Context**: Specify the physical location, emotional context, or social setting in which the action is performed
     - In patient rooms
   - **Target**: Specify the person/people with/for whom the action is performed
     - Patients receiving care at the hospital
   - **Time**: Specify when the action is performed (the time/date/frequency)
     - Before and after touching a patient

2. **Multi-Actor, Multi-behaviour AACTT**
   - **Action**: Specify the behaviours that need to change, in terms that can be observed or measured
     - Use alcohol-based hand gel (local)
     - Check and refill empty gel dispensers (ancillary)
     - Order dispensers and gel (ancillary)
   - **Actor**: Specify each person/people that do(es) or could do each of the actions targeted
     - Staff physicians, nurses and residents
     - Cleaning staff
     - Hospital administrator
   - **Context**: Specify the physical location, emotional context, or social setting in which the action is performed
     - In patient rooms
     - In patient rooms
     - In own office
   - **Target**: Specify the person/people with/for whom the action is performed
     - Patients receiving care at the hospital
     - Staff physicians, nurses, residents
     - Cleaning staff
   - **Time**: Specify when the action is performed (the time/date/frequency)
     - Before and after touching a patient
     - Every shift
     - Quarterly

3. **Single Actor, Multi-behaviour AACTT**
   - **Action**: Specify the behaviours that need to change, in terms that can be observed or measured
     - Prescribe new or increase dose of existing antihypertensive
   - **Actor**: Specify each person/people that do(es) or could do each of the actions targeted
     - Family doctor
     - Nurse
     - Family doctor
   - **Context**: Specify the physical location, emotional context, or social setting in which the action is performed
     - Practice clinic room
     - Practice clinic room
     - Practice clinic room
   - **Target**: Specify the person/people with/for whom the action is performed
     - Patients with type 2 diabetes with uncontrolled hypertension whose BP is > 160/90 mmHg even after previous management
     - Patients with type 2 diabetes
     - Patients with type 2 diabetes who have not had attended for retinopathy screening in the last year
   - **Time**: Specify when the action is performed (the time/date/frequency)
     - During annual review
     - During annual review
     - During annual review

Presseau et al (2019)
An example of multi-actor, multi-behaviour AACTT specification for intervention description

**STUDY PROTOCOL**

Assessing the feasibility, acceptability, and fidelity of a tele-retinopathy-based intervention to encourage greater attendance to diabetic retinopathy screening in immigrants living with diabetes from China and African-Caribbean countries in Ottawa, Canada: a protocol

Valerie Umaefule1, Mackenzie Wilson1, Marie Carole Boucher2, Michael H. Brent3, Maman Joyce Dogba4, Olivia Drescher5, Jeremy M. Grimshaw6, Noah M. Ivers7, John G. Lawsonson8, Fabiana Lorenccato9, David Mabery10, Nicola McLerny11, Sheena McHugh12, Olivia Sutakovic12, Keshnapa Thavorn13,14, Holly G. Wittman15, Catherine Yu16, Hai Cheng17, Wei Han18, Yi Hong19, Balkissa Idissa20, Tina Leech21, Joffie Malette22, Isabelle Mongeon23, Zawadi Mugisho24, Marlyne Mbakop Nguebou25, Sara Pabla25, Sifan Rahman26, Azarou Samambouougou27, Hasina Yismai28, Richard You29, Junjing Zhao30, and Justin Presseau30,31

**RESEARCH**

The co-development of a linguistic and culturally tailored tele-retinopathy screening intervention for immigrants living with diabetes from China and African-Caribbean countries in Ottawa, Canada

Valerie Umaefule1, Mackenzie Wilson1, Marie Carole Boucher2, Michael H. Brent3, Maman Joyce Dogba4, Olivia Drescher5, Jeremy M. Grimshaw6, Noah M. Ivers7, John G. Lawsonson8, Fabiana Lorenccato9, David Mabery10, Nicola McLerny11, Sheena McHugh12, Olivia Sutakovic12, Keshnapa Thavorn13,14, Holly G. Wittman15, Catherine Yu16, Hai Cheng17, Wei Han18, Yi Hong19, Balkissa Idissa20, Tina Leech21, Joffie Malette22, Isabelle Mongeon23, Zawadi Mugisho24, Marlyne Mbakop Nguebou25, Sara Pabla25, Sifan Rahman26, Azarou Samambouougou27, Hasina Yismai28, Richard You29, Junjing Zhao30, and Justin Presseau30,31

1. Study Protocol
2. Research
More than ‘just’ attending screening: A multi-behaviour, multi-actor intervention

**Actions**
- Referral
  - Diabetes Educators
  - Screen staff
  - Primary care docs
  - Eligible patients
  - Education sessions
  - Screen community outreach sites
  - At primary care clinic
  - Online
- Booking
  - Community health centre admin
  - Via phone at community health centre
- Attendance
  - People with diabetes eligible and due for eye screening from China or African/Caribbean countries
- Screening and language support
  - Trained screener
- Diagnosis & Follow-up
  - Retina specialist

**Actors**
- People with diabetes eligible and due for eye screening from China or African/Caribbean countries

**Contexts**
- During education session
- During outreach
- During routine diabetes appointment

**Targets**
- People with diabetes eligible and due for eye screening from China or African/Caribbean countries

**Times**
- When referrals come in and reminder before appointment
- At booked date/time

Can be used to then assess fidelity of delivery and receipt, acceptability, and barrier/enablers

Presseau et al 2019; Umaefulum et al 2023
Interventions to change >1 behaviour

Multiple behaviour insight 2
What do we know about interventions to change >1 behaviour?

Two systematic reviews looking at:

1. Effectiveness of interventions targeting >1 health behaviour to manage of chronic disease in patients/public
2. Effectiveness of interventions targeting >1 clinician behaviour to manage chronic disease

• Synthesizing the change techniques/strategies used within interventions targeting multiple behaviours

Carolina Silva
Doctoral student

https://osf.io/preprints/psyarxiv/7dwrv
A systematic review of multiple health behaviour change interventions for patients with chronic conditions

Inclusion Criteria:

- **Population:** Individuals with chronic conditions
- **Intervention:** Any multiple health behaviour change
- **Comparators:** Any control group
- **Outcomes:** health behaviours
- **Study design:** RCTs in the healthcare context, including digital

3696 studies screened

\( k = 61 \) studies included

**Of included studies:**

- 25 Cardiovascular diseases
- 10 Type 2 Diabetes
- 9 Hypertension
- 7 Cancer
- 3 Multiple conditions
- 1 One or more chronic conditions

Silva et al; https://osf.io/preprints/psyarxiv/ch2yx
Intervention characteristics

- Number of behaviours targeted: 2 to 5 ($M = 3$)
- Most frequently targeted behaviours: Physical activity ($k = 60, 98\%$) and diet ($k = 56, 92\%$)
- 10 clusters of multiple behaviours identified
  - Most frequent behavioural clusters: ‘Physical Activity, diet and smoking’ ($k = 20, 33\%$) and ‘Physical Activity and diet’ ($k = 16, 27\%$)
- Order of multiple behaviour change: Simultaneous ($k = 46, 75\%$), Sequential ($k = 8, 13\%$), unclear ($k = 10, 16\%$)
- $K = 43$ included in meta-analyses

Silva et al https://osf.io/preprints/psyarxiv/ch2yx
## Meta-analyses of effects of interventions targeting >1 behaviour on specific health behaviours

<table>
<thead>
<tr>
<th>Diet: Fruit &amp; Veg Consumption</th>
<th>Diet: Fat Consumption</th>
<th>PA: Physical Activity</th>
<th>PA: Sedentary behaviour</th>
<th>Smoking Cessation</th>
<th>Alcohol Consumption</th>
<th>Medication Adherence</th>
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<tr>
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<td>CI $= N/A$</td>
<td>CI $= -.21$ to .17</td>
<td>CI $= -.05$ to .21</td>
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</table>

Silva et al https://osf.io/preprints/psyarxiv/ch2yx
A systematic review of interventions to change >1 health care professional behaviour

Inclusion Criteria:

- **Population**: Any health care professional
- **Intervention**: Aiming to change two or more clinical behaviors (at least one focused on health behaviour change advice)
- **Comparators**: Any
- **Outcomes**: clinician behaviours
- **Study design**: RCTs

Included studies targeted:

- MDs (n=8)
- Nurses (n=2)
- Physiotherapist (n=1)
- Combo of HCPs (n=6)

- 4 were theory based
- 9 delivered the intervention through a combination of in person and remote contacts
- 5 had a duration of 1 day

6703 studies screened
k=17 studies included

Silva et al https://osf.io/abe92/
### Preliminary descriptive results to date *analyses ongoing*

Types of HCP behaviours targeted:

<table>
<thead>
<tr>
<th></th>
<th>Provision of advice</th>
<th>Screening/assessment</th>
<th>Prescription</th>
<th>Referral</th>
<th>Treatment</th>
<th>Diagnosis</th>
<th>History taking</th>
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<td>Provision of advice</td>
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</tbody>
</table>
How are behaviours interconnected?
3 Exploring how multiple intentions and behaviours are linked

- Relationship between **intention** and **behaviour** among the strongest and most consistently observed
- Almost everything we know about intention-behaviour is based within the single-behaviour paradigm
- People tend to have lots of intentions and engage in many behaviours

**Research Questions**
- How many behaviours do individuals intend to enact at any given time?
- Does the number of intentions relate to the success or failure in following through to enacting behaviours?
- Does the number of intended behaviours, and success/fail rate in enacting them, correlate with QoL?
N=116 students completed a baseline and 1-week follow-up questionnaires

Extracted every intention measure from 185 papers in systematic review of Theory of Planned Behaviour studies (Armitage & Conner, 2001); removed duplicates, those n/a to adults or that do not have a 1-week time-frame

Baseline: Intention items for 51 different behaviours adjusted to have same time-frame (“in the next 7 days, I intend…”); + age & sex

Follow-up: behaviours measured as self-report at follow-up for all 51; QoL (WHOQOL)

Dichotomised intention responses into “intenders” and “non-intenders” then for each respondent, computed:

- Total number of intentions out of 51;
- Number successfully translated into behaviour in subsequent week;
- Number of intentions failed to translate
Results

M = 18 (SD=8) intentions out of 51 possible options for the next week. Of those:

- M=13 (SD=6) were successfully translated into behaviour
- M=5 (SD=4) failed to be translated into behaviour

- Having more intentions associated with more success translation into behaviour and more failed attempts at behaviour
- Having more intentions, successfully translating them, and failing at some all associated with greater QoL

Bivariate correlations

<table>
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<tr>
<th></th>
<th>Intentions</th>
<th>Failed</th>
<th>Succeeded</th>
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<td>.263**</td>
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<tr>
<td>QOL meaningfullife</td>
<td>.281**</td>
<td>.216*</td>
<td>.238*</td>
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<tr>
<td>QOL selfsatisfaction</td>
<td>.233*</td>
<td>.234*</td>
<td>.162</td>
</tr>
<tr>
<td>QOL depression</td>
<td>-.047</td>
<td>-.081</td>
<td>-.016</td>
</tr>
</tbody>
</table>

Sniehotta et al 2016
Social network analysis has provided insight into how people are interconnected.

What if applied such approaches to the behaviours that people engage in?

- Each behaviour = a node in a person’s behavioural network.
- Each node is potentially linked to each other node (a tie).
- Possible to think of each individual as having their own behavioural network.
Establishing the methods for behavioural network analysis

Modelling co-occurring and co-varying health behaviours: applications of network psychometrics and machine learning\(^1\)

- **Co-occurrence**: an individual engaging in 2+ behaviours
- **Covariation**: association between the behaviours that an individual engages in

\(^1\text{PhD thesis, van Allen 2023}\)
### Co-occurrence and covariation in multiple behaviours

<table>
<thead>
<tr>
<th>Co-occurrence = person centered</th>
<th>Co-variation = behaviour centered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorize people into groups based on their behaviours they share</td>
<td>Examine the relationship amongst the behaviours that people engage in</td>
</tr>
<tr>
<td>(cluster analysis)</td>
<td>(network analysis)</td>
</tr>
</tbody>
</table>

**Group 1:** People who smoke, drink regularly, walk, and eat moderately healthily

**Group 2:** People who don’t smoke, drink occasionally, exercise regularly and eat healthily

[Diagram showing relationships between behaviours]
Clustering of multiple behaviours

Canadian Longitudinal Study on Aging (CLSA), nationally representative survey (2010-2033) of 50,000+ individuals ages of 45-85.
3 Results

7 Clusters people defined by the extent to which they engage in measured behaviours

van Allen et al 2023
Covariation of multiple behaviours: a network analysis perspective

- Secondary analysis of two large datasets:
  - Canadian Longitudinal Study on Aging (n=40,268) including 7 behaviours
  - iCARE data focused on health behaviours during the COVID-19 pandemic (n=23,168)
- Used Graphical Gaussian Model (GGM) to model and visualize the network of polychoric partial correlations between behaviours (Epskamp & Fried, 2018)

https://osf.io/vsxu6
Covariation: 2 datasets

CLSA dataset

Age: 45-64

van Allen (Chapter 2; 2023) https://osf.io/vsxu6

iCARE dataset (survey 5-10)

Age: < 46 Years
Implications

• Co-occurrence (behaviour clusters) and covariation (behaviour networks) demonstrate how behaviour systems can be mapped

✓ Identifying clusters of similar co-occurring behaviours: opportunities for tailoring to multiple behaviours

✓ Identifying covarying behaviours (+ & -) provides opportunity to leverage or evaluate knock-on/spillover effects in interventions

Next steps: Testing in healthcare provider behaviour network (leverage routinely collected data)
Implications

Mapping the behaviour system opens new research questions:

• What happens to other behaviours in the behaviour network when one behaviour is changed (increased, decreased), added (new behaviour) or stopped (de-implemented)?

• Which behaviours are most central? Are our target behaviours central? (measure of priority). How many degrees of separation between central and peripheral behaviours?

• Can we focus on a central behaviour to promote a knock-on (spillover) effect to our target behaviour?
Integrating multiple behaviour perspectives into existing theory
Dual process models suggest that behaviour is determined by two interacting processes:\n
1. **Reflective process**:
   - Analytical
   - Effortful
   - Resource intensive
   - Slow, Low capacity
   - Conscious, deliberate

2. **Impulsive process**:
   - Perceptual and cued
   - Minimal effort, resources
   - Fast, High capacity
   - Unconscious
   - Automatic
   - Default process
   - Operates in parallel

• Dual process approach provides an opportunity to jointly account for:
  - Skilled decision-making involving behaviours with highly salient consequences (**reflective process**)\n  - Automatic responses to environmental cues in stable contexts (**impulsive process**)\n
---

Theory testing across >1 clinical behaviour

Tested a dual process model predicting six clinical behaviours in same sample

Reflective and Automatic Processes in Health Care Professional Behaviour: a Dual Process Model Tested Across Multiple Behaviours

Justin Presseau, Ph.D., Marie Johnston, PhD, Tarja Heponiemi, PhD, Marko Elovainio, PhD, Jill J. Francis, PhD, Martin P. Eccles, MBBS, MD, FMedSci, FRCP, Nick Steen, PhD, Susan Hrisos, MPhil, Elaine Stamp, MMathStat, Jeremy M. Grimshaw, MBChB, PhD, FRCP, FCAHS, Gillian Hawthorne, MBChB, PhD, FRCP, Falko F. Sniehotta, PhD

Author Notes

• Prospective predictive design\(^1\). Postal questionnaires sent at baseline and 12 months to GPs and nurses across the UK

• **Main outcome:** Six clinician self-reported diabetes management behaviours @12 months follow-up

---

**Six nested studies**

- \(N=335\) Prescribing for blood pressure (140/80mmHg)
- \(N=288\) Prescribing for HbA1c (>8%)
- \(N=417\) Providing weight management advice (BMI >30)
- \(N=332\) Providing diabetes self-management advice
- \(N=346\) Providing diabetes education
- \(N=218\) Examining feet

---

## Results

<table>
<thead>
<tr>
<th>Clinical Behaviour</th>
<th>Reflective process</th>
<th>Impulsive Process (Automaticity)</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indirect effect (via AP or CP)</td>
<td>Direct intention effect</td>
<td></td>
</tr>
<tr>
<td>1. Prescribing (BP)</td>
<td>via AP; $B = .11$ (95% CI .00, .24)</td>
<td>$B' = .49^{**}$</td>
<td>0.14</td>
</tr>
<tr>
<td>2. Prescribing (HbA1c)</td>
<td>ns</td>
<td>$B' = .36^{*}$</td>
<td>0.14</td>
</tr>
<tr>
<td>3. Advising (self-management)</td>
<td>via CP; $B = .14$ (95% CI .02, .29)</td>
<td>$B' = .49^{*}$</td>
<td>0.24</td>
</tr>
<tr>
<td>4. Advising (weight management)</td>
<td>via CP; $B = .08$ (95% CI .01, .16)</td>
<td>$B' = .09$</td>
<td>0.23</td>
</tr>
<tr>
<td>5. Advising (general education)</td>
<td>via AP; $B = .36$ (95% CI .11, .65)</td>
<td>$B' = .38^{**}$</td>
<td>0.28</td>
</tr>
<tr>
<td>6. Examining (feet)</td>
<td>ns</td>
<td>$B = .76^{**}$</td>
<td>0.55</td>
</tr>
</tbody>
</table>
Both reflective and impulsive processes involved in predicting clinician behaviours

Impulsive process involved in prescribing, examining and advising, though not without the input of the reflective process

Testing theory across multiple behaviours provides internal replication and robust hypothesis testing
An integrative theory that describes how behaviours are inter-linked and can influence each other (Kruglanski et al 2002; 2023)
Multiple behaviour approaches = opportunity to draw in factors that describe the relationship between behaviours

Opportunity to better account for and address multiple competing demands

- **Behaviour Conflict**: Behaviour A may interfere with Behaviour B, making it less likely that Behaviour B will be pursued by accounting for (limited) available resources

- **Behaviour Facilitation**: Behaviour A may help Behaviour B, making it more likely that Behaviour B will be pursued

- **Behaviour Priority**: Behaviour A may have an absolute or context-specific importance over Behaviour B

Do these factors add value in understanding behaviour above and beyond “classic” MTFs?
Study 1: Do behavioural facilitation and conflict predict physical activity beyond a ‘classic’ theory?
4 Methods

• Procedure
  • Time 1 (N=260): Theory of Planned Behaviour + Personal Projects Analysis
    • Elicit goal-directed behaviours characterising their daily life (‘personal projects’) then add ‘participate in regular PA’ to their list
    • TPB questionnaire for Physical Activity
    • Goal conflict and goal facilitation rating
  • Time 2 (N=137): short self-report follow-up (online) eight weeks later
  • Participants: Mean: 21.3 years old (sd=6.89); 79% women; 55% psychology students
## Results: adding conflict

<table>
<thead>
<tr>
<th>Step</th>
<th>$\Delta R^2$</th>
<th>$\beta$</th>
<th>$B$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>.15</td>
<td>.15</td>
<td>.28</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>Perceived Behavioural Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intention</td>
<td>.28</td>
<td>.60</td>
<td>&lt;.01</td>
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<tr>
<td>Step 2</td>
<td>&lt;.01</td>
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<td></td>
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<tr>
<td></td>
<td>Intention</td>
<td>.28</td>
<td>.61</td>
<td>&lt;.01</td>
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<tr>
<td><strong>Conflict</strong></td>
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<td>-0.06</td>
<td>-0.07</td>
<td>.49</td>
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<tr>
<td><strong>Step 3</strong></td>
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<td>.26</td>
<td>.45</td>
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</tr>
<tr>
<td></td>
<td>Intention</td>
<td>--</td>
<td>.61</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>Conflict</td>
<td>--</td>
<td>-.07</td>
<td>.47</td>
</tr>
<tr>
<td><strong>Intention X Conflict</strong></td>
<td>--</td>
<td>--</td>
<td>-.07</td>
<td>.41</td>
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</table>

Results: adding conflict
### Results: adding facilitation

<table>
<thead>
<tr>
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<th>$B$</th>
<th>$p$</th>
</tr>
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<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>.15</td>
<td>.15</td>
<td>.28</td>
<td>.13</td>
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<td>.60</td>
<td>.006</td>
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<td>.10</td>
<td>.19</td>
<td>.30</td>
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<tr>
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<td>.26</td>
<td>.57</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Facilitation</td>
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<td>.19</td>
<td>.23</td>
<td>.02</td>
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<tr>
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<td>.20</td>
<td>.20</td>
<td>.28</td>
</tr>
<tr>
<td>Intention</td>
<td>--</td>
<td>.66</td>
<td>.69</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Facilitation</td>
<td>--</td>
<td>.24</td>
<td>.24</td>
<td>.02</td>
</tr>
<tr>
<td>Intention X Facilitation</td>
<td>X</td>
<td>.13</td>
<td>.13</td>
<td>.09</td>
</tr>
</tbody>
</table>

- $\Delta R^2$: Change in $R^2$ from the previous step.
- $\beta$: Standardized regression coefficient.
- $B$: Unstandardized regression coefficient.
- $p$: Significance level.

Facilitation shows a direct relationship with behaviour in Step 2, with $\beta = .19$, $B = .23$, and $p = .02$. There is no interaction between Intention and Facilitation in Step 3, with $\beta = .13$, $B = .13$, and $p = .09$.
Study 2: Do behavioural facilitation and conflict predict physical activity beyond a ‘classic’ theory in community sample?

Do goal conflict and goal facilitation account for variability in walking in people with diabetes beyond…

• Demographic

• Motivational and volitional factors from the Health Action Process Approach (Schwarzer et al)

• Methods: Cross-sectional survey with people with diabetes across Scotland; n=356 (mean age: 65.24)

Namadian, Presseau, Watson, Bond, Sniehotta (2016)
# Results: do demographic and motivation constructs predict walking?

<table>
<thead>
<tr>
<th>Variables</th>
<th>Med $R^2$</th>
<th>Med $\Delta R^2$</th>
<th>Unstandardised coefficients</th>
<th>Sig.</th>
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<td><strong>Step 1 – Demographics Factors &amp; Predictors of Intention</strong></td>
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<td>$B$ $SE$</td>
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<tr>
<td>BMI**</td>
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<td>$-0.74$ $0.24$</td>
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<tr>
<td>Age*</td>
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<td>$0.04$</td>
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<td>Sex</td>
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<td>$0.12$</td>
</tr>
<tr>
<td>Outcome Expectations</td>
<td></td>
<td></td>
<td>$0.06$ $1.93$</td>
<td>$0.98$</td>
</tr>
<tr>
<td>Social Support</td>
<td></td>
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<td>$-0.02$ $0.88$</td>
<td>$0.98$</td>
</tr>
<tr>
<td>Risk Perceptions</td>
<td></td>
<td></td>
<td>$-0.84$ $0.89$</td>
<td>$0.35$</td>
</tr>
<tr>
<td><strong>Step 2 – Predictors of Motivation</strong></td>
<td>0.07</td>
<td>0.03</td>
<td>$B$ $SE$</td>
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</tr>
<tr>
<td>BMI**</td>
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<td>$-0.70$ $0.23$</td>
<td>$&lt;0.01$</td>
</tr>
<tr>
<td>Age*</td>
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<td>$-0.29$ $0.13$</td>
<td>$0.03$</td>
</tr>
<tr>
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<td>$3.43$ $2.49$</td>
<td>$0.17$</td>
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<td>$0.17$</td>
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<td>Social Support</td>
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<td>$0.46$</td>
</tr>
<tr>
<td>Intention**</td>
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<td></td>
<td>$5.61$ $2.08$</td>
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</tr>
<tr>
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<td></td>
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<td>$0.05$</td>
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<tr>
<td>Variables</td>
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<td>Sig.</td>
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<tr>
<td>---------------------------------</td>
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<td>-----------------------------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$B$</td>
<td>$SE$</td>
</tr>
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<td><strong>Step 3 – Predictors of Volition</strong></td>
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<td>BMI**</td>
<td></td>
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<td>$0.13$</td>
</tr>
<tr>
<td>Age*</td>
<td></td>
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<td>$3.12$</td>
<td>$2.48$</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td>$-3.20$</td>
<td>$2.22$</td>
</tr>
<tr>
<td>Outcome Expectations</td>
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<td>$0.98$</td>
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<td>Social Support</td>
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<td>$-0.87$</td>
<td>$0.91$</td>
</tr>
<tr>
<td>Risk Perceptions</td>
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<td>$2.40$</td>
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<tr>
<td>Intention</td>
<td></td>
<td></td>
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<td>$1.84$</td>
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<td>Self-efficacy</td>
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<td>$2.38$</td>
<td>$2.61$</td>
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<td>Action Planning</td>
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<td>$2.37$</td>
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<td>$0.22$</td>
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<td>BMI*</td>
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<td></td>
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<td>$0.13$</td>
</tr>
<tr>
<td>Age**</td>
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<td></td>
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<td>$2.40$</td>
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<td>$0.88$</td>
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<tr>
<td>Goal Conflict</td>
<td></td>
<td></td>
<td>$-1.46$</td>
<td>$1.50$</td>
</tr>
</tbody>
</table>
Study 3: Ok, what about predicting objectively-assessed behaviour?

- Do behaviour facilitation and behaviour conflict predict objectively assessed PA?
- Does daily resource use in facilitating and conflicting behaviours contribute to predicting?

Cognitive assessment
- Perceptions of behaviour facilitation
- Perceptions of behaviour conflict

PA-specific cognitions
- PA Intention & PBC

Behavioural assessment
- Daily Time in facilitating behaviours
- Daily Time in conflicting behaviours

Objectively-assessed Physical Activity

Presseau et al (2013) Health Psychology
Study 3: Design

- Design: Prospective study with daily objective assessment of physical activity
- **Baseline**: *Microsoft Excel*-based procedure\(^1,2,3\) sent and returned by email including intention and self-efficacy items, and personal goal elicitation, *behaviour conflict* and *behaviour facilitation* ratings
- **Follow-up**: Day Reconstruction-based 7-day diary, and research-grade accelerometer
- Participants: 123 students sent baseline materials, 118 completed all measures (29 men, 89 women), mean age 23.4 years. Final sample: \(n=106\)

\(^1\text{Little, 2006, }^2\text{Little, 1983; }^3\text{Presseau, Sniehotta, Francis, Little, 2008}\)
Study 3: Follow-up

- Modified **Day Reconstruction Method**\(^1\) daily diary for 7 days: “Think of today as a continuous series of scenes or episodes in a film”
  - Episode name
  - Start and end time
  - Activities involved
  - Interaction partners
  - Which personal projects is each episode related to (if any?)

- **Behavioural measure** of *behaviour conflict* and *behaviour facilitation*: Daily time spent in *conflicting* and *facilitating* behaviours computed from daily diaries

- Wore RT3 tri-axial accelerometer\(^2\) for 7 days.
  - Daily time spent in moderate to vigorous (MV)PA as main outcome. Raw accelerometer data filtered using recommended procedures\(^3\) and cut-offs\(^4\) for MVPA

\(^1\) Kahneman et al 2004; \(^2\) Stayhealthy Inc; \(^3\) Masse et al 2005; \(^4\) Rowlands et al 2004
### Study 3: Follow-up

**Multilevel Model Testing the Prediction of MVPA From Cognitively Assessed (Hypothesis 1) and Behaviorally Assessed (Hypothesis 2) Goal Facilitation and Goal Conflict**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Hypothesis 1</th>
<th></th>
<th></th>
<th>Hypothesis 2</th>
<th></th>
<th></th>
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<tr>
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<td>$B \ (SE)$</td>
<td>$p$</td>
<td>$\beta$</td>
<td>$B \ (SE)$</td>
<td>$p$</td>
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<td>Intercept</td>
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<td>102.93 (6.08)</td>
<td>&lt;.01</td>
<td>.37</td>
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<td>&lt;.01</td>
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<td>-1.50 (4.7)</td>
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<td>1.38 (1.38)</td>
<td>.32</td>
<td>.07</td>
<td>1.50 (1.42)</td>
<td>.29</td>
</tr>
<tr>
<td>Intention</td>
<td>-.09</td>
<td>-4.58 (2.99)</td>
<td>.13</td>
<td>-.10</td>
<td>-5.07 (3.05)</td>
<td>.10</td>
</tr>
<tr>
<td>Perceived behavioral control</td>
<td>.15</td>
<td>7.39 (2.97)</td>
<td>.01</td>
<td>.14</td>
<td>6.87 (3.03)</td>
<td>.02</td>
</tr>
<tr>
<td>Perceived goal facilitation</td>
<td>.12</td>
<td>.40 (.19)</td>
<td>.04</td>
<td>.10</td>
<td>.30 (.21)</td>
<td>.16</td>
</tr>
<tr>
<td>Perceived goal conflict</td>
<td>.05</td>
<td>.18 (.20)</td>
<td>.38</td>
<td>.10</td>
<td>.37 (.22)</td>
<td>.09</td>
</tr>
<tr>
<td>Fixed effects level 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily time wearing accelerometer</td>
<td>.40</td>
<td>.14 (0.01)</td>
<td>&lt;.01</td>
<td>.41</td>
<td>.14 (0.01)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Daily pursuit of facilitating goals</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>.10</td>
<td>.03 (.01)</td>
<td>.06</td>
</tr>
<tr>
<td>Daily pursuit of conflicting goals</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>-.16</td>
<td>-.04 (.01)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2 variance ($\sigma^2_{b0}, \ SE$)</td>
<td>290.59 (178.18)</td>
<td>.10</td>
<td>330.07 (178.65)</td>
<td>.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 variance ($\sigma^2_{b1}, \ SE$)</td>
<td>2755.71 (211.80)</td>
<td>&lt;.01</td>
<td>2673.20 (204.42)</td>
<td>&lt;.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$ (autocorrelation parameter)</td>
<td>521.30 (210.10)</td>
<td>.01</td>
<td>510.40 (205.90)</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* $B$ = unstandardized coefficients; $\beta$ = standardized coefficients; $SE$ = standard error; MVPA = moderate to vigorous physical activity. All $p$ values are two-tailed.
Study 3: summary

- **Replication**: *Perceptions* of behaviour facilitation, but not behaviour conflict, predict objectively measured PA over and above intention and perceived control.

- **Extension**: *Behavioural assessment* of goal conflict but not goal facilitation negatively predicted PA over intention and perceived control.

  - Less objectively-assessed physical activity on days when spent more time in conflicting behaviours, controlling for intention and perceived control towards physical activity.
Manage infections without antibiotics

Exercise advice

Referring to nurse

Ask about stress

Address patient agenda

Update history

Measure BP

Manage infections without antibiotics

Discussing health risks

Discuss prescribing options

Shared decision about treatment

Exercise advice

Nutrition advice

Ask about stress

Referring to nurse

Stay on time

Prescribe for blood pressure to achieve <140/80 mmHg

Prescribe for glycemic control when Hb1c is >8%

Provide diabetes-related education

Provide self-management advice

Examine feet

Provide weight advice
Study 4: Do these perspectives extend to healthcare professionals?

- Questionnaire study using a predictive design w/ 6 month follow-up of behaviour in Scotland

- 53 GPs and nurses (out of 606) from 40 practices (out of 153) responded to both time points

**I’LL TAKE THAT**

![Diagram showing the relationship between Intention, Perceived Behavioural Control, Behaviour Facilitation, Behaviour Conflict, and Providing physical activity advice to people with hypertension.]

- $B = 0.28^{*}$
- $B = -0.15$
- $B = -0.31^{**}$

* $p < .05$; ** $p < .01$

Presseau, Francis, Campbell, Sniehotta (2011) *Implementation Science*
Insights gleaned by moving to a multiple behaviour perspectives

Summary
Summary and take homes

✓ Behaviour is a fundamental unit of analysis in implementation science

✓ Shifting from a single behaviour to a multiple behaviour paradigm can help to:
  ✓ Describe the AACTT sequences of people at multiple levels who need to do things differently
  ✓ Identify clusters of people engaging in similar levels of multiple behaviours: tailoring
  ✓ Model the behaviour system using network analysis to visualize the interconnections and potentially serve to explore knock-on effects in interventions

✓ Interventions addressing >1 behaviour at a time are being developed and evaluated; intervention strategies that go beyond treating each behaviour as independent are likely needed

✓ Multi-method theory integration and testing needed to continue to build a cumulative evidence-base to inform the multiple behaviour paradigm

✓ Building behaviour facilitation and address behaviour conflict (or for de-implementation, introducing behaviour conflict or reducing facilitation)
Future outlook

• Opportunity to leverage routinely collected data of multiple behaviours

• Linking behavioural network analysis to social network analysis to map how our own behaviour and those of others inter-connect

• A multiple behaviour paradigm has implications for key areas in implementation science:
  • Implementation/De-implementation
  • Equity-focused implementation science
  • Sustainment over time
  • Scale and spread

• Keen to collaborate with anyone interested in exploring this further; please reach out if interested