

Supplementary Data 4. Theory and Behavior Change Techniques (BCTs)

Author (year)	Development framework	Behavior change theory	Behavior Change Technique (BCT) groups
Aguilera (2020)	Not reported	COM-B model	- Goals and planning - Feedback and monitoring - Shaping knowledge* - Natural consequences - Associations* - Reward and threat - Self-belief
Almeida (2015) Estabrooks (2011)	Not reported	- The Ecological Model of Physical Activity (EMPA) - Protection Motivation Theory (PMT)	- Goals and planning - Feedback and monitoring - Shaping knowledge - Natural consequences - Repetition and substitution - Comparison of outcomes - Reward and threat - Identity - Self-belief - Covert learning
Alos (2022)	Behavior Change Wheel	Theories underlying the Behavior Change Wheel	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Associations - Reward and threat*
Al-Ozari (2018)	Not reported	- Motivational interviewing - Cognitive Behavior Therapy (CBT)	- Goals and planning - Feedback and monitoring - Natural consequences - Self-belief

Ambeba (2015) Bizhanova (2023) Burke (2017, 2020, 2022a, 2022b) Cheng (2023) Kariuki (2023) Wang (2012)	• Not reported	• Self-regulation theory	• Goals and planning • Feedback and monitoring • Shaping knowledge • Comparison of outcomes • Reward and threat • Self-belief*
Baert (2018) Bohanec (2021) Clays (2021) Voorend (2019)	• Human Centered Design	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Associations • Reward and threat*
Beckie (2024) Sengupta (2020a, 2020b)	• Design science research (DSR) methodology	• Social Cognitive Theory (SCT) • Theory of Planned Behavior (TPB) • Self-Determination Theory (SDT) • Trans Theoretical Model (TTM) • Information, Motivation and Behavior skills model (IMB) • Control Theory • Theory of Reasoned Action • Operant conditioning	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Associations • Repetition and substitution • Comparison of outcomes* • Reward and threat* • Antecedents
Bennett (2013, 2018) Foley (2012, 2016) Steinberg (2013)	• Not reported	• Social Cognitive Theory (SCT)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences* • Repetition and substitution • Comparison of outcomes • Reward and threat*
Boh (2016)	• Not reported	• Cognitive Behavior Therapy (CBT)	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Associations

			• Regulation • Antecedents • Identity • Self-belief
Bond (2014) Thomas (2015)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Natural consequences • Associations • Reward and threat
Boudreau (2016) Moreau (2015)	• Planning model for tailored print materials	• Self-Determination Theory (SDT) • Motivational interviewing • I-Change Model	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Comparison of behavior • Associations • Comparison of outcomes • Reward and threat • Regulation • Self-belief • Covert learning
Buchan (2020)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Comparison of behavior • Associations • Repetition and substitution • Comparison of outcomes • Reward and threat • Antecedents • Identity

Chokshi (2017)	Not reported	4 important psychological principles: Individuals tend to be more motivated by losses than gains, favor immediate over delayed gratification, try to avoid the feeling of regret, and tend to be more driven for aspirational behavior around temporal landmarks such as the beginning of the week (the fresh start effect).	- Goals and planning - Feedback and monitoring - Reward and threat - Scheduled consequences
Collins (2010, 2012, 2013)	Not reported	Social Cognitive Theory (SCT)	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences* - Reward and threat
Daryabeygi-Khotbehsara (2022, 2023)	None	None	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Associations - Repetition and substitution
Dorsch (2018, 2020)	Not reported	- Theory of Planned Behavior (TPB) - Self-regulation theory - Mindful decision making	- Goals and planning - Feedback and monitoring - Shaping knowledge - Natural consequences* - Associations - Repetition and substitution
Evans (2015)	User-centered design	Self-regulation theory	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Repetition and substitution - Reward and threat* - Self-belief

Finkelstein (2015)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Associations
Forman (2019, 2019) Goldstein (2017, 2020, 2021a, 2021b)	• Conceptual model of JITA components	• Goldstein2021b: Information-Motivation-Strategy (IMS) model	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Associations • Repetition and substitution • Reward and threat • Regulation • Self-belief
Gatwood (2020)	• Planning model for tailored print materials	• Self-Determination Theory (SDT) • Health Belief Model (HBM)	• Goals and planning • Shaping knowledge* • Natural consequences* • Associations*
Golbus (2024) Hellem (2023)	• Not reported	• Social Cognitive Theory (SCT) • Self-Determination Theory (SDT)	• Goals and planning • Feedback and monitoring • Shaping knowledge • Associations
Gupta (2015)	• Not reported	• Not reported	• Feedback and monitoring • Associations
Hamborg (2024) Martens Anderson (2022)	• Not reported	• Health Action Process Approach (HAPA)	• Goals and planning • Feedback and monitoring • Social support • Associations • Comparison of outcomes* • Reward and threat
Hemnes (2021) Martin (2015)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences

			• Associations • Reward and threat
Hietbrink (2023a, 2023b)	• Conceptual model of JITAI components • Planning model for tailored print materials	• Health Action Process Approach (HAPA) • Relapse prevention theory • Rothman's theory of maintenance	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Comparison of behavior • Associations • Repetition and substitution • Comparison of outcomes • Reward and threat • Regulation • Identity • Self-belief
Hurley (2015)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Reward and threat
Khunti (2021) Morton (2015) Yates (2015)	• Model by Dijkstra and De Vries for developing computer-generated tailored interventions • The mHealth development and evaluation framework	• Social Cognitive Theory (SCT) • Gollwitzer's implementation intentions • Leventhal's common sense mode • Chaiken's dual process theory	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Associations • Repetition and substitution • Comparison of outcomes • Reward and threat • Identity • Self-belief
Kim (2024) Park (2024)	• Not reported	• Self-regulation theory	• Goals and planning • Feedback and monitoring • Natural consequences*

			Reward and threat
Klein (2014)	Not reported	The integrated model of behavior change COMBI	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Associations* - Reward and threat - Antecedents*
Korinek (2018)	Not reported	Social Cognitive Theory (SCT)	- Goals and planning - Feedback and monitoring - Reward and threat
Leitner (2022)	Not reported	Not reported	- Goals and planning - Feedback and monitoring - Shaping knowledge
Lim (2016)	Not reported	Not reported	- Goals and planning - Feedback and monitoring - Shaping knowledge - Natural consequences* - Associations - Comparison of outcomes
Lin (2015)	Not reported	- Health Belief Model (HBM) - Trans Theoretical Model (TTM) - Self-regulation theory	- Goals and planning - Feedback and monitoring; - Shaping knowledge - Natural consequences - Associations - Comparison of outcomes - Reward and threat
Mansour-Assi (2022)	Not reported	- Operant conditioning - Theories of social comparison - Theories of social support - Ecological theory	- Goals and planning - Feedback and monitoring; - Social support - Shaping knowledge - Comparison of behavior - Comparison of outcomes

			• Antecedents
Martinho (2023), Pinto (2022)	• Not reported	• Trans Theoretical Model (TTM)	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Repetition and substitution
Miller (2021)	• Not reported	• Social Cognitive Theory (SCT); • Social Ecological Model	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Repetition and substitution • Comparison of outcomes • Reward and threat • Self-belief
Nezami (2022)	• Not reported	• Social Cognitive Theory (SCT)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Repetition and substitution • Reward and threat* • Identity
Novak (2024) Vetrovsky (2023)	• The mHealth development and evaluation framework	• Self-regulation theory	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Associations • Repetition and substitution • Comparison of outcomes • Reward and threat
Pardos (2023)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge

			• Natural consequences • Reward and threat
Park (2024)	• Not reported	• Habit Formation framework	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Associations • Repetition and substitution • Reward and threat
Pellegrini (2015)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Associations
Pimenta (2022)	• Not reported	• Self-Determination Theory (SDT)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Antecedents • Self-belief
Plaete (2015) Poppe (2017, 2018, 2019a, 2019b)	• Intervention mapping	• Health Action Process Approach (HAPA) • Self-regulation theory	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Repetition and substitution • Reward and threat
Radhakrishnan (2020, 2021)	• Not reported	• Fogg behavioral model	• Goals and planning • Feedback and monitoring • Shaping knowledge* • Natural consequences • Comparison of behavior • Reward and threat • Scheduled consequences

Reinwand (2013) Storm (2016)	• Not reported	• Health Action Process Approach (HAPA)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Repetition and substitution • Reward and threat*
Richardson (2007, 2010)	• Not reported	• Social Cognitive Theory (SCT) • Health Belief Model (HBM) • Social learning theory	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Comparison of behavior • Repetition and substitution • Reward and threat • Self-belief • Covert learning
Schoenthaler (2020)	• User-centered design	• COM-B model • Technology Acceptance Model (TAM)	• Goals and planning • Feedback and monitoring • Shaping knowledge • Comparison of outcomes
Schultz (2022)	• RE-AIM framework	• Social Cognitive Theory (SCT) • The Five A's model	• Goals and planning • Feedback and monitoring • Social support • Reward and threat*
Shibuta (2023)	• Not reported	• Social Cognitive Theory (SCT) • Trans Theoretical Model (TTM)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Repetition and substitution • Reward and threat • Antecedents

Spruijt-Metz (2022)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences • Associations • Repetition and substitution
Stein (2019) Tabak (2018)	• Chambers and Norton's guidance and Stirman model	• Combination of various social-cognitive and socio-ecological factors	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Natural consequences • Comparison of outcomes • Reward and threat
Steinberg (2020)	• Not reported	• Not reported	• Feedback and monitoring • Shaping knowledge • Natural consequences • Reward and threat
Sun (2020)	• User-centered design	• Not reported	• Goals and planning • Feedback and monitoring • Social support • Associations • Comparison of outcomes • Reward and threat
Sze (2023) Waki (2024)	• Not reported	• Social Cognitive Theory (SCT)	• Goals and planning • Feedback and monitoring • Social support • Shaping knowledge • Associations • Comparison of outcomes • Reward and threat
Tabak (2013, 2014a, 2014b, 2014c) Wieringa (2011)	• Self-defined design approach consisting of (1) user needs/state of the art, (2) design, (3) evaluation, (4) product implementation	• Not reported	• Goals and planning • Feedback and monitoring; • Shaping knowledge • Associations

			Reward and threat*
Tamura (2020)	- User-centered design - Community-based participatory research principles	Adapted socio-ecological model	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Associations - Reward and threat
vanderWeegen (2013, 2015) Verwey (2014a, 2014b)	- User-centered design - Shah's methodological framework for medical device development	- The Five A's model - Physician-based Assessment and Counselling for Exercise intervention (PACE)	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge* - Natural consequences - Comparison of outcomes* - Reward and threat*
vanGenugten (2010, 2012, 2014)	Intervention mapping	- Theory of Planned Behavior (TPB) - Self-Determination Theory (SDT) - Relapse prevention theory - Precaution Adoption Process Model (PAPM) - Self-regulation theory	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences - Associations - Repetition and substitution - Comparison of outcomes - Reward and threat - Regulation - Antecedents* - Self-belief - Covert learning
Watson (2012)	Not reported	Combination of behavioral and social cognitive strategies	- Goals and planning - Feedback and monitoring - Social support - Shaping knowledge - Natural consequences* - Reward and threat*

Yom-Tov (2017)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Natural consequences • Comparison of behavior* • Associations*
Zahedani (2023)	• Not reported	• Not reported	• Goals and planning • Feedback and monitoring • Shaping knowledge • Natural consequences* • Repetition and substitution • Reward and threat • Covert learning*

The * next to a BCT group indicates that it is likely that this behavior change technique is included in the intervention based on the intervention description, but this cannot be confirmed with certainty.