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Harnessing centred identity transformation to reduce executive function burden for maintenance of health behaviour change: the Maintain IT model

Ann E. Caldwell^a, Kevin S. Masters^{a,b}, John C. Peters^{a,c}, Angela D. Bryan^d, Jim Grigsby^{b,c}, Stephanie A. Hooker^b, Holly R. Wyatt^{a,c} and James O. Hill^{a,c,e}

^aColorado Nutrition Obesity Research Center, University of Colorado, Anschutz Medical Campus, Denver, CO, USA; ^bDepartment of Psychology, University of Colorado, Denver, CO, USA; ^cDepartment of Medicine, University of Colorado, Anschutz Medical Campus, Denver, CO, USA; ^dDepartment of Psychology and Neuroscience, University of Colorado, Boulder, CO, USA; ^eDepartment of Pediatrics, University of Colorado, Anschutz Medical Campus, Denver, CO, USA

ABSTRACT

The inability to produce *sustainable* lifestyle modifications (e.g., physical activity, healthy diet) remains a major barrier to reducing morbidity and mortality from prevalent, preventable conditions. The objective of this paper is to present a model that builds on and extends foundational theory and research to suggest novel approaches that may help to produce *lasting* behaviour change. The model aims to integrate factors not typically examined together in order to elucidate potential processes underlying a shift from behaviour initiation to long-term maintenance. The central premise of the Maintain IT model builds on approaches demonstrating that in-tact *executive function* (EF) is critical for health behaviour initiation, for more complex behaviours beyond initiation, and in unsupportive environments and circumstances, but successful recruitment of EF is effortful and prone to error. Enduring changes are more likely if the underlying cognitive processes can become less effortful (non-conscious, automatic). The Maintain IT model posits that a *centred identity transformation* is one path leading to less effortful processing and facilitating successful recruitment of EF when necessary over the long term, increasing the sustainability of health behaviour change. A conceptual overview of the literature supporting the utility of this integrative model, future directions, and anticipated challenges are presented.

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Health behaviour; behaviour maintenance; identity transformation; executive function; self-regulation; intervention

Producing *sustainable* lifestyle modifications remains a major barrier to reducing morbidity and mortality from prevalent and preventable conditions. The leading causes of disease burden in the modern world can be avoided, delayed, or managed through healthy lifestyle behaviour changes (Kontis et al., 2014; Reiner, Niermann, Jekauc, & Woll, 2013; Yoon, Bastian, Anderson, Collins, & Jaffe, 2014). Serious efforts have been made by researchers to understand how to effectively encourage health-promoting behaviours and discourage health-risk behaviours (Michie et al., 2013, 2016); such efforts have been moderately successful at getting motivated individuals to adopt healthier behaviours for the short term, but are largely unsuccessful at facilitating maintenance of these changes over time (Bryan et al., 2013; Marcus et al., 2000; Rothman et al., 2015). Sustaining behaviour change is a critical challenge because most behaviours that decrease chronic disease risk require

continued maintenance to achieve optimal health (e.g., weight loss; MacLean et al., 2015; Magkos et al., 2016).

Our objective is to present an integrative model that builds on and extends foundational theory and research from health, social, cognitive, clinical and positive psychology, and suggests novel and promising approaches to guide the development of interventions that produce *lasting* health behaviour change. The model aims to integrate factors from existing perspectives not typically examined together that are important for behaviour change and/or maintenance, and introduce centred identity transformation (IT) as one process that can lead to less effortful and more sustainable behaviour change. Existing theories and approaches typically focus on behaviour change or maintenance, but not both (with notable exceptions: e.g., the transtheoretical model, Prochaska & DiClemente, 1982; Rothman's self-regulated behaviour change model, Rothman, 2000; health action process approach, Schwarzer, Lippke, & Ziegelmann, 2008). Even these exceptions lack specific guidelines for successfully leading people from behaviour initiation, where active self-regulation and/or self-control and increasing self-efficacy are primary, to a point where the health behaviours can be more consistently and reliably maintained.

The Maintain IT model utilises a comprehensive approach to guide change in both the behaviour *and* the individual to facilitate behaviour adoption in an integrated way, and guide the identity of the individual to a more empowered and resilient state more broadly. The model recognises the utility of existing behaviour change frameworks, but substantively extends their reach by inspiring innovative research and intervention approaches. This model has the potential to enhance the likelihood of successful maintenance of health behaviours. The following sections will: (a) present the Maintain IT model within a conceptual overview, (b) describe principles of the Maintain IT model in practice, and (c) summarise challenges and future directions.

Maintain IT model of health behaviour change and maintenance: a conceptual overview

The central premise of the Maintain IT model (Figure 1) builds on more recent behaviour change approaches which recognise that *executive function* (EF) is critical for deliberate, and specifically health-related behaviour (e.g., Hall & Fong, 2007, 2010; Hofmann, Schmeichel, & Baddeley, 2012). These approaches note that, because EF is relatively slow, effortful, and prone to errors, enduring changes in behaviour are more likely if the underlying cognitive processes guiding behaviour become more efficient and less effortful (that is, non-conscious, automatic, or habitual) and therefore rely less explicitly on EF. Maintain IT builds on and extends these well-known aspects of behaviour

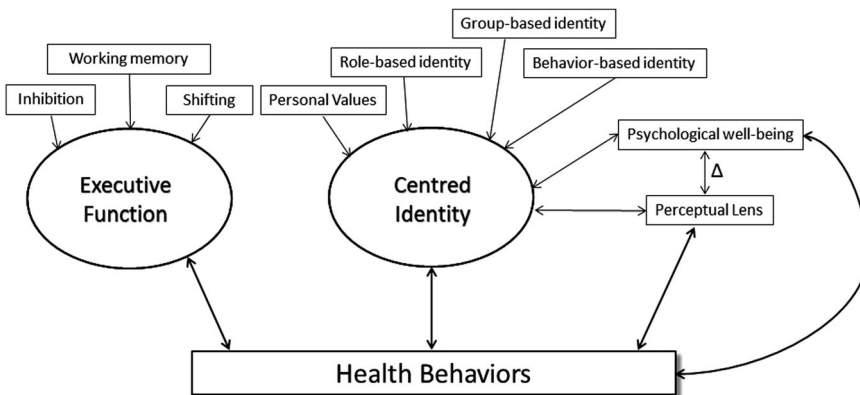


Figure 1. Represents the components of the Maintain IT model, including the facets important for executive function and centred identity.

change by suggesting processes and techniques that can facilitate relatively more automatic behaviour overall, and increase the likelihood that EF can successfully be recruited when needed. Maintain IT was in part inspired by Kahneman's cognitive processing view that distinguishes between System 1 (intuitive, fast, automatic, effortless, implicit, governed by habit) and System 2 (slow, effortful, controlled, deliberate, rule-governed) processes (Kahneman, 2003, 2011). Guided by prior research (Rothman, 2000; Rothman, Baldwin, Hertel, & Fuglestad, 2004), Maintain IT suggests that behaviour that relies more on System 1 is more likely to be sustainable for the long term and notes the importance of increased automaticity for behaviour maintenance. However, existing approaches do not specify how one might go about incorporating a behaviour into System 1 processing, and instead implicitly rely on repeated performance to transition from initiation to automaticity. Repeating the behaviour in a stable and predictable context, attaching the new behaviour to an already established habit (Judah, Gardner, & Aunger, 2013), and creating an environment that either constructs the choice architecture to facilitate healthy defaults (Thaler, Sunstein, & Balz, 2010) or consistently has visible cues that promote healthy choices (Galla & Duckworth, 2015; Orbell & Verplanken, 2010) have proven successful for helping create automaticity to change behaviour. But *maintaining* behaviour change over the long term creates difficulties for these techniques because maintenance often requires performing the behaviour in a multitude of environments (including unsupportive ones), and under variable individual states that cannot always be controlled.

Furthermore, although automatic behaviours are unquestionably more efficient; it may not be possible to make all, or even most, health behaviours completely automatised. Hall and Fong (2007) note that the extent to which a behaviour will become automatic or habitual depends on the competing neural drives or impulses that influence the behaviour. For example, restricting caloric intake frequently competes against an internal drive of hunger, and environmental cues of palatable, tempting, and rewarding foods that are often out of individual control. Thus, caloric restriction is a more difficult behaviour to make automatic than behaviours such as flossing teeth or wearing a seatbelt, because there are generally no internal drives or environmental cues that directly oppose these behaviours. For some behaviours, interventions can emphasise creating automaticity (e.g., wearing a seatbelt), whereas other behaviours (e.g., healthy eating, caloric restriction, exercise) may require additional techniques to develop less effortful cognition, and/or increase the likelihood that effortful cognition can occur.

This premise is also consistent with dual systems and dual-process theories of mind. Both are increasingly utilised in health psychology (Hagger, 2016; Hagger & Chatzisarantis, 2014; Hofmann, Friese, & Wiers, 2008; Sheeran, Gollwitzer, & Bargh, 2013) because they provide a more comprehensive characterisation of the conscious and non-conscious factors that influence behaviour. These perspectives suggest that behaviour is the result of the interplay between automatic and controlled processing, or between impulsive and reflective processes, rather than primarily driven by rational, goal-oriented cognition (Brannigan, Stevenson, & Francis, 2015; Smith & DeCoster, 2000; Strack & Deutsch, 2004). Individual differences in EF abilities, particularly working memory and attention, influence the extent to which individuals can control behaviour by superseding automatic impulses and drives (Barrett, Tugade, & Engle, 2004).

Thus, a key contribution of Maintain IT is in noting that some level of active self-regulation will always be necessary for many health behaviours, and may be needed for all health behaviours during difficult environmental or individual circumstances (stress, opposing drives for unhealthy behaviours, lower inherent EF ability, etc.), and in certain physiological states (e.g., fatigue, anxiety, depression, intoxication). We propose the novel idea that a centred identity transformation and the connection of behaviour to valued identities may present a way to scaffold existing behaviour change approaches. This transformation aims to help create less reliance on EF for engaging in health behaviours globally and improve the likelihood that EF can successfully be recruited when needed.

A centred identity transformation is one approach that can be harnessed for maintaining more complex behaviours, because it can allow more efficient processing to develop over time by

integrating the behaviour with identity. Furthermore, a centred identity can increase the likelihood that successful recruitment of EF can occur by improving how empowered and resilient that identity is more broadly speaking (see [Figure 2](#), which illustrates the relative importance of EF and identity along the continuum from behaviour initiation to maintenance. Please note these are not distinct stages of behaviour change nor is this necessarily a linear process). Centred identity transformation is a process through which a person develops self-representations that incorporate the new behaviour, and reaches a more centred (i.e., empowered, resilient) state. This process first involves recruitment of EF, which is the foundation for deliberate conscious action, to facilitate the procedural learning of adaptive habits (Cohen & Squire, 1980; Mishkin, Malamut, & Bachevalier, 1984) – but further suggests a deliberate transformation of identity as an active approach to allow more efficient cognition to develop over time. This perspective contrasts with passive approaches that rely on successful repetition of a health behaviour to lead to automaticity. Maintain IT suggests that interventions should move beyond the behaviour, to help people work toward a more centred and empowered state more broadly, which can improve resilience in the face of inevitable obstacles, decrease the harmful effects of these challenges, and increase the likelihood that successful self-regulation can occur. Through a centred identity transformation, the new health behaviour becomes integrated with fundamental roles and/or groups and values that make up an individual's existing sense of self. More resilience and empowerment are developed to recover from setbacks, and deficits in psychological well-being can be addressed.

Initiation of behaviour change

An essential prerequisite for adaptive behaviour change is intact EF (Cohen & Squire, 1980; Mishkin et al., 1984), which Fuster (2008) defines as, 'the ability to temporally organise purposive behaviour,

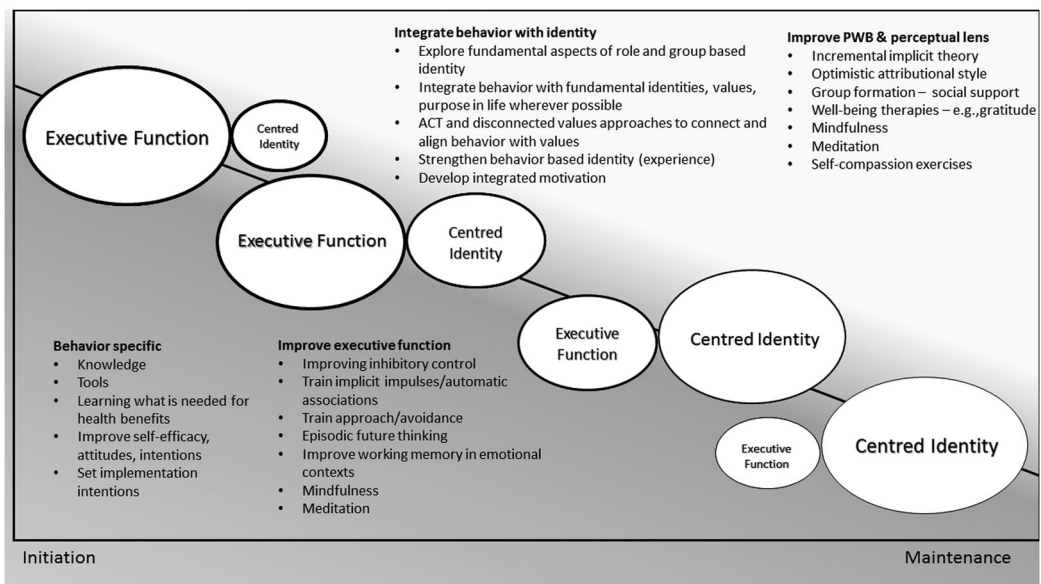


Figure 2. Depicts the process from behaviour initiation to maintenance, where centred identity transformation decreases the burden on executive function over time. Please note, this is not a linear, nor stage based process, but the four examples illustrate the relative importance of executive function and centred identity at four points along the sliding, diagonal continuum. The width of the outline indicates the accessibility of both executive function and centred identity, each becoming more accessible over time. More complex behaviours and less supportive environments and individual states may necessitate more recruitment of executive function during maintenance; but overall, the burden on executive function is reduced over time. Intervention strategies for behaviour initiation, and improving executive function and centred identity transformation are provided. Acceptance and commitment therapy (ACT); Psychological well-being (PWB).

language, and reasoning' (p. 191), essential components of which are the planning and initiation of purposeful behaviour, and the inhibition of attentional interference and behavioural impulsivity. More broadly, it may be considered as comprising a set of overlapping cognitive control processes (e.g., attentional and inhibitory control, monitoring of conflicting information, planning, working memory, shifting) that are necessary to engage in goal-directed behaviour (Miyake & Friedman, 2012), especially over an extended period of time. EF is required for deliberate, conscious behaviour that inhibits habitual, implicit, and impulsive processes; it frequently involves delaying gratification, and places more value on long-term rewards over easier, more automatic, or hedonically rewarding experiences in the moment (Miller & Cohen, 2001). EF is important for performing health behaviours that decrease chronic disease risk (Hall & Marteau, 2014).

Associated with EF are active self-regulation and self-control. A large body of research demonstrates that both contribute to the initiation of purposeful activity among motivated individuals. Self-regulation is defined as a goal-guided process in which behaviour is controlled to attain and maintain personal goals (Bandura, 2005; Maes & Karoly, 2005), and self-control is defined as the ability of the individual to alter dominant responses or inner states such as impulses, urges, emotions, and thoughts, and replace them with a different response in the service of higher order goals, attitudes or standards (Friese, Hofmann, & Wiers, 2011). These abilities allow people to set, focus on, and monitor progress toward health behaviour goals (Bandura, 2005; Maes & Karoly, 2005). Most health behaviours require a degree of effortful control and conscious, top-down processing, particularly when such behaviours are initially unfamiliar and not habitual. Relatively more complex health behaviours continue to require self-regulation and self-control.

In comparison with the automaticity that characterises many daily behaviours, EF, self-regulation and self-control typically involve relatively slow, effortful, and error-prone cognitive processing. Inherent EF abilities help with initiation and self-regulation, but people tend to default to a habitual or automatic mode of functioning in novel, complex, or threatening situations (Shallice, 1988). Individual (trait) differences, variability in physiological state (e.g., mood, energy level, endocrine and immune status, intoxication, 'hot' states, and ego-depletion; but see Hagger, Chatzisarantis, et al., 2016), and situational factors such as stress, cognitive load or demand, and tempting environmental stimuli are known to affect the extent to which EF can be activated and used to successfully guide behaviour (Appelhans, French, Pagoto, & Sherwood, 2016; Baumeister, 2002; Hagger, Luszczynska, et al., 2016; Hall & Fong, 2007; Heatherton & Wagner, 2011; Hofmann et al., 2012). Hence, the effortful processing characteristic of EF is not a sustainable or realistic strategy over the long term for most people, particularly when adopting a more complex health behaviour, and when confronted with the realities and stressors of life outside the context of an intervention.

Classic intervention approaches that seek to improve the social cognitive antecedents of intentions are also problematic because they tend to be more successful strategies for those with inherently greater executive control (Allan, Johnston, & Campbell, 2011). Even approaches like implementation intentions, which are designed to decrease the need for effortful control in the moment, are shown to be more successfully utilised by those with higher inherent EF ability (Hall, Zehr, Paulitzki, & Rhodes, 2014). Strategies that can help scaffold these approaches and can work equally well among those with high and low in EF ability are currently lacking.

The Maintain IT model posits that effortful processing for self-regulation is not sustainable for maintaining health behaviours in part because of the effect that emotions and emotion regulation have on rational decision-making and EF. Research in behavioural economics has found that emotions and emotional arousal can disrupt rational decision-making, either by contributing to constraints on cognition (Kaufman, 1999), or in functional ways that motivate behaviour contrary to optimal or 'reasonable' choices (Muramatsu & Hanoch, 2005). Empirical evidence demonstrates that emotions affect EF in the domains of attention, learning, and memory (reviewed in Muramatsu & Hanoch, 2005). Negative emotions and poor emotion regulation are associated with decreased activation in certain areas of the brain associated with self-control and self-regulation, and individuals

who have difficulties regulating emotions frequently have difficulty with goal-directed behaviour (Tang, Posner, Rothbart, & Volkow, 2015).

Stress has also been shown to increase impulsivity and disrupt prefrontal processing and attentional control (Liston, McEwen, & Casey, 2009), but cognitive ability appears to play a role in individual responses. For example, individuals with greater working memory capacity are better able to deal with negative feedback (Schmeichel & Demaree, 2010), and happiness may increase working memory capacity (Storbeck & Maswood, 2016). There is substantial overlap in the areas of the brain that influence self-regulation and emotion regulation and processing, which may lead to interference or contribute to cognitive load and self-regulatory depletion. This has led some to argue that stress, emotion regulation, and self-regulation should be considered as integrated processes, thereby allowing us to more accurately understand the ways emotions and goal-pursuits influence one another (Diamond & Aspinwall, 2003). Maintain IT builds on this research, asserting that behaviour change interventions to improve EF (detailed later) can be used at the beginning of an intervention to improve successful initiation. But it further suggests that intervention strategies that provide people with tools to regulate emotions generally, but are not necessarily related to behaviour, may indirectly increase health behaviour by improving the likelihood that successful recruitment of EF and self-regulation can occur.

Long-term maintenance will be much more likely if the need for effortful, relatively slow processing that is prone to errors and adversely affected by physiological and psychological states and environmental conditions can be reduced over time. Maintain IT asserts that by activating other functional systems to reduce or circumvent the need for EF, it will be possible to facilitate recovery from inevitable setbacks and lapses in behaviour without obstructive emotional stress.

Maintaining behaviour change

Maintain IT proposes that a process of identity transformation towards a *centred identity* (i.e., one that allows for integration of the behaviour with already formed components of identity, and more resilience in the face of emotions, stress, and lapses in behaviour) is one approach to facilitate the maintenance of behaviour change over the long term. This transformation involves integrating the newly adopted behaviour with one's sense of self, and developing a more centred and empowered state for this sense of self. This transformation can complement the majority of approaches used currently that rely heavily or exclusively on effortful EF. As the behaviour becomes a part of one's identity, it requires less effortful self-regulation (Ryan & Deci, 2000). And as one's identity is more centred and empowered, the harmful effects of inevitable setbacks, stress, emotions, or other difficulties on self-regulation are reduced.

Maintain IT extends goal-oriented self-regulation approaches by acknowledging that knowing where one wants to go is necessary, but insufficient, for planning an effective route to that destination. In order to strategise how to achieve behaviour or health goals, individuals must first know their point of origin. The model asserts that identity transformation can begin with a process of reflection and exploration of individuals' perceptions of the most fundamental roles and groups that constitute their identity and the degree to which adopting the behaviour is consistent, or at odds with their identity and values (Brook, Garcia, & Fleming, 2008). This examination can serve two purposes. First, it can help individuals adopt and integrate the behaviour in ways that are consistent with fundamental aspects of their identity wherever possible. Second, it can ascertain aspects of identity that are unlikely to change (family roles/relationships), but can make adopting the behaviour for the long term more difficult. This latter aspect of the discovery process can illuminate social contexts where more self-regulatory effort will be required to engage in the behaviour, and to strategise the implementation intentions to be used under more difficult circumstances.

Several converging lines of evidence support the importance of identity as a central component of successful self-regulation of health behaviour. Overall, an understanding of the self (i.e., an individual's belief about the totality of himself or herself, including the body, sense of identity, and attributes

about who and what the self is; Baumeister, 1999), is fundamental to self-regulated behaviour (Heatherton, 2011). For example, aspects of identity, such as masculinity, are related to drinking and risk taking (Bishop, Weisgram, Holleque, Lund, & Wheeler-Anderson, 2005; de Visser & Smith, 2007; Lewis et al., 2010). Identity has shown to be important for exercise and physical activity (Rhodes, Kaushal, & Quinlan, 2016), in food choices (Bisogni, Connors, Devine, & Sobal, 2002; Fox & Ward, 2008; Strachan & Brawley, 2009), and in diabetes management (Liburd, 2003; Luyckx et al., 2008; Tilden, Charman, Sharples, & Fosbury, 2005). Furthermore, integrating the health behaviour into an individual's sense of self, and creating a self-schema consistent with the behaviour (in addition to repeated performance), can aid the formation of associative networks, increased attention, and more efficient processing (Bargh, 1982; Tacikowski, Freiburghaus, & Ehrsson, 2017). These associative networks, increased attention and more efficient processing may reduce the level of effortful control needed to perform the behaviour. Foundational work from identity theory (or identity control theory) and social identity theory (Stets & Burke, 2000) also detail the centrality of roles and social structure for the formation of identity. Identity control theory further suggests that individuals form a set of standards that correspond to the meaning and expectations of a given identity and are inherently motivated to behave in ways that are consistent with their values and conceptions of themselves (Burke, 2006). When behaviour does not align with identity standards, it creates negative affect, and motivates behaviours that reinforce self-concept. Thus, incorporating the new behaviour into one's identity allows it to become more self-reinforcing. These ideas are also consistent with self-determination theory (SDT; Ryan & Deci, 2000), which details the advantages of moving from external regulation to perform a behaviour, to more integrated and autonomous forms of regulation, where the behaviour is in line with the self-concept of the individual. Maintain IT goes beyond these perspectives to suggest that integrating behaviour into identity has the added advantage that it can reduce the need for slow, effortful processing to guide behaviour, because self-schemas (heuristic cognitive generalisations about the self) allow self-relevant information to be processed more efficiently and quickly than non-relevant information (Markus, 1977).

Components of centred identity

The *centred identity* construct is comprised of *behaviour-based identity*, *role- and group-based identities*, *personal values*, *perceptual lens*, and *psychological well-being*.

Behaviour-based identity. Behaviour-based identity is merely the extent to which an individual identifies as a person who performs a given behaviour. It has been shown to be an important predictor of health behaviours (e.g., Rhodes et al., 2016; van den Putte, Yzer, Willemsen, & de Bruijn, 2009). It is predicted by Maintain IT to change with repeated performance of the behaviour, *and* to improve with successful integration of the behaviour with other aspects of identity (Gillman & Bryan, 2017). It may also limit the damage of lapses, as one study demonstrated that those with a more highly developed behaviour-based identity perceived the reasons for having a lapse in behaviour as being more transient (Kendzierski & Sheffield, 2000).

Role- and group-based identity. Identity is also defined as a set of hierarchically organised multidimensional components including roles that correspond to the social structure (Stryker & Burke, 2000). To improve the likelihood of maintaining behaviour change, individuals may need to examine the roles and groups that are most fundamental to their identity, and determine those that will facilitate versus those that will inhibit changes in health behaviours or identity. The process of identity transformation involves integrating the new health behaviour into one's sense of self, recognised anew after initial examination. This will allow individuals to more appropriately specify behavioural strategies whenever possible that simultaneously reinforce the health behaviour and honour the most fundamental aspects of one's role- and group-based identities. Concurrently, recommendations should also be made to distance oneself from groups and roles that are anticipated or experienced to inhibit transforming behaviour, and to obtain and sustain supportive groups and roles that

reinforce behaviour integration to increase the likelihood that behaviour will be maintained over the long term. When the existing role or group-based identities are not congruent with the behaviour, but it is not possible or desirable to change those roles or groups, individuals should be encouraged to recognise that these contexts will necessitate more active self-regulation and successful recruitment of EF. Developing implementation intentions for these identity-based unsupportive environments constitutes one potentially effective strategy adapted from existing approaches for the Maintain IT context. This awareness can also improve resilience, because interventions can highlight that failures are more likely in unsupportive environments, and individuals can recognise that the failure was partly due to transient/situation specific conditions, rather than global and stable ones.

Personal values. Personal values have a long history in the clinical psychology and behaviour change literatures. Rokeach (1973) argued that values are core beliefs that guide behaviour, provide impetus for motivating behaviour, and provide standards against which behaviour is assessed. Clinical and behaviour change approaches like acceptance and commitment therapy (ACT; Hayes, Strosahl & Wilson, 1999; Hayes, 2004), motivational interviewing (Rollnick & Miller, 1995), and the disconnected values model (Anshel, 2008) are widely used and empirically supported approaches in which values play a foundational role. Overall, individuals who live with a daily awareness of what they value are better able and more motivated to make choices that support their health and well-being (Hooker & Masters, 2018; Roepke, Jayawickreme, & Riffle, 2014), including choices about health behaviour (Segar, Eccles, & Richardson, 2011).

Perceptual lens. The *perceptual lens* is defined herein as a filter through which new circumstances and information are perceived and interpreted. As depicted in Figure 1, centred identity influences behaviour directly, as well as indirectly through this perceptual lens; thus, the relationship between perceptual lens and centred identity is bidirectional. This relationship helps determine the course of action (or inaction) individuals take in response to environmental circumstances.

There are two novel components of the perceptual lens that are the primary focus of Maintain IT and are hypothesised to improve resilience and increase success at long-term maintenance. The first component of perceptual lens is *attributional or explanatory style*, that is the 'default' tendency to interpret positive and negative events (Abramson, Seligman, & Teasdale, 1978). In behaviour change, a more pessimistic attributional (or explanatory) style is one that would interpret difficulties and setbacks as being internal, stable, and global, and is predicted to make lasting behaviour change more difficult. A more optimistic style is one that views setbacks as situational, transient, and specific, and is predicted to facilitate lasting behaviour change and recovery from lapses in behaviour. The second component of perceptual lens is *implicit theory surrounding behaviour and identity change*, or the extent to which one believes the behaviour of interest and identity more generally are malleable and within individual control to change (incremental implicit theory), as opposed to stable and impossible to change (entity implicit theory; Dweck, 1999). An *entity* (or fixed) implicit theory is likely to make lasting behaviour change more difficult, whereas an incremental (or growth) implicit theory will facilitate lasting behaviour change.

Psychological well-being. As with perceptual lens, the relationship between centred identity and psychological well-being is bidirectional (see Figure 1). The primary focus for psychological well-being is on *eudaimonic* well-being, a multidimensional construct that represents positive psychological function or flourishing (Ryff, 1989; Ryff & Keyes, 1995). Eudaimonic well-being is related to, but not synonymous with subjective or hedonic well-being (i.e., happiness, high positive affect, or satisfaction). Eudaimonic well-being is particularly relevant during the health behaviour change and identity transformation processes because it is associated with integrating perceptions of the past, present, and future, whereas subjective well-being is largely present-oriented (Baumeister, Vohs, Aaker, & Garbinsky, 2013). Many health behaviours are not inherently enjoyable (Ryan, Patrick, Deci, & Williams, 2008), and may even be unpleasant, and thus demand the ability to tolerate distress (Hayes,

2004), at least initially. Furthermore, long-term behaviour change that involves in-depth examination of the self, values and goals for future health is not expected to immediately or exclusively evoke positive feelings (hedonic well-being). However, goal-directed behaviour has been shown to be associated with greater eudaimonic well-being (Ryan & Deci, 2001), and existential writers such as Frankl (1997) demonstrated the potency of meaning for perseverance in the face of adversity.

Eudaimonic well-being includes six core dimensions: purpose in life, environmental mastery, positive relationships with others, personal growth, autonomy, and self-acceptance (Ryff & Keyes, 1995). This perspective precedes, but in some ways broadens the formative work of Deci and Ryan's SDT (Deci & Ryan, 2000). SDT is founded on the premise that people have innate psychological needs for autonomy, competence, and relatedness, and are more highly motivated when environments satisfy these needs (Ryan & Deci, 2001). These psychological needs are analogous, though not identical to, three of the six facets of psychological well-being as defined by Ryff and Keyes (Lent, 2004).¹ Maintain IT extends these perspectives by suggesting that rather than only focusing on three of the dimensions outlined by Ryff and colleagues, deficits in any of the six dimensions of well-being can stall or prevent progress toward adopting and maintaining health behaviours or lead to relapse. Maintain IT suggests that in addition to having a high overall sense of positive engagement in life (high eudaimonia), balance among the facets of psychological well-being is important for optimal well-being (Sirgy & Wu, 2009). Scheier et al. (2006) also suggest that connecting to one's purpose or meaning in life is an important aspect of behavioural self-regulation, because it provides the intrinsic 'why' for engaging in and maintaining certain behaviours.

Eudaimonic well-being is robustly related to better health, including biomarkers of health (e.g., lower cortisol and inflammatory markers), longitudinal self-reports of health, and even the prevention of and recovery from health problems (Ryff, 2014; Ryff, Radler, & Friedman, 2015; reviewed in Vázquez, Hervás, Rahona, & Gómez, 2009). However, causal properties of this relationship, if any, are unknown. Maintain IT predicts that whereas health can improve psychological well-being, intervention approaches that help individuals improve psychological well-being can also support health behaviour maintenance. Maintain IT hypothesises that deficits in psychological well-being increase both the drive for unhealthy behaviours and cognitive load, particularly the demand for emotion regulation. This may render self-regulation less likely; and lead to unhealthy coping behaviours and poorer resilience in the face of inevitable setbacks and stress.

Within the Maintain IT framework, broader improvements to perceptual lens (attributional style and implicit theory) and psychological well-being can make performing healthy behaviours less effortful and facilitate sustained behaviour change in several ways. Perceptual lens and psychological well-being can improve the way individuals regulate emotions and deal with stressors, fostering a psychological state more conducive to self-control and self-regulation. It may also decrease impulses to perform unhealthy coping behaviours, and strengthen resilience to deal with impediments and obstacles that can lead to lapses and relapses. For example, a functional magnetic resonance imaging study showed that individuals with higher eudaimonic well-being have slower response and lower activation of the amygdala in response to aversive stimuli (van Reekum et al., 2007). This suggests that improvements to eudaimonic psychological well-being may blunt the physiological response in the brain to negative or aversive circumstances.

Maintain IT posits a bidirectional relationship between behaviour and centred identity, such that performing healthy behaviours improves multiple aspects of the centred identity, particularly behaviour-based identity, incremental implicit theory (the belief that behaviour and identity are malleable), and psychological well-being. In this way, a positive feedback loop is stimulated, leading the behaviour to become more self-reinforcing, and decreasing the need for effortful self-regulation. This approach can further increase the likelihood that successful self-regulation can occur even under stressful or unsupportive conditions by enhancing eudaimonic well-being and perceptual lens to create a more centred, balanced, and empowered sense of self.

Furthermore, broad improvements to psychological well-being and perceptual lens will reduce the effect that stress and negative emotions have on cognitive load, thus increasing the likelihood

that the reflexive, self-control system is not overly taxed, distracted, or depleted. The newly formed centred identity will allow performing the behaviour to be more cognitively efficient, and more resilient in the face of setbacks and conditions that make successful self-regulation less likely.

The importance of identity in the performance and maintenance of health behaviours is widely recognised. In a recent meta-analysis on identity/schema in association with physical activity, there was a robust and significant positive relationship ($r=0.44$), on par with intentions (Rhodes et al., 2016). Self-identity has also been included by some in the Theory of Planned Behaviour, and significantly adds to the predictive power of the model to predict intentions and behaviour (e.g., Bélanger-Gravel & Godin, 2010; de Bruijn & van den Putte, 2012; Sparks & Guthrie, 1998). Identity in health behaviour research thus far primarily focuses on behaviour-based aspects of identity. Maintain IT extends the behaviour-based identity, in order to appreciate that identity also includes the roles (e.g., parent, nurse, etc.), groups, and values that are fundamental to the individual. This broader conceptualisation of identity can allow individuals to incorporate the health behaviour in ways that simultaneously reinforce both identity and behaviour. Kwasnicka, Dombrowski, White, and Sniehotta (2016) systematically reviewed 100 behaviour change maintenance models and presented five overall themes. Identity was recognised as a core component of the maintenance motives theme. Similar to the Maintain IT perspective (drawing from identity theory), the authors conclude that identity is important because people are more likely to behave in ways that are consistent with their values and sense of self; and that self-relevant information is processed more quickly and efficiently than non-relevant information. Identity (i.e., self-concept) was also identified as an important factor in weight loss maintenance in a recent systematic review of qualitative studies (Greaves, Poltawski, Garside, & Briscoe, 2017). The authors noted that identity can inhibit weight loss maintenance when identity is inconsistent with weight management behaviours. In contrast, successful weight loss maintainers list a change in their self-perceptions as an important factor contributing to their success.

Maintain IT in practice

The goal of the Maintain IT model is to pragmatically integrate previous lines of theory and research to inspire interventions that result in lasting behaviour change. The following sections briefly summarise the current state of evidence for relatively novel intervention approaches and techniques that improve individual and combined facets of Maintain IT. By highlighting these approaches we hope to draw attention to existing conceptual links between Maintain IT and current intervention approaches. An example of an intervention drawing from some of these approaches follows.

Approaches that target EF

The literature on training EF has yielded mixed results for a number of reasons. For example, samples range from children (Diamond & Lee, 2011) and healthy undergraduates (Soveri, Waris, & Laine, 2013) to experienced (Tsai & Chou, 2016) and very experienced (Van Vugt & Slagter, 2014) meditation practitioners. In most cases, the range of EF capacity was relatively narrow, with few individuals showing impairment that was worse than mild. Training and experience were similarly variable, ranging from one brief guided session of meditation (Colzato, van der Wel, Sellaro, & Hommel, 2016) through the use of extremely experienced meditation practitioners (Tsai & Chou, 2016; Van Vugt & Slagter, 2014). Interventions have included aerobic exercise (Hillman, Erickson, & Kramer, 2008), computerised training (Mackey, Hill, Stone, & Bunge, 2011), commercially available online training (Thorell, Lindqvist, Nutley, Bohlin, & Klingberg, 2009), mindfulness meditation (Gallant, 2016), focused attention and open monitoring meditation (Colzato, Sellaro, Samara, Baas, & Hommel, 2015; Tsai & Chou, 2016), Ch'an (Zen) and Confucian movement-based meditation (Teng & Lien, 2016) and others (Diamond & Lee, 2011). Further

complicating the issue is the variety of conceptualisations of EF, and the different instruments used to measure EF or its subcomponents.

EF plays an essential role in a number of health-related behaviours (Tran, Baxter, Hamman, & Grigsby, 2014), including weight control (Gettens & Gorin, 2017). But EF is mediated by a modular, distributed anatomic network involving different areas of prefrontal cortex, as well as the dentate, caudate, and subthalamic nuclei, dorsomedial thalamus, and other regions, and the fibre tracts that connect them (Fuster, 2000, 2008; Grahn, Parkinson, & Owen, 2008; Schmahmann & Sherman, 1998), and the specific subcomponent functions associated with these regions vary in importance for different behaviours. In general, inhibitory control appears to improve somewhat more with adequate practice than other aspects of EF, such as set-shifting and working memory. Techniques such as mindfulness meditation (Gallant, 2016) and an adaptive version of the stop-signal task (Berkman, Kahn, & Merchant, 2014) have demonstrated success at improving inhibitory control. However, a meta-analysis of studies that examined the effects of training inhibitory control on subsequent health behaviour concluded that the effects of improving inhibitory control may only be effective in the short term, and more studies are needed to examine the longevity of training effects (Allom, Mullan, & Hagger, 2016). Set-shifting ability was less readily improved (Soveri et al., 2013), although Tsai and Chou (2016) reported a positive effect on this subcomponent of EF in association with Ch'an training. Working memory appears to be the most difficult of these three executive sub-functions to improve, at least with techniques that show a generalisation of improvement beyond performance on the training task and related skills, although certain approaches show a positive effect (Au et al., 2015; Salminen, Kuhn, Frensch, & Schubert, 2016).

Some recent work has shown promise for training implicit impulses and EF to increase health behaviours. Friese et al. (2011) note that a dual systems approach can inform interventions by considering three components: reflective processes (attitudes, personal standards); impulsive processes; and self-control abilities. They summarise a growing number of recent studies that demonstrate possible targets to change impulsive processes by training changes in automatic associations, attentional biases, and approach tendencies. There is some evidence that interventions can train impulses and facilitate the creation of associative networks that reduce the need for effortful control to perform behaviour (described in more detail in Example of Maintain IT Intervention below). These approaches have been successful at training automatic associations and implicit approach/avoidance tendencies for eating unhealthy foods and drinking alcohol, as well as changing behaviours themselves (Fishbach & Shah, 2006; Houben & Jansen, 2011; Houben, Havermans, & Wiers, 2010; Leeman, Wiers, Cousijn, DeMartini, & O'Malley, 2014; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Wiers, Rinck, Kordts, Houben, & Strack, 2010). Episodic future thinking, or vivid simulations of future events, is another technique that has shown promise for decreasing impulsivity (Benoit, Gilbert, & Burgess, 2011; Bickel, Yi, Landes, Hill, & Baxter, 2011; Gellert, Ziegelmann, Lippke, & Schwarzer, 2012). The relationship between EF and health behaviours may also be bidirectional, such that changes in behaviour (increasing physical activity, quitting smoking) may improve EF (Colcombe & Kramer, 2003; Gettens & Gorin, 2017; Gunstad et al., 2007; Heijnen, Hommel, Kibele, & Colzato, 2016; Loprinzi et al., 2015; Sofis, Carrillo, & Jarmolowicz, 2017). Despite some evidence suggesting that healthy changes in behaviour may lead to improvements in EF, this is far from conclusive currently (Gettens & Gorin, 2017).

Trait-level working memory capacity may be largely stable, but the ability to improve working memory over the short term (Melby-Lervåg & Hulme, 2013), and successfully employ working memory in emotional contexts (Schweizer, Grahn, Hampshire, Mobbs, & Dalgleish, 2013; Schweizer, Hampshire, & Dalgleish, 2011), may be amenable to training. The latter types of training may be important for health behaviour change interventions, because they increase the likelihood that self-regulation can occur in emotive environmental conditions. In addition, a recent study demonstrated that impulsivity could be experimentally reduced with a negative urgency task, but particularly among those who were lower in working memory (Gunn & Finn, 2015). If working memory is more difficult to change, approaches that work better for those lower in working memory will be

particularly valuable, because existing intervention techniques have been shown to be more successful in those with greater working memory (Hall et al., 2014).

Maintain IT builds on this work, by suggesting that approaches which improve response inhibition, and reduce impulsive behaviours help create associative networks surrounding the health behaviour and potentially improve state level working memory. These approaches can complement self-regulatory approaches focused on the reflective system, like goal setting and monitoring. The fluid structure of Maintain IT suggests that such approaches may be more important during behaviour initiation, when EF strategies and abilities are most needed.

Approaches that target centred identity

A large body of research demonstrates that behaviour-based identity is associated with the successful performance of health behaviours. Behaviour-based identity is largely comprised of one's perception of the frequency with which they have engaged in the behaviour in the past, therefore, the transformation of this facet of identity is expected to occur primarily after successfully adopting and performing the behaviour repeatedly. The novel aspect of Maintain IT is that it also considers aspects of identity more broadly, beginning with an examination of personal values, and fundamental role- and group-based identities, and the extent to which the behaviour is consistent with or at odds with these values and identities. Second, Maintain IT proposes that it is critical for individuals to link the health behaviour to their values, and find individualised ways to incorporate the behaviour to be consistent with, rather than at odds with, fundamental roles and groups central to their identity. Some fundamental roles may be in opposition to the behaviour, but are not changeable (e.g., child of unhealthy parent), or individuals may simply not want to change them (e.g., spouse of unhealthy partner). The practice of identifying unsupportive roles can be helpful to be able to set implementation intentions for how to deal with these unsupportive roles, and attribute setbacks in the context of these roles as being transient, rather than global. This optimistic attribution can improve resilience and recovery in the face of such setbacks.

Next, individuals examine their social or group-based identity, to ascertain groups with which they identify, that are important to them, that have values or goals that contrast with the health behaviour, or that will resist attempts to transform aspects of identity. As with roles that are in opposition to behaviour, remaining in groups that do not value the new behaviour may be necessary, or desired, but will require more active self-regulation, and therefore make maintenance more difficult over the long term. Important personal relationships that inhibit the adoption of a health behaviour or transformed identity may create emotional turmoil and stress, which can increase the need for more effortful self-regulation, but decrease the likelihood that it can occur. Implementation intentions, or similar approaches that acknowledge difficult social circumstances and anticipate strategies for dealing with them, can likely help people maintain health behaviour. Social support, on the other hand, has been shown to significantly increase both completion of a weight loss intervention, weight loss during an intervention, and long-term maintenance of weight loss (Wing & Jeffery, 1999). When necessary, individuals may need to develop new, supportive social relationships or groups that will not push back against the adoption of a new health behaviour or the formation of a new, more centred identity. Interventions should facilitate the formation of new relationships and groups (even virtual groups) for support, and the development of a transformed group-based identity (Coursaris & Liu, 2009). Positive and strong relationships with others represent a core dimension of psychological well-being (Ryff & Keyes, 1995), and are important for the formation of identity (Tajfel & Turner, 1986).

The Maintain IT model predicts that interventions that support people's attempts to examine their identity, set goals consistent with their values, and integrate behaviour in ways that reinforce their fundamentally valued roles/groups will increase how autonomously they view their goals and behaviour, and in turn, improve the likelihood of long-term maintenance. This is in line with a large body of theoretical and empirical work from SDT that demonstrates that people are more likely to

consistently perform a behaviour that is autonomously chosen and directed (Teixeira, Silva, Mata, Palmeira, & Markland, 2012).

Maintain IT suggests that interventions should also integrate methods to improve psychological well-being and perceptual lens. Promising approaches from positive and clinical psychology have shown that well-being can be improved through writing gratitude letters or journals, count-your-blessing exercises, practicing optimistic and positive thinking, and expanding positive relationships with others (Chan, 2010; Emmons & McCullough, 2003; Ryff, 2014; Seligman, Steen, Park, & Peterson, 2005; Sin & Lyubomirsky, 2009). Practicing gratitude and developing a more grateful orientation during the IT process is expected to improve several dimensions targeted in the centred identity construct of Maintain IT. Gratitude has been shown to predict well-being, both directly and through perceptions of social support and fostering adaptive coping styles, and is related to lower stress and depression during a life transition (Lin & Yeh, 2014; Wood, Maltby, Gillett, Linley, & Joseph, 2008). Furthermore, gratitude may be an intervention approach to which people are more able to adhere; for example, one body-dissatisfaction intervention demonstrated that twice as many people completed a gratitude intervention compared to a control intervention (Geraghty, Wood, & Hyland, 2010).

Approaches that target multiple facets of Maintain IT

Research has shown that mindfulness is an approach that targets EF and centred identity components. Mindfulness can be used to train attention and working memory, and can help regulate areas of the brain associated with self-control (e.g., anterior cingulate cortex, medial prefrontal cortex) and reduce the drive for addictive health-risk behaviours (Tang et al., 2015). Mindfulness is also related to greater psychological well-being (Brown & Ryan, 2003), lower stress (Creswell, 2015), and engagement in health behaviours directly (Roberts & Danoff-Burg, 2010). In a preliminary study, a mindfulness-based meditation intervention demonstrated significant effects on physical health that were mediated by perceptions of social connectedness (Kok et al., 2013), which suggests that mindfulness can also potentially improve group-based identity and the relatedness facet of psychological well-being.

Some authors have suggested that the relationship between mindfulness and health/well-being is mediated by self-compassion (Baer, 2010; Hölzel et al., 2011). Proponents posit that self-compassion is particularly useful in promoting resilience in the face of minor failures (Neff, 2011; Neff, Kirkpatrick, & Rude, 2007) and specifically when trying to adopt health behaviours or reach a health-related goal (Sirois, Kitner, & Hirsch, 2015). Some suggest that self-compassion promotes self-regulation, because it helps individuals set appropriate goals, monitor progress toward goals, regulate emotions and promote emotional resilience and stability (Terry & Leary, 2011). Self-compassion is also associated with intrinsic motivation and greater personal initiative to make necessary changes and has been shown to facilitate health behaviours (Neff, 2003). A recent meta-analysis of 15 studies found that self-compassion is associated with health behaviours directly, though the effect size was small ($r = 0.25$; Sirois et al., 2015). Importantly, self-compassion has been shown to improve when targeted via multiple intervention approaches (Barnard & Curry, 2011). The Maintain IT model predicts that self-compassion and mindfulness will also lead to attributional styles more amenable to recovering from setbacks.

Example of a Maintain IT intervention

The sections above demonstrate that Maintain IT has common ground with many current interventions or aspects thereof. However, we believe that full consideration of the Maintain IT model may lead to a systematic and effective integration of these interventions. To that end, we present a case example. Consider a woman who is enrolled in a Maintain IT intervention to increase physical activity. First, the intervention could involve activities designed to train the impulsive system and improve inhibition and attention. Activities could be designed to train approach/avoidance implicit tendencies by having participants pull a joystick toward themselves when viewing images or words

associated with physical activity, and pushing the joystick away from themselves when viewing images or words associated with sedentary behaviours. This approach has proven effective to influence unhealthy eating (Fishbach & Shah, 2006) and decreasing and abstaining from alcohol consumption (Leeman et al., 2014; Wiers et al., 2011). Similarly, Go/No-Go tasks could be adapted for physical activity as they have been successfully adapted to train inhibition for drinking beer (Houben, Nederkoorn, Wiers, & Jansen, 2011) and eating chocolate (Houben & Jansen, 2011).

On the identity side, the intervention would first involve examining the fundamental roles and groups that constitute identity, and rate the extent to which those roles and groups are consistent with (or in contrast to) adopting and maintaining physical activity (adapted from Brook et al., 2008 to measure identity congruence). Upon this examination, the participant might discover that she identifies with being a mother and belonging to her family as the most fundamental to her identity; but sees both as working against her ability to adopt and maintain physical activity. The intervention can encourage her to find individualised ways to frame exercise as a part of investing in her children, focusing on the ways being active sets a good example, allows her to more fully engage with her children, and makes it more likely she will live long enough to care for her children. The intervention should encourage her to incorporate physical activity in ways that reinforce her role as a mother, including taking her family to the park or walking or hiking with her child in a stroller or backpack, rather than having her identity as an 'exerciser' compete with her identity as a 'mother' (requiring time and resources to find a babysitter to spend time away from her child and go to a gym). Incorporating the behaviour into her role-based identity may encourage the behaviour to become more automatic because the behaviour becomes self-relevant, and aligns with and reinforces both her fundamental role-based identity and her goal to be more active. This process would be expected to increase her integrated (i.e., more autonomous) form of motivation. In terms of perceptual lens, the intervention would adopt techniques that are used in implicit theory interventions to teach or reinforce characteristics such as intelligence (Blackwell, Trzesniewski, & Dweck, 2007), personality (Yeager et al., 2014), and weight loss (Burnette & Finkel, 2012) are malleable (incremental) rather than fixed (entity). This can change perceptions about whether being an active person is a malleable trait, rather than fixed trait. To our knowledge, no intervention approaches have been developed in health behaviour adoption contexts to help individuals develop more optimistic attributional styles (i.e., styles that interpret negative events or setbacks as being situational, transient, and specific, or positive events as being global). However, we are confident that approaches that have been used in the treatment of depression to improve attributional style, can be adapted for health behaviour contexts. Recall that the woman in our example sees her family as the group that is most fundamental to her identity, but is at odds with increasing physical activity. Increasing physical activity will not be more important than being part of her family, and we would not expect her to change families in order to succeed at increasing physical activity. But recognising that her family social context will make changing and maintaining physical activity more difficult, she can then set implementation intentions to increase the likelihood that she can be active in these difficult circumstances. She can also learn to utilise a more optimistic attributional style by recognising failures in difficult social contexts as being situational, transient, and specific, as opposed to internal, stable, and global. This is predicted to help recovery from setbacks and improve resilience. Clinical approaches currently in use, such as ACT and the disconnected values (intervention) model (Anshel, 2008; Anshel & Kang, 2007; Anshel, Brinthaup, & Kang, 2010) include careful consideration of values in order to engage discussion around values clarification and to explicitly align endorsed values with behaviour. These approaches parallel Maintain IT and provide specific techniques for use in clinical behaviour change settings that can be incorporated into health behaviour change interventions. Finally, techniques from positive psychology interventions summarised above that improve psychological well-being and multiple facets of Maintain IT more broadly (i.e., not behaviour specific) such as mindfulness, gratitude, and self-compassion exercises should also be incorporated. These techniques are predicted to improve the likelihood that EF can be recruited when necessary, reduce the drive for health-risk behaviours, and help build resilience to recover from setbacks.

Summary, challenges, and predictions

Maintain IT aims to build on approaches to health behaviour change that recognise the limitations of interventions that depend primarily on self-regulation strategies that involve cognitively taxing EF and rational, top-down, conscious processing. These approaches are crucial for the initiation of healthy behaviour, but for most people, this type of effortful control is not sustainable. Maintain IT posits that a process of *centred identity transformation* is one potent strategy for creating less effortful and ultimately more self-reinforcing behaviour, and allowing individuals to be resilient in the face of difficult circumstances and inevitable setbacks. This approach acknowledges that EF is critical for behaviour initiation, for more complex behaviours beyond initiation, and in less supportive individual or environmental circumstances; but emphasises that decreasing the need for effortful control, and increasing the likelihood that EF can be successfully recruited when necessary, will help make behaviour changes more likely to be maintained. Second, existing approaches do not typically factor in individual differences aside from measuring previous behaviour and motivation or readiness to change (i.e., the strength of intentions to begin a new behaviour) at the outset of an intervention. In contrast, Maintain IT incorporates not only past experience with the behaviour of interest and motivation to change, but also includes differences in individuals' perceptions of the fundamental roles and groups that constitute identity. By working to incorporate the target behaviour within the fundamental aspects of an individual's identity and values, and more broadly improving psychological well-being and perceptual lens, behaviour change methods need not rely solely on strategies that utilise slow and costly EF that tend to only succeed in the context of an intervention or particular environment, or that are more effective for those higher in EF. Furthermore, this approach buffers against the challenges that often lead people to revert back to unhealthy behaviours, such as cognitive load, ego-depletion, intoxication, 'hot' states, novel and/or unsupportive environments, stress, and emotion/affect.

Maintain IT is the product of decades of research and thought collectively among the authors in multiple domains of behaviour change, but is itself in the early stages of development. We acknowledge its limitations and several challenges that need to be overcome in order to acquire the data necessary to support or refute the assertions of the model. As with all models, it is an over-simplification of the truly complex set of interrelated factors that influence behaviour change and maintenance. The first notable challenge is that not all constructs in the model can be reliably and validly measured at present. The development of appropriate and potentially behaviour-specific measures for each of the constructs will be necessary. Second, this is a model of process and maintenance, which means outcomes based on long-term maintenance will require longitudinal research for which funding may be difficult to obtain. Third, many of the approaches are individualised, or are modelled after clinical approaches that require one-on-one interactions that are not ideal for large, population-based interventions. However, if they are substantially more effective than current approaches, the costs and benefits of including some level of individualised, patient centred approaches can be evaluated. In addition, many of these approaches are being developed for digital formats that would allow for lower-cost solutions (Dimidjian et al., 2014). In addition, the most effective way to facilitate the process of identity transformation is not currently well-understood. Finally, the model suggests that EF is important both during the initiation phases of behaviour change and under challenging social, contextual, or emotional circumstances. Thus, from an intervention perspective, it is unclear what the 'critical timing' of the presentation of each of these strategies might be. It will take many iterations and creative experimental designs including adaptive randomisation (Zhang & Rosenberger, 2012) to determine what the optimal order and timing for the different components will be.

Despite these challenges, we hope that Maintain IT is inclusive, integrative, and comprehensive enough to shed light on some of the lesser considered factors in sustainable behaviour change, that it has meaningful heuristic value, and that it can generate new and clear hypotheses that can

be tested and replicated in current and future interventions. An empirical test of the model would measure behaviour, EF and aspects of identity (including values, eudaimonic psychological well-being, implicit theory and attributional style) at baseline, during, and at the conclusion of an intervention. Behaviour maintenance would be measured with post intervention follow-up measures of behaviour. The model posits that EF will predict behaviour initiation, and to a lesser degree maintenance. Long-term maintenance will primarily be predicted by the extent to which aspects of identity and values are consistent with, rather than at odds with the behaviour, as well as eudaimonic well-being, an incremental implicit theory surrounding changing the behaviour, and a more optimistic attributional style. An alignment of identity and values with behaviour, an incremental implicit theory, and an optimistic attributional style will be associated with maintenance whether they are present at baseline or developed over time during an intervention. The identity transformation aspects of this intervention approach are predicted to be particularly relevant for more complex behaviours (e.g., diet, exercise), and perhaps more efficacious when attached to circumstances when identity is already changing (e.g., pregnancy, puberty, parenthood, bariatric surgery, cancer diagnosis). Thus, an empirical test could compare the utility of an identity transformation intervention to change a complex behaviour compared to one that was more readily automatised (e.g., wearing a seatbelt); hypothesising that the identity components are less relevant for predicting adherence to more easily automatised behaviours. Another empirical test could compare the efficacy of an identity transformation intervention in a population where identity is changing to one in which identity is not already changing; positing that incorporating the new behaviour into identity is more likely when identity is already undergoing change. Other testable predictions we see as relevant to the field of sustainable behaviour change that derive from the model include, but are not limited to the following: (a) improvements in EF, behaviour-based identity, psychological well-being, and perceptual lens over the course of an intervention predict long-term maintenance of health behaviours, (b) interventions that help individuals integrate health behaviour with their role- and group-based identity will lead to greater increases in behaviour-based identity, autonomous motivation, and maintenance of health behaviour changes, (c) centred IT interventions will lead to more successful maintenance compared to traditional, behaviour-only focused interventions, and finally (d) a centred IT intervention approach will work similarly well for those inherently high and low in EF. Overall, we hope this approach can lead to more comprehensive, novel interventions that facilitate long-term maintenance of health behaviours.

Note

1. It should be noted that SDT also differs from Ryff's perspective on well-being in that SDT theorises that competence, autonomy, and relatedness foster well-being, whereas Ryff's approach uses these constructs to define well-being.

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