Positive Psychology, Proactive Coping, Behavioural Change and Digital Technologies

A literature review

About the authors

Method X Studios is a pioneering force in revolutionising mental health prevention for the mass market, blending expertise from technology, science, healthcare, and media to challenge conventional approaches. Supported by visionary backers such as Guys and St Thomas Charity, Zinc.VC, and Wellcome Trust, among others, Method X Studios stands at the forefront of innovation with luminaries like Dr. Sarah Woods and John Lazar driving its mission forward. Through collaborative partnerships and a commitment to excellence, Method X Studios aims to transform the landscape of mental health prevention, envisioning a future where well-being is accessible to all.

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Introduction

Human flourishing, health and happiness, are themes which psychologists have been urged to explore under the rubric of 'positive psychology'. A realm of wellbeing research then developed from the 1970s (Bandura, 1977; Harter, 1975), through to the 1980s (Dienar, 1984; Emmons, 1986) expanded the field further which gradually culminated in a more codified field of positive psychology articulated in Martin Seligman's 1998 American Psychological Association speech. The notion of linking psychology with community health however had its roots with Albert Adler in the 1930s who is regarded as the first community psychologist who expressed an interest in the social determinants of mental health and on community prevention, health and wellbeing.

While Abraham Maslow (1943, 1954) emphasised a humanistic psychology which focuses on social welfare and social responsibilities at both the individual, community and wider societal level. Albert Ellis theorised on the notions of self-actualisation, life goals, self-acceptance and happiness and how these are linked to wellbeing and happiness outside the sole scope of the individual to impact community and wider societal levels.

Bandura (2019) opined that guided mastery will enhance coping skills and thus future situations will be regarded as less challenging, less daunting and less threatening. Having a positive outlook on life helps with handling stress and is associated with a proactive approach to aging, physical activity, and avoidance of negative and harmful pursuits. Carver et al. (2009) in their essay on "Optimism" in The Oxford Handbook of Positive Psychology bring attention to how pessimism can lead to procrastination and not dealing with a problem and distancing oneself away from the problem for as long as possible, giving up if the situations remain difficult.

A proactive approach however involves engaging with a problem prior to its presence and this outlook is associated with optimists.

Optimism instils proactive efforts and include taking actions in order to minimise health risks. Carver et al. suggest that due to these preventative steps optimists will tend to have better health than pessimists. To the extent that they posit that research has demonstrated that optimists with this proactive approach heal faster form wounds and even demonstrate slower disease progression when seriously ill.   Compton and Hoffman nevertheless discuss in their book Positive Psychology: The Science of Happiness and Flourishing (2020: 100) that some realism needs to be applied to optimism however so that it does not lull one into a false sense of hope or inaccurate risk perception. They mention that unless an optimist is highly motivated s/he will not wish to complete a challenging task, so that potential failure does not infringe on their optimism.

Hence, one can be too optimistic about just how optimistic one should be! They mention that a study in Germany found that people over 65 years of age who were overly optimistic had worse health outcomes than those of the same age who were more realistic about aging and more aware of potential health problems and took preventative actions. They also interestingly note that sadness and depression, and other negative emotions, can have positive consequences. Such emotions may provide rare opportunities for reflection, gratitude, analysis of complex problems and prompt creative methods to handle difficulty. They also discuss nostalgia and its impact as either a positive or negative emotion and that it is experienced differently by men and women. Nostalgia can serve as a psychological resilience resource that fosters mental strength by bolstering one's sense of both belongingness and social connectedness. Moreover, nostalgic memories amplify our sense of being loved and appreciated by others, progressed in life, developed as a person and gained valuable life experiences to impart to others.

When it comes to human behaviour therefore, this refers to both emotional and physical activities, with a behaviour being what happened, when and why? There are many factors and nuances which impact human behaviour and as a result patterns of behaviour are very difficult to change. Behavioural theories aim to understand why people get involved in, or abstain from, health behaviours. People must be both motivated and also able to act on their motivations in order to take on new behaviours. Some motivations for change emanate from individual agency as when one endeavours to lose weight for instance by going on a diet.

However, in other cases a change in behaviour is not down to individual agency and motivation but rather via behaviour change interventions. Behaviour change has been suggested, as per Prochaska and DiClemente (1982), to manifest itself in stages, often as: precontemplation through contemplation; preparation; action and maintenance. These stages were applied to the process a smoker for instance would take in order to quit smoking, although they mentioned the possibility of the 'revolving door' whereby a person may ebb and flow between pre-contemplation to contemplation.

Behaviour theory can be useful for explaining and changing individual factors linked to health behaviours, however how these theories can come to practical fruition in people's daily lives is another matter and has resulted in a plethora of theories, explanations and interventions. Furthermore, the dissemination of digital technologies in the current era is now leading to a 'shift' in how psychological treatments, behavioural therapies and wellbeing can be facilitated. Digital interventions in the form of online interventions, apps and cognitive exercises has boomed over the last few years particularly representing a tech-health revolution.

This literature review aims to look at literature on the human quest for happiness and positive cognition, coping when obstacles to this quest surface and the behaviour which is sought after, the theories surrounding behaviour, interventions for behaviour change and then how the 'digital shift' is being harnessed to facilitate behaviour change.

Background: In Pursuit of Happiness?

Research has demonstrated that happy people are better at 'active coping' which contributes to an 'upward spiral' in both health and wellbeing. Further to this, a growing body of research has suggested considerable success in enriching happiness via positive interventions such as showing appreciation and expressing gratitude (Carr, 2004; Watkins, 2013), practicing forgiveness (McCullough et al., 2000; Kalayjian and Paloutzian, 2009; Kiper and Divietro, 2018; Tsang and Martin, 2021), writing about life goals (King, 2001), avoiding social comparison (Herman et al., 2019), avoiding self-evaluations (Sheldon and Lyubomirsky, 2006), and instilling a sense of optimism (Peterson and Bossio, 1991; Seligman, 1991, 2018). According to the hedonic perspective, wellbeing consists of subjective happiness, pleasure and pain avoidance (Ruini, 2017: 5).

Framing human behaviour in goal-orientation may reap benefits as when life goals are developed it involves actively pursuing improvements in one's life. When lives, livelihoods and lifestyles are threatened the reaction to this can be the reproduction of basic life goals. The mind itself has its own nutritional needs and intrinsic goals, at the same time however, the relentless pursuit of the 'good life' is undermined by the breakdown of circumstances which lead to a change and then the pursuit of social and environmental goals is very challenging for the mind. Yet when one achieves a goal that they previously did not have time to do such as voluntary or charitable work it can make up for the low self-esteem and the inability to enjoy life to flourish. Ahuvia (2018: 308) has opined that although people may be able to indicate their happiness in the present-sense, they struggle when it comes to estimating their future happiness.

It is suggested in self-determination theory, as articulated by Ryan and Deci, that people's basic psychological needs can be met by giving which fosters happiness. Ahuvia has argued (2018: 316) that giving enhances relatedness in many when, as exhibited in giving gifts to someone, or when two people work closely together on a prosocial activity. Giving meets the giver's need to feel competent and effective, especially if the gift makes a difference in someone's life. Giving also helps meet the giver's need for autonomy, especially when it was given freely and from one's own volition.

Self-determination theory holds that people will be happier, mentally healthier and even physically healthier, with lower stress levels, when they strive to meet these needs and gain success in doing so. The theory calls motivations and goals associated with meeting these needs, intrinsic needs. While extrinsic motivations are goals associated with social prestige, wealth etc., all of which essentially district from, or work against, meeting one's intrinsic needs. Frey and Stutzer (2014) further note that a focus on extrinsic benefits can cause one to undermine intrinsic benefits, such as family time.

Self-determination theory was described by Ahuvia (2018: 316) as providing a model which is analogous to providing 'psychological nutrition' which then provides the basis for happiness. When the mind is given its requisite 'psychological nutrition' when intrinsic goals are met, and psychological health is fulfilled. While extrinsic goals are akin to 'mental desserts', the superfluous psychological delights which merely provide short-term immediate indulgence and gratification. Pursuit of these 'mental delights' do not promote psychological health and hence long-term happiness is not gained. And while desserts can be wholly pleasurable, it would not be entirely healthy to indulge in such delights most of the day and everyday. Indeed, immersing oneself in these mental desserts, extrinsic goals, has been associated with anxiety and depression (Borkovec and Sharpless, 2004: 230), ego-driven pursuits and stress (Yamaguchi and Halbserstadt, 2011: 99), negative emotions, substance abuse (Heshmat, 2015: 137), behavioural disorders, lower levels of self-actualisation (Deci et al., 2015: 119), reduced vitality, less life satisfaction and few pleasant emotions (Ahuvia, 2018: 317).

As discussed earlier, happiness there are interventions which aim to instil and promote their overriding sense of emotional cognitive wellbeing, happiness interventions try to do this by a range of brief, self-guided, reflective or behavioural activities which are designed in ways to mimic the thoughts and behaviours of naturally happy people (Layous, 2021: 191). These interventions are sometimes referred to as positive psychology interventions (PPIs) or positive activity interventions (PAIs).

These can involve individual or group therapy or self-guided formats wherein an individual receives activity instructions from either a book, a facilitator, or an online platform or app. There activities are engaged with without any therapeutic supervision.

Coping Strategies, Stressors, Discrimination and Positive Adaptability

Coping is a volitional construct and Wei et al. (2010) posited that there are five common coping strategies adopted by people of colour who experience racism and discrimination: education/advocacy, resistance, internalisation, detachment and substance misuse.

Education involves being involved in educational activities about discrimination or advocacy regarding it at both an individual and societal level. Such activities have been associated with life satisfaction, self-esteem and a strong sense of one's ethnic identity.

Resistance is the active challenge against racism and discrimination and confrontations to this end. Internalisation is when one attributes discrimination and racism to one's own self, while detachment is to merely remove oneself from social support and not being confident to address it. Substance misuse, along with internalisation and detachment, are maladaptive methods of coping with discrimination and are associated with depression, low self-esteem, poor life satisfaction and instilling a negative perception of one's own ethnic identity.

The fact that education/advocacy and resistance are not correlated with these feelings which may indicate that societal efforts to challenge discrimination are required. It may also indicate the optimism involved in both advocacy and resistance as those who are optimistic tend to do better as do those who cope via problem solving and seeing a challenge in adversity.

Indeed, Ferssizidis et al. (2013: 103) in their paper "Positive Psychological Experiences and Psychopathology" opine that research has demonstrated that resilient people have a greater capacity for generative experiences, i.e. developing new hobbies and forming new relationships and positive emotions after trauma. Resilient people can express positive emotions with behaviours such as smiling, humour and laughter while at the same time emerging from the aftermath of challenging events. This all serves to indicate the ability of, what John Zelenski describes in his book Positive Psychology: The Science of Wellbeing as, the 'psychological immune system' to cope when faced with adversity and return to a level of happiness (2020: 206).

Discrimination, racism and disadvantage can likely increase stress which then has the knock-on effect of possibly leading to maladaptive behavioural coping strategies such as smoking or substance misuse. Terrell et al. (2007: 133) also brought attention to how black youth resort to substance misuse as a coping mechanism to discrimination in a desperate attempt to self-medicate against racism. Perry-Parrish et al. (2016: 93) posit in their paper "Mindfulness-Based Therapies" that black youth, in the American context for example, are at high risk of exposure to many stressors that may increase the likelihood for developing emotional and behavioural problems. High rates of stressful experiences may result in maladaptive coping and emotional regulation strategies that contribute to psychopathology and maladjustment. The same has also been documented in regards women who face gender discrimination and also for African American women who have been subject to behavioural exhaustion and physiological distress (Napholz, 2005: 19).

Schofield et al. (2019) conducted four focus groups from 2014-15 with 35 participants from the Black African and Black Caribbean community in Lambeth and Southwark, who had been diagnosed with a psychotic illness. They found that there was an elevated risk of psychosis in their communities due to the presence of several stressors: social disadvantage; poor experiences with mental health services; lack of community support and a double stigma of external discrimination due to ethnicity from the wider society and an internal discrimination due to the stigma attached to mental health within the black community itself.

This was also noted by Jones and Fung (2005: 262), that family poverty and exposure to stressful environments disproportionally impact the mental and physical health of youth of colour. Rogers and Pilgrim (2014: 56) note black adolescents are over-represented in mental health services especially if they were born outside of the UK and had refugee status.

Earlier studies had indicated British-born black youth, but more recent data indicates the impact of migration and the particular stressors involved in this such as displacement, trauma, conflict etc. on top of all of the other factors involved in arriving to a new and different country. This can also be seen with Latino communities in the US and indigenous communities in New Zealand, Australia and the US wherein discrimination, acculturation and the erosion of indigenous protector factors also results in maladaptive coping and poor mental health (Benuto and O'Donohue, 2016: 2).

Coping with threats to social identity affects aggression, eating, decision-making and attention. Corning and Viducich (2020: 233) also highlight that maladaptive coping models are when the experience of stress initiates a cascade of events that can result in disordered eating. A person's coping self-efficacy, or confidence in their own ability to cope, has been linked to a range of important health outcomes such as successful weight maintenance.
However, Prochaska and Prochaska (2020: 351) in their paper "Digitally Assisted Interventions for the Treatment and Prevention of Risky Behavior in Adults: Incorporating the Transtheoretical Model" put forward that it may be too difficult to expect t100% self-efficacy from people and it is but a mere ideal to work towards as for some it may require a lifetime of maintenance.

Sagiv et al. (2015: 110) suggest, somewhat in tandem with Bandura's social cognitive theory, that environments which are congruent with an individual's goals and values will facilitate the opportunities to attain their goals, whereas incongruent environments offer the opposite and block the path of such goals. Social support is important when it comes to coping with stressors (Sagiv et al., 2015: 110-111). Faulkner et al. (2015: 213) exercise can help people feel good, and this boost of positive emotions. Sports and exercise, following trauma, has been linked to post-traumatic growth. More specifically, women undergoing breast cancer treatment have found exercise classes as safe spaces which offered a positive support system and a renewed confidence. It also led to positive health behaviours such as a change in diet, quitting smoking and increased exercise.

Duckworth et al. (2018: 296) highlight that children who grow up in risky social environments may be more likely to develop maladaptive coping styles and emotional dysregulation. Some of the literature also suggests that this is the case also for children who have parents that are in conflict and then divorce (Cummings and Papp, 2012: 393-398). These maladaptive coping mechanisms are deployed when stressors are triggered as a means of coping with distress. in doing so however, they also block the means to new corrective emotional learning (Rafaeli et al., 2016: 62).

Noble and McGrath (2013: 563) have argued that young people in the modern era are struggling with the coping skills needed when facing the challenges of life. They highlight that young people more than ever are struggling with disappointment and the inevitable downs which occur in life. Noble and McGrath (2013: 563) have highlighted that some of the present challenges to the wellbeing of young people include family breakup, family relocation, blended families, school pressure, cybersafety, easier access to drugs, less time with parents, family stress, increased loneliness and less connection to their local community.

Searle and Parker (2013: 712) bring attention to the importance of positive activated affect (PAA) for prompting proactivity. PAA is a subjective mental state of energy and enthusiasm related to health and well-being. Simply put, a positive mental state. Joseph (2015: 451) evokes Sharoof (2004) by emphasising that coping-skills training facilitates the development of self-esteem, and tolerance. Indeed, Lazarus and Folkman in 1984 in their transactional theory of coping, found a positive problem-solving appraisal was associated with attempts to alter a stressful problem. This is known as problem-focused coping.

Adaptive coping necessitates a willingness to confront and work with distressing stimuli. People with PTSD engage in excessive attempts to avoid interaction with such stimuli (Ferssizidis et al., 2013: 104). People with generalised anxiety disorder (GAD) have difficulty coping with negative emotions and fail to capitalise on positive events.

Exposure to community violence as a victim or witness is associated with several adverse effects such as post-traumatic stress disorder, suicidal ideation, antisocial behaviour, social withdrawal and underachievement at school (Perry-Parrish et al., 2016: 93).

Watkins in his book Gratitude and the Good Life: Towards a Psychology of Appreciation highlights that there is an association between coping and gratitude and that grateful individuals cope with difficult situations quite well and that some studies have demonstrated this with combat veterans with PTSD (Watkins, 2013: 166). He mentions that this is also seen in spiritual behaviour and that grateful people appear particularly good at repairing their unpleasant moods. Some clinicians working with African-American communities integrate religious beliefs with coping strategies into the treatment plan. This is discussed further in The Psychology of Religion and Coping: Theory, Research and Practice. Watkins also opines that people who have gratitude use positive adaptive coping strategies and were less likely to use avoidant maladaptive coping strategies such as substance misuse, denial or self-blame.

Proactive Coping and Optimism

Aspinwall (2011: 335) in her paper "Future Orientated Thinking, Proactive Coping, and the Management of Potential Threats to Health and Well-Being" differentiates proactive coping from anticipatory coping, in that the former is based on the possibility of altering one's outcomes by responding to a potential stressor prior to, or early in its, development. While the latter refers to efforts to brace oneself for the expected consequences of a known and imminent stressor.
A core aspect of the proactive coping model is the idea that many potential stressors in health, employment, social life and aging facilitate preparatory actions and ideas that serve as a bulwark against the onset of negative events.

Proactive coping strategies promote good health and wellbeing and is associated with an optimistic approach which is not just a reaction to adversity. It also involves taking active steps to ensure positive outcomes in the future, it is somewhat similar to problem-focused coping except that no stressor is yet present (Carver et al., 2009: 306).

It has been Kahana and Kahana (1996) and Aspinwall and Taylor (1997) who have emphasised that proactive coping is distinguished by preventing problems and also reducing the impact of possible future events. Along with efforts to build resources that facilitate promotion-orientated goals and, as per Schwarz and Knoll (2003), personal growth. Aspinwall however also posits that there is a possibility that one could waste time expending efforts being proactive against a possible threat – yet said threat or event may not even materialise!

Nevertheless, Aspinwall asserts that an individual would have at least gained knowledge about the potential stressor and developed associated resistance resources. Secondly, one may "jump the gun" by trying to be prepared yet has gained incorrect information about the potential stressor which results in ineffective management of the problem. Thirdly, engaging in proactive efforts must be given is due and appropriate estimation otherwise there will be an exaggerated, excessive and even unhealthy focus on a rather unlikely occurrence. Whereas in the workplace context, proactivity initiatives may backfire it they are regarded as being too frequent and unresponsive to feedback (Aspinwall, 2011: 339).

Aspinwall (2011: 339-340) opines that the daily experience of discrimination have been linked to negative mental and physical health outcomes. She offers that daily diaries and other approaches to measuring productivity to document where proactivity or inaction takes place. She also notes that this can be applied to all forms of discrimination or situations.

However, Aspinwall takes into consideration that although there may be proactive management by de-escalation of conflict or not allowing discrimination to hinder one's performance, the discriminatory behaviour may not be addressed. Unless, as Wei et al (2010) have provided in their framework, that the discrimination is coped with via education, advocacy and resistance which are notions which Aspinwall does not consider as proactive coping mechanisms.

Carver et al. (2009: 305) bring attention to the impact of optimism on caregivers and that research conducted by Given et al. in 2003 indicated that caregivers with increased optimism had less depression and less of a negative toll on their own physical health. Carver et al. discuss how seeking knowledge is a proactive coping strategy, and give the example of individuals learning about heart attack risks to see how they health may be affected. Proactive efforts in health promotion have also been studied in regards to cardiac rehab patients and have found that more optimistic individuals were more likely to be eating lower fat foods, involved in exercise and taking vitamins.

Aspinwall (2011: 343) also mentions as improving one's general health, build social resources for support, build the financial resources in anticipation of long-term health needs and perusing the medical literature and other sources for information about the condition and its treatment as examples of a proactive approach. She highlights exercise, insurance, predictive genetic tests, assessing family risks and predispositions to particular diseases as specific proactive behaviours. Optimists therefore are more likely to take proactive steps to reduce their risk and safeguard their health and do not ignore threats to their wellbeing.
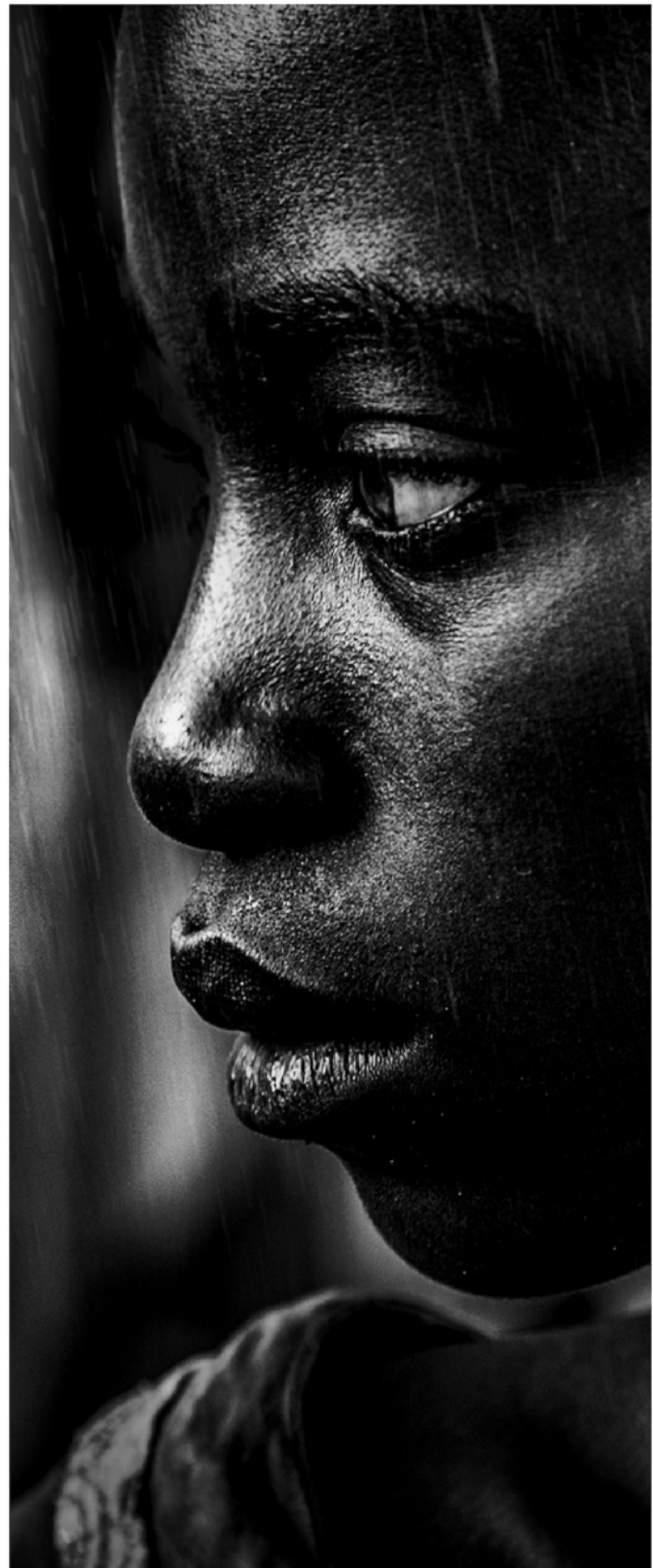
Behaviour Change Theories

A significant means to exert one's volitional control to bolster one's happiness, positive opportunities and emotional wellbeing is in optimising individual intentional behaviour and thereby bolster the upward spiral. The volitional process includes methods and techniques that can change behaviour, and for over a century psychology has explored behaviour change with Thorndike's "Law of Effect" theory standing out as an example. The theory postulated that the production of a satisfying effect after a behaviour increases the likelihood of said behaviour continuing (Thorndike, 1927).

Behaviour change, via different theories, has also been emphasised greatly over the last few years in the work environment, with businesses, enterprises and companies exploring ways in which to both change the way work is conducted. Constantini et al (2019) outline in their paper "The Theory of Planned Behaviour as a Frame for Job Crafting: Explaining and Enhancing Proactive Adjustment at Work" that goal setting and action planning are techniques adopted to facilitate and support employees in new challenges at work. Behavioural change theories are relevant in job-crafting activities which are volitional, intentional and conscious changes which one makes to how they work (Constantini et al., 2019: 169). Moreover, proactive behaviours are largely discussed in the literature in the context of the applicability of the Theory of Planned Behaviour in the workplace.

Earlier, the use of self-determination theory to account for happiness was alluded to and this discussion then leads on to the significance of different theories to explain human behaviour and at this juncture it will be worth taking a closer look at behaviour theories and how they can provide frameworks for behaviour change interventions.

Below is a breakdown of the core behavioural change theories:

Theory	Description and Constructs	Benefits	Limitations
Theory of Reasoned Action/Theory of Planned Behaviour (Ajzen, 1995)	The process before behaviour is based on intentions and expectations. The decision to behave in a particular way is due to the possibility of specific outcomes.	Behaviour includes the constructs of: **Attitude** (what a person thinks). **Subjective norms** (what do other people in my circle think?). **Social norms** (customary codes of behaviour of a people in a broader cultural context). **Perceived power** refers to the presence of factors which facilitate or impede behaviour. **Perceived behavioural** control (whether the person feels s/he has the means to make a change in behaviour easily).	• Assumes all people have equal access to health care • Does not account for factors which influence motivation and intention. • Assumes that behaviour is a result of a linear decision-making process, and therefore will not consider that behaviour can change over time. • There is no timeframe between intent and behavioural action, as theory is poorly equipped to address this within its six constructs. • In the construct of 'perceived behaviour control' was a 'intention-behaviour gap'. Gollwitzer (1995, 1998) answered this with the notion of 'implementation intention'. This emphasised the 'what' to be changed; the 'where' the behaviour change will occur and 'when' the behaviour will happen. Hence, **"if (a certain situation) occurs, then (behaviour is implemented)".** In this way, situational cues prompt action which requires little thought. Implementation intention can be used in health behaviour change counselling.
Social Cognitive Theory (Bandura, 1986)	Expanding on Bandura's 1977 **Social Learning Theory** (how observation in society informs learning), its core constructs are **Reciprocal determinism** (the reciprocal interaction between person, environment and behaviour). **Behavioural capability** (a person's ability to perform a behaviour through knowledge and skills). **Observational learning** (asserts that people observe a behaviour by others and then reproduce those actions, i.e. 'modelling'). **Reinforcements** (the internal and externals responses which inform the likelihood to dos/continue a behaviour). **Expectations** (people anticipate the consequences of their actions before embarking on the behaviour change). **Self-efficacy** (refers to a person's confidence to change behaviour).	• Is unique as it focuses on maintenance of positive healthy behaviours, and not merely the intent to embark on changing behaviour. • Emphasises how behaviour can be established in observing and imitating those with direct influence and reinforcement.	• Assumes change in the environment will then lead to change in person. • Unclear as to which factors contribute to behaviour. Do all three cognitive, behavioural and environmental factors all have to coalesce? How much of each factors contributes to change. • Model is rather broad, and individuals are grouped as one with little emphasis on individual emotions or motivations.
Transtheoretical Model/ Stages of Change (Prochaska and DiClemente, 1983)	People are at certain stages when it comes to behaviour change: **pre-contemplation** (people are unaware that behaviour is negative and requires change); **contemplation** (when people recognise behaviour needs to be changed and there is intent to change it); **preparation** (when people are ready to take action and take small steps to behaviour change); **action** (when people have changed behaviour and intend to move forward with new or different healthy behaviour); **maintenance** (sustained behaviour change) and then **termination** (when people have no intention to return to negative behaviour or relapse). The stage influences the likelihood of behaviour change.	This model is the main stage model in health behaviour research and for interventions designed to change unhealthy and negative habits.	• Decision-making process assumes a linear one, when this is not the case for everyone. • There is no clear of time for each time. • No social-context for different individuals.

Theory	Description and Constructs	Benefits	Limitations
Social Ecological Model (Brofenbrenner,1977)	Theory related to the relationships between individuals, social groups, the community or the environment. It is a model of health which looks at the links between different factors/determinants which impact health. These determinants are both macro and micro and include: **Social/policy** (laws, regulation, racism, discrimination). **Community and institutional environments** (employment, transport, services, schools). **Interpersonal** (social support and family). **Individual** (genetics and individual behaviours).	• By addressing different health determinants it can help to develop and guide the design of interventions and policies applicable for each factor. • Strategies can be developed to influence multiple levels and determinants.	• For there to be effective intervention, multiple levels, factors and determinants may have to be addressed simultaneously. These may also be expensive and time-consuming. • Multiple interventions at the same time may conflict with each other. It can offer a 'one size fits all' approach without considering that different populations may require specific interventions for particular determinants. Population-specific interventions may be required for the desired health outcomes to be attained. • The model does not account for when there is a lack of motivation for change in the environment. • Not all diseases, illnesses and conditions can necessarily be prevented. • Can be more effective if combined with other behaviour change theories such as TTM, HBM and HAP.
Self-Determination Theory (Deci and Ryan, 1985)	The theory suggests that people are motivated to grow and change by three universal psychological needs: **Competency** (gaining mastery over tasks and learning new skills; taking action to achieve goals). **Connection and Psychological Relatedness** (when people gain a sense of attachment and belonging to others; peer groups where attachment has been fostered can lead to motivation). **Autonomy** (when people feel they have the agency to change their behaviour; making decisions and taking actions for behaviour change helps to instil determination). The theory also posits that there are two types of motivation: **Intrinsic** (mastery, meaning, earning, autonomy, belonging etc.) and **Extrinsic** (rewards, money, fear of failure, points etc.)	• Highlights that each person is able to make choices and decisions about their own life. • The theory emphasises individual agency in making behavioural change. • It has an impact on motivation as when people feel they have more control they are thus more motivated to take action and own a change in behaviour.	• The theory assumes that all individuals are able to self-motivate themselves. • Environments and external factors which foster controlling behaviours may impede autonomy. Situations where directives are issued, controlling words used and knowledge monopolised is all contrary to instilling autonomy. • Likewise, external factors can also hinder competence by not allowing individuals to formulate their own ideas, answers and concepts. Also by providing solutions without allowing individuals their own time and space to discover and explore these for themselves. • Although extrinsic rewards such as positive feedback can boost self-determination, other extrinsic rewards, such as financial compensation, can reduce the intrinsic motivation of an individual due to a lack of control and autonomy • Not everyone has competence. • Developing relatedness and connections with people can be both time-consuming and costly. • When people do exert autonomy, they may be criticised, ostracised or punished as a result, all of which will serve to demotivate an individual. • Pink (2010) adapted the theory with his three basic needs to drive intrinsic motivation, **mastery, autonomy** and **purpose** (drive to connect a cause larger than oneself).
Health Belief Model (Becker et al., 1977)	Focuses on people's cognitive representations of health behaviour: **perceived susceptibility** to illness and the **expected severity** or impact of illness. A person's perception of the **benefits** of health promoting behaviour. It also considers **barriers** to health promoting behaviour.	A popular model of understand behaviour. The cues to action construct posits that cues serve to trigger behaviour when appropriate beliefs are held. **Cues to action** may include reminders, a symptom or an advertisement. The **self-efficacy** construct which refers to a person's confidence to engage in healthy behaviour. Does one have confidence in their own ability to engage in healthy behaviour by taking action? Informs many health interventions.	• Assumes everyone has equal access to information on illness and disease. It also assumes that all cues to action encourage action, although it varies from person to person. Likewise, it assumes that decision-making processes for health behaviour action are the same for everyone, when this also differs from person to person.

Theory	Description and Constructs	Benefits	Limitations
Goal Setting Theory (Lock and Latham, 1990, 2002)	Emphasises that feedback is important, goals should be accepted and hard-specific goals are more effective than vague, unclear simple goals.	• Due to increased motivation and efforts, there is better behavioural action. • It assists an individual to set targets and work towards an attainable goal.	• Motivation can waver and wane when goals are too difficult and felt as being beyond the scope of an individual's abilities. • Simpler short-term goals are often not taken into the same consideration or offered the same • When goals are more complex, and thereby not achieved, it may lead to either unethical cutting of corners or risky behaviour. • There are missed learning opportunities, due to encouraging a simple focus on an outcome, without affording appropriate time to enquiry, investigation, exploration and comprehension. • There is sometimes decreased intrinsic motivation due to the emphasis on merely reaching an outcome.
Habit Alteration Model (Pinder et al, 2016)	The Habit Alteration Model (HAM) is a practical conceptual model that synthesises Dual Process Theory, modern habit theory and Goal Setting Theory so it can be applied more easily to digital change behaviour interventions. Goals drive behavioural repetition to support habit formation. With a three-step phased approach of **filter, prepare** (impulses and intentions) and **act** (a single response which may have an outcome, with interventions such as self-monitoring to form alternative intentions to act).	Habitual behaviour is common in everyday life in multiple domains. Secondly, we have shown that reasoned-action theories and corresponding Type 2 techniques alone are unable to achieve lasting behaviour change in the face of strong habits. Thirdly, we have identified multiple opportunities for pervasive computing technology to deliver interventions that can target	• Still very new as a theory • Needs to be tested more widely • Largely only applies to digital change behaviour interventions
Precaution Adoption Process Model (Weinstein, 1988)	This model assumes that when people begin new and complex behaviours aimed at protecting themselves from harm, they move through around seven stages of belief about their personal susceptibility. The stages of PAPM are as follows: Unaware of hazard→ unengaged (optimistic bias)→ undecided about acting (action is not necessary)/decide not to act (precaution would be effective)→ decide to act→ acting→ maintaining.	• Useful for stage-targeted interventions. • Offers a wider perspective on the adoption of preventative behaviours. • Is useful as target behaviours do not exist in isolation.	• Assumes one goes from one stage to the next in a linear manner. • Does not describe specific processes of change. • Stage progression may be due to various intervention techniques. • Other theories can provide more insight on the workings of the PAPM stage progression.
Health Action Process Approach (Schwarzer, 1992)	Suggests two separate processes for changing health-related behaviours: **motivation and volition.** It constructs the **Pre-intentional phase** (perceived risk; outcomes and action self-efficacy). **Intention** (statements of action related to behaviour change). **Volitional Phase** (action planning; initiative; maintenance and recovery). There must first be the intention to change, on the basis of self-beliefs. Secondly, the change must be planned, initiated and maintained. Any relapses must be managed and hence self-regulation is therefore important in this process. HAPA argues that both the two distinct phases of behavioural intention and the actual action need to be studied longitudinally. Certain social-cognitive variables have different roles at each phase.	The model has been used to inform health behaviour change analyses and interventions for a number of conditions and also to assess individuals. This support could involve motivational constructs such as action self-efficiency, positive outcome.	• The theory gives scant attention to non-conscious processes, where people do not know about their own emotional barriers and temptations that guide their behaviour. • Maintenance should include continued action and coping planning.

Theory	Description and Constructs	Benefits	Limitations
Model of Action Phases (Heckhausen and Gollwitzer, 1987)	A person's motives produce more wishes and desires that can be achieved. Therefore, one must choose a goal which is feasible and realistic to achieve from one's wishes. Gollwitzer argued that a general cognitive orientation, with distinct features and procedures, is activated when one deliberates on one's goals. The MAP is a framework for understanding goal achievement based on the distinction between the motivational issue of goal setting (intention formation) and the volitional issue of goal striving (intention realisation). Intention formation is guided by people's beliefs about the feasibility of certain courses of action. While intention realisation is guided by un/conscious processes that promote the initiation and effective pursuit of a goal.	• An emphasis on how intentions are translated into action. • The distinction between intention formation and intention realisation is important as it clarifies the particularity of the concept of 'implementation intentions'.	• Intentions to engage in health-related behaviours may be a prerequisite for behavioural engagement, but intentions are often insufficient.
Diffusion of Innovation Model (Rogers, 1962)	Explains how a new product spreads and gains popularity among a population. Its constructs are: **Relative advantage** (the degree to which the innovation is seen as better than that which it is replacing). **Compatibility** (how consistent is the product with the needs of the people who may need it). **Complexity** (how difficult is it to use?). **Triability** (the extent to which it can be tested before a commitment is made to adopt it). **Observability** (extent to which the innovation provides tangible results).	Has been applied in over 5000 studies, is well-accepted as it provides a useful explanation of the process in which an innovation is received by people, noting the: - **Innovators and risk-takers** (the 2.5%) - **Early Adopters**, opinion-leaders who embrace change opportunities to change and are comfortable with it (the 13.5%) - **Early Majority** (the 34%) who require more evidence before adopting new product and may be swayed by hearing success stories - **Late Majority** (the 34%) are sceptical and will only accept new product when tried by majority - **'Laggards'** (the 10%) who are conservative and resistant to change. Stats, appeals and pressure is required to convince them. The theory has also informed theories such as the United Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003). This looks at **performance expectancy, effort expectancy, social influences** and **facilitating conditions** which inform the **behavioural intention** to use the new technology, this then affects **use behaviour.**	• Rogers himself was aware of the assumptions, biases and weaknesses of his own theory and included these in his book alongside his theory. Rogers was conscious that any intellectual endeavour had to be cognisant of its flaws to progress any field of enquiry. • An 'innovator' is not a personal characteristic. An innovator today may be a 'laggard' tomorrow. It will come down to the relevance of the new product to a particular person. • The 'laggards' demarcation is somewhat arrogant and judgemental. There could be a plethora of reasons as to why a new product is not taken up immediately. Such as previous negative experiences, conflicting results, redundancy of new product etc. • Rogers himself mentioned that the term 'laggard' was somewhat derogatory. He suggested that the real issue may lie with environment, processes and systems in which the person functions. • **A pro-innovation bias**. In that it is assumed that a new product will be beneficial to all. When products should only be adopted insofar as it is useful to an individual. • Individual-blame bias. Individuals are blamed for non-uptake of a new item. There could be external reasons such as poor communication of innovation or lack of need of the innovation. • 'Recall problem'. Where adopters of an innovation cannot recall when they first adopted it or heard of it. This then affects the diffusion data. • Equality. The socio-economic benefits of an innovation may not be equally distributed through a population. Socio-economic gaps may also emerge as a result of this innovation.

The Stages of Change Model indicates that changes in behaviour occur generally with a patient going from being uninterested, unaware or unwilling to make a change (precontemplation) to then considering a change (contemplation), to then deciding and preparing to make the necessary change. Real, honest and determined action is then taken and then over time attempts to maintain the new behaviour occur. Relapses are inevitable and become part of the process towards lifelong change.

With this transtheoretical model of change (TTM), it is assumed that different psychological processes are involved when people move from one stage to the next and hence different intervention strategies are needed at different stages of the change sequence. Adams and White (2004) in their paper argued that stage-based intervention programs are ineffective when applied to physical activities due to: the complexity of the physical activity; the lack of validated staging algorithms and the possibility that the real determinants of activity change are not included in the TTM.

Regarding the first point, Adams and White's contention is that physical activity is not one single behaviour but includes a range of complex category of different specific actions such as transport behaviours, work-related physical activities and leisure activities.

Adams and White therefore note that people have different efficacy beliefs about an action such as cycling to work than for a gym work-out for instance. Hence, when it comes to 'physical activity', people will be at different stages of change for such activity. Due to the multifaceted nature of physical activity there will also be misconceptions about one's own adherence as although people think they follow recommendations for diet, activity and fruit and vegetable intake their behaviour is often falling far short of the recommendations for both activity level and diet.

Staging algorithms are based on self-reporting and deemed as being in the maintenance stage when such individuals are not and in fact demonstrate no motivation for change. Lechner et al (1998) therefore emphasise the importance to distinguish between aware and unaware pre-contemplators. Aware pre-contemplators being those who know they are too inactive and do not intent to change. While unaware pre-contemplators are those who do not know that they are too inactive and therefore feel no need to change. Brug et al here highlight that although TTM is the most well-known and applied stages of change construct, other stages of change models could be more appropriate as they consider optimism in self-assessed physical activity levels, such as Weinstein et al.'s (1998) Precaution Adoption Process phase models (PAPM).

TTM also argues that processes of change, decisional balance and self-efficacy are the most important stage transition determinants. Modifiable stage-change transition determinants can inform interventions that are stage-matched. However, outside of TTM's determinants, behaviour change research reveals other stage-transition determinants such as those offered by those models which emphasise behaviour feedback to facilitate more intent to change along with an increased awareness of one's personal behaviour.

PAPM for instance put forward stages of change from which predictions can be derived. Health promoting action can be based on individual's own intentions when specific action plans to these ends are developed, this is noted in implementation intention research (Gollwitzer, 1999). People can be motivated into action if there are ample opportunities for healthy behaviours which can enhance the motivation to change without a reliance on mere educational interventions as social marketing and ecological models of health behaviour change suggest (Baranowski et al., 2003).

The contention of Adams and White therefore is that stage-targeted interventions are more likely to inspire short-term behaviour change and other mediators of change such as changes in motivation and others. Hence, short-term interventions, which are often restricted to educational strategies, are unlikely to result in long-term effects. Based on this, long-term unhealthy habits will require a combined approach of legislation, education and facilitation all under the rubric of a comprehensive intervention which has the longevity to make a meaningful impact on physical health (Baranowskil et al., 2003). Brug et al (2005) note that the objections of Adams and White however can be flipped on themselves in that their criticisms may also be opportunities for supporting stage-based targeted interventions. So while Brug et al concede that stages of change in activity promotion are problematic there are however promising results from stage-based interventions.

Based on the above, Pinder et al. (2016) put forward the Human Alteration Model (HAM) noting that goals drive behavioural repetition to support habit formation. With a three-step phased approach of filter, prepare (impulses and intentions) and act (a single response which may have an outcome, with interventions such as self-monitoring to form alternative intentions to act).

Schwarzer et al. (2011) have highlighted that research into how to intentionally change behaviour has posited the dual processes of motivation and volition. The motivational process entails developing the intentions to change, which is frequently connected to self-beliefs. The volitional process involves planning, initiating, and maintaining change. While the motivational process relates to self-beliefs, the volitional process relates more to self-regulation (Schwarzer et al., 2011). Health behaviour change programmes emphasise responsibility, agency and 'volition', coupled with an environment wherein people have the opportunity to improve their health, think differently and make changes to how they behaviour.

In terms of the influence of the social environment many researchers have therefore discussed how social influence offers effective motivational traits for behaviour implementation, and that these motivational features can lead to behaviour change through text message-based intervention systems. Literature on social influence reinforces this effect for behaviour change. For example, Ashida et al. (2012) suggest that interventions using social influence have been shown to increase physical activity, recreational reading, and healthy eating behaviour. Prestwich et al. (2014) used social influence in partner-based interventions to reduce fat intake based on self-report measures of dietary fat intake, psychosocial mediators, weight, and waist size.

Albert Bandura has demonstrated that modelling has a profound impact on development of behaviours and serves as a type of observational learning. It represents the acquisition or enactment of behaviours by seeing other people performing these behaviours (Bandura, 1977, 1997). Baumeister & Finkel (2010: 392) have discussed how humans "follow the lead of others" and "use the beliefs, attitudes, and actions of others, particularly similar others, as a standard of comparison against which to evaluate the correctness of their own beliefs, attitudes, and actions".

The theorist of cognitive dissonance, Leon Festinger, in 1954 devised social comparison theory, a branch of social validation theory, posits that when objective cues are unavailable, individuals evaluate their opinions and beliefs by comparing themselves to others, and social comparison is most likely to be directed at similar others. Similarly, social facilitation theory suggests that people increase their performance in the presence of others. Both social comparison and social facilitation theories have been explored in research into eating disorders (Herman et al., 2019).

Ajzen and Schmidt (2020) have looked at the theory of planned behaviour (TPB) and its use as a framework for behaviour change interventions. TPB suggests that human behaviour is guided by three notions: beliefs about the likely consequences of one's behaviour; beliefs about what other relevant individuals think one should do and beliefs about one's ability to carry out the behaviour. These beliefs will then inform intentions to do the behaviour. When there are changes in the beliefs behind intentions effective interventions will then be developed. TPB is regarded as a useful approach to understand behaviour and to help design effective behaviour change interventions.

There are many behaviour change interventions and techniques, designed to 'nudge' people to take on protective behaviours via education; policy change; incentives particular behaviours; facilitate the usage of new simple items or technologies; enabling environments wherein people can make healthier choices etc.

Behavioural Change Techniques and Digital Technologies

Behaviour change theory of late has undergone a detailed taxonomy wherein behavioural change techniques (BCTs) have been somewhat scrutinised further. Michie et al. (2013) analysed behavioural change techniques (BCTs) across studies utilising meta-regression techniques and the Delphi method. Nevertheless, Hall et al (2015) have mentioned that many review authors have called for more research on the use of BCTs for text message-based interventions. Likewise, Moller et al (2017: 94) in their review of BCTs in the context of a digital health revolution, buttressed Michie et al.'s taxonomical approach,

> ...in order to maximize opportunities, researchers should explicitly identify and systematically apply evidence based BCTs in their interventions.

From the 2013 taxonomy offered by Michie et al., there has been a rapid progression in the research on the digital function of BCTs for health-related behaviour, even though the field is still within its formative phase.

> Barnes (2015) has noted that exorbitant amounts of money are spend on behaviour change programs while there is little assessment of the impact of these initiatives and are also poorly evaluated. Moreover, such interventions often ignore the structural factors underlying poor health and are merely based on maximising markets for their products or to enforce infrastructure development under the banner of 'promoting behaviour change'.
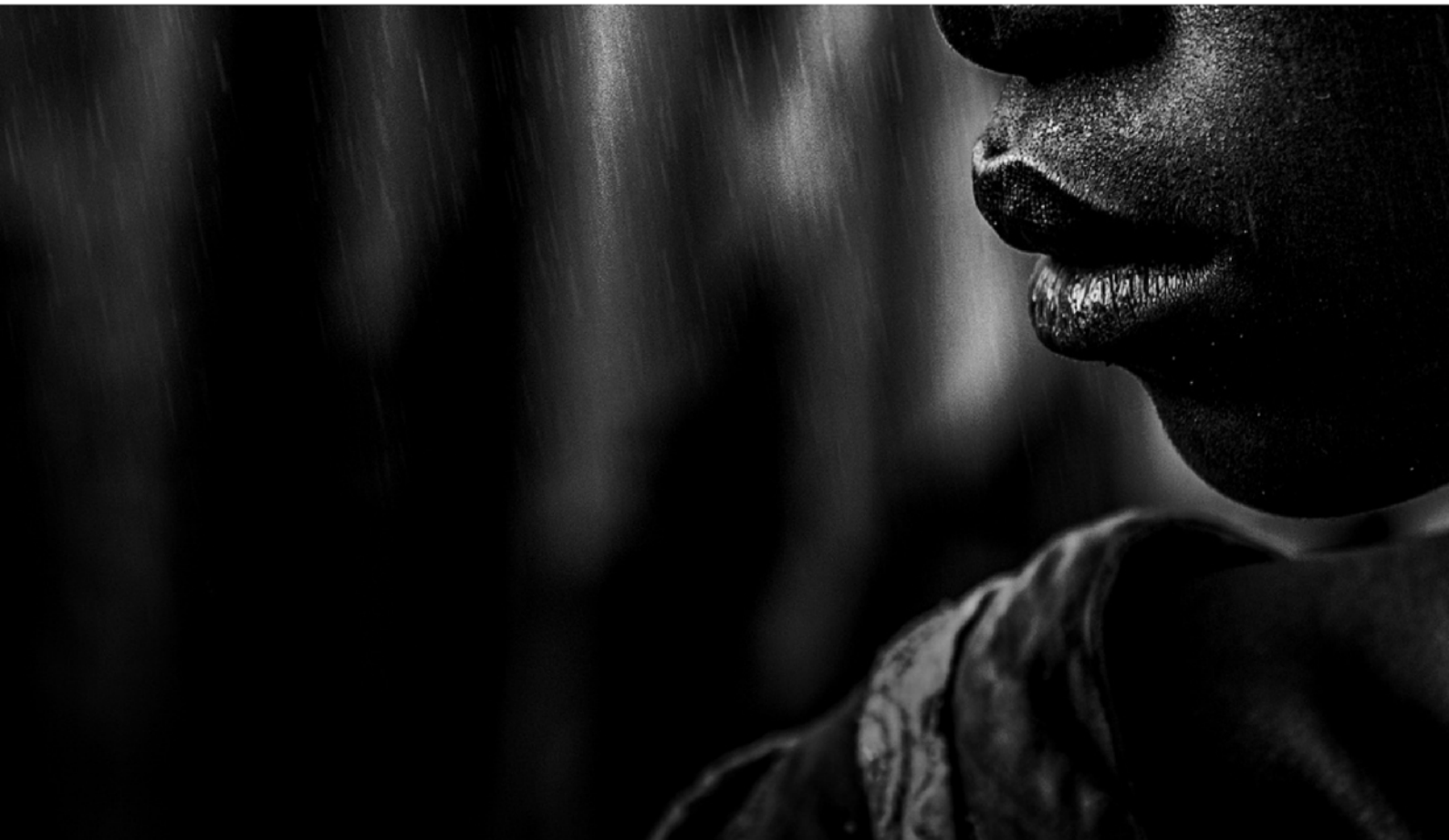
The Habit Discontinuity Effect and the Problem with Behaviour Change at the Policy Level – London's Low Traffic Neighbourhoods

The important role that habit plays in our lives and behaviours is very important and no more has this been seen than in London of late. In London over the last 2 years there have been several health behaviour change initiatives such as the low-traffic neighbourhoods (LTNs) which were designed with the express intent to lower carbon emissions, reduce car usage, encourage walking, promote cycling and make safer streets for school children.

Many of these behavioural changes were forced through via policy changes encouraged by central government, with the Department of Transport aspiring for the UK to become a 'world leader of accessible and inclusive travel'. Due to this the Department argues that LTNs and similar projects will 'help embed altered behaviours and demonstrate the positive effects of active travel' – however the 'embedding of altered behaviours' can fail if this is not conducted in tandem with the locale in a co-produced and co-designed format. This is where behaviour change, when looked at and coordinated at the policy level, can become problematic especially when it evokes encouraging or discouraging certain actions and there is little co-design or co-production in the process.

Technocratic and interventionist approaches to enforce behavioural change via infrastructure development is problematic and even though there are lofty intents about 'promoting inequality' this is ironically expressed while seemingly not involving those directly impacted by specific infrastructure changes in equitable ways.

Moreover, it speaks to a wider issue related to belonging, community and change as communities feel that there is inadequate involvement in decision-making and local affairs – which should in fact be a core aim of councils and local authorities. The approach however has been, often, to make behaviour change, as in the case of London's LTNs, without consultation and then subsequently retort that those impacted by the changes will "get used to the change" and make the necessary behavioural amendments as mere passive recipients devoid of their own social agency.

Using Digital and Tech Innovations to Impact Behaviour Change

Brown et al. (2020) have looked at reminders, not in text-messaging but via email, for web-delivered acceptance and commitment therapy interventions to enhance subjective well-being and encourage engagement with lifestyle behaviour change habits among health care staff. They found that there were high dropout rates in mobile health interventions although they can provide links to additional crisis support. Stawartz (2015) therefore posits that implementation intention are a good strategy for habit formation apps. Having a goal, thinking about how it will be implemented practically and specifically, and then schedule the plan. Implementation intentions help to visual the contexts and imagining how the goal will realistically completed and has been shown to be useful for new behaviours in emotional control, relationships, employment goals, health behaviours, physical exercise and fitness.

Carden and Wood (2018: 118) highlight that people with high in self-control strongly inclined to healthy activities for sleep, diet and exercise and poorly inclined to unhealthy activities such as eating junk food. Positive habits can therefore play a role in protecting people from conflicting desires. In this way, high-trait self-control may reflect a situational strategy wherein environmental cues are arranged to promote beneficial habit formation. People with high control appear to actively avoid situations offering temptations and distractions.

Behaviour change interventions have been harnessed in order to inform and restructure lifestyle behaviours around health, physical and mental, with some involving planning and reminders. Implementation intentions for instance, help people to remember to act on intentions to change behaviour. Past reviews of implementation intentions revealed their effectiveness, a more recent study of over 44 diet studies demonstrated just small behaviour change during the interventions and negligible long-term impact (Adriaanse et al., 2011).

In regard to text-message reminders as an intervention to impact habits, Hardy et al. (2011) formulated an approach in which participants were sent medication reminders that could include new, weather and sport etc. Researchers reported that to their knowledge, this was the first randomised controlled trial of a mobile phone reminder system. It demonstrated far better short-term improvement in medication compliance in comparison to simple standard beeper reminder system. Reminders and symbolic rewards, such as stars, points and trophies, are a common feature of online interventions and smartphone apps.

Yet Stawarz et al. (2015) highlight that reminders may only have a short-term effect and have no bearing on long-term change, as reminders can merely serve to cause a person to deliberate about repeating a behaviour and this deliberation prevents habit formation (Carden and Wood, 2018: 119). Online applications, particularly smartphone apps, may cause 'app dependency' instead of continued repetition of a behaviour following app use (Renfree et al., 2016). Few of the existing apps focus on repetition of a behaviour in a particular context and context-aware technology has only recently been explored. Carden and Wood (2018: 119) posit the possibilities of context-aware digital applications that can remind users to perform particular behaviours in specific environments. Thus, behaviour change apps can facilitate habit formation by connecting specific environmental cues with desired responses.

Moreover, when environments change the cues activating habits can also change, this leads to disruption of habit performance. Without familiar habit cues, people are forced to make new decisions about how to behave. The habit discontinuity effect refers to how behaviour change interventions are more effective when changes happen in life which disrupt usual habit cues. Examples are moving house, changing jobs, readjusting due to sickness, having children, coping with the loss of a loved one etc. The absence of old cues provides a window of opportunity to make decisions and implement new goals. This has been particularly seen over the last 18 months with the COVID-19 pandemic and discussion of the 'new normal'. Due to significant external environmental factors during the pandemic there have been changes in transport (encouraging walking and cycling), employment (increased home-working), health (digital shifts, social distancing, exercise, respiratory health and diet). Travel mode choice and habit discontinuity for instance was explored by Verplanken et al. (2008) and how context change can activate processes sustainable behaviours.

Although habits can be disrupted by changes in macro-environments or during life transitions, habit performance can also be altered via choice architecture or environmental engineering interventions which change the structure of everyday decisions (Carden and Wood, 2018: 119-20). Hence, it was perhaps no surprise that during the pandemic a number of behaviours which had been the realm of theory and 'future goals' beforehand became realities as the opportunities for behaviour change were now present.

It is important to initially recognise factors which influence one's ability to engage in health behaviours when thinking about health behaviour change initiatives. Sabharwal et al. (2020: 38) posit that individual influences on engagement in health behaviours can include a person's cognitive abilities (nonmodifiable) and one's own knowledge or beliefs about their condition (modifiable). The nonmodifiable being for instance the influences of one's family and personal support network on engagement in health behaviours. While the modifiable refers to the involvement of family members around one's disease management. Tech-based approaches to behaviour change may have promise for some modifiable influences. Digital tech tools which share the data with one's social and peer network and provide encouraging feedback can target modifiable individual and interpersonal influences such as motivation, confidence and social support.

Sabharwal et al. (2020: 40) adapted the following table from Michie et al. (2013) to demonstrate how the core behaviour change theories (SDT, SCT, BHM, TPB and TTM) can be applied to technologies that can be modifiable through digital behavioural health interventions:

Behaviour change technique	Tech examples	SDT	SCT	HBM	TPB	TTM
Reward and threat (includes providing incentives, identification of future negative outcomes, identification of positive outcomes and identification of discrepancies between current behaviours and goals)	• Notifications when in "danger zones" (aka just-in-time interventions)			✓		✓
Feedback and monitoring (includes observing or recording behaviours; feedback on behaviour and outcomes of behaviour; self-monitoring of behaviour and behavioural outcomes and receiving biofeedback)	• App and text message reminders • Sensor-based tracking • App-based diaries			✓		✓
Scheduled consequences (includes rewarding completion of a task; rewarding alternative behaviour and removing punishment)	• Gamification/points for engaging in health behaviours			✓		✓
Goals and planning (includes setting target goals; action planning and problem solving)	• Goal trackers	✓	✓		✓	
Social support (includes encouraging target behaviours; receiving practical help from friends, relatives or staff and receiving emotional support)	• Social networking via online forums or apps	✓			✓	
Comparison of behaviour (includes providing examples of the performance of behaviour; allowing comparison between individual performance and the example and providing information about what others think about the behaviour)	• Sharing health behaviour tracking with friends via apps		✓		✓	
Self-belief (includes providing evidence that the person is capable of performing the behaviour; practicing imaging performance of the behaviour; focusing on past success and promoting positive self-talk)	• Summaries of health behaviour with encouraging messages via tracking apps	✓	✓		✓	
Shaping knowledge (includes providing advice or agreement on how to perform a behaviour; information about situations or events that lead to the behaviour and providing alternative explanations for behaviour)	• App-based accessible information and tips		✓			
Regulation (includes advising on ways to reduce negative emotions; minimising demands on mental resources and managing stress)	• Text message-based stress management strategies • Guided meditation apps	✓	✓		✓	

Carden and Wood (2018: 120) in their paper "Habit Formation and Change" also note that smartphone technologies offer revolutionary ways to study daily habits and the context-cues that trigger everyday habits. They refer to a smoking cessation study (by Kirchner et al, 2013) that combined ecological momentary assessments of reported cravings with geo-location mapping via smartphones of exposure to point-of-sale tobacco cues. Relapse rates increased with greater exposure to smoking cues, even when participants were not experiencing cravings.

Ramos and Chavira (2019) in their analysis of behavioural intervention technologies (BIT) among minority communities offer that many of the studies highlighted the following cultural adaptations which were made for app-based BIT. In some examples no cultural adaptations were made at all (Hertzverg et al., 2013; Ben Zeev et al., 2014; Dennis and O'Toole, 2014; Hantsoo et al., 2018; Stoll et al., 2017). Heilemann et al. (2017) made use of Latinx actors, and focus group and interview feedback on relatability and appropriacy of stories for psychological education. Muroff et al. (2017) for the app-based CBT had some material translated into Spanish for Latino communities.

For online web-based BIT, Ramos and Chavira revealed that in some cases no cultural adaptations were made (Baggett et al., 2017; Cheng et al., 2019; Kelman et al., 2018). In some cases, CBT material was translated into Spanish, vocabulary was adapted, culturally relevant examples were utilised, social support system incorporated into intervention and religious components addressed where appropriate. This was adopted by Muñoz et al., 2014; Barrera et al., 2015 in their randomised controlled trial on online prevention of postpartum depression for Spanish and English-speaking pregnant women; Muñoz et al., 2016). Choi et al. (2012) noted that an online CBT intervention in Australia with a Chinese community (the 'Brighten Your Mood' program) translated material into Chinese, as also done by Liu et al (2014), and included illustrations of people of Chinese and Far East Asian features. Concepts were also modified in tandem with Chinese culture and there was an emphasis on challenging cultural myths about depression. Skills were also reframed as per collectivistic values. Wang et al. (2013) looked at an online web-based CBT initiative for a Chinese community and all material was translated into Chinese and new audio material was developed in Chinese. Stewart et al. (2017) utilised bilingual therapists.

Likewise, Ince et al. (2013), in a randomised controlled trial, looked at an online intervention to address depressive symptoms and anxiety among a Turkish community in the Netherlands. The intervention was translated into Turkish, cultural idioms to describe disorders were utilised, culturally recognised examples referred to and there was explicit discussion of migration experience and culture. While Campbell et al. (2015), in their study of a Native American community CRA behavioural intervention mentioned that although no culturally-specific approaches were used they did explore user's perceptions of the intervention to inform cultural adaptation of BIT in future.

Both the app-based and web-based BIT interventions therefore, although they may have obtained positive overall results, largely did not harness cultural nuances as much as they could. Including cultural aspects does not necessarily mean that an intervention will automatically be successful. So for instance in the following examples, which were carried out among participants who were largely, or significantly (25-45%) from racial and minority ethnic groups:

• Baggett et al. (2017) – high risk and low-risk families equally engaged in treatment and reported satisfaction. There was also a significant increase in positive parenting and a decrease in negative parenting, with gains more pronounced among high-risk families.

• Ben Zeev et al. (2014) – found high use of the app, and significant reductions in psychotic and depressive symptoms.

• Cheng et al. (2019) – significant reduction in insomnia symptoms and significant reductions in depressive symptoms in active condition.

• Dennis and O'Toole (2014) – found a reduction in anxiety among users of their app.

• Hantsoo et al., 2018 – app users self-perception of care behaviour increased, there was increased contact made with mental health services and there were reductions in psychotic and depressive symptoms. The app was the Nancy app

• Hertzverg et al. (2013) – 82% of users reported quitting smoking.

• Kelman et al., 2018 – increases in self-reassurance, reductions in self-criticism as well as decreases in anxiety and depressive symptoms.

• Stoll et al., 2017 – high overall usage of the app.

However, it will be an additional added value if cultural appropriacy is taken into consideration as for instance 'mindfulness' for people from many communities is not necessarily instilled by yoga and meditation. Martinez (2021) therefore has noted that the design of digital mental health in some instances may have to adapt tools for people of different languages, ages, cultures etc. This is relevant as Insel (2019) argues that the 'digital divide' is more along the lines of age than it is across socio-economic, racial or international factors.

Three of the examples noted above had a strong focus on Chinese cultural markers and idioms, possibly due to the lack of any interventions for Chinese communities in English-speaking countries generally and also due to the language gap and the need for material in Chinese. It is also worth pointing out that in Ramos and Chavira's analysis they looked at BIT across the globe and there was little they did not refer to any examples within Europe except for the Turkish community in the Netherlands. This itself is quite surprising considering the communities present within Europe. It is even more concerning given that in the UK experience, in which people from a black background are over-represented when it comes to being detained under the Mental Health Act, may also have a similar cultural gap when it comes to behavioural interventions, let alone those interventions which are either app-based or web-based.

Digital Technologies in Mental Health Interventions

It has been highlighted in the literature that there is a stigma of walking into mental health services, and this is a barrier to gaining treatment (Hinshaw and Stier, 2008; Jung et al. 2017). Additionally, there are high costs associated with psychological treatments which many people cannot afford (Green et al., 2012; Kremer & Gesten, 2003). Consequently, stigma, logistical barriers, and cost are significant patient-level barriers to receiving timely treatment.

Online Health Information Seeking (OHIS) has become pervasive as we speak in 2021 and after the COVID-19 pandemic, in tandem with a growing number of people using the internet and going online in order access medical information. A user has before them an array of information 24 hours per day, 7 days a week regarding guidance and links to additional support. Also to access platforms to check diagnoses, treatment options, appointments etc. Furthermore, health institutions usually face a triple aim challenge: (a) improving the individual experience of care; (b) improving the health of populations; (c) reducing the per capita costs of care for population (Berwick et al., 2008). Other reasons for online health-seeking include a lack of information about a specific condition, negative experiences with face-to-face interactions, and the desire to be an empowered health care consumer merely engaging in a liberating arena of health knowledge exchange.

Reflective of the current health market, which has been theorised for nearly two decades and then accelerated due to the COVID-19 pandemic, new technologies are developing at rapid pace. This is especially the case when it comes to mental health and how the increased attention it has received in the public sphere with many famous people brining the issue to light. The convergence of the reorganization of health services, time constraints, changing patient behavioural patterns, rising costs and the epidemiological profile change has caught the ears of healthcare solution providers on one hand, and tech developers on the other, to broaden access and reduce costs (Lee and Han, 2015). In light of this, service innovations have been thriving which has facilitated both quality improvement and breakthroughs in greater efficiency and cost reduction (Thakur et al., 2012).

The ubiquity of the Internet as an information source for healthcare is a phenomenon that directly influences health services, due to easy access, patient empowerment, direct and fast information, relationships between patients and health professionals, making the role of health service users more relevant (Lee et al., 2015).

Chopik (2016) noted that social technology use was associated with higher subjective wellbeing, less depressive symptoms in order adults, fewer chronic illnesses, better self-rated health. Stawartz et al. (2015) suggested in their research that real-time engagement is preferred by users in apps for mental health, reminders and notifications to engage, links to additional crisis support. Stawartz et al. also found that users appreciated user discretion, accessibility and portability. Goodwin et al (2016) suggested that user-set notifications act as reminders for activities. Hence, designing precise and time-limited value-based goals along with reminder notifications that appear on the same device on which many of the training activities take place is useful.

Titov et al. (2020) in their study on digital mental health services (DMHS) in Australia note that the benefits of such services outweigh the challenges. They note that DMHS should include assessment and information services, robust systems for training therapists and specialist skills to operate the services. They mention that future mental health policies can be formulated from data from such services.

AI diagnostic tools on apps and platforms are inexpensive, are touted as removing the stigma associated with mental health, improve predictability as they monitors signs common in deterioration and provide 24hr support. Also gives advice on diet, supplements, lifestyle and medication. ML algorithms can include research-based objective tests which make the need to seek treatment and evidence-based data and medical based practices. Here is a list of some prominent online platforms in this space:

• Silvercloud Health – the leading mental health platform on DTx (digital therapeutics).

• Laddr – a mobile platform which uses behaviour change principles for various health and life issues based on an individual's goals. If offers science-based health behaviour change tools to target behavioural challenges such as anxiety depression, drug use, binge eating, alcoholism, smoking etc.

• Sentio Solutions – a San Francisco-based company that develops DTx (digital therapeutics) and biomarkers for diagnosing, managing and caring for mental health. Their Feel and Relief program is a human-centred, data-driven digital mental health platform that leverages continuous monitoring, telehealth, person-focused interventions and objective data for tailored support. Its end-to-end program for depression and anxiety begins with sensors → emotion recognition algorithms (joy, stress, anger etc.) → real time interventions → through to a qualified therapist → then onto an educational programme. They boast high usage of their application.

• Magellan Healthcare – developed a Virtual Care Solution platform, which aims to identify individuals with commonly identifiable behavioural health conditions sooner, and then help to guide them to appropriate solutions depending on what they are experiencing. The core suite of the platform includes digital cognitive behavioural therapy (DCBT) program; a resource library and additional/optional features of clinical call centre and online chat with a clinician and alerts in cases of high-risk conditions which can be followed up by a case manager or clinician and offer additional support such as face-to-face therapy.

• Clarigent Health – who have plans to disseminate to schools, hospitals, primary care and out-patient BH.

• Cigna

• Cincy Tech

Benefits of Mobile Apps for Mental Health

Due to the omnipresence of smartphone access, mobile technologies and applications are exponentially affecting the user experience with health services, deriving a subfield called as 'mobile health', or simply mHealth (Sweileh et al., 2017). Mobile applications are a popular repository of behavioural and health interventions since they are personal, smart and connected (Fiordelli et al., 2013). They are also fast, comprehensive, handy and easy accessible to all in a liberating and empowering expression of actually 'taking one's health into your own hands'.

Zucchelli et al (2021) in recent research looked at how mobile health (mHealth) apps can offer a viable method for delivering psychological interventions for people who have atypical appearances (i.e. visible difference) and struggle with appearance-related distress. They found that there were concerns about using mobile health (mHealth) in regards to user safeguarding and adherence to programmes. However, the participants in their study expressed design preferences toward relatable human content, interactive and actionable features, flexibility of use, accessibility and engaging content.

Armontrout et al. (2018) discuss an app in the US designed to help with the recovery from an alcohol use disorder. even though the app demonstrated positive clinical outcomes, when it was used in actual clinics, only 3 of 14 clinics continued to use it after 2 years, citing challenges of integrating it into their own unique systems. Bauer et al. (2020) note that a major challenge to smartphone apps for mental health is how their effectiveness can be tested in a cost-effective manner along with questions over whether clinical trials are always necessary. Bauer et al. (2020) mention that most app developers will never be able to afford the costs of a thorough but simple clinical trial in order to establish efficacy.

In the UK however, one app did manager to establish efficacy after a thorough 18-month trial was conducted. The app, based on CBT, was designed to assist people with insomnia, sleep apnoea and other sleep problems and was trialled in the Thames Valley area of England, comprising Buckinghamshire, Berkshire and Oxfordshire (Stott et al., 2021). The app, Sleepio, comprises 6 sessions each of 25 minutes. Initial research into Sleepio was the world's first placebo-controlled trial for a digital therapeutic and was shown to be more effective than the placebo.

After six weeks, 76% of users achieved healthy sleep patterns (Stott et al, 2021). The app was a collaborative partnership between Innovate UK, Big Health, Oxford Academic Health Science Network (AHSN) and NHS England that from October 2018 was first trialled in the Thames Valley area within 9 GP practices and was subject to an Office of Health Economic evaluation at the end of 2019. Within the first 18 months, 15,000 people accessed the programme.

The app was the first NHS rollout of direct-access digital intervention which aims to reduce an over-reliance on medication such as hypnotics by helping people to discover their ideal personal sleep patterns and overcome the barriers to sleep such as the 'racing mind'. Therefore, for such applications to have any discernible impact Mohr, Lyon, et al. (2017) emphasise that health care stakeholders must be involved in the initial rollout alongside externally valid research. While Williams et al. (2019) noted that commissioning processes need to facilitate digital health solutions and that tech developers and innovators to be aware of barriers to engagement and market access. In the mobile app space there are some initiatives worth noting at this juncture:

• Shout - founded by Dr Fiona Pienaar, which from May 2018 to April 2019 had 70,000 conversations with 35,000 texters. It also has 1000 crisis volunteers "on call", 26 clinical supervisors and 5 coaches. The age demographics of their users are from 13 and under; 14-17; 18-25 and 26-34. Shout had 1800 active rescues wherein the police were called. The Metropolitan Police in London recognised the work they were doing and set up a dedicated number for Shout to call into, as by the time the Met Police are called there has already been a clinical process and a decision has been made to call a case in. Shout during its pilot phase found that the top presenting issues tagged by their volunteers were: suicidal ideation (40%); depression (37%); anxiety and stress (29%); relationships (29%); loneliness and isolation (20%) and self-harm (20%).

• Orygen Digital – Orygen is an Australian youth mental health organisation who recently launched a digital platform referred to as Moderated Online Social Therapy (MOST). The platform was designed specifically for youth mental health and was supported with grants from the Victorian government in Australia and also the Telstra Foundation. The suite of tools provided by MOST includes: personal therapy programs (targeted to each young person's individual needs by automated processes and specialist clinicians), targeted coping support (a diverse digital toolkit of coping supports for young people), tailored human support (peer works, clinicians and vocational specialists), social connection (a safe virtual network of young people with shared experiences) and real-time mental health tracking (including progress towards goals and monitoring of risk).

• Nod – developed by both Hopelab and Gritt Digital Health to tackle loneliness and depression among college students in the US and bolster social connection. Researchers at Hopelab and the University of Oregon carried out a pilot randomised controlled trial to understand how using Nod impact students' loneliness and wellbeing. They enlisted 221 participants entering their first year at college. Among students in the control group there was a positive relationship between earlier depression and later loneliness. Students who started the year reporting higher symptoms of depression tended to report higher levels of loneliness. The students who were assigned to receive Nod showed no significant relationship between earlier depression and later loneliness, and also had better sleep quality.

• Brain-in-Hand – covers many different areas and works by setting a diary of all activities which you have and then breaks them down into dividual steps and then breaks down again into the challenges one has with those steps. The app is good for people already with a mental health support strategy. It also operates with a traffic light system and therefore allows for people to feedback how they are doing and will feedback green if they are doing well, amber if they are struggling a bit and showing signs of anxiety, and then red wherein it will refer the user to a specialist.

• Daylio – a mood tracker which tracks your mood on a daily basis and allows for you to indicate your feelings with icons. Daylio has a simple user interface and has a detailed outputs which looks at activities which are associated with particular moods, allows for keeping track of mood, a monthly mood chart etc.

• Woebot – founded by Dr Alison Darcy (lecturer in Psychiatry and Behavioural Sciences at Stanford Law School) it is a chatbot therapist which asks how your mood is and keeps track of your mood. It also provides CEBT, psychological coaching, improving therapy adherence, coping with medication, handling medical settings, caregiver burnout support etc.

• PTSD Coach – has been downloaded over 400,000 times in nearly 1000 countries, the app provides information about PTSD and also helps users to track their symptoms. It then supplies referrals for crisis support and offers CBT-based coping tools at difficult times. It also notifies the National Suicide Hotline and quickly refers people to emergency care if necessary.

• Mymoai – designed by Mryth, it provides a platform for an individual's support network to interact, communicate and talk.

• Headspace – a mindfulness app which has been studied by Economides et al. (2018) who found that there was a 14-28% reduction in stress after 10 days of usage. An earlier studied asserted that the app improved focus by 27%.

• Calm – a mindfulness app which was also studied by Huberty et al. (2019) who found that college students who used the app regularly had reduced stress and increased mindfulness. A study by Clark and Draper (2020) revealed that the app increased wellbeing among university students. Both studies demonstrated the efficacy of the app to improve mindfulness.

• Pixel – using coloured pixels to indicate how you are feeling on a particular day.

• Black Dog Institute

• Chill Panda

• Meetwo

• DistrACT

In contrast to the lengthy waiting times associated with conventional in-person care, smartphone-based treatments are rapid in real-time and thus may provide treatment at the onset of symptoms, crises or episodes. Interventions and treatments offered via smartphone are often designed in ways that can incorporated into one's daily routine and hence work around an individual's schedule without causing too much disruption. Extra arrangements which may be usually made to participate in these interventions, such as work, travel and childcare, are easily rectified and worked around with a smartphone-based intervention.

Some mobile apps for mental health based on empirical principles have shown impressive early outcomes. Interventions conducted either online or via mobile apps may address the barriers to accessing mental health care which many people experience. For instance, access to mental health support is addressed due to the ubiquitous nature of smartphones, along with the scalability of smartphone-based interventions. Yet the space is still an emerging field and more research is needed.

Conclusion

People who hold positive expectations respond to difficultly in more adaptive ways than those who are largely pessimistic. Although there is still much work to do to assess how proactive routes to wellbeing can be facilitated via digital technologies, it is important to be optimistic about developments in this field which are progressing at a rapid rate.

From a digital health perspective research has recently demonstrated that there has been significant scope for personalised interventions which can be both scalable and cost-effective. There may therefore be recourse for designing apps which have a positive psychology approach and promote optimism, gratitude etc. Apps which focus on problem-solving and coping skills which target behaviours associated with downward spirals.

Mindfulness-based interventions promote making those cognitive changes in how one interacts with situations, self-regulations, acceptance of experiences, and relaxation. This is as opposed to immediate gratification, emotional reactivity and automatic arousal. To what extent such mindfulness interventions can be adapted for the online and mobile app space is still being researched as has been noted earlier, however there is massive scope in harnessing digital technologies to facilitate proactive strategies and mindfulness.

Proactive coping can be harnesses to build and develop personal and social resources, promote preparatory activities, monitor complex stressors, promote efforts to manage the problem and limit the impact on oneself. Such an approach has considerable benefits on both physical and mental health and wellbeing. As Aspinwall opined (2011: 359) this is particular the case for disadvantaged people and communities, and hence the significance of promoting proactive coping methods among people who can benefit the most from them. Resilience is also required however and is characterised by effective coping in the face of loss, hardship and adversity in one's life, and being able to navigate through the challenge in order to remain emotionally healthy. Superior coping skills therefore could explain why happier people are healthier, the inability to cope leads one down the road to stress, depression and negative states.

Enhanced emotional wellness can contribute to increased coping strategies, which in turn are important for self-confidence, reduced anxiety and personal growth. Emotional wellness may also include contentment, enjoyment, self-sufficiency and self-assurance in life. Research has also demonstrated the significance of have behaviour is influenced by social factors such as reciprocity, consistency, and social validation have a pronounced influence on behaviours. The literature also indicates that there is more research needed in regard to whether social influence can be harnessed to increase intentional behaviours in digital technologies.

Recommendations

- Specific interventions designed to promote proactive management of health threats.

- Mindfulness-based CBT approaches for emotion regulation and coping. Mindfulness-based interventions may reduce emotion regulation problems which precede and follow social and interpersonal conflicts and stressors that trigger chronic stress.

- Mindfulness can also reduce and inhibit maladaptive coping methods such as emotional reactivity, avoidance and aggression.

- Coping-skills based health coaching. Controlling and avoiding unpleasant internal experiences is an adaptive short-term strategy for coping with stress. However, coping and positive emotion may play a stronger role in recovery and allows an individual who positively reframes a stressful situation to one wherein some scope for navigation is possible.

- Social and emotional learning initiatives that have a strong focus on coping skills and resilience.

- Physical and arts activities not only help people gain life skills which then help them cope with setbacks more.

- Interventions that disrupt maladaptive cascades are vital, this is all the more relevant when many youth merely 'self-medicate'.

- Although behavioural intervention technologies can be used even with some of the most underserved families and disadvantaged communities, this demographic is still somewhat affected by a digital divide and access to technologies. The COVID-19 has accelerated the ability of most in society to not 'lag behind' in this regard, however there are still some gaps in regards to the accessibility of digital technologies.

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