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### *Interventions to increase physical activity in disadvantaged communities: A review of behavioural mechanisms*

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# Interventions to Increase Physical Activity in Disadvantaged Communities: A Review of Behavioural Mechanisms

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## Abstract

Physical inactivity is now a significant driver of health and social inequalities among socioeconomically disadvantaged communities and poses a major challenge to policymakers, worldwide. Although a vast amount of research has focused on designing and evaluating interventions to increase physical activity, there remains little consensus on which interventions are likely to work. In this narrative review, we build on previous reviews by not only examining what interventions tend to work but by trying to understand why certain interventions tend to work, while others do not, through the lens of behavioural science. We present a behavioural framework through which the existing body of physical activity research could be viewed, in order to identify potentially effective mechanisms that would be likely to work in their intended domain. Our analysis finds that while there is evidence that the physical and educational environment matter for increasing levels of physical activity, interventions are more likely to be successful where they involve a social component. We conclude that a behaviourally informed physical activity intervention would thus employ a set of focused educational and socially-mediated behavioural mechanisms, within an appropriate physical environment.

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## Non-technical Summary

Physical inactivity has become one of the policy problems of our time and is more prevalent in disadvantaged communities. A large volume of research is devoted to the design and evaluation of interventions designed to increase physical activity within such communities. This review of the relevant international literature summarises some of the lessons that can be derived from it.

Given the large, indeed vast, volume of relevant research and the existence of several recent literature reviews, it is reasonable to ask: why do we need another one? The answer to this question is provided by the alternative approach taken in the present paper, which views the existing research through the lens of behavioural science.

Our aim is to summarise the lessons contained in previous studies by asking not only *what* interventions tend to work, but trying to gain insight into *why* some kinds of interventions tend to work while others do not. This is important, because by identifying and understanding the behavioural mechanisms behind changes in physical activity, we can make better inferences about whether an intervention that proved effective in one context is likely to work in other contexts too. That is, because the behavioural approach aims to understand the causes of behaviour, it has the potential to identify those interventions, or types of interventions, that are most likely to generalise from one place, time and community to another. Insights into which interventions scale and spread effectively are essential to building a solid evidence base for public health policy.

We first summarise two established behavioural frameworks, COM-B and EAST. The former highlights how behaviour change typically requires the individual to have the capability (C), opportunity (O) and motivation (M) to change behaviour (B). By contrast, the latter focuses not on the psychology of the individual but on the nature of the intervention designed to change behaviour. The argument is that success is more likely where the desired behaviour is made easy (E) and attractive (A), where it has a social (S) component, and where the intervention is timely (T). While distinct, these frameworks overlap substantially. An intervention that makes the desired behaviour easier helps people to feel more capable, while a timely intervention increases opportunity. Making an opportunity attractive and social taps into motivation.

Armed with these frameworks, we summarise evidence for the effectiveness of interventions classified by the changes made to the target individuals' environment. We consider previous

research under three broad headings, namely studies centred on changes to: (1) the physical environment; (2) the educational environment; (3) the socially mediated environment.

### **(1) The physical environment**

The broad lesson from research on changes to the physical environment is that while giving individuals access to appropriate physical spaces is a necessary part of increasing physical activity, it is not sufficient. There is some evidence that making localities more walkable, attractive and safe reduces some barriers to physical activity. However, there are multiple examples where improvements to physical structures and amenities in disadvantaged communities have had no measurable impact on activity, even when coupled with the provision of organised activities. There is some evidence that involvement of the community itself in the regeneration process may be beneficial.

In relation to the behavioural frameworks, while upgrades to local environments and amenities provide more opportunities and make it easier to engage in physical activity, they may not help people to feel capable or motivated, unless coupled with a stronger social element.

### **(2) The educational environment**

A very large number of interventions designed to increase physical activity in disadvantaged communities have relied on the provision of information or educational materials about the benefits of physical activity. Interventions that rely on this method have, generally, produced disappointing outcomes.

There are nevertheless useful findings on what kinds of messages are more likely to be successful. Evidence favours messages focused on only physical activity rather than on a range of health-related behaviour (diet, smoking etc.), messages that are framed positively (activity is good for you) rather than negatively (inactivity is bad for you), and messages that emphasise one or two strong arguments rather than contain lists of many reasons to be active. Timely feedback on levels of physical activity, including via pedometers, can be effective.

### **(3) The socially-mediated environment**

There is good evidence that physical activity is socially contagious. People are more likely to be active if surrounded by others who are active, which establishes a positive “social norm”. Social comparison may be part of the behavioural mechanism, because people like to compare themselves favourably to their peers. There is good evidence that interventions are more likely

to be successful where they operate through groups rather than being targeted at individuals, thereby exploiting these behavioural mechanisms. The effect may be stronger where individuals identify more strongly with the social group involved.

There is also good evidence of increased physical activity in response to incentives, especially financial incentives. While such incentive effects may initially be short-term, they can lead to positive habit formation. Similarly, where individuals make a public pre-commitment to engage in physical activity, sometimes with a penalty for failure, they are more likely to follow through and undertake the activity. In both cases, as well as the introduction of an explicit reward system, the social interactions involved and mental planning required to meet a goal may contribute to effectiveness. However, more evidence specific to disadvantaged communities is needed in this area in particular.

## **Conclusion**

Overall, there is good evidence that some underlying behavioural mechanisms are more likely to be effective than others in promoting physical activity among disadvantaged communities. While there is evidence that the physical and educational environment matter for increasing levels of physical activity, research suggests that interventions need to move beyond the traditional modes of public health policy, which prioritise the provision of amenities and information. People are social creatures. Their motivations and perceptions of themselves are important drivers of their behaviour. Physical activity, while of benefit primarily to individuals, is no different. The evidence suggests that interventions are more likely to be successful where they target social groups, invite positive social comparisons and involve social interactions that recognise achievements and offer rewards.

## **1. Introduction**

Changing behaviour is difficult. Changing health behaviours, where immediate incentives for unhealthy behaviour often outweigh incentives for healthy behaviours, is even more so. Arguably, nowhere is this more apparent than in the area of physical activity, where the interaction of personal, societal and environmental structures of modern society have led to 31% of adults being physically inactive (Hallal et al., 2012). Physical inactivity is now the fourth leading risk factor for mortality worldwide (Kohl et al., 2012; World Health Organization, 2018). Added to this, international data show social inequalities in physical activity participation. Although the populations of high income countries are more likely to be physically inactive than low income countries, members of socioeconomically disadvantaged groups within high income countries are substantially less likely to be physically active than their less disadvantaged peers (Craike, Wiesner, Hilland, & Bengoechea, 2018; Guthold, Stevens, Riley, & Bull, 2018; Lunn, 2007). Physical inactivity among socioeconomically disadvantaged groups is a significant driver of health and social inequality and thus represents a public health and policy challenge (Craike et al., 2018).

For public health policy to be successful, data that provide evidence about the likely effects of specific interventions are important. However, recent reviews of literature on efforts to increase physical activity among socioeconomically disadvantaged groups highlight two main problems: (1) While many interventions have been tested, most are context-specific or not theoretically grounded, making it difficult to identify forerunners likely to be successful or generalizable; (2) The standard of published research on physical activity interventions is markedly poor (Cleland, Tully, Kee, & Cupples, 2012; Craike et al., 2018; Michie, Jochelson, Markham, & Bridle, 2009), with technical descriptions falling short of standards that would allow other researchers to evaluate, replicate or extend findings, thus hampering the implementation of tested interventions in real-world settings (Hoffmann et al., 2014). Despite the large volume of studies, there remains a scarcity of evaluations that employ high-quality research designs with rigorous experimental control (e.g., Vilhelmsson & Östergren, 2018).

A number of previous reviews and meta-analyses have made high-level conclusions about contextual factors that may influence an intervention's success, but not about the behavioural mechanisms that drive it (e.g. Bull, Dombrowski, McCleary, & Johnston, 2014; Bull et al., 2018; Cleland et al., 2012; Cleland, Granados, Crawford, Winzenberg, & Ball, 2013; Craike et al., 2018). Cleland et al. (2012) concluded that interventions carried out in a group setting are

more effective than those carried out with individuals, and also that interventions based on a theory of behaviour change tended to be more effective than those that were a-theoretical. In another review, Craike et al. (2018) determined that interventions that target physical activity specifically are more effective than more holistic public health interventions, but found a lack of conclusive evidence to inform attempts to increase physical activity among socioeconomically disadvantaged adults. A further challenge in synthesising results and deriving conclusions lies in the diversity of interventions tested (Craike et al., 2018; Michie et al., 2009). Michie et al.'s (2009) systematic review of interventions that target health behaviours more generally, including smoking, physical activity and/or diet, found that interventions varied greatly across studies, employing as few as four and as many as 19 techniques. Of these, there was substantial variation in findings: nine interventions had positive effects, seven produced no change and one intervention resulted in adverse effects. While some studies included a theoretical foundation for intervention design and content, few specified how the intervention package or its effects related to the proposed theoretical framework (Michie et al., 2009). There is no consensus on which interventions are likely to work.

Since there are relevant, recent reviews of the literature on efforts to increase physical activity in disadvantaged communities, why do we need another one? Firstly, because while the abovementioned reviews are important and useful, it remains difficult for policymakers and public health practitioners to make good use of the relevant evidence base. Here, we offer an alternative approach based on applied behavioural science and focused on behavioural mechanisms. It concentrates on the subset of literature on physical activity interventions for socioeconomically disadvantaged groups that is of sufficient quality to draw some inferences for public health policy, but includes also some research on the general population that highlights specific behavioural mechanisms that may be helpful.

## 1.1 A Behavioural Science Perspective

To increase physical activity in socioeconomically disadvantaged communities, policies need to be effective not just in a specific context, but across multiple contexts. As behavioural scientists who undertake research directly for policymakers, our experience is that judgements about how well an intervention generalises are likely to be assisted by research that addresses not only the question “Does this physical activity intervention work?”, but also “Why does this physical activity intervention work?”. This argument is at the heart of the following literature review.

Physical activity is defined by the World Health Organisation (WHO) as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2010). It includes structured, repetitive, and purposeful activity (i.e., exercise), as well as leisure time activity, occupational activity, active transportation, household chores and recreational activities. The WHO recommends that adults aged 18-64 engage in at least 150 minutes of moderate intensity physical activity or 75 minutes of vigorous physical activity each week (World Health Organization, 2010). Yet physical activity is a complex behaviour that necessitates alignment of individual, societal and environmental factors. For some people, the decision to be physically active is hampered by environmental constraints such as lack of access to facilities or a safe neighbourhood (Kramer, Lakerveld, Stronks, & Kunst, 2017). Social structures or norms can also be barriers to physical activity (Shelton et al., 2011). On an individual level, motivation, effort and sufficient knowledge are all factors that contribute to an individual's decision to be physically active or otherwise (Michie et al., 2009; Prochaska & Velicer, 1997).

Given the interactions between these three broad categories, interventions could, and do, employ a wide range of techniques to tackle these barriers, often in combination. While employing a large number of different behaviour change techniques might make an intervention more effective, it can make it harder for researchers or policymakers to disentangle those techniques that are effective from those that are not. This problem takes on particular importance when an intervention appears to have no effect, because it is possible that some intervention elements were effective but masked or altered by competing elements. The argument to design studies that directly test causal mechanisms has been made for applied behavioural research generally by Ludwig, Kling, and Mullainathan (2011). They argue that understanding the causal mechanism through which a policy or intervention acts can be more informative and important than putting a policy in place and evaluating it. The growing application of behavioural science to policy has led to a greater appreciation of the importance of testing interventions that either confirm or sometimes rule out specific mechanisms (Ludwig, Mullainathan and Kling, 2011). So-called "mechanism experiments" can act as powerful screening tools, supporting more costly policy evaluation should strong effects be identified. This approach is currently sparse in the physical activity literature but, we argue, of importance for designing public health interventions to tackle physical inactivity.

In the absence of mechanism experiments, adopting a perspective based on the evaluation of causal mechanisms can still be productive. Consider again the finding referenced above that



group interventions tend to be more effective (Craike et al. (2018). Research can go deeper to isolate more specific mechanisms. The efficacy of activities in group settings may differ, for example, depending on whether the group is merely the method of delivering the intervention or whether individuals' identification with the group is part of the intervention (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2005; Stevens et al., 2017). Across multiple domains, group identity is a strong driver of behaviour (Tajfel & Turner, 1986), so individuals may engage in physical activity where it strengthens bonds with members of groups with which they identify. If this causal mechanism is behind the above result, an intervention that uses a group-based method of delivery, but does not exploit identification with the group, may not be successful. Understanding the causal mechanism is therefore key for developing and implementing future interventions. This is one example of many that this review will attempt to unpick by reviewing the existing literature through a behavioural lens.

This is the first review, to our knowledge, that focuses on behavioural mechanisms in this way. It is not intended to be a comprehensive review or meta-analysis, but rather a narrative review that provides insights on behavioural theories and techniques that have been used in this literature and that have been shown to be effective or otherwise. However, as it is the first review of this kind we took a systematic approach to identifying studies, in order to minimise the chances of inadvertently omitting relevant research. The methods used are outlined below.

## **2. Methods**

Given that a recent umbrella review on this very large literature had been undertaken (Craike et al., 2018), we used this as a starting point. Craike et al. (2018) reviewed 17 review articles assessing physical activity interventions for socially disadvantaged groups. We used the same search terms to search PubMed for studies published since May 2017 – the end point for the previous review – up until August 2018. A total of 248 studies were reviewed for relevancy. We did not apply strict inclusion or exclusion criteria but only included articles that were written in the English language. Seventeen studies were flagged for full-text review. These 17 studies were assimilated with the review articles cited in the reference section of the Craike et al. (2018) umbrella review. We combed the reference lists of these 34 articles to identify additional studies of interest. We also searched OpenGrey.eu, using the terms employed by Craike et al. (2018) which revealed four additional studies of interest within the grey literature (policy documents, unpublished theses, etc.). There was large overlap between the studies covered by the review articles. Following a full-text review of all studies that had been

identified up to this point, we were able to characterise fourteen that could be defined by a behavioural mechanism.

As previous research in this area has not been characterised by behavioural mechanisms, we expanded our search to the health behaviour literature more generally. We discovered two narrative reviews that theorised specific behavioural mechanisms relevant for health behaviour interventions (Thorgerirsson & Kawachi, 2013; Zimmerman, 2009). These reviews contained a list of potentially beneficial behavioural mechanisms to be considered when designing physical activity interventions. These mechanisms included social norms, present bias, feedback, commitment contracts, loss aversion, channel factors, framing, anchoring, and status quo bias. Employing a snowball search strategy, we then used these mechanistic terms to search for any studies that had previously been missed in the reviews. As the literature examining the behavioural mechanisms underlying physical activity interventions is limited, we did not restrict this search to socioeconomically disadvantaged groups. The resulting studies were subsequently categorised according to the behavioural mechanism employed. We have highlighted the studies included in this review that do not focus on socioeconomically disadvantaged groups.

### **3. Results**

#### **3.1 Behavioural Frameworks**

The rational choice model of behaviour suggests that individuals will act in accordance with their best interests. Indeed much physical activity research assumes that once individuals are armed with information, their activity levels will increase because they will be aware that it is in their best interest (Kelly & Barker, 2016). In line with this, traditional physical activity policy approaches are often based on educational campaigns.

Reviews of the literature on physical activity, and indeed across all areas of health behaviour change, consistently demonstrate that these types of campaigns produce, at best, only modest effects (Cleland et al., 2012; Datta & Mullainathan, 2014; Olstad et al., 2017). Thus, it is likely that there are important mechanisms at play other than individual knowledge and understanding of the benefits of activity. This is not a surprise from a behavioural science perspective. Multiple theories suggest that the interaction between the individual and the environment influences people's decisions in systematic ways that distort or override choices based on

comparing costs and benefits (Luoto & Carman, 2014; Mitchell et al., 2013; Zimmerman, 2009). Such theories also imply that beneficial behavioural choices can be supported by improving the interaction between the individual and their environment.

One such theoretical framework, the Behaviour Change Wheel, was developed by Michie, van Stralen, and West (2011) and proposes that the interaction between capability (C), opportunity (O) and motivation (M) is a key driver of behaviour (B) (COM-B model). Capability is broadly defined as an individual's knowledge, skills and physical and cognitive ability to engage in a particular behaviour. Opportunity relates to the social and physical factors, external to the individual, which make the behaviour possible. These factors include social cues about what is and what is not acceptable behaviour, as well as the practical considerations of changing behaviour. Motivation refers to the automatic and reflective processes that direct behaviour. In this instance, automatic processes are characterised as impulses and desires, while the reflective processes are defined as the conscious intentions and beliefs about behaviours.

Another framework of behaviour change, which was developed by the Behavioural Insights Team (BIT) in the United Kingdom, proposes that behaviour change can be induced by making the desired behaviour easy (E), attractive (A), social (S) and timely (T) (EAST framework) (Behavioural Insights Team, 2014). Generalising across their own experimental studies, BIT argue that behavioural interventions that take these principles into account generate better outcomes than those that do not. While BIT's recent work in the health sector has tended to focus on interventions within public health institutions (e.g., reducing error on dispensing prescriptions), they have broadly considered how these behaviour change principles can be applied to promote physical activity. BIT proposes that the COM-B model of behaviour and the EAST framework are complimentary, and the components of each need to be considered when designing lifestyle interventions (Burd & Hallsworth, 2016). The frameworks clearly overlap. An intervention that makes the desired behaviour easier helps people to feel more capable, while a timely intervention increases opportunity. Making an opportunity attractive and social taps into motivation.

This review focuses on behavioural mechanisms that the literature suggests either have been or could be useful in interventions to improve physical activity in socioeconomically disadvantaged groups. Using a combination of the concepts within the COM-B and EAST frameworks, along with an examination of the intervention literature, we group existing interventions into three broad categories defined by the behavioural context that was the core

target of the study. These are: (1) The Physical Environment; (2) The Educational Environment; (3) The Socially Mediated Environment.

Within each of these categories we discuss specific behavioural mechanisms that may drive the efficacy or otherwise of interventions.

### 3.2 The Physical Environment

We use the term physical environment here to relate solely to physical structures and amenities within an individual's environment that may influence their decisions around physical activity. There is growing evidence that aspects of the physical environment, including aesthetics, residential density, infrastructure, recreational facilities, availability of green spaces and mixed land use, can influence people's levels of physical activity (Handy, Cao, & Mokhtarian, 2008; Kaczynski & Glover, 2012; Kramer et al., 2017). The importance of an appropriate physical environment has been championed at a national level in the United Kingdom (National Institute for Health and Care Excellence, 2010), the USA (Transportation Research Board), and Australia (Department of Health and Ageing, 2013). Linking this to the two behavioural frameworks we have outlined above, EAST and COM-B, we can hypothesise that the physical environment may act as a facilitator of, or a barrier to, physical activity. Relating the hypothesis to EAST, the physical environment could act as a facilitator when physical activity amenities are accessible and easy to use, for example through the provision of safe spaces to exercise or the existence of footpaths, cycle lanes or public parks. Turning to COM-B, the physical environment can impact on an individual's perceived capability to engage in physical activity, their opportunity to do so and, in some cases, also their motivation.

This section of the review focuses on studies that have investigated the physical environment. Most centre on the nature and degree to which neighbourhood walkability and the attractiveness of recreational areas affect levels of physical activity among socioeconomically disadvantaged communities. As no environmental context exists in isolation, however, we also examine the interaction between the physical and social environment.

#### 3.2.1 *Walkability*

Kramer et al. (2017) conducted a review of qualitative studies to examine the impact of urban regeneration on the leisure time walking of adults in deprived areas. The authors focused on leisure time walking as they noted that previous research found it was the only physical activity

to be improved following urban regeneration programmes (p. 705). The review considered only qualitative studies because quantitative studies had not assessed possible mechanisms to explain potential changes in leisure time walking. However, they discussed two large scale urban regeneration programmes in Western Europe. A regeneration programme in the most deprived areas of England had been designed to tackle multiple issues including health, education, employment, and crime. The regeneration did not show an increase in physical activity of adults, although did report improvements across other health metrics – such as improvements in mental health (Beatty et al., 2010). Findings following a second similar large scale programme in the Netherlands reported some positive effect of regeneration initiatives on physical activity, but only for leisure time walking, and not leisure time cycling or other sports (Kramer et al., 2014). However, in both cases physical activity improvements were only one of a range of issues targeted by the programmes.

Within the studies assessed in the Kramer et al. (2017) review, poor physical neighbourhood design was consistently cited as a barrier to walking, with a number of key factors highlighted as indicative of poor environmental design. Broadly speaking, these factors included the absence of available settings, fear of crime or concerns for safety, inconvenience of location, lack of provision of amenities, and lack of aesthetic appeal. Furthermore, these barriers were substantially more prevalent in areas associated with socioeconomic deprivation. The authors concluded that urban regeneration programmes that enhance walkability have a role to play in promoting leisure time walking in deprived areas, although definitive recommendations for how to achieve this are lacking. In addition, as these were qualitative studies, a causal link between these factors and variation in leisure time walking has not been established.

Another recent review measures the impact of ten ‘smart growth’ principles in urban design on physical activity levels (Durand, Andalib, Dunton, Wolch, & Pentz, 2011). Smart growth initiatives are development strategies designed to make communities in the USA “more attractive, economically stronger, and more socially diverse”<sup>1</sup>. Within the 44 studies reported, most utilised a cross-sectional design, again making causal inferences difficult. The impact of the ten ‘smart growth’ principles on walking levels was varied. For example, in studies measuring the impact of the ‘take advantage of compact building design’ principle, 56% of these studies reported significant differences in walking levels in the expected direction of

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<sup>1</sup> United States Environmental Protection Agency, 2019, *About Smart Growth*, [online United States Environmental Protection Agency, Available at: <<https://www.epa.gov/smartgrowth/about-smart-growth#smartgrowth>> [Accessed 10/06/2019]

association, whereas the same was true for only 6% of studies measuring the effect of the ‘preserve open space’ principle on walking levels. Note also that while ‘smart growth’ applies to urban developments, the studies were not focused exclusively on disadvantaged communities.

### *3.2.2 Attractiveness of recreation areas*

Some research suggests that the aesthetic appeal and accessibility of the physical environment may influence the extent to which people engage with recreational areas such as public parks.

Tester and Baker (2009) evaluated the impact of renovating playing fields on levels of attendance and physical activity in two parks in San Francisco. Both parks were situated in low-income areas. Following the renovations in both parks, there were significant increases in attendance across all gender and age groups, on average increasing by five to nine times the baseline attendance. The number of park visitors engaging in sedentary, moderate and vigorous activities also significantly increased.

However, in a separate study, Cohen et al. (2009) found that regeneration of park facilities in low-income communities did not necessarily result in increased use and improved levels of physical activity. In fact, they observed an overall reduction of 25% in park use and physical activity over time, with 39% of this decline attributed to fewer scheduled and organised activities across both the control and intervention conditions.

These two studies were substantially different in several ways, and so any comparison between the two must be made cautiously. However, some distinctions may provide some explanations as to the conflicting results. The first is the scale of the improvements. In the Tester and Baker (2009) study, renovation was “significant” (p. 316) – for example “artificial turf replaced uneven dirt fields” (p. 317), which may have radically transformed the usability of the parks. The authors note that very few children used the parks at all during the summer-time pre-intervention observation count. It is possible that for many, these parks were not deemed to be usable in their pre-intervention state. The significant renovation to the environment of the facility may have been tantamount to the provision of a new recreation facility as opposed to a further improvement to an already functional facility. This hypothesis would be consistent with some tentative findings of the Cohen et al. (2009) study, that new recreation facilities were more likely to report increases in usage than general upgrading or replacement of facilities.

Cohen et al. (2013) set out to test whether neighbourhood parks could tailor their programming and outreach efforts if they had access to a limited budget, performance criteria and information about park use and local preferences. Fifty parks serving diverse populations in the City of Los Angeles participated. Parks assigned to the intervention condition received a modest budget of \$4,000, in addition to outreach training and marketing recommendations for the park directors. Park directors were also given feedback from park users and local residents to assist with park regeneration. Compared to control parks that received no additional support, usage increased by 7%-12% among intervention parks.

A further study by Cohen et al. (2017) tested the effectiveness of the provision of free exercise classes and frequent user programmes at parks in high poverty areas. The budget for intervention parks was limited to the same budget for intervention parks in the Cohen et al. (2013) study. However, classes and programmes were randomly assigned across participating parks and were not explicitly tailored to individual parks or users, and standard marketing was adopted to promote these events. Findings from this study suggests that the provision of classes and frequent user programmes alone was insufficient to increase overall park use and physical activity.

Together, the results of these studies tentatively suggest three things. First, the existence of a suitable physical environment is required to provide the opportunity to take part in physical activity. Second, evidence of the success of the provision of organised activities is mixed. Cohen et al. (2009) claim reduced organised activities may explain a fall in park attendance, but Cohen et al. (2017) find that the introduction of new programmes does not always lead to an increase in overall park use. Third, and potentially related to the second, the regeneration of recreation areas appears more likely to be successful when there is active community input into these decisions, as seen in Cohen et al. (2013). One of the parks in the Tester and Baker (2009) study also benefitted from improved recreation and community programmes as part of the intervention. Findings suggested a greater increase in physically active visitors to the park that used community input to direct its regeneration, particularly for female teenagers, who they recognise to be a particularly hard to reach demographic for encouraging physical activity (p. 319). This is particularly interesting from a behavioural perspective as a sense of ownership or control may induce greater motivation to use new facilities. However, since the studies did not explicitly separate competing mechanisms, we can only hypothesise that this is a potentially important mechanism. This further highlights the importance of studies that assess causal

mechanisms, and demonstrates why research such as this present review is important in attempting to better understand which mechanisms drive change, and in which contexts.

### 3.2.3 *The relationship between the physical and social environment*

Consistent with findings from the physical environment literature that have been summarised above, there is a growing consensus that interventions seeking to promote physical activity cannot solely focus on factors related to the physical environment. Sawyer, Ucci, Jones, Smith, and Fisher (2017) carried out a literature review of 46 studies, which examined the role that a neighbourhood's physical and social environment plays in supporting engagement in physical activity, as well as the interaction between the two. Measures of the social environment typically focused on perceptions of cohesion and safety, but also trust, networks, reputation, engagement and capital. The results were somewhat inconsistent but, overall, found that physical activity levels could be affected by both the social environment and the physical environment independently. However, few studies had investigated the interaction between the two. Of the four studies that had, some evidence was found for an interaction. In one study, for example, participants who lived in highly-walkable neighbourhoods and perceived there to be low levels of crime walked for an additional 91.2 minutes of exercise per week than in areas where crime was also perceived to be low but walkability was poor. In areas where crime was perceived to be high, however, walkability had a smaller impact on exercise with a difference in high and low walkability neighbourhoods of only 38.8 minutes per week. These findings were additionally supported by Kaczynski and Glover (2012), not included in the Sawyer et al. (2017) analysis, who examined the impact of neighbourhood walkability and social connectedness on activity levels of the general population in Ontario, Canada. Results showed that people who felt socially connected to their neighbourhood *and* perceived it to be highly walkable displayed greater levels of recreational and transport-related activity, when compared to their peers who either perceived the environment to be highly walkable *or* felt socially connected. Overall, however, the relatively low number of studies that test for interactive effects of physical and social environment on physical activity levels means that further research is warranted before definitive conclusions can be drawn.

One specific example of the potential interrelationship of the physical and social environment regards safety concerns and the built environment, and existing literature specific to this has revealed some varying evidence in the degree to which they inhibit physical activity (Foster & Giles-Corti, 2008). Importantly for the target demographic groups for this present review, there



is some evidence that more vulnerable groups (women, older adults, ethnic minorities and those with lower educational attainments) feel less safe in these environments. However, there is little research that identifies the relationship between safety perceptions and physical activity across different sociodemographic groups (Foster & Giles-Corti, 2008).

Safety concerns can also be viewed in the context of the recreation area studies above. Whether perceptions of safety are a genuinely important driver for the success of recreation areas is not fully clear. The Cohen et al. (2009) study did report an overall increase in perceptions of safety for intervention parks which had undergone improvements, however, this was uncorrelated with observed park use or self-reported behaviour. The interventions in the Cohen et al. (2017) study did not increase overall park use. However, the authors did note a substantial decrease in perceptions of safety in intervention parks. The Tester and Baker (2009) study cite improved perceptions of safety as a plausible rationale for increased use of intervention parks, but this was not measured.

#### *3.2.4 Summary of literature on the physical environment*

Overall, the existing evidence on the effects of the physical environment on physical activity levels is mixed. The strongest effects of the relationship between physical environment and physical activity levels tend to be drawn from studies suggesting that more attractive, safer and better-connected neighbourhoods and environments can facilitate both structured and incidental physical activity. However, a growing consensus within the literature is that environmental regeneration alone will not produce increases in physical activity levels. This is consistent with behavioural frameworks, such as EAST and COM-B, which emphasise the interaction between the individual, their behaviour, the physical setting and the social environment. For example, from the perspective of EAST, improvements in the physical environment make it easier to engage in physical activity, but how attractive, social and timely the activity appears will depend on other contextual factors. One might anticipate, therefore, that changes to the physical environment will have modest effects on behaviour unless coupled with other interventions that have an impact on capability or motivation. As such, we conclude that an appropriate physical environment is necessary but generally not sufficient for promoting physical activity in socially disadvantaged groups, and needs be considered in tandem with other mechanisms that drive physical activity behaviour.

### 3.3 The Educational Environment

Providing information is one of the most frequently used interventions to address health-related behavioural issues among socioeconomically disadvantaged groups (Bull et al., 2018; Cleland et al., 2012; Lehne & Bolte, 2017; Michie et al., 2009; Vilhelmsson & Östergren, 2018). One hypothesis suggests that disadvantaged groups may benefit more from this type of intervention because they start off with less knowledge than more advantaged groups (Michie et al., 2009). In this section, we define the educational environment as an individual's knowledge of any factor that may impact their decision to be physically active. This includes, among others, their comprehension of the benefits of physical activity, their awareness of facilitators and barriers to physical activity, or real-time feedback on physical activity.

The general assumption that disadvantaged communities may benefit more from educational communications is difficult to test given the substantial degree of heterogeneity across educational interventions in content, mode of delivery, target population, and target outcomes. Cleland et al. (2012) conducted a systematic review of physical activity interventions for socioeconomically disadvantaged populations and found inconclusive support for education when used as part of a treatment package. Individual studies sometimes find effects. Clarke et al. (2007) recorded moderate increases in physical activity in an intervention that included a 30-minute physical education programme followed immediately by a 30-minute exercise class. Similarly, Hovell et al. (2008) found increases in physical activity following a supervised aerobics class with a modelling component. Overall, however, the Cleland et al. (2012) review reports that eight studies produced only a small increase or no increase on disadvantaged adults' physical activity levels, despite the use of educational campaigns that targeted lifestyle change strategies, problem-solving skills, knowledge of available resources, and skills training.

Re-examining this literature in light of behavioural frameworks, it is not surprising that the provision of information alone does not impact behaviour. From the perspective of the COM-B model, it is necessary to look at whether information is understood, how it is perceived and how it interacts with the environment in which it is given. Considering the EAST model, the time at which information is delivered may also play a role in the attention it is given. We consider below how the inconsistent success of education-based interventions may be partially explained by issues related to the content and delivery of the educational message. Our analysis suggests that important factors may be message focus, feedback, framing, source and strength.

### 3.3.1 *Message focus*

Following independent systematic reviews, Bull et al. (2018) and Craike et al. (2018) concluded that increased activity among socioeconomically disadvantaged groups was substantially more likely if interventions focused solely on physical activity rather than multiple health behaviours (e.g., promoting healthy eating and physical activity). Consistent with this, Olstad et al. (2017) found that government policies targeting physical activity had little to no impact among disadvantaged groups because they addressed a range of obesity-related behaviours, rather than physical activity alone. Interestingly, Bull et al. (2018) concluded the opposite for healthy eating; targeting multiple behaviours was associated with better outcomes. Although it seems contradictory that a multi-behaviour focus is preferable for healthy eating but not physical activity, Bull et al. (2018) argue that weight loss is a typical goal for individuals taking part in multi-behaviour interventions and, since weight loss is more easily achieved through a combination of calorie restrictions and exercise induced calorie deficits, it is easy to see why multi-faceted interventions may be more successful. If, on the other hand, increasing physical activity is the goal, then it may be more beneficial to concentrate interventions on one specific goal. The self-regulation necessary to produce behaviour change draws on already limited cognitive resources. Focussing on just one desired behaviour change may mean that attention can be directed towards one message instead of multiple. If greater attention drives comprehension then one message may increase capability to understand and process information. In addition, attention is more likely to be drawn to information that is relevant to a goal (Craike et al., 2018; Hallworth et al., 2016). If an individual's goal is to increase physical activity then it is possible that physical activity interventions that also focus on healthy eating and obesity prevention are not as effective because the information provided is not necessarily goal-relevant but takes up valuable cognitive resources.

The Presenter's Paradox is another example of how the amount of information delivered affects the decisions and behaviour of the receiver. According to the Presenter's Paradox, less favourable evaluations occur when mildly positive or mildly negative information is added to highly positive or highly negative information (Weaver, Garcia, & Schwarz, 2012). This is a significant issue for public health announcements, which often rely on "Top ten reasons" campaigns to promote healthy lifestyle changes. Such lists typically combine strong and mildly strong reasons to change behaviour, with the intention that adding more information will increase the persuasiveness of the message (Weaver, Hock, & Garcia, 2016). However,

Weaver, Hock, and Garcia (2016) found that when a sample of 61 public university students were given a combination of mild and strong reasons to exercise, they expressed a lower interest in exercise than when they were exposed to strong reasons alone. (Lack of) intention does not necessarily translate into (lack of) action, but if communication methods reduce motivation it seems unlikely that they would simultaneously induce physical activity. Therefore, while more research is required to fully evaluate the role of the Presenter's Paradox in the promotion of physical activity, policy-makers concerned with promoting physical activity should be cautious of adopting a 'more is better' approach and instead use fewer and stronger arguments. Weaver et al.'s study was not carried out in a socioeconomically disadvantaged group but the lesson is still worth including in this review, particularly given the view that disadvantaged groups may have a lower knowledge base and may therefore glean greater benefit from information campaigns (Michie et al., 2009).

### *3.3.2 Feedback*

Feedback can be an effective means of inducing behaviour change but the type, timing and method of feedback can determine success or otherwise. Bull et al. (2018)'s review found that educating people from low-income groups about the contexts in which physical activity is more or less likely, was ineffective in producing target behaviour change. However, other studies find that education, in the form of immediate and frequent feedback, can enhance awareness of health behaviour and intentions to make lifestyle changes (Thorgeirsson & Kawachi, 2013). Bravata et al. (2007) conducted a systematic review of 26 studies involving a total of 2,767 participants and found that participants exposed to pedometer-based feedback increased their physical activity by an average of 26.9% over baseline levels. Note in this study that socioeconomic status was not reported. In another equity-focused systematic review, Lehne and Bolte (2017) also reported a positive association between pedometer feedback and walking levels among older adults with low levels of education.

In line with the EAST framework and the COM-B model, the timeliness of feedback and its interaction with people's motivation may be key in predicting the behaviour change observed in both reviews. Behavioural research illustrates that the timing of a reward has an impact on the likelihood of a behaviour being repeated (Cooper, Heron, & Heward, 2013; Skinner, 1953, 1969). Therefore, timely feedback, as a form of reward, may increase the likelihood of a behaviour being repeated and, with subsequent repetitions, move the motivation for behaviour from being conscious to habitual.

### *3.3.3 Message framing*

An individual's behaviour and decisions are also impacted by the manner in which choices are described or framed. This has significant implications for behaviour change interventions tackling the educational environment. For example, in a study unrelated to physical activity, Elliot and Harackiewicz (1996) tested the impact of framing performance goals in the context of achieving success or avoiding failure. They told half of participants that most people performed equally well on the puzzles they were about to complete but that some people did remarkably poorly (avoid failure frame). They told the other half that most performed equally well but some people were remarkably good (achieve success frame). In two experimental studies with 176 participants, those whose goal was to avoid failure, had reduced motivation compared to those whose goal was to achieve success.

It is straightforward to see how this approach can apply to the physical activity literature. Warnings about physical inactivity may be framed as failure (i.e. messages that highlight how many people are failing to be physically active) or as success (i.e. messages that highlight how many people are physically active). In line with these findings, Latimer, Brawley, and Bassett (2010) review of physical activity literature found that gain-framed messages, such as "Physical activity can improve your health – get active!" (p. 666, Latimer et al., 2008) are demonstrably more effective at encouraging activity uptake than loss-framed messages, such as "Physical inactivity can cause health problems – get active!" (p. 666, Latimer et al., 2008). Moreover, gain-framed messages also resulted in greater levels of physical activity uptake than mixed-framed messages.

These findings are consistent with Prospect Theory (Kahneman & Tversky, 1979), which predicts that when preventive behaviours like exercise are associated with low risk, promotion is best achieved through positive message framing (Jones, Sinclair, & Courneya, 2003). However, it must be noted that for the most part, participants in the studies included in the Latimer et al. (2010) review were middle-aged adults recruited from workplaces or media advertisements. It is unclear, therefore, how relevant these findings are for adults from socioeconomically disadvantaged communities. Nonetheless, since information provision is one of the most frequently used interventions to address physical inactivity among socioeconomically disadvantaged groups, it is important to understand that message framing may mask or enhance the effects of an information-based intervention. It would be helpful to establish whether previous physical activity campaigns inadvertently adopted loss- or mixed-

framed approaches rather than gain-framed ones. Unfortunately, procedural descriptions in previous studies are not sufficiently detailed to facilitate this more granular analysis.

#### *3.3.4 Information Source*

The source of information can play a significant role in the likelihood of behaviour change because an individual's perception of the messenger affects the weight given to the information provided. The seminal study of Kassin (1983) tested the hypothesis that a jury's impression of an absentee witness and their testimony would be influenced by the person reading out the deposition. The characteristics of the reader significantly affected the perceived credibility of the testimony. The authors termed this bias in persuasion the 'messenger effect'.

Jones et al. (2003) examined this bias within the context of physical activity among university students. Participants received an educational intervention that promoted regular physical activity, defined as "vigorous intensity (exercise) three or more times per week for at least 30 minutes each time" (p. 184). However, the credibility of the information source and framing of the information was manipulated across experimental conditions. Those who received a positively framed message about physical activity from a credible, expert source were significantly more likely to report that they had engaged in physical activity at a 2-week follow-up. They were also more likely to express intentions to exercise, despite unchanged attitudes towards physical activity. However, a later study failed to replicate these findings, although the authors were reluctant to definitively rule out the messenger effect (Jones, Sinclair, Rhodes, & Courneya, 2004). Additional research on sources of information is clearly required. The evidence in support of this mechanism for boosting informational campaigns is presently inconclusive.

#### *3.3.5 Summary of literature on the educational environment*

Consistent with work in other domains, the provision of educational information alone appears to be insufficient to generate behaviour change with respect to physical activity. However the variation that previous reviews have noted in the success of educational interventions for promoting physical activity, including among socioeconomically disadvantaged communities, may in part be explained by intervention differences in message focus, feedback, framing, source and strength. In other words, educational or informational interventions need to do more

than promote the benefits of physical activity. They need to be grounded in good behavioural theories and behaviour change frameworks.

Where education forms part of a physical activity intervention, the content can be informed by behavioural science. The above evidence suggests that it should focus exclusively on physical activity, deliver a strong, positively framed message and, preferably, provide some form of feedback. An educational package that incorporates these elements is likely to enhance an individual's perception of their capability to engage in various types of physical activity, as well as their underlying motivation to do so. We know from research in other areas that the messenger effect can exert positive or negative effects on behaviour. However, the degree to which people's perception of the message source impacts their motivation to improve their levels of physical activity remains, as yet, unclear. Furthermore, the available studies, which examine the influence of message framing, information source and message strength on physical activity, have not focused on socioeconomically disadvantaged groups. More studies specific to disadvantaged groups would be helpful.

### 3.4 The Socially-Mediated Environment

Social environments play an important role in determining individual behaviour. This section defines the socially-mediated environment as the influence of other people or societal structures on physical activity behaviour. This may include personal relationships, group identity, cultural or social norms, and the interaction between individual responsibility, accountability and social perceptions. According to the COM-B model, an individual's capability, opportunity and motivation are driven to varying degrees by the social context (Michie, Atkins, & West, 2014). Similarly, the EAST framework highlights the social element of interventions as beneficial for behaviour change. The socially-mediated environment is arguably the one for which there is the strongest behavioural evidence based on interventions to date. Nearly all reviews in this area highlight that group-focused physical activity interventions are more effective for adults in socioeconomically disadvantaged communities than individually-targeted ones (Cleland et al., 2012; Craike et al., 2018). However, as argued above, the efficacy of interventions in group settings may differ depending on whether the group is merely the method of delivering the intervention, or whether identification with the group forms part of the intervention itself (Burke et al., 2005). In this section we discuss socially mediated behavioural insights that have demonstrated varying degrees of efficacy in

promoting engagement with physical activity. These can be categorised as targeting social norms, social identity and accountability.

#### *3.4.1 Establishing social norms*

An individual's exercise-related choices and behaviours can be influenced by the choices and behaviours of their peers. Aral and Nicolaides (2017) analysed the geographic locations, social network ties and daily running patterns of 1.1 million people, worldwide, over a 5-year period. They concluded that exercise is "socially contagious" (p.5, Aral & Nicolaides, 2017) and its contagiousness varies with the relative activity and gender relationships between friends. For example, people's running behaviour is significantly influenced by the running behaviour of their friends whose performance is slightly worse or slight better (not far worse or far better) than their own performance. Aral and Nicolaides (2017) also found that men's exercise is impacted by the exercise behaviour of both men and women in their social network. This is not the case for women, however. Their exercise is influenced only by other women in their network.

Although the Aral and Nicolaides (2017) study focused on people who were already active, such social comparisons may also be behind the increased physical activity observed by Shameli, Althoff, Saberi, and Leskovec (2017). They examined data from 3,637 users in 2,432 walking challenge competitions that took place on a mobile app platform, over a 1-year period. Results showed that the average participant increased daily physical activity by 1,400 steps during the walking competitions. Increases were relatively consistent across gender, age, weight status and baseline activity levels (although socioeconomic status of participants was not disclosed). However, the largest improvements were observed among those previously considered "fairly inactive" (p. 2). Based on these findings, the authors recommend that members of a competition group are gender balanced and approximately matched according to pre-competition activity levels.

Social comparison may play a role too in the findings of Lamb, Bartlett, Ashley, and Bird (2002). They found that 39% of middle-aged adults who were encouraged to attend lay-led walking groups could be described as active after 12 months compared to 27% of a control group who received advice sessions on exercise with a physiotherapist. There may have been some issues with selection bias in this study, as participants were asked to participate in a trial to investigate different methods of encouraging physical activity. As such, people who chose



to take part in the research may have been already motivated to change their behaviour and the study provided a prompt for them to do so. However it is promising that availability of a lay-led walking programme led to greater proportions of participants being active. The focus of this study was to test cost-effective methods of health promotion rather than to evaluate the role of social norms, so it is not certain that this was a mechanism driving the effect. The mere availability of the activity may have been the stronger driver. In addition, the study did not address socioeconomic disadvantage directly, but instead focused on people aged 40-70 years who took less than 120 minutes of moderate intensity activity per week, implying an increased risk of health problems.

This idea that physical activity is contagious, is supported by other work on social norms. Priebe and Spink (2012) found that office workers were significantly more likely to increase their physical activity if they were told that others around them were physically active, compared to workers who received information only on health and appearance-related benefits of physical activity. Koeneman, Chorus, Hopman-Rock, and Chinapaw (2017) demonstrated a similar effect among older adults in a residential setting. Those in the control group were given a news report about older adults in the community, with no reference to being physically active, and were asked to select a suitable photo to accompany the article. Participants in the intervention group completed the same task, with the exception that the news report included information on the activity levels of older adults in the community. At a 3-month follow-up, 80% of the experimental group reported being physically active, compared to only 22% of the control group – a substantial treatment effect. Both studies demonstrate that receiving information on social norms can affect change; actually seeing others exercise was unnecessary. Arguably, providing factual information on how many people are physically active is a type of educational intervention, although it is the social nature of the information that is instrumental in altering behaviour.

The above studies did not specifically involve socioeconomically disadvantaged groups or provide information on the socioeconomic status of participants. However, Craike et al. (2018) concluded from their umbrella review that interventions occurring in group-based settings were effective in improving physical activity among socioeconomically disadvantaged groups. Similarly, based on their systematic review and meta-analysis of the literature, Cleland et al. (2013) recommend that group delivery should be considered an essential component of physical activity programmes for women experiencing socioeconomic disadvantage. Part of the reason that group-based interventions are so effective for disadvantaged groups may be the

salient manner in which they reformulate a social norm. International data show that members of socioeconomically disadvantaged groups are substantially less likely to be physically active compared to their less disadvantaged counterparts (Craike et al., 2018; Lunn, 2007). Therefore, people experiencing this type of disadvantage are less likely to have been exposed to physically active peers. By delivering a physical activity intervention in a group setting, individuals from socioeconomically disadvantaged backgrounds have the opportunity to witness their peers being active, which may function to establish new social norms around physical activity.

### *3.4.2 Leveraging social identity*

Simply knowing about the behaviour of others can significantly impact one's own behaviour. However, the degree to which one identifies with a particular group can magnify this effect (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006). Based on a meta-analysis of 44 studies, Burke et al. (2006) conclude that interventions that promote physical activity in group settings were superior to interventions using individual-based activities for the general population. This is consistent with findings from the research on socioeconomically disadvantaged groups (Cleland et al., 2012; Craike et al., 2018). Furthermore, Burke et al. (2005) found that interventions that promoted group cohesiveness were the most successful of all at increasing activity levels among participants. Despite substantial differences between interventions, consistency in achieving positive outcomes appears to be robust (Estabrooks, Harden, & Burke, 2012).

According to social identity theory, group affiliations are among the most powerful and significant determinants of human behaviour. This theory proposes that by simply affiliating with members of a particular group, individuals incorporate the values of this group into their sense of self, causing them to “align (their) attitudes and behaviours” (p. 1913, Stevens et al., 2017). Evidence from the applied literature supports this hypothesis, with research showing that people in exercise settings tend to create in-groups, and the opportunity to exercise with members of the in-group subsequently predicts exercise habits (Beauchamp et al., 2018; Bruner, Dunlop, & Beauchamp, 2014). In one study, Beauchamp et al. (2018) randomly assigned 627 older adults to 1 of 3 conditions: 1) a control condition with a standard mix of age and gender; 2) an intervention condition with mixed gender but a similar age range, or 3) an intervention condition with mixed age and same gender. Exercise adherence over a 12 and 24-week period was measured and results showed that participants in the intervention conditions participated in significantly more exercise classes over the course of the study than

those in the control condition. Activity levels across the two intervention conditions did not differ significantly.

These results are consistent with research on social identity theory, which illustrates that a strong group dynamic can be formed from a seemingly minimal categorisation (Tajfel & Turner, 1986). An individual's identity is usually formed from identification with multiple groups, some of which become more salient according to the situation. Participants in intervention group 1 may have identified with others as they were of a similar age, while participants in intervention group 2 may have identified with others in the group as they were the same gender. Although Beauchamp et al. (2018) did not directly measure participants' identification with their respective groups, this study tested a causal behavioural mechanism directly by comparing intervention groups to a control group that differed by a single element. Therefore, we can conclude that grouping people by a shared attribute is more powerful than random assignment to a group. This evidence hence generates an important consideration when designing group-based physical activity interventions. Highlighting an attribute that group members share, whether pre-existing or created via the intervention, will likely lead to more beneficial outcomes.

While Beauchamp et al. (2018) did not focus on socioeconomically disadvantaged groups specifically, there is some evidence that social identity may also be a causal mechanism in physical activity interventions designed to induce positive behaviour change in these groups. However, the groupings that establish shared social identity may differ across the socioeconomic spectrum and perhaps also by location. Bull et al. (2014) reported that physical activity studies with female-only low-income samples did not differ significantly in effectiveness from mixed gender samples. However, other demographic factors, such as culture, may be stronger influences of shared social identity. For example, Hovell et al. (2008) focussed on low-income Latino women specifically. Aerobic dance classes were provided three times each week for 6 months for participants in the intervention group. Participants in the control group attended 18 safety education classes instead. Higher levels of vigorous exercise and walking were reported by participants in the intervention condition at post-test. Results also showed a five-fold greater increase in relative aerobic fitness ( $VO_{2max}$ ) among intervention participants compared to control participants. Furthermore, although there was a decrease in exercise and fitness levels across both groups at the 1-year follow-up, these levels remained higher in the intervention group. As with many other physical activity intervention studies that target socioeconomically disadvantaged groups, Hovell et al. (2008) did not measure or test

participants' identification with their allocated group. The success of the exercise intervention may have been enhanced by specifically targeting Latino women, but without being able to compare this exercise group to an exercise group that was culturally neutral it is not possible to draw definite conclusions.

### 3.4.3 *Public accountability*

Failure to engage in adequate and sustained levels of physical activity may be a “problem of... initiation *and* maintenance” (p. 658, Mitchell et al., 2013). People often understand the health and social benefits of physical activity, but experience a disconnect between the initial motivation to become more active and the process of taking and maintaining action (Goldhaber-Fiebert, Blumenkranz, & Garber, 2010). Initially, being physically active requires immediate time and energy investment with only the prospect of future benefits; the ‘costs’ are experienced ‘now’ but the benefits are delayed (Goldhaber-Fiebert et al., 2010; Leonard et al., 2013; Luoto & Carman, 2014). However, people typically act in a way that prioritises their immediate benefit at the expense of future well-being – an effect known as present bias. Immediate, tangible consequences exert a substantially greater influence on behaviour when compared to delayed consequences, particularly when provided by an external source (Cooper et al., 2013; Mitchell et al., 2013). As a result, techniques are required that bridge the gap between the upfront costs and the delayed benefits of physical activity. Two types of interventions designed to achieve this exploit the ideas of accountability, in the form of incentives, and commitment contracts.

*Incentives.* An incentive is a temporary mechanism, but can establish a long-term behavioural pattern by manipulating the short-term benefits of being physically active (Goldhaber-Fiebert et al., 2010; Mitchell et al., 2013; Volpp et al., 2008). Incentives operate through the principle of behavioural reinforcement. On one hand, they establish motivation to engage in a behaviour, and on the other, they provide positive consequences that increase the likelihood that the behaviour is repeated (Cooper et al., 2013).

Incentives can take a variety of forms but a systematic review and meta-analysis of the literature concluded that financial incentives are a particularly effective tool for promoting exercise adherence in the general adult population (Mitchell et al., 2013). One study reported that financial incentives resulted in improved and sustained exercise levels for at least a year (Jeffery, Wing, Thorson, & Burton, 1998) and two studies found that physical activity was

sustained among previously inactive participants after the incentives were removed (Charness & Gneezy, 2009; Gomel, Oldenburg, Simpson, & Owen, 1993). The latter finding is quite important as the principle criticism of financial incentive interventions is the potential for extrinsic motivation to ‘crowd out’ or depress the effects of intrinsic motivation (Gneezy, Meier, & Rey-Biel, 2011), resulting in a lack of behavioural maintenance following removal of the extrinsic motivator. However, the potential for ‘crowding out’ intrinsic motivation may be lower for incentive interventions targeting inactive adults, as they have a lower base level of intrinsic motivation to exercise (Charness & Gneezy, 2009). Incentives may therefore be particularly useful for interventions targeting socioeconomically disadvantaged groups, given the elevated likelihood for physical inactivity among this cohort. Nevertheless, Michie et al. (2009) highlight a lack of effective intervention studies using incentives to increase physical activity among low-income groups. This issue is also reflected in the umbrella review carried out by Craike et al. (2018). In the absence of a body of research that evaluates the impact of incentives on the physical activity levels of socioeconomic groups, firm conclusions are not possible.

*Commitment contracts.* Commitment contracts represent another method of incentivising future behaviour (Royer, Stehr, & Sydnor, 2015) and have been used in both research and commercial settings to encourage health-promoting behaviour. Royer et al. (2015) evaluated the long-term impact of incorporating commitment contracts into incentive programmes that were aimed at increasing physical activity levels of workers at a fortune-500 company. A total of 1,000 employees recruited from a single workplace were randomly assigned to a control or intervention condition. Participants assigned to the intervention condition were offered a financial incentive to attend the workplace gym facility over a one-month period. This financial incentive had a substantial impact, with gym engagement doubling relative to the control condition. After the one-month incentive period had elapsed, half of the participants in the intervention condition were randomly assigned to a deposit contract condition. In this condition, participants had the opportunity to create a self-funded commitment contract and invest as much money as they wanted in the contract. Participants were asked to put their own money at risk, with no external financial incentive, but were guaranteed its return if the commitment was met. Participants in the original one-month only incentive group did not maintain their increased gym attendance over a two-month period. Participants in the commitment contract group showed long-term effects equivalent to a 20% increase in attendance compared to baseline over 2-3 years. This was despite the commitment contract

ending. The authors hypothesised that while one month was generally insufficient to form a lasting habit, the commitment contract allowed participants to lengthen the incentive period, thereby promoting habit formation.

Findings from Studer, Koch, Knecht, and Kalenscher (2019) provide further empirical support for the role of commitment contracts in habit formation. In this lab-based experimental study participants were presented with a choice; accept an effort-free small reward or pre-commit to a larger, more effortful reward by eliminating the option of the small reward. Results showed that participants used the pre-commitment tool as a means of optimising their motivation to achieve the more effortful reward. The authors concluded that pre-commitment is an effective “self-motivational and behaviour-optimization tool” (p. 11) with substantial potential for physical activity interventions.

According to the results of a study carried out by Goldhaber-Fiebert et al. (2010), the impact of commitment contracts can be further enhanced by manipulating the anchoring effect. The anchoring effect refers to a phenomenon whereby individuals are disproportionately influenced by initial reference points and have difficulty adjusting away from these (Tversky & Kahneman, 1974). Participants in the Goldhaber-Fiebert et al. (2010) study were all given the opportunity to enter into a commitment contract aimed at improving physical activity levels. Participants were randomly shown a contract duration of 8, 12 or 16 weeks. However, they had the option of changing the duration to one of the other two options and they were made explicitly aware of this. A total of 619 people recruited from the general population participated in this study. Initial exposure to a longer contract duration option was associated with the selection of a longer contract duration. Longer contract durations, in turn, translated into a large, significant, positive effect on the majority of participants’ overall exercise time. Instead of substituting longer contracts with more frequent ones, participants increased the length of their commitment period and, consequently, their total exercise time. In addition, the amount of money invested and the sign-up rates among participants were unaffected by the initial contract duration shown and the contract duration chosen. As such, seeing the longer 16 week contract option first did not adversely affect participants’ sign-up rates or the financial commitment they were prepared to make. Setting a higher default value on the initial contract duration can therefore enhance the long-term effects of physical activity interventions.

In a follow-up randomised control trial involving over 4,000 users of stickK.com (a free, web-based commitment contract site), Bhattacharya, Garber, and Goldhaber-Fiebert (2015)

replicated and extended the results of Goldhaber-Fiebert et al. (2010). Results showed that participants were more likely to choose longer contracts when the initial duration option viewed by participants was set at a higher value (i.e., 20 weeks versus 8 weeks). In addition, participants exposed to the higher duration option initially were more likely to achieve their physical activity goals and were more likely to sign-up to a subsequent commitment contract after the original expired.

While commitment contracts appear to represent a promising mechanistic-based intervention for increasing physical activity, research to-date has not addressed effectiveness among lower socioeconomic groups. The studies cited above focused on people who, arguably, had the financial resources available to them to commit to these exercise contracts, e.g. two studies involved pre-existing members of stickK.com and employees of a fortune-500 company. Thus, while it is likely that people from socioeconomically disadvantaged backgrounds are as susceptible to the psychological mechanism tapped by commitment contracts, having the means to establish such a contract may represent a significant barrier for this population. Nevertheless, the consistency of findings provides some evidence for pre-commitment as a mechanism for encouraging physical activity. Moreover, non-financial forms of pre-commitment could be tested in a socially disadvantaged population.

#### *3.4.4 Summary of literature on the socially mediated environment*

While the literature in this area is limited with respect to socioeconomically disadvantaged communities, on balance, we conclude that social norms, social identity and accountability are mechanisms with potential for physical activity behaviour change. Socially focused interventions can capitalise on the notion of physical activity being contagious, by highlighting shared characteristics of group members (e.g., gender, age) and providing information about the physical activity of others; actually witnessing this activity is not necessary. Knowledge of what peers are doing is likely to boost people's opinion of their own ability, as well as their motivation to engage, especially if they possess a sense of connection with these peers. Psychological research shows that it is possible to establish group identity by allocation of people to groups (Billig & Tajfel, 1973). This suggests that group interventions need not even necessarily be based on pre-existing shared characteristics, but could be carefully designed to create group affiliation through the intervention itself. These insights may be of particular relevance to members of socioeconomically disadvantaged communities who are typically less likely to be exposed to active peers.

Short-term incentives can be used to make activity more immediately attractive and to establish longer-term healthy behaviours. Financial incentives have proven particularly effective and there is emerging support for their role in creating physical activity habits, albeit not specifically in socioeconomically disadvantaged groups. Arguably, the most effective and cost-efficient method of incentivising engagement in physical activity is through deposit contracts, particularly because they involve people putting their own money at risk. There may of course be limits to which such interventions can be applied in more socioeconomically disadvantaged communities. Nonetheless, an intervention employing incentive techniques is likely to improve physical activity by enhancing motivation levels through the provision of timely consequences. Whether these consequences can be in a form other than financial needs to be tested.

#### **4. Discussion**

Physical inactivity is a major challenge facing policymakers, community leaders and individuals, particularly in socioeconomically disadvantaged communities. The current body of literature in this area suggests that existing interventions tend to be of mixed quality and efficacy with no clear indication as to what predicts a successful outcome. One of the major problems facing the literature is the lack of theoretical structure on which many interventions are based and, as a result, a lack of guiding mechanisms on which interventions may be designed. In order to fully answer the question “What physical activity interventions work?” we need to have insight also into the question “Why do interventions work?”.

This review set out to re-examine the physical activity literature using a behavioural science framework that considers the psychological mechanisms that are engaged by interventions. The overarching goal was to present a framework through which the existing body of research could be viewed, in order to determine if there is evidence for specific mechanisms that influence the likelihood of an intervention being effective. The review examined the impact of specific behavioural mechanisms within a wider socioecological context based on three overarching categories: the physical environment, the educational environment and the socially-mediated environment.

Evidence suggests that a physical environment conducive to physical activity is a necessary but not sufficient requirement for a successful intervention. An appropriate physical environment should be the location in which other behavioural mechanisms are levered for a given intervention. An educational intervention should deliver a strong, positively framed



message, provide regular, informative feedback, and focus on a clear, singular objective. From the perspective of behavioural mechanisms, these principles target people's motivation states, as well as their subjective evaluation of their own capabilities. However, as with the physical environment, and particularly for socioeconomically disadvantaged communities, access to behaviourally informed educational interventions may still not be sufficient to generate a successful physical activity intervention.

The majority of effective interventions incorporate a social component. Emerging evidence supports the idea of physical activity being socially contagious. Simply receiving information on the activity levels of peers raises the likelihood that individuals increase their own physical activity, and the strength of this effect is linked to the degree to which people identify with their peer group. Social influence, in this form, may be particularly beneficial in promoting long-term engagement in physical activity. However, despite evidence supporting the role of social influence in the context of physical activity, there may be a need for short-term incentives to make activity initially attractive. Incentives can help to bridge the gap between the upfront costs and the delayed benefits of being physically active.

Given all of the above, policymakers seeking to raise levels of physical activity in disadvantaged communities might seek to incorporate elements from each of the above approaches. Engaging complimentary behaviour change mechanisms might lead to more sustained success than the (at best) patchy outcomes associated with interventions based on a single element, such as those that commonly accompany improvements in local facilities or educational campaigns. By contrast, the research community needs to combine rigorous evaluation of such interventions with studies that seek to test specific behavioural mechanisms in isolation (mechanism experiments).

There are nevertheless a number of limitations that apply to the current review. First, there is a risk of study bias and the inadvertent exclusion of potentially relevant studies. Our initial attempt at systematically reviewing the literature led to an independent but collective conclusion that this approach would not facilitate progress in answering the designated research questions, as too few studies were rounded in a theoretical or mechanistic framework. The majority of studies have not been set up to assess causal mechanisms, making it difficult to make inferences about efficacy and generalisability beyond the specific study context. We determined that a more exploratory review that structured the literature around a behavioural framework would provide better insight. Second, there is an inherent problem of design

heterogeneity. This makes categorising mechanisms and standardising effectiveness across studies difficult. Third, the categorisation of behavioural mechanisms within this present review, which was informed by work that has considered the potential importance of behavioural mechanisms (Thorgeirsson & Kawachi, 2013; Zimmerman, 2009), may have resulted in some studies being overlooked. We sought to minimise this risk by searching through the reference lists of included studies, as well as by reviewing relevant grey literature. Finally, not all studies were carried out in socioeconomically disadvantaged populations. Because we structured evidence around the testing of specific behavioural mechanisms, we included some studies that focused on the general population. Although there are likely to be behavioural mechanisms that are common across groups in society, we have been mindful to temper conclusions based on such studies, as effective mechanisms implied by studies carried out in the general population may not transfer to disadvantaged groups. Furthermore, the multiple definitions of disadvantage used in research studies are broad, incorporating concepts based on financial, educational, social or geographic disadvantage. We used the same search terms as employed in the latest review of reviews on physical activity in socioeconomically disadvantaged groups (Craike et al., 2018). However, the effectiveness of interventions might, in principle, differ not only between disadvantaged and non-disadvantaged communities, but also between communities identified by different definitions of disadvantage. Such differences are beyond the scope of the present paper.

## **5. Conclusion**

Interventions designed to increase physical activity in socioeconomically disadvantaged communities typically incorporate multiple features into an intervention package, often without consideration of the potential effects of each component. While such packages are a reasonable approach to trying to increase levels of physical activity, the success or otherwise of the component mechanisms is integral to understanding intervention success. Where isolating individual mechanisms is not possible in field trials, or where they may only work in combination with each other, having a theory of the important behavioural mechanisms on which to base an intervention is likely to result in more successful physical activity interventions.

In sum, we conclude that a behaviourally informed intervention package would employ a set of focused educational and socially-mediated behavioural mechanisms, within an appropriate physical environment. Notice should be taken of the specific elements within each of these

environments that may determine the success of an intervention or otherwise. Consideration of these factors, as well as designing studies that test specific mechanistic effects, would be likely to improve the efficacy of future work on physical activity in disadvantaged communities and enhance the development of effective, scalable public health policies.

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