A Conceptual Primer on the Potential of Adaptive Policies to Reduce Physical Inactivity

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Background: Despite the existence of physical activity policies across many countries, insufficient physical activity remains a major global public health problem. Physical inactivity is an emergent feature of complex systems; it results from a wide range of factors at multiple levels that interact to influence behavior. Traditional approaches to public policy often fail within complex systems, largely due to unpredictability in how the system will respond. Adaptive policies, which are designed to allow for uncertainty about future system behavior and to change over time, may offer a promising solution. In this paper, we introduce the concept of adaptive policies and illustrate how this innovative approach to policy making may be beneficial for reducing physical inactivity. Design: Drawing on existing literature and guiding principles for policy making, we provide 3 examples to illustrate how the concept of adaptive policies can be applied to address physical inactivity. Discussion: The examples illustrate how changes to the way policies and interventions are developed, implemented, and evaluated could help to overcome some of the limitations in existing practices. A key challenge will be engaging policymakers to take a broader perspective of the physical activity system, develop policies that are designed to be adaptable across a range of different future scenarios, and embrace uncertainty and long-term adaptability. Conclusion: Adaptive policies may support decision makers globally to achieve the widespread and sustained changes necessary to increase population levels of physical activity.

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Regular physical activity is associated with a wide range of health benefits including reduced risk of coronary heart disease, type 2 diabetes, and several cancers.1 To achieve these benefits, the World Health Organization recommends that adults undertake at least 150 to 300 minutes of moderate-intensity or 75 to 150 minutes of vigorous-intensity physical activity per week (or some combination of the 2), in addition to muscle-strengthening activities on at least 2 days per week.1 The term physical inactivity is commonly used to describe an activity level that is insufficient to meet current recommendations.1 Despite the existence of physical activity policies across many countries,2 surveillance data indicate that more than a quarter of the world’s adult population (1.4 billion adults) are insufficiently active.3 Consequently, physical inactivity is responsible for around 9% of premature mortality globally.4

Physical inactivity, both at the individual and collective levels, is an emergent feature of complex systems; it results from a wide range of factors at multiple levels (demographic, psychological, social, economic, and environmental), that interact to influence behavior. Systems thinking is the process of understanding the linkages, relationships, interactions, and behaviors among different elements that characterize the system, to inform comprehensive and integrated policies and practices.5,6 A systems approach encourages a broader perspective of the causes of a problem and the consequences of any action, beyond a narrow and specific pre-defined set of expected outcomes.6–8 While there is increased recognition of the need to adopt a “systems approach” to physical activity promotion in general, the majority of policies and interventions aimed at reducing physical inactivity are typically static in nature and therefore not well suited to addressing the complexity of the problem. In this paper, we introduce the concept of adaptive policies and illustrate, through 3 hypothetical examples, how this innovative approach to policymaking may be beneficial for reducing physical inactivity.

Interventions Within Complex Adaptive Systems

Public policy is defined as a broad orientation, a specific commitment, or a statement of values, issued by governments and other forms of administration,9,10 whereas the term intervention is used to describe individual measures or actions. Therefore, policies are not individual actions to promote physical activity but the framework in which interventions are developed, financed, or implemented.11 However, policies often include overarching intentions and goals as well as the proposed strategies/courses of action to achieve them,11 causing the distinction between policies and interventions to become blurred.

Interventions have traditionally been conceptualized as consisting of a discrete set of parts or activities, and it is the relations between these parts and associated behavior changes that underpin the assumed causal mechanisms of interventions. Systems thinking recognizes that the effect of an intervention may not primarily be due to these intervention components per se, but rather to the interplay between these parts and the contexts in which they are introduced and with which they interact.12 As such, researchers have referred to interventions as “events” or “disruptions” within a system.13
Systems evolve dynamically as they respond adaptively to interventions. Therefore, interventions with proven efficacy through randomized controlled trials may not always be effective when introduced within complex systems. The interrelated elements within a system interact with one another, such that a change in any part may cause reactions in other parts of the system. These reactions may include changing relationships, displacing existing activities, and redistributing resources. These adaptive responses may result in moves toward a desired new system configuration and regime or unintentionally in moves in the opposite direction. It is possible that the system responds in both positive and negative ways in tandem. It is also possible that interventions lead to systemic responses to resist the attempted changes to the system and sustain the status quo, a phenomenon known as intervention or policy resistance.14

An example of system adaptation that achieves the opposite effect to that which is intended is demonstrated by Jevons’ paradox. Improvements to the design of the steam engine in the late 18th century greatly improved efficiency, reducing the amount of coal required for a given use. Jevons observed that while technological improvements increased the efficiency of coal use, this led to increased consumption of coal.15 Reducing the amount of coal needed for a given purpose lowered the relative cost of using the resource, which led to increased demand. Furthermore, improved efficiency led to increases in economic growth, further increasing the demand for coal. Rather than efficiency gains leading to lower resource consumption, the opposite effect was observed.15

**Systems Archetypes and Causal Loop Diagrams**

Systems archetypes describe patterns of behavior of a system.16 They can help in diagnosing problems that may be limiting the performance of the system and identifying potential intervention strategies to enable more effective action.16 Many of the systemic patterns of behavior, as characterized by the systems archetypes, are generated by common loop structures.16 Causal loop diagrams can be used to map the structure and the feedbacks of a system to understand its operation.17 The feedback loops on such diagrams are either reinforcing or balancing.17 Balancing loops serve to provide stability in the system and counteract change, while reinforcing loops compound change in one direction by generating greater change in the same direction.17 Figure 1 shows the anatomy of a basic causal loop diagram.

**Static Versus Adaptive Policies**

Policymaking (ie, a decision to set and direct a specific course of action) typically involves “one-time” decisions, with a view that the selected course of action will provide a long-term solution to the problem it seeks to address. These types of one-time decisions may include single or multiple actions, but due to the assumed likelihood of success, no formal mechanisms are established for monitoring implementation and outcomes, and for making future adjustments. While this “static” approach to policymaking may be suitable in certain situations, particularly when the range of available policy options is clear and the outcomes of each are highly predictable, the complexity of many of the problems that policymakers are faced with means that such policies often lead to unintended consequences or failure.18 As an example, the free swimming program in England was a £140 million investment designed to increase participation in swimming in England by providing free swimming for children aged 16 years or under and adults aged 60 years or over. However, the evaluation showed that the majority of those accessing free swimming (73% of those aged 16 y and under, and 83% of those aged 60 y and over) were swimming already and would have paid to swim in the absence of the scheme. Thus, rather than reducing inequalities in participation, the scheme served to widen inequalities due to failure to engage those who did not swim and supporting regular swimmers to swim more.19

Mueller18 identified 5 “pathologies” to explain why traditional approaches to public policy fail within complex systems, all of which stem from the unpredictability of such systems. The outcomes of policies that are introduced within complex systems are nonlinear and emergent; they cannot be fully anticipated at the outset and can only be realized once the policy has been introduced. In contrast, the outcomes of noncomplex systems are highly predictable. An example of a noncomplex action or behavior would be tossing a coin. The outcome is not influenced by wider contextual factors and will always be one of 2 outcomes—heads or tails. However, in complex systems, the context in which policies are introduced and the ways in which people respond to policies are constantly evolving. This makes it difficult for policymakers to predict the outcomes of actions that are introduced within complex systems.

In contrast to the traditional static approach to policymaking, “adaptive policies” are designed to allow for uncertainty about future system behaviors, and how the system will respond to interventions or “events.” Adaptive policies include, by design, mechanisms to adapt or change over time based on future developments and learning.20 Adaptive policies are not intended to be optimal for a single “expected future,” but rather, to be flexible and able to change in response to emerging situations, and thus remain robust across a range of possible futures.20,21 Through adaptive management—a structured iterative process of decision making that embraces learning and adaptation—policies can continue to perform optimally to achieve their objectives, despite the changing context in which they operate.21 The concepts of adaptive policies and adaptive management are similar to the Plan, Do, Check, Act cycle,22 in that implementation and outcomes are monitored and the learning is used to revise the initial plan.

![Causal Loop Diagram](image-url)

**Figure 1** — Example of a causal loop diagram. Arrows indicate cause-and-effect relationships. Beside the arrowheads, S means that variables change in the same direction (increase → increase; decrease → decrease), and O means that variables change in opposite directions (increase → decrease; decrease → increase). The R inside the clockwise loop indicates a reinforcing feedback loop. The B inside the counterclockwise loop indicates a balancing feedback loop.
As an example, an adaptive policy could include, as part of its implementation plan, the resources required for seeking new and additional information at various stages of the policy process. Additional information could include proximal and distal outcomes of the policy, unintended outcomes, or evidence for reducing/widening inequities among certain groups. The adaptive policy implementation plan could also incorporate feedback and monitoring of actions, and reactions, from different actors in the system, to inform necessary adaptations. In the case of the coal consumption example above, an adaptive approach to policymaking could ensure that the cost of coal is adjusted based on usage, such that the overall cost of use remains the same or higher, reducing the risk of increased resource utilization. In regard to the free swimming program, information pertaining to inequalities could have been used to adapt the approach, for example, by restricting the offer to the most deprived communities, given the link between both family location and affluence on swimming ability.

The Relevance of Adaptive Policies to Physical Inactivity

There are several reasons why actions to reduce physical inactivity may benefit from adaptive policies. First, achieving sustained, higher levels of physical activity requires a reconfiguration of the underlying systems (ie, changes to the way systems are structured and operate), but these kinds of reconfigurations can trigger systemic resistance and other unpredictable and/or unintended responses and consequences. For example, the introduction of road user charging, with the goal of reducing motor vehicle volume, improving traffic flow, and creating a safer and more appealing environment for walking and cycling, could lead to widespread resistance from drivers and businesses. While this policy might indeed be effective at reducing motor vehicle volumes, reducing congestion is likely to facilitate higher vehicle speeds, potentially reducing road safety, leading to higher numbers of collisions and casualties, and discouraging active travel.

Second, the world is changing at a rapid pace. The COVID-19 pandemic caused major disruption to daily life, including physical activity patterns—with lockdowns, closures of sports facilities, and changes to working practices. Many policies developed prior to the pandemic quickly became unfulfilled as individuals found themselves in. For example, workplace policies to encourage a reduction in car use (such as reduced parking spaces, increased parking prices, and the introduction of “park and ride” bus services) became redundant when populations were encouraged to work from home. The world is expected to experience further extreme events, emphasizing the importance of designing policies that are capable of adapting to an uncertain future.

Third, policy objectives change over time, as do the most appropriate approaches to tackling problems (including physical inactivity) in a given context. As an example, many countries have imposed fuel taxes to discourage use of fossil fuels, reducing carbon emissions while also reducing vehicle use and incentivizing active travel. However, a transition towards electric vehicles reduces the influence of such taxes on travel behavior, meaning alternative policies—such as road user charging—will need to be introduced to achieve similar aims.

Adaptive Policy Development

Swanson et al outline 4 key interrelated features of adaptive policies: (1) they are designed to perform well in a range of anticipated conditions, (2) can accommodate unanticipated changes in context, (3) have built-in processes for monitoring and identification of changes in context that can impact the policy’s performance, and (4) have built-in mechanisms to trigger adjustments when the policy actions no longer meet the objectives. Decision makers at all levels, within government, nongovernment, and private sector organizations, have a key role to play in formulating and implementing public policies that promote physical activity. To assist decision makers, Swanson et al propose 7 guiding principles to support the development and implementation of adaptive policies: (1) using integrated and forward-looking analysis, (2) monitoring key performance indicators to trigger built-in policy adjustments, (3) undertaking formal policy review and continuous learning, (4) using multistakeholder deliberation, (5) enabling self-organization and social networking, (6) decentralizing decision making to the lowest and most effective jurisdictional level, and (7) promoting variation in policy responses. A brief description of each of these principles is provided in Table 1.

The Application of Adaptive Policies to Counter Systems Archetypes

Some of the issues observed in physical activity promotion strategies can be mapped onto systems archetypes. Adaptive policies are particularly appropriate when it is necessary to avoid or counter unwanted patterns of behavior of a dynamic system, as characterized by the archetypes. Below, we provide examples of 3 systems archetypes that can be applied to physical activity promotion and illustrate how adaptive policymaking could be utilized to avoid or counter these. These archetypes are perhaps the most commonly observed in physical activity promotion. The examples are hypothetical and were developed through consideration of Swanson et al’s 7 guiding principles described above. For each example, we provide a causal loop diagram to illustrate the structure and feedbacks of the system (in solid lines), and how the adaptive policy approach could modify the system state (in dotted lines).

System Archetype 1: Growth and Underinvestment

An erosion of the system’s performance can happen when a period of growth or progress is observed, and a decision is made to reduce investment. The initial period of growth leads to a reduction in the gap between the desired (goal) and perceived system state, leading decision makers to believe that less investment is now required to close the remaining gap. As a result of reduced investment, fewer corrective actions are taken and the system’s performance is lowered, leading to a gradual erosion of the initial observed success. In practice, initial growth is often easy, but becomes progressively harder over time, meaning that increased investment—rather than a reduction in investment—is necessary to sustain and grow the initial observed success.

For instance, a company could make a policy decision to increase active travel among its employees. To achieve this policy objective, the company decides to implement a cycle-to-work initiative, with a goal to increase the number of employees cycling to work by 15 percentage points in 3 years. At the beginning, the company invests heavily in actions that create conditions to close the gap between desired and current levels of cycling to work, for example, improved cycling infrastructure in the surrounding area, increased bicycle storage, the installation of changing facilities in its buildings, and financial support for employees seeking to purchase a bicycle. After the first 18 months, levels of cycling to work increase by 10 percentage points. However, as the gap between the desired and current levels of cycling is now only 5
percentage points, the company stalls investments, as it considers that less is needed to close the remaining gap. Less action leads to fewer people adopting the behavior, and even some returning to old travel habits. At the end of the 3-year period, levels of cycling to work have only increased by 8 percentage points from baseline.

The company decides to keep the initiative for another 3 years but sets a goal of an 8-percentage-point increase because it seems more realistic (“we did all we could the first time, and this is the best we can achieve”), which sets the conditions for further erosion of investment and performance (Figure 2).

Table 1  Guiding Principles for Adaptive Policies

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Using integrated and forward-looking analysis</td>
<td>Identify, to the extent possible, the key factors that might influence the performance of the policy and develop indicators that could be used to trigger a policy review and/or adjustment</td>
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<td>2. Monitoring key performance indicators to trigger built-in policy adjustments</td>
<td>Monitor key indicators to understand how well the policy is performing and to trigger (ideally built-in) policy adjustments</td>
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<tr>
<td>3. Undertaking formal policy review and continuous learning</td>
<td>Ongoing review, using preset processes, should be undertaken, even when a policy is perceived to be performing well, and may help in identifying unanticipated circumstances and emerging issues</td>
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<tr>
<td>4. Using multistakeholder deliberation</td>
<td>Seeking input from a range of stakeholders in the development of a policy can help to ensure a range of perspectives and insights are considered, which can strengthen policy design</td>
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<tr>
<td>5. Enabling self-organization and social networking</td>
<td>Those involved in the operation of the system are usually best placed to spot problems and develop innovative solutions; thus, the creation of forums and social networking should be encouraged</td>
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<tr>
<td>6. Decentralizing decision making to the lowest and most effective jurisdictional level</td>
<td>Assigning decision-making power to people close to those affected by a policy can help in gaining feedback about problems and effects, and facilitate well-informed decisions</td>
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<tr>
<td>7. Promoting variation in policy responses</td>
<td>Implementing a range of strategies to address the same issue increases the likelihood of the policy objective being achieved and can enhance the chances of policy success when faced with unanticipated conditions</td>
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Figure 2 — Example of the “growth and underinvestment” archetype applied to physical activity promotion (in solid lines), and possible actions triggered by an adaptive policy to counteract it (in dotted lines). S = variables change in the same direction (increase → increase; decrease → decrease). O = variables change in opposite directions (increase → decrease; decrease → increase). ⊥ = delay.
Adaptive Policies to Reduce Physical Inactivity

One way to avoid a “growth and underinvestment” scenario is to build-in mechanisms for monitoring and increasing demand. For example, by monitoring the number of people contemplating the transition to cycling (or reverting to old travel habits) and the barriers and facilitators for these transitions, in addition to levels of cycling to work, reductions in demand could trigger built-in adjustments that make demand increase again. This could be achieved via campaigns and events that increase the social desirability of cycling, or that address the main barriers for employees to start cycling to work. This increase in demand could in turn encourage investment to sustain and expand the initiative.

**System Archetype 2: Limits to Success**

A system’s performance can deteriorate even with increases in resources and efforts. In a “limits to success” scenario, an increase in resources and efforts initially leads to improved performance, which stimulates more resources and efforts to be employed. However, as the system reaches its limits, its performance stabilizes or deteriorates, even if resources and efforts continue to rise.

For example, a city may commit to increasing active travel and invest in a range of actions. The city might be encouraged to increase their investment as they observe a cumulative modal shift happening. However, the marginal increases in active transport levels start to stall after some time, even though investments are at a record high. With no observed increases—and facing political pressure from those arguing for investment in vehicular transport—the city decides to divert investment from active to motorized travel, which is followed by a reduction in active transport levels (Figure 3).

In terms of the application of adaptive policies, it is key in this scenario to monitor patterns in active travel behavior over time. Undertaking formal policy review may help in identifying unanticipated circumstances or emerging issues. In the “limits to success” archetype, there is usually something within the system that is limiting further progress. Until the success limiting factor is identified and eliminated, further investment along existing lines will continue to yield disappointing results. For example, if cycle lanes and cycle storage have reached capacity, any additional uptake would lead to worse system performance thereby discouraging usage. By understanding the success limiting factor, the investment can be reoriented toward eliminating the problem, for example, widening cycle lanes or installing additional bicycle storage, which should lead to continued positive trends in active travel behavior. Multistakeholder deliberations, including with those who travel actively and those who do not, can provide insights to strengthen the design and implementation of a range of actions.

**System Archetype 3: Fixes That Fail**

Some policy solutions may aggravate the very problem they are trying to address. While they may seem effective to solve the problem in the short term, they divert attention away from more fundamental solutions and generate long-term unintended consequences that can make the original problem return, sometimes worse. This cycle is exacerbated because the implemented solution alleviates observed symptoms but does not address the underlying causes of the problem.

Strategies to reduce inequalities in physical activity practice can result in a “fixes that fail” situation. For instance, a local authority might commit to reducing inequalities by promoting physical activity in the most deprived communities. As one part of the implementation plan, the local authority decides to invest in the renovation of a public park in a disadvantaged community, which could attain short-term success in promoting physical activity among the local population. However, in the longer term, this action could increase inequalities as people from more affluent areas start to use the park as well, leading the local people to feel that “they do not belong there,” exacerbating their experience of gentrification, disenfranchisement, and lack of access to places and opportunities for physical activity. This could lead to even lower usage of the park among disadvantaged communities than that observed prior to the renovation; thus, the “fix” could actually worsen the original problem (Figure 4).

There are a range of ways in which the principles of adaptive policies could be applied to this example. In terms of monitoring key performance indicators, there is a need not only to monitor park usage but to include measurement of the sociodemographic mix of users to understand whether the renovation is achieving the desired goal of increasing physical activity levels among the local population, both in the short and longer term. If, over time, it is observed that park usage among the locals is decreasing, as more people travel to the park from affluent areas, further action could be taken.
to counteract this unintended consequence. Enabling self-organization and social networking among local community members would facilitate the development of innovative solutions. Implementing a variety of small-scale approaches to tackle the same problem will increase the likelihood of the policy objective being achieved. For example, introducing car parking fees may act as a deterrent to people traveling by car from more affluent areas, but if not, providing additional services at the park (eg, ice cream van and coffee shop) could capitalize on the “park tourism” and generate job opportunities and additional revenue for the local community, contributing to economic development. Research has shown a strong association between deprivation and physical inactivity; thus, growing the local economy may indirectly support the original policy objective of increasing physical activity levels among the local community.

**Discussion**

Increasing population physical activity levels is complex, due to the wide range of factors that influence the behavior. As such, many of the actions taken to promote physical activity have the potential to lead to unintended consequences and even reductions in the behavior in the longer term. For example, a common policy objective is to increase physical activity levels among school-aged children. One approach to achieving this objective in recent years is the establishment of walking school buses, designed to encourage children to walk part of the way to school. While such initiatives may lead to increases in active travel to school, which is the key outcome against which they are typically evaluated, these schemes have the potential to lead to wider unintended consequences. For example, walking school buses may cause children to perceive that walking is a dangerous activity unless accompanied by a leader wearing high visibility clothing, reducing the likelihood of children walking outside of this structured type of program. A more effective long-term solution would be to increase road safety and improve pedestrian infrastructure, creating an environment where children feel encouraged and safe to walk. A further example is daily running programs to increase children’s physical activity during the school day. While such programs could lead to short-term increases in physical activity among school children, requiring children to run every day could create negative experiences of physical activity. This negative experience might be felt most intensely by the least active or overweight children, leading to further disengagement from physical activity in the future. Thus, the policy objective of helping the least active school-aged children to become more active may not be realized through these sorts of programs. The value of a systems approach is that it encourages a broader view of the system, and the wider consequences of these sorts of programs, to recognize instances when the policy objective is not being achieved, such that modifications to the course of action can be made.

It is important to support policymakers to move away from short-term “fixes” (including programs such as walking school buses), to considering the steps needed to reconfigure the physical activity system to support populations to be more active. Foundational steps to achieve system-wide change may not yield short-term “successes,” which can be politically uncomfortable given the pressures on policymakers to demonstrate impact. However, without a longer-term vision for system-wide change, policies are unlikely to achieve a sustained increase in population levels of physical activity.

There is also a need to shift the approach to policymaking away from solely “static” policies, to considering adaptive approaches that are more able to deal with uncertainty and changing conditions. In many cases, it is unlikely that a policy is fully “static” or fully “adaptive,” rather policies are situated along a static-adaptive continuum. Therefore, it is not a case of adopting static or adaptive policies; rather, we argue that there are situations in which adaptive policymaking would be more effective at achieving the fundamental, widespread, and sustained changes that are required globally to change population levels of physical activity.

A key challenge will be engaging policymakers to take a broader perspective of the physical activity system, develop policies that are designed to be adaptable across a range of different future scenarios, and embrace uncertainty and long-term adaptability. Success in this aim will require collaboration between policymakers, citizens, academic experts, and other stakeholders to co-create policy responses that take account of the complexities of the systems in which we are intervening.

With a move towards more adaptive policies, there is a need to consider the approach taken to evaluate policies and programs. To date, evidence has typically been generated using methods that are more appropriate for testing the effectiveness of clinical interventions. Such approaches are grounded in linear models of cause and effect, which limits understanding of the broader impacts of an intervention on the system. In addition, adaptive management should be embraced, facilitating ongoing learning about the implementation and outcomes of policies and programs, such that modifications can be made to maximize the gains and avoid negative unintended consequences.

**Conclusions**

This is the first paper to introduce how the concept of adaptive policies could be applied to physical activity. We have provided a range of examples to illustrate how adaptive policies could be used to overcome systems archetypes in physical activity promotion. While the examples are hypothetical, they highlight how changes...
References


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