Review

What are the components of complex interventions in healthcare? Theorizing approaches to parts, powers and the whole intervention

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A B S T R A C T
The components of complex interventions are frequently discussed, invoked and examined in theory and research but seldom defined. This leads to theoretical and ontological ambiguities, lack of methodological transparency, and potentially, resistance to the wider movement towards complex intervention. This paper is the first to compare and contrast the different approaches that can be taken to the components of complex interventions. Most basically, complex interventions are defined as being composed of parts that make the whole intervention and, in isolation or combination, can generate the power of the intervention. Examples from the field of cardiac rehabilitation are used to illustrate key points. In relation to complex interventions past approaches variously: downplay complexity, focus on the complicatedness of complex interventions, or emphasize the complexity of complex interventions. Thus, approaches can be categorized as viewing components variously as: (1) Non existent parts and powers; (2) Irrelevant parts and powers; (3) Undifferentiated powerful parts; (4) Higher order parts and non-existent lower parts; (5) Higher order parts with non-powerful lower order parts; (6) Higher and lower order parts with powers; and (7) Components as the parts and the whole with powers. Based on this overview, complex interventions should be defined as being formed of parts, which can be material, human, theoretical, social, or procedural in nature, possibly stratified into higher and lower realms, that exercise power individually, in combination, or as emergent properties.

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Introduction

What are the components of complex interventions? This paper is the first to explore how the components of complex interventions can and should be understood and researched. It analyzes the different stances or conceptualizations that can be taken to the components of complex interventions and compares and contrasts the different ways in which components have been understood to cause changes in outcomes from these interventions. This examination is important because like other key sociological concepts, such as social structure (Elder-Vass, 2010; Scott, 2001) and causality (Thompson, 2011), components are everywhere and nowhere - commonly discussed and often invoked but seldom defined (Petticrew, 2011).

Components are defined in this discussion as being the parts of the complex intervention that are distinct from but compose the whole of the intervention in full or part. From this basis, the ‘components’ of complex interventions are now recognized as being important and researchable aspects of interventions at every stage of the research process (Bartholomew, Parcel, & Kok, 1998; Campbell et al., 2007; Glasgow, 2008; Pawson & Tilley, 1997; Sridharan & Nakaima, 2011). For example, investigators are encouraged to use and develop theory to optimize the design of components of interventions prior to formal large-scale evaluation in trials (Medical Research Council, 2008). Taxonomies have been developed to describe components more systematically whether these components relate to content (Krumholz et al., 2006) or theoretical basis (Abraham & Michie, 2008). Researchers are increasingly required to measure or describe components of complex interventions in data collection (Glasgow, 2008; Medical Research Council, 2008) and, via new CONSORT guidelines, for reporting (Boutron et al., 2008). Research can then explore which components contribute most or are essential to successful interventions, which are superfluous and how the components interact to influence outcomes (Craig et al., 2008).

Deeper consideration of the nature of the components of complex interventions is timely because of growth in the complexity intervention movement. The distinctive notion of the ‘complex intervention’ has emerged over the last decade through debate focused on what complex interventions are and how their components should be described (Davidson et al., 2003) and
evaluated (Campbell et al., 2007; Craig et al., 2008; Medical Research Council, 2000; Murray et al., 2010; Pawson & Tilley, 1997; Petticrew, 2011; Rogers, 2008; Shiel, Hawe, & Gold, 2008). Most notably, a group from the Medical Research Council (Medical Research Council, 2008) presented practical guidance to researchers on how to develop and evaluate complex interventions (henceforth: MRC framework) which were defined as ‘interventions with several interacting components such as occur in health service, public health and social policy’ (page 6).

As such, complex interventions can encompass a wide variety of non-pharmacological interventions, including those that seek to foster behavioral change at the individual level (Michie, Fixsen, Grimshaw, & Eccles, 2009) such as weight reduction programs, population-wide public health strategies (Ogilvie et al., 2011); public smoking bans, or strategies to promote organizational change in health care settings; patient safety initiatives (Paterson, Baarts, Launso, & Verhoef, 2009). Throughout this paper, examples of cardiac rehabilitation will be used to illustrate key points about complex interventions. These complex interventions focus on providing support to people with heart disease to foster changes in health behaviors associated with higher risk of cardiovascular disease, notably: smoking, unhealthy diet and weight, sedentary lifestyles and poor psychosocial wellbeing.

A consideration of how the components of complex interventions can be viewed brings to the fore important but often tacit ontological assumptions about the nature of components and their relationship with other aspects of interventions, such as its context, mechanism and the whole intervention. This is not only theoretically important but has practical implications because an appreciation of the differences in approaches to components should foster greater methodological clarity and higher coherence between the theory and methods underpinning research (Petticrew, 2011). As such, the paper adds to but complements other recent work that maps or theorizes different approaches to elements of complex interventions, including: the mechanisms through which these interventions work (Astbury & Leeuw, 2010), the outcomes of these interventions (Paterson et al., 2009), how the interventions cause change (Thompson, 2011), and the interventions themselves (Clark, Hartling, Vandermeer, Lissel, & McAlistier, 2007; Clark, MacIntyre, & Cruickshank, 2007; Hawe, Shell, & Riley, 2009).

**Complex interventions: as complicated and as having complexity**

Prior to discussing the range of approaches to components, it is important to consider the context from which such discussions have arisen: research and theory into ‘complex interventions’ (Greenhalgh, Pseki, Wilson, Fraser, & Holt, 2010) and, more specifically, what is complex about complex interventions. This is important because ‘the complex’ and the terms associated with complexity are often used interchangeably or inconsistently (Glouberman & Zimmerman, 2002; Mohammadi, 2010; Paley, 2007; Rogers, 2008) but are central to different perspectives that can be taken to components. Approaches to complex interventions can adopt different views of what ‘complex’ means (Shiel et al., 2008). Complex interventions can be viewed as being either complicated or, alternatively, as possessing the properties of complex systems, that is, of having complexity (Rogers, 2008; Shiel et al., 2008). The activities required to send a rocket to the moon are ‘complicated’ because this requires appropriate formulae, expertise and, to lessen risk, precedence, that is, past experience of how to do this successfully (Glouberman & Zimmerman, 2002). Yet, if these steps are followed, success is relatively well assured.

As applied to complex interventions, Shiel et al. (2008) argue that this complicated view of interventions is exemplified by the MRC framework (Medical Research Council, 2008), which views interventions as being composed of multiple ‘components’ that interact and involve behaviours (either in those delivering or receiving the intervention) with the purpose of changing one or more outcomes (Campbell et al., 2007; Craig et al., 2008). Work using this complicated-lens has drawn attention to the combined and separate influence of organizational, social, cultural and geographical systems on intervention effects (Campbell et al., 2007).

In contrast, taking a complexity-driven view, the activities required to raise a child successfully have ‘complexity’ because formulae have limited application, too many factors are potentially involved, past experience provides limited assurance of future success, and every child is unique (Glouberman & Zimmerman, 2002). As such, even with ostensibly the same parenting approach and actions, the outcome of raising a child is far less certain than sending a rocket to the moon.

This latter approach posits that complex interventions have the properties of complex systems (Hawe et al., 2009; Shiel et al., 2008). In health, this approach to complexity was prominently stated in a series of papers published in the British Medical Journal in the early 2000’s that recognized overtly the complex nature, not only of health and illness but also policies, strategies, initiatives, and programs intended to improve health (Fraser & Greenhalgh, 2001; Pseki & Greenhalgh, 2001; Wilson & Holt, 2001). From this perspective, complex interventions have similar properties to the complexity of the wider systems in which such interventions are introduced (Shiel et al., 2008). In this way, the complex intervention is viewed as being composed of nested systems which function in non-linear ways without clear, direct consistent links between characteristics of the interventions and particular outcomes (Shiel et al., 2008). Other characteristics of complex systems may also be ascribed to the complex intervention, such as the possession of feedback loops which function to provide information back to the providers, recipients or other systems involved in the intervention that may modify aspects of performance of the intervention (Fraser & Greenhalgh, 2001; Mohammadi, 2010; Pseki & Greenhalgh, 2001). For example, the presence of patient satisfaction surveys to solicit user feedback for providers of a cardiac rehabilitation intervention may foster ongoing evolution of the other components of these services when these providers hold values and undertake practices that show commitment to continuous quality improvement. Recourse to the characteristics that are taken to matter in complex interventions may also be made using theory about which factors matter most. For example, particular complexity theories, such as complex adaptive systems theory (Jordon, Lanham, Anderson, & McDaniel, 2010) or normalization process theory (Murray et al., 2010) or frameworks, such as realist evaluation, draw attention to particular factors, such as the importance of the mechanisms through which interventions work (Pawson & Tilley, 1997).

To reprise: debate, research and theory into complex interventions continues to grow. Irrespective of whether complex interventions are viewed in terms of complexity or complicatedness, components are seen to be important but are often discussed ambiguously or vaguely. It is timely then to consider the various ways in which components have been theorized to date.

**Complex interventions: parts, wholes and powers**

Before addressing the different ways in which components have been theorized in complex interventions, three key common conceptual building blocks are required, the:
• Parts of the complex intervention
• Whole of the complex intervention
• Powers of the parts and whole of the complex intervention

The ‘parts of the complex intervention’ are the characteristics of the intervention that are distinct from but, in full or in part, compose the whole of the intervention. These parts can be material, human, theoretical, social, or procedural and micro or macro in nature and may themselves have parts. For example, the parts of a cardiac rehabilitation intervention to promote healthy behaviors in people with heart disease conceivably consist of the following parts: (1) Content to support smoking cessation, regular physical activity, healthy diet and psychosocial wellbeing, (2) The means through which this content is provided to patients, such as group-based education or email, (3) The research basis on which support is offered, most appropriately: clinical guidelines, (4) The health professionals who provide the interventions, such as a multidisciplinary health care team, (5) The theoretical basis guiding the intervention, such as ‘stage of behavioral change’, and (6) The settings in which the intervention is provided, such as a hospital (Abraham & Michie, 2008; Davidson et al., 2003; Michie & Prestwich, 2010; Whitlock, Lin, Chou, Shekelle, & Robinson, 2008).

The ‘Whole’ of the reference refers to the intervention as a single whole entity as distinct from the parts that compose it. Using the previous example, this would be the ‘cardiac rehabilitation’ intervention. The existence of the whole of the intervention depends on its parts — without the parts stated, no cardiac rehabilitation could be said to exist. However, some approaches view the whole as being more than the parts that compose it — as such the parts are insufficient to explain changes in the intervention’s outcomes. For example, just as a ‘social group’ can be seen as real and conceptually distinct from the individuals composing the group (Sawyer, 2005), so the whole of the intervention can be seen to be distinct from the parts and have more or different powers than the aggregate powers of the parts (Elder-Vass, 2010).

Finally, the ‘powers of the intervention’ refers to the causal powers or properties that are generated by the intervention. This concept of causal power is common in theories of causality (Elder-Vass, 2010). For a cardiac rehabilitation intervention, this refers to the ability of the intervention to influence key health behaviors associated with the risk of heart disease. Indeed, interventions only gain the capacity to lead to changes in outcomes by having causal powers(s). Depending on the perspective taken, causal powers may be viewed as arising from the parts and possibly the whole.

Powers are distinct from the mechanisms of the intervention which refer to the underlying reasons why powers have the effects that they do (Elder-Vass, 2010). There are underlying mechanistic explanations for why water is a liquid, solid or gas at different temperatures but these are distinct from any causal powers that water has in a particular state, such as to extinguish fire when a liquid (Elder-Vass, 2010). Hence, a cardiac rehabilitation intervention may accrue the causal power to increase physical activity through its ability to trigger mechanisms associated with increased social wellbeing, camaraderie with other people with heart disease, and more opportunities to exercise in social settings (Clark, Hartling, Vandermeer, & McAlister, 2005a, 2005b).

Using these key concepts of parts, whole and causal powers, a variety of approaches can be taken to the nature of components of complex interventions. As will be shown, components can be viewed as:

Downplaying the complex

Approach 1: Components as non-existent parts and powers
Approach 2: Components as irrelevant parts and powers

The complicatedness of complex interventions

Approach 3: Components as undifferentiated powerful parts

The complexity of complex interventions

Approach 4: Components as powerful higher order parts and non-existent lower parts
Approach 5: Components as powerful higher order parts with non-powerful lower order parts
Approach 6: Components as powerful higher and lower order parts
Approach 7: Components as powerful parts and the whole

Components as non-existent parts and powers

Two approaches to components define parts by their absence or irrelevance, effectively writing components out by viewing interventions exclusively as ‘wholes’ (Fig. 1: Approaches 1 and 2). This occurs when complex interventions are viewed and researched as if they are single ‘undifferentiated’ interventions without any discrete parts. For example, the early meta-analyses of cardiac rehabilitation programs for patients after a heart attack examined the effects of interventions without any attempt to distinguish analytically between any of the intervention’s different parts, such as exercise type(s), and duration and intensity of exercise programs (O’Conner, Buring, & Yusuf, 1989; Oldridge, Guyatt, Fischer, & Rimm, 1988). The parts of the interventions included were not described in any detail nor the influence of these parts examined via sensitivity or sub-analysis (Clark, MacIntyre, et al., 2007). Components may be defined by their absence either because the parts of the intervention and any powers that may result from these parts are viewed as non-existent (Approach 1) or these parts are judged to be insufficiently important (analytically, ontologically or otherwise) in terms of power to justify overt identification, separation, or exploration in terms of existence or powers (Approach 2).

Yet, focussing only on the powers of the whole intervention, thereby removing the parts from conception and analysis, renders potentially influential parts of the intervention to be unnamable to research (Clark, MacIntyre, et al., 2007). Complex interventions are thus reduced to something akin to a tablet (Clark, MacIntyre, et al., 2007) or single treatment (Pawson, 2006b) in which the complex intervention is seen to be a single agent with no description of the parts or exploration of the powers of these parts. In practice, this

Approach 1: Components as non-existent parts and powers

Approach 2: Components as irrelevant parts and powers

Fig. 1. Approaches that downplay the complex.
removal can occur either in primary studies or when studies are pooled or compared in systematic review (Pawson, 2006b). Some accounts view the process of 'writing out' parts of the intervention to begin when researchers write up studies for publication to disciplinary audiences and filter their articles for audiences which are disposed to view some parts as being particularly more or less important (Dolby, 1996). Overall, this lack of recourse to the parts of the intervention limits the capacity of research to identify the relative influence of different parts of the intervention on outcomes.

Finally, it is important also to recognize that there are occasions when the line between whole interventions and parts is unclear. This occurs when whole interventions are defined by the presence of a single part and all other parts are removed from consideration, or when a single part becomes equated with the whole of the intervention. Cardiac rehabilitation interventions are notably diverse in terms of parts, for example, in terms of content, theoretical basis, professions of providers, and setting. However, recent debate and research has occurred principally around the merits and demerits of programs defined by single parts – most notably the setting in which most of the intervention is provided: the home, hospital or via telehealth. In this way, elements that may have been considered parts of complex interventions come to be defined over time as being synonymous with the whole intervention, that is, a home-based cardiac rehabilitation program.

Recognizing complexity

The complicatedness and complexity of complex interventions

Approaches which posit that complex interventions are complicated or have complexity, almost by definition, view components as being important parts of interventions that exist and may explain the powers of the intervention. As such, these approaches recognize that a complex intervention cannot be understood as a single undifferentiated ‘whole’ intervention. Rather, it is possible and useful to develop, describe and uncover the relative and cumulative contribution of different parts of the intervention (Sridharan & Nakaima, 2011).

The remaining approaches to components all share this compositional view. This means the existence of the intervention is taken to depend on the existence of its parts and any power(s) the intervention has depends on the properties of those parts (Elder-Vass, 2010). While the parts may only become powerful when they interact with factors outside of the intervention, nevertheless: the parts possess potential or actual powers. This definition draws a distinction between components and other aspects of or germane to interventions, such as the context in which the intervention occurs, its mechanisms and, importantly, the intervention as a ‘whole.’

This compositional view has its roots in the manner in which scientists have historically sought to understand complex phenomena (particularly in systems) by reducing these to component parts in the hope of discovering the underlying parts and powers that explain events and phenomena (Sawyer, 2005). Whether interventions are viewed as being complicated or having complexity, a wide range of parts can be seen to affect the outcome of the complex intervention, including: individual human phenomena such as how people see, understand and experience the interventions in relation to their bodies, beliefs, attitudes, knowledge, skills and values (Clark, Fryedberg, et al., 2009; Clark, Savard, et al., 2009; Glass & McAtee, 2006), upstream factors such as cultural and social norms (Wiltshire, Bancroft, Amos, & Parry, 2001), and potentially, factors that are external to the intervention, including aspects of communities (Putnam, 2000), geography (Gatrell, 2005), places (Macintyre, Ellaway, & Cummins, 2002) and history (Freydberg et al., 2010). These parts may be cited in frameworks to support research of components (Campbell et al., 2007) or invoked in any theories that researchers use to conceptualize complex interventions (Byrne, 2005).

Defining components as the main parts of an intervention is probably the most widespread current approach to components but still leaves considerable scope for how components are understood. Within these perspectives, four approaches are noted here, from the view that interventions are complicated, that components are: undifferentiated powerful parts (Approach 3; Fig. 2) and from the view that components have complexity (Fig. 3) that components are: higher order parts with non-existent lower order parts (Approach 4), higher order parts with non-powerful lower order parts (Approach 5) and higher and lower order parts with powers (Approach 6).

The complicatedness of complex interventions

Approach 3: Components as undifferentiated powerful parts

Components can be seen as the powerful parts of complex interventions in the absence of any hierarchy or similar organization regarding the nature and power of the intervention. This view of components as undifferentiated powerful parts is clearest in approaches that view complex interventions as being complicated (Shiell et al., 2008) (Fig. 2). For example, the MRC framework states that components are different from other parts of interventions when it asks researchers to classify: “the variant forms of a complex intervention, in terms of components, mode of delivery or intensity, in order to make sense of variability in outcomes...” (Medical Research Council, 2008 page 14) This implies that components are only the main content strands of the complex intervention and equates components with some kind of primary characteristics – those parts from which the intervention mostly attains its power. Alternatively, in relation to what counts as a component, other approaches view components as a wider range of parts, extending from content/elements to characteristics of the intervention’s provider, format, setting, recipients, intensity, duration, and fidelity (Davidson et al., 2003).

These approaches propose no clear hierarchy or organization of the components and assume a direct relationship between powerful parts and the outcomes of the complex intervention. Hence, the intervention’s powers are seen to result from the presence of particular components in a linear way. The ontology implicit in this approach is common in the evidence-based practice movement (Clegg, 2005) and adopts a view of causation which views outcomes as being directly consequential of the presence of particular parts (Clegg, 2005; Pawson, 2006b). Thus, outcomes from the complex intervention are assumed to be highly consistent in the presence of powerful parts – the ‘recipe’ of what is needed to make the complex intervention most powerful is taken to be knowable and this is what science seeks to find. In terms of ontology, the more linear view of causation implicit in this approach appeals to policy makers and government who simultaneously recognize the complicatedness of complex interventions.

Approach 3: Components as undifferentiated powerful parts

![Fig. 2. Approaches that emphasize complicatedness.](image-url)
but often want relatively simple solutions to problems (Clegg, 2005; Pawson, 2006b). This view of causation has been widely criticized because causation does not operate in such consistent straightforward ways, particularly as complex interventions involve human behavior in providing or receiving the intervention or its outcomes (Byrne, 2005). This linear ontology, it is argued, gives a false sense of patterning and even certainty that is contradicted by the inconsistent results of studies of complex interventions in trials, meta-analyses and policy (Clark, MacIntyre, et al., 2007; Pawson, 2006b; Pawson & Tilley, 1997).

Within this approach, what then determines which parts of the intervention are labelled powerful or potentially powerful parts? The selection of particular parts as potentially or actually powerful parts appears to be based on a combination of reason, evidence, convention, politics and/or tradition. As noted earlier, cardiac rehabilitation interventions have many parts but are discussed principally in terms of parts relating to intervention content on distinct risk factors, these being: 1) physical activity, 2) diet, 3) smoking and 4) psychosocial wellbeing (Thompson & Bowman, 1995). The selection of these parts over others reflects the emphasis of past research on different risk factors that cardiac rehabilitation has drawn on historically more than actual differences in the interventions. Indeed, cardiac rehabilitation interventions could also be equally classified around other parts, such as program providers, individual versus group provision, content, program length, site of provision or a myriad of other parts around which programs can differ (Clark, Hartling, et al., 2007). Relying on such conventions may inadvertently ignore powerful parts.

Cardiac rehabilitation programs internationally commence four to six weeks after hospital discharge — although there is almost no evidence used to justify this part (Dafoe, Arthur, Stokes, Morrin, & Beaton, 2006). A recent meta-analysis following forty years of research into these interventions found that the timing at which the intervention commences after hospitalization may contribute most to the overall effects of programs (Haykowsky et al., 2011). Indeed, for every week that programs were delayed patients needed to exercise for an additional month to attain comparable health benefit. Yet this part of cardiac rehabilitation has been almost wholly neglected in over four decades of trials and clinical guidelines (Clark et al., 2005b).

Hence, components can be seen to be the parts of the intervention that for empirical, social or cultural reasons, come to be viewed as the powerful parts of the intervention. Yet, this does not
mean they actually are powerful or the most powerful parts of the intervention. More fundamentally, the consistency with which particular parts may exercise these powers is contentious and arises from the approach to causality adopted.

**The complexity of complex interventions**

- **Approach 4**: Components as powerful higher order parts and non-existent lower parts
- **Approach 5**: Components as powerful higher order parts with non-powerful lower order parts
- **Approach 6**: Components as higher and lower order powerful parts

In contrast to the previous approaches, complexity-driven approaches to components grounded in critical realism theorize that the parts of the interventions are stratified and have generative and emergent powers (Byrne, 2004) (Fig. 3). In these approaches parts of the complex intervention are seen to exist and operate in ways that have greater complexity, in particular, in terms of how a causal power is generated by the intervention and, in approaches 5 and 6, the relations of the parts to each other.

Firstly, these approaches take reality to be stratified — the intervention consists of distinct but mutually dependent levels (or ‘strata’) of matter (termed here: higher and lower order parts), which include: social and cultural norms, psychological factors, biological factors, experience, knowledge, beliefs and values (Clark, Lissel, & Davis, 2008; Sayer, 2000). Hence, a complex intervention consists of a wealth of different levels of matter that are dependent on but irreducible to each other.

In contrast to a linear view of causation, critical realist approaches view causation in generative terms, that is, the causal power of an intervention is dependent on a larger number of its parts coming together in particular ways to generate the outcome(s). Small changes in one or a small number of parts could lead to marked changes in outcomes. This generative view of causation posits that a large number of factors have to come together in the right combinations for causation to occur. Using a common example (Clark et al., 2008), even the ostensibly simple act of lighting a candle requires a myriad of different factors to be in place in the right combination. These include: the presence of oxygen in the atmosphere, the absence of a heavy wind, the correct chemical composition of the candle’s wick, match and matchbox, the absence of damp in the wick, the match or matchbox, the presence of a human being physically able to strike the match and sufficiently able to undertake the acts of striking the match and transferring the lit match to the wick in a relatively short amount of time. Should any one of these factors be absent or non-conducive to success, the candle will not light.

In the same way as this example, complex interventions cause changes when parts of the intervention come together under particular circumstances to generate changes in outcomes (Connelly, 2001). When parts are viewed as being stratified to form the whole intervention, even small differences in one part of the intervention may lead to marked larger changes in the outcomes of the complex intervention (Byrne, 2002). These generative causal powers are also prone to temporal changes — causation not necessarily being static over time but prone to shifts in the parts and the causal powers arising from them (Byrne, 2004).

In addition to this generative view, critical realism posits that new and potentially powerful parts may emerge from parts of complex interventions. Emergence approaches in complexity theory date from the 1980’s (Castellani & Hafferty, 2009) and arose from complexity theories about chaos, games and complex adaptive systems (Sawyer, 2005). Emergence-based approaches view societies as complex systems in which behaviors are produced — or emerge — from the interaction of individuals and groups (Sawyer, 2005). From this perspective, new and influential parts of the complex intervention can emerge from the actions and interactions of pre-existing parts of the intervention, such as elements of its content, design, providers or recipients. This can extend the notion of parts from referring only to the primary human, social, or material facets of the intervention at different strata to encompass emergent powers created from the pre-existing components (Easton, 2010; Elder-Vass, 2010).

Using the key concepts of generative causation and emergence, parts of the complex intervention can be categorized into strata of higher and lower order parts that interact to generate outcomes of the intervention and, through emergence, new parts that may be powerful (Approaches 4, 5 and 6). *Higher order parts* refer to a relatively small number of macro parts of the complex intervention that are composed of ‘lower order parts’ which themselves may have other lower order parts. In this way, interventions are stratified into parts that exist in a hierarchy at multiple levels with the existence and power of higher order components being distinct from but dependent on the existence and power of lower order components.

Interventions that are labelled the same in terms of higher-level components may have markedly different lower order components. For example, a cardiac rehabilitation program (Fig. 4) may focus on improving psychosocial health and promoting physical activity. A higher order part of this intervention is then a ‘Psychosocial care’ component focussing on actions intended to promote psychosocial wellbeing. Proponents of approaches 4 and 5 (Fig. 3) may adopt a generative view of causation and describe the existence of this ‘care-related’ part, but not the parts which compose this psychosocial care either because these lower order parts are seen to not exist (Approach 4) or to exist but not be sufficiently powerful (Approach 5). Such lower order parts to the intervention could include: a paper-based patient education manual, telephone-based nurse support using a formalized protocol, and a relaxation audio tape (Lewin, Robertson, Cay, Irving, & Campbell, 1992). Deeper still, just the audio tape part alone may also be seen to contain different lower order parts with dedicated content to address anxiety, depression, and fear via an additional part: a theoretical basis — such as cognitive behavioral therapy.

This stratified nature of components is important because it has implications for reporting, usefulness and translation. The CONSORT statement of the Cochrane Review requires investigators to describe interventions ‘comprehensively’ (Boutron et al., 2008) without clarifying what level of description of components is needed to achieve this. For example, ‘comprehensive’ description could extend from higher to lower order parts or include either part. To increase the

![Fig. 4. A stratified cardiac rehabilitation intervention.](image-url)
usefulness of research for practice and policy, components at different strata should be described in published manuscripts (Glasgow, 2008; Glasgow & Emmons, 2007); however, in the majority of cases neither higher nor lower level components are well reported (Glasziou, Meats, Heneghan, & Shepperd, 2008). This makes it very difficult to implement research findings about the intervention in practice (Glasgow, 2008; Glasziou et al., 2010).

Even adopting a more complexity-centred view, ignoring lower order parts either because they are taken not to exist (Approach 4) or not to have power (Approach 5) effectively ‘writes-out’ lower order parts from research. This risks, as is the case with focussing only on powerful parts with a linear view of causation (Approach 3), ignoring potentially powerful parts. For example, recent meta-analyses examining the small number of studies that do address lower order parts of cardiac rehabilitation programs identified that programs that incorporated individualization of content and care strands were 25 times more effective at reducing hospitalization as programs with standardized content (Clark et al., 2005a). Yet, discussions about program effectiveness over the past two decades have focused on higher order factors, as noted, particularly the setting (hospital versus home) in which programs were delivered (Clark, Hartling, et al., 2007).

As before, the selection of particular parts as constituting higher order components may initially appear arbitrary (Clark, Freydberg, et al., 2009; Clark, Savard, et al., 2009; Clark & Thompson, 2008). However, it likely reflects parameters of past and current political, disciplinary, and epistemological debate that has framed interventions as being of particular ‘types’ and then compared and contrasted interventions around these types (Dolby, 1996; Again, this may ignore parts that may actually be pivotal to explaining its effects in terms of causal powers (Pawson, 2006a, 2006a).

Higher or lower parts: which are more important?

Hence, approach 6 goes deeper to describe and explore the nature and powers of the lower order parts which compose the higher order parts and how these powers interact together to create emergent powers. This approach (Fig. 3) invokes both higher and lower order parts but disagreements can still occur over the relative influence of higher versus lower parts. Recognizing the power of lower order parts on interventions is well established through the notion of the ‘butterfly’ effect – the sense that a small change in a lower order part can cause a large change (or phase-shift) in outcomes at a much higher level (Byrne, 1998, 2002). For example, the values or ethos of the professionals involved in delivery of a cardiac rehabilitation intervention may have a marked effect on whether the intervention is effective in motivating individual patients to engage in behavioural change (Clark, Barbour, & MacIntyre, 2002). The powers of such lower order parts can be hard to detect with research, given the likely number and complexity of lower order parts. However, with complexity approaches, research should measure and understand the effects of a greater number of lower order parts of programs.

However, others disagree. The concept of supervenience describes how higher level parts are causally more important than lower level parts (Sawyer, 2005). Moreover, the higher level powers influencing an intervention may also include factors related to context — for example — realist evaluation pointedly assumes that it is not only the parts of interventions (whether higher or lower) that are important to the intervention’s powers but also the context in which the intervention is provided and the mechanisms through which it works (Pawson & Tilley, 1997).

**Approach 7: Components as the parts and the whole with powers**

The final approach, grounded also in theory, recognizes that the power of the intervention results from either or both the actions of its parts (whether higher and/or lower order) and also from the whole of the intervention. Hence, both the parts and the whole are viewed as existing and being potentially powerful (Fig. 5).

This recognition that interventions have powers that arise from the whole is not inherently antithetical to complexity. Drawing on realist emergence theory (Elder-Vass, 2010), the powers of the intervention as a whole may not be possessed by its parts but formed from the relations and interactions between these parts in terms of the whole intervention. The parts then have emergent powers with no part being understood without reference to other parts within the broader system and the whole of the system (Sawyer, 2005). It is from the relationships between the parts and the whole that new powers are produced (Elder-Vass, 2010).

In this manner, the whole and components are viewed in the same terms as being structures that have causal power (Elder-Vass, 2010). Though the existence of the whole of the intervention is dependent on the existence of the respective components, the causal power of the intervention can lie at both levels (Elder-Vass, 2010). For example, a cardiac rehabilitation intervention that provides support for psychosocial wellbeing and physical activity (Fig. 4) may offer added benefits over two separate interventions that address these factors.

**Implications for research and theory**

The different approaches to the components of complex interventions presented each focus on the parts and powers of these interventions and, respectively, downplay complexity (Approaches 1 and 2), focus on complicatedness (Approach 3) or emphasize complexity in terms of the parts (Approaches 4–6) and also the whole of the intervention (Approach 7). These categorizations represent an attempt to capture the variety and implications of current conceptions of components. In practice, the conceptions

![Fig. 5. Approaches that emphasize complexity (ii)](image-url)
adopted in research and theory may cross these distinctions and subtle but salient variations may exist within the broader approaches identified.

The approaches noted to the components of complex interventions echo other work around theory-driven evaluation, particularly, approaches 6 and 7 share an emphasis on basing evaluation on theory and examining generative causal links between interventions and changes in outcomes. However, proponents of theory-driven evaluation, in practice, focus more on explicating a range of outcomes (short-term, intermediate, long-range) and the relationships between them than on components of the intervention per se. The intervention itself is assessed in terms of moderators (population characteristics or treatment variations) or mediators (changes in learning or behaviour). Finally, theory-driven evaluation typically relies on statistical modelling to assess relationships between variables (Coryn, Noakes, Westine, & Scherder, 2011).

The wide range of approaches identified suggests that further theoretical consideration is needed of what complex interventions minimally comprise. This clarity is important for the utility, transparency and coherence of method. Moreover, it will avoid the conceptual ambiguity that has beset past debates around pivotal conceptualizations in a variety of different ways that have markedly different assumptions and implications. Using the concepts of the parts and the whole of the intervention is a useful means of demarcating and comparing these ways. However, views of the nature of components and how they cause changes in outcomes can differ markedly around the nature and status ascribed to the parts of the intervention, the power of these parts and their function in terms of the whole of intervention. These distinctions represent the formative stages of attempts to develop clear conceptions of what complex interventions are.

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