Carrots, sticks, and health behaviours: a framework for documenting the complexity of financial incentive interventions to change health behaviours

Abstract

Financial incentive interventions are increasingly used as a method of encouraging healthy behaviours, from attending for vaccinations to taking part in regular physical activity. There is a growing body of research on the effectiveness of financial incentive interventions for health behaviours. Wide variations in the nature of these interventions make it difficult to draw firm conclusions about what makes an effective incentive, for whom and under what circumstances. Whilst there has been some recognition of the theoretical complexity of financial incentive interventions for health behaviours, there is no framework that categorises these interventions. This limits the research community's ability to clearly establish which components of financial incentives interventions are more and less effective, and how these components might interact to enable behavioural change. We propose a framework for describing health promoting financial incentive interventions. Drawing on our experience of a recently completed systematic review, we identify nine domains that are required to describe any financial incentive intervention designed to help individuals change their health behaviours. These are: direction, form, magnitude, certainty, target, frequency, immediacy, schedule and recipient. Our framework should help researchers and policy makers identify the most effective incentive configurations for helping individuals adopt healthy behaviours.

Keywords

Incentives; health behaviour; behavioural economics; motivation

Carrots, sticks, and health behaviours: a framework for documenting the complexity of financial incentive interventions to change individual health behaviours

'Carrot' and 'stick' financial incentive interventions are increasingly being used to encourage healthy behaviours. Pregnant smokers in Scotland are offered grocery vouchers if they provide smoke-free breath tests at weekly check-ups (Ballard & Radley, 2009). Australian families are eligible for additional social security benefits if their children are up-to-date with all their vaccinations (Lawrence, MacIntyre, Hull, & McIntyre, 2004). Obese English adults can earn monthly cash rewards for achieving pre-specified weight loss goals (Relton, Strong, & Li, 2011). Voucher based contingency management, where clients receive vouchers exchangeable for a range of goods and services contingent on achievement of therapeutic goals (Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006), is recommended by the UK National Institute of Health and Care Excellence to reduce illicit drug use and promote drug users' engagement with services (National Institute for Health and Care Excellence, 2007). Online, www.stickK.com gives users the facility to set up and monitor commitment contracts that allow users to pledge to achieve any behavioural goals they choose, alongside making a cash deposit that is forfeited in the event of failure (S. Halpern, Asch, & Volpp, 2012). These examples demonstrate the variety and complexity of financial incentive interventions.

There is a growing body of research on the effectiveness of financial incentive interventions for helping individuals to change their health behaviours (e.g. Cahill & Perera, 2011; Lagarde, Haines, & Palmer, 2007; Lussier et al., 2006; O' Malley, Baker, Francis, Perry, & Foster, 2012; Paul-Ebhohimhen & Avenell, 2008; Prendergast et al., 2006; Wall, Ni Mhurchu, Blakely, Rodgers, & Wilton, 2006). But wide variations in the nature of these interventions make it difficult to draw firm conclusions about what makes an effective incentive, for whom and under what circumstances.

It is not necessarily always clear exactly what a financial incentive intervention is, and is not. The key components of incentive interventions identified in the behaviour change literature are that

they are rewarding and that they are contingent on behaviour change (Abraham & Michie, 2008). However, this leaves unclear what exactly a 'financial reward' is. Grocery vouchers certainly have financial value, but they are not directly monetary. Nor is entry into a Quit & Win competition necessarily a reward if an individual does not win one of the prizes offered, despite having quit smoking. Commitment contracts are only rewarding in that they involve avoidance of penalties, rather than clear positive rewards.

It is, therefore, challenging to capture the complexity of financial incentive interventions in a simple definition. Recently there has been some recognition of the theoretical complexity of financial incentive interventions for health behaviours (Johnston & Sniehotta, 2010). For example, Johnston & Sniehotta (2010) highlighted the range of behavioural change techniques that might be involved in a financial incentive intervention – from agreeing a contract, through goal setting, behaviour monitoring, feedback, to eventual reward. Such interventions draw on a range of behaviour change theories, including Self-Regulation Theory (Bandura, 1986), Operant Conditioning (Skinner, 1953), Contingency Management theories (Petry, 2011) and learning theories. Although some attempts have been made to list important design aspects of financial incentive interventions (Lynagh, Sanson-Fisher, & Bonevski, 2013), we are not aware of any framework that has been proposed to capture, systematically, the complexity of the nature of financial incentive interventions and provide standard terminology to help achieve this. Such a framework would help authors and readers describe and compare the detailed nature of financial incentive interventions, and highlight the complexity of such interventions to policy makers and those designing new interventions. The absence of such a framework limits the research community's ability to clearly establish which components of financial incentives interventions are more and less effective, and how these components might interact to enable behavioural change (Michie & Johnston, 2012).

A framework of financial incentive interventions for health behaviour change

We propose a framework for describing health promoting financial incentive interventions. Drawing on our experience of an on-going systematic review in this area (J. Adams, Giles, Robalino, McColl, & Sniehotta, 2012), we identify nine domains that are required to fully describe any financial incentive intervention designed to help individuals change their health behaviours. We offer dimensions, with examples, for each domain in Table 1, and the domains are described in more detail below.

Direction. The 'direction' domain specifies whether the reward component of an incentive intervention is a positive gain associated with engaging in a healthy behaviour, or the avoidance of a negative loss that might be imposed for not engaging in the behaviour. This allows 'stick' incentive interventions, such as those popularised by www.stickK.com, to be considered alongside more common 'carrot' incentives. It is worth noting that even if participants adhere to commitment contracts and retain their investment, there is an opportunity cost associated with any investment and this may limit the value individuals place on such commitment contract 'rewards'.

Form. 'Form' describes the nature of the incentive – i.e. cash, vouchers exchangeable for a range of goods or services, or vouchers exchangeable for only one specific good. Some concern has been expressed that it is unacceptable to reward financially costly behaviours such as smoking cessation with cash that can then be spent on exactly the behaviour it was designed to discourage (Bonevski, Bryant, & Paul, 2011).[1] Vouchers for a restricted range of products, or only one product, avoid this risk. The attractiveness of different incentives is also likely to vary between individuals and this may moderate the effects of incentives. For example, cash incentives might be more valued by, and hence more effective in, individuals with lower disposable incomes (Paul-Ebhohimhen & Avenell, 2008).

[1] This is only one aspect of the ethics and acceptability of financial incentive interventions that has been questioned. Fuller discussion of the ethics and acceptability of financial incentive interventions are available elsewhere.(S. D. Halpern, Madison, & Volpp, 2009; Marteau, Ashcroft, & Oliver, 2009)

Magnitude. This domain describes the total value of incentive available to participants in the programme. We conceptualise this as a continuous, rather than categorical, variable and do not make any attempt to define what is a 'high' or 'low' magnitude of incentive as this is likely to vary with the individual circumstances of participants. The magnitude of incentives described in the literature range widely from as little as, for example, US$5 for attendance for influenza vaccination (Nowalk et al., 2010) to as much as, for example, US$750 for attendance at a smoking cessation programme and continued cessation over 12 months (Volpp et al., 2009). Others have offered variable incentives based on the level of behaviour performed (Hunter, Tully, Davis, Stevenson, & Kee, 2013). Those with lower disposable incomes may consider smaller absolute values of incentives to be more 'valuable' than those with higher incomes. For this reason, it is possible that the effectiveness of any particular magnitude of financial incentive varies according to the socio-economic circumstances of participants (White, Adams, & Heywood, 2009). It also makes intuitive sense that larger magnitude incentives would be more effective overall and this accords with Equity Theory which proposes that perceived overcompensation for a particular behaviour arouses feelings of guilt and compensatory action to reduce that guilt – e.g. taking part in the requested behaviour (J. S. Adams, 1965; Biner & Barton, 1990). Whilst there is some evidence that increasing incentive magnitude increases effectiveness, this has not been extensively studied in the context of health behaviours. Paul-Ebhohimhem & Avenell (2008) considered the value of financial incentives in terms of participants 'personal disposable income' (PDI) and reported only a weak trend for greater effectiveness with incentives larger than 1.2% of PDI. In contrast, Reactance Theory suggests that financial incentives may be perceived as a threat to individuals' freedom of choice and that they will act to restore this freedom by choosing not to perform the behaviour (Brehm & Brehm, 1981). If perceived threat increases with incentive magnitude, a simple linear relationship between magnitude and incentive effect should not be expected.

Certainty. The 'certainty' domain describes how sure participants can be, from the start of the incentive programme, that they will receive the incentive if they successfully change their behaviour. We have included three dimensions of this domain.

Certain incentives. 'Certain' incentives are incentives which participants will definitely receive if they successfully perform the health behaviour of interest. Grocery vouchers given every week a smoke-free breath test is provided (Ballard & Radley, 2009) are a good example of a certain incentive.

Certain chance incentives. Participants will not necessarily receive 'certain chance' incentives even if they achieve the behaviour, but they can be sure from the outset what the likelihood of receiving the incentive is. For example, each time a weight loss target is achieved, individuals might be given the opportunity to draw a ticket from a bowl of 500 tickets, only half of which are associated with prizes (with tickets returned to the bowl after each draw) (Petry, Barry, Pescatello, & White, 2011).

Uncertain chance incentives. In the case of uncertain chance incentives, participants are both unsure whether they will receive the reward if they achieve the behaviour, and what their chances of receiving it will be. Quit & Win contests are the best example of uncertain chance incentives (Cahill & Perera, 2011). In these contests, the chances of winning depend both on how many other people enter the contest and how many of these manage to quit by the end of the contest – neither of which can be accurately predicted from the outset. Lottery tickets given in exchange for behaviour change (Glasgow, Hollis, Ary, & Boles, 1993) would be also considered uncertain chance incentives as the recipient cannot be sure that they will win anything in the lottery, or what their chances of winning will be at the outset of the intervention.

Target. The 'target' domain captures the difference between financial incentive interventions for what we term 'process', 'intermediate' and 'outcome' behaviours. Process

behaviours are those that involve engaging in a process that is likely to help individuals achieve healthy behaviour outcomes by providing behavioural change skills, but which are not healthy in themselves – for example, attending drug rehabilitation sessions (Carroll et al., 2006), or smoking cessation counselling (Volpp et al., 2009). Intermediate behaviours are those that could be considered healthy in themselves, but which are encouraged as intermediaries to other outcomes – for example, incentivising regular physical activity as an intermediary to achieving weight loss (Jeffery, Wing, Thorson, & Burton, 1998). Outcome behaviours are those representing healthy distal behaviours – for example, rewarding drug-free urine samples (Carroll et al., 2006). Incentives have also been offered for non-behavioural proxy markers of behaviour, such as weight loss (Jeffery, Gerber, Rosenthal, & Lindquist, 1983).

Frequency. 'Frequency' describes the proportion of occurrences of the behaviour that are incentivised. We have categorised this domain into 'all' or 'some' instances of behaviour being rewarded. Some behaviours are much easier to continuously monitor, making it possible to reward every occasion on which the behaviour is performed (e.g. rewards based on the number of physically active minutes, monitored by pedometer) (Finkelstein, Brown, Brown, & Buchner, 2008). In other cases, on-going monitoring of every occurrence of the behaviour may be impossible or impractical. For example, it is probably unfeasible to reward every cigarette avoided in a smoking cessation incentive intervention, but a reward can be given for each smoke-free breath test (Ballard & Radley, 2009). There is some evidence from laboratory-based work that partial reinforcement with incentives for some, rather than all, instances of a desired behaviour is likely to lead to more sustained behaviour change than rewarding every instance of the behaviour (Bitterman, 2006), but it is not clear if this also occurs in the community.

Immediacy. The 'immediacy' domain describes how soon after the behaviour occurs that the incentive is provided. Too long a delay between behaviour and reward may mean that participants do not easily link the two and the incentive fails to act as an effective reinforcer. It is likely that there

is an optimum time between behaviour and incentive for changing health behaviours, and this may be different for different behaviours. Again, laboratory-based work suggests that variable intervals between behaviour and reward may be more effective than fixed intervals (Bitterman, 2006). As far as we are aware, this is not something that has been explored in terms of health behaviours in the community and this may be a fruitful avenue for future research. As immediacy is a continuous, rather than categorical, domain we do not provide dimensions for it in Table 1.

Schedule. The domain of 'schedule' is dichotomised into those incentives that offer fixed magnitudes of incentives for each instance of the behaviour that is incentivised, and those that offer variable incentives in response to prolonged behaviour change. In most cases, varying reward schedules are incremental with values of rewards increasing as the number of monitoring sessions at which the behaviour is confirmed increases (Carroll et al., 2006). Contingency Management Theory predicts that gradually increasing the value of incentives as maintenance of behaviour progresses will lead to more sustained behaviour change and there is some evidence to support this in the context of cigarette abstinence (Roll, Higgins, & Badger, 1996).

Recipient. The final domain in our framework is 'recipient'. The majority of financial incentives are given to the individuals who are asked to perform incentivised behaviours. However, some programmes cluster participants into groups with rewards for average group performance (Jeffery et al., 1983). Others reward clinicians (Salize et al., 2009), significant others (Jeffery et al., 1983), or parents (Lawrence et al., 2004; Minkovitz et al., 1999) in addition to, or instead of, the individuals who change their behaviour.

Conclusion and unanswered questions

We believe that it is possible to describe all health promoting financial incentive interventions according to our framework and give some examples of this in Table 2. In practice, many financial incentive interventions designed to change health behaviours include a number of

different incentive components. For example, individuals might receive a cash reward at each monthly check-up that they provide a smoke-free breath test, and also be entered into a lottery each month they are confirmed as smoke-free (Glasgow et al., 1993). In these cases, the framework should be used to describe all individual incentives components separately.

The framework should also help provide a structure for future research on financial incentive interventions for healthy behaviours. Given the complexity of financial incentive interventions, the framework highlights the naivety of current research that tends to focus on simple questions of whether or not financial incentive interventions "work" to successfully change healthy behaviours. Our framework will help guide a more mature approach exploring how financial incentive interventions can be configured to achieve the most sustained behaviour change, and whether different configurations are required for different groups of individuals or behaviours. For example, it is not clear what the optimal configuration of each domain is for effective behaviour change and whether this varies across different behaviours or according to the personal, socio-economic characteristics of participants.

The order we have presented the domains here is arbitrary and we do not, at this point, have good reason to believe that any domains are more important, in terms of intervention effectiveness than others. Further research is required to clarify this. Furthermore, it is likely, but not clear, that the domains are not independent of each other. For example, whilst cash incentives have been reported to have higher perceived value than voucher incentives (of the same face value) of relatively low magnitudes (Rosado, Sigmon, Jones, & Stitzer, 2005), this difference may reduce as magnitude increases. Additionally, given that individuals tend to overestimate the probability of events with low chance occurring (Tversky & Kahneman, 1974), there may be an interaction between certainty and magnitude such that higher potential magnitude incentives (e.g. £1000) with low certainty (e.g. 1 in 100 chance) may be more effective than lower magnitude (e.g. £10) ones of

higher certainty (e.g. definite chance) – even if the absolute expected return remains the same (£10 in both cases).

This framework should help researchers and policy makers recognise the complexity of financial incentive interventions and how they can vary across a range of different domains. We do not believe that this complexity has been widely recognised previously and the framework helps both to highlight this and to provide a vocabulary to begin to explore it further.

Completing interests

The authors declare that they have no competing interests.

Authors' contributions

This manuscript arose from discussions associated with an ongoing systematic review being carried out by JA, ELG, EM and FFS. JA drafted the original manuscript and redrafted it following critical discussions with ELG, EM and FFS. All authors have read and approved the final version.

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Table 1: Framework of nine domains, with dimensions and examples, of financial incentives for health-behaviour change

Domain	Dimension	Example
Direction	Positive reward	Welfare benefits increased for confirming all immunisations are up to date in children (Lawrence et al., 2004)
	Avoidance of penalty	Welfare benefits decreased for failing to confirm all immunisations are up to date in children (Minkovitz et al., 1999)
Form	Cash	Cash reward for weight loss (Jeffery et al., 1983)
	Vouchers for range of goods/services	Grocery voucher for smoke-free breath test (Ballard & Radley, 2009)
	Specific goods/service	MP3 player for weight loss (Petry et al., 2011)
Magnitude	Continuous (not categorical) variable	Total value of incentive available to participants; ideally considered in relation to individual socio-economic circumstances
Certainty	Certain	Grocery voucher for smoke-free breath test (Ballard & Radley, 2009)
	Certain chance	Chance to draw from bowl of 500 tickets, 250 of which are associated with prizes, for weight loss (Petry et al., 2011)
	Uncertain chance	Entered into lottery to win holiday for smoke-free breath test (Cahill & Perera, 2011)
Target	Process	Shopping vouchers for attendance at routine out-patient drug rehabilitation sessions (Carroll et al., 2006)
	Intermediate	Cash reward for attending supervised walks to achieve weight-loss (Jeffery et al., 1998)
	Outcome	Shopping vouchers for drug-free urine (Carroll et al., 2006)
	Proxy measures of behaviour	Cash reward proportionate to weight loss (Jeffery et al., 1983)
Frequency	All instances incentivised	Cash reward based on number of physically active minutes per week (Finkelstein et al., 2008)
	Some instances incentivised	Grocery voucher for smoke-free breath test, measured once per week (Ballard & Radley, 2009)
Immediacy	Continuous (not categorical) variable	How soon reward is received after behaviour is performed
Schedule	Fixed	Weight loss reward at a fixed rate per pound lost (or maintained as lost) per month (Relton et al.,

		2011)
	Variable	Drug users received $25 shopping vouchers for the first treatment session attended, increasing by $5 for each additional consecutive session attended (Carroll et al., 2006)
Recipient	Individual	Cash reward proportionate to weight loss achieved by individual participant (Jeffery et al., 1983)
	Group	Cash proportionate to average weight loss in group of participants (Jeffery et al., 1983)
	Significant other	Cash to nominated significant other for weight loss in participant (Jeffery et al., 1983)
	Clinician	Cash for each patient who quits smoking (Salize et al., 2009)
	Parent	Welfare benefits increased for confirming all childhood immunisations are up to date (Lawrence et al., 2004)

Table 2: Example financial incentives for health behaviour change characterised using the framework

Domain	Example 1 – £12.50 grocery vouchers for pregnant smokers who give smoke-free breath tests at 12 weekly appointments (Ballard & Radley, 2009)	Example 2 – commitment contract at www.stickK.com with $10 forfeited for every day healthy eating for weight control goal not met	Example 3 - $10 cash reward for injecting drug/crack cocaine users who returned on time to have a tuberculosis skin test read (Malotte, Rhodes, & Mais, 1998)
Direction	Positive reward	Avoidance of penalty	Positive reward
Form	Vouchers for restricted goods/services	Cash	Cash
Magnitude	£12.50 per week with smoke-free breath test, achieving a maximum possible of £150	$10 per day of participation	$10 for one-off on-time return
Certainty	Certain	Certain	Certain
Target	Outcome	Intermediate	Outcome
Frequency	Some instances incentivised	All instances incentivised	All instances incentivised
Immediacy	Within 7 days of behaviour	Within 24 hours of behaviour	Immediately following behaviour
Schedule	Fixed	Fixed	Fixed
Recipient	Individual	Individual	Individual