Incentives and Children's Dietary Choices: A Field Experiment in Primary Schools*

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Abstract

We conduct a field experiment in 31 primary schools in England to test whether temporary incentives are effective in increasing children's choice and consumption of fruit and vegetables. The intervention consists of rewarding children with stickers and little gifts for a period of four weeks for choosing a portion of fruit or vegetables at lunch. We compare the effects of two incentive schemes (piece rate and competition) on choice and consumption over the course of the intervention. We also examine the effect of the interventions immediately after the incentives are removed and six months later to see if the temporary incentives had any lasting effect on dietary choices. We find that the two interventions, in general, had positive effects on choice and consumption and that the competition works better overall. However, we find that the treatment effects vary dramatically by age, gender and socio-economic background. We find little evidence of sustained long term effects, except for children from poorer socio-economic backgrounds.

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1. Introduction

Poor nutrition is a primary cause behind the recent surge in obesity which is not only one of the leading causes of death but is also contributing to the rising cost of health care in many developed countries[1]. According to the World Health Organization (2009) poor nutrition is related to three of the five highest risks for morality in the world: high blood pressure; high blood glucose; and overweight and obesity. In response, policy makers have been pushing information interventions, such as "5-a-day" campaigns, to encourage people to develop better eating habits. However, the effectiveness of information only campaigns have been questioned and policy makers are now considering if rewarding individuals for eating healthier is a better approach[2].

Despite the push by policy makers, it is actually an open question if rewarding individuals for eating healthier will work or play any long lasting role in solving the problems caused by poor nutrition. Indeed some research shows that rewarding children for eating healthy items can lead to those items being less preferred[3]. Recent work by Just and Price (2013) has shown that schools where short term rewards are given for eating healthy items does lead to an increase in the proportion of children consuming a serving of fruits or vegetables at lunch time. Two weeks after the incentive is removed, however, there is no lasting change in the amount of fruits and vegetables consumed at the project schools. The lack of longer term effects could be due to the intervention period being too short or the incentives not being large enough.

Recent research in education (see Angrist and Lavy (2009), Angrist, Lang, and Oreopoulos (2009), Kremer, Miguel, and Thornton (2009) or Frey (2011)), smoking cessation (see Volpp et. al (2009) and Gin et. al. (2011)), and exercise (see Charness and Gneezy (2009) and Acland and Levy (2011)) has shown that incentives can induce individuals to engage in positive behaviour. Furthermore, the research on exercise has even shown that the habits developed during the incentive period can carry over to the post-intervention period. However, as pointed out by Rabin (2011), we still know very little about which health behaviours are really habitual, how important habits are and what type of incentive schemes are most effective in changing those bad habits[4]. Given the potential for external incentives to crowd out intrinsic motivation (see Gneezy and Rustichini (2000) for an ex-

[1]See Bhattacharya and Sood (2011) for an overview of the costs of obesity

[2]See Ciliska et al (2000) for a review of many community based interventions. Information campaigns have some success in changing attitudes but have less success in changing actual behaviour, Robertson (2008) and Verplanken and Wood (2006). See the NICE citizens council report (http://www.nice.org.uk/media/9AF/56/CCReportIncentives.pdf) for a review of the issues of the National Health Service (NHS) using incentives to change health related behaviour.

[3]See Birch et. al. (1982), Birch et. al. (1984), and Newman and Taylor. (1992) for examples.

[4]See the recent discussion by Gneezy et al. (2011)

ample) and the fact that health research has shown negative effects of rewarding healthy eating, it is of utmost importance to examine the effects of incentivizing individuals to choose healthy items; especially given the recent push by policy makers.

We are particularly interested in testing whether incentives work for sub-groups of the population who have been shown to respond little or not at all to alternative interventions (such as information campaigns). Specifically, one robust finding in the literature (Muller et al. (2005), Perry et al (1998) and Kelder et al (1995)) is that interventions are much less effective among boys than girls on the one hand, and among children from poorer socio-economic status. This is of particular concern because these two sub-groups (boys and children from poorer socio-economic status) are also those with the worse eating habits and most at risk of developing nutrition-related diseases. One important question is whether incentives can trigger responses from these sub-groups. The individual level effects are of particular importance because, while, on average, the number of healthy items consumed at an intervention school may increase, vulnerable groups may eat worse due to the intervention. In terms of societal welfare, one may not want to implement a policy if the increase in the proportion of healthy items consumed is driven by an increase in consumption by those already eating healthily while those eating poorly decrease their consumption.

Of course, one important question here is "what kind of incentives?" There are many ways one could incentivise and, as in the case of alternative policy interventions, different incentive schemes may work better for some people than others. The question is then: which incentives are most effective for which sub-groups of people? There is now for example a well-established literature showing that boys tend to be more competitive than girls (see Gneezy et. al. (2003) and Gneezy and Rustichini (2004)). The competition incentive has not yet been used in the exercise or health interventions looking at incentivizing positive behaviour. Given the gender differences in eating behaviour and in response to alternative interventions, we find it of particular interest to compare the effects of an individual-based scheme (piece-rate) and a competitive (tournament) incentive in the context of eating.

Using two schemes also allows us to examine one aspect of why the individual-based rewards in Just and Price (2013) may not have found effects beyond two weeks: does competition or a group based award work better than an individual-based reward? Keeping the intervention period constant, one could vary the incentive scheme and find longer term effects.

As in the research on exercise and smoking cessation, besides changing choices during

the intervention period, the short-term effects could lead to changes in longer term habits. Indeed work on habit formation in exercise has shown that changes in behaviour remain after the invention has been removed, though, it is unknown just how long these changes last[5]. With regards to healthy eating there is evidence that habits form early on in life and track into adulthood (see Kelder et. al. (1994); Resnicow et. al. (1998); and Singer et. al. (1995)). Given this, we did not only monitor choices and consumption of students during the intervention period but also in the week after the intervention stopped and six months later. This allows us to see if any effects we observe during the intervention period last into the future. Furthermore we followed students in year two (roughly six years of age) and year five (roughly nine years of age) to examine age effects.

Therefore, considering the habit formation literature and the closely related topic of incentivising positive behaviours, our paper has two major contributions: it examines the heterogeneous effects of incentivizing students to adopt a positive behaviour; and it examines how the type of incentive scheme matters during and after the treatment. We are also able to examine why these different incentive schemes have different effects. We examine how these contributions fit into the habit formation literature by looking at how different subgroups respond both immediately after the incentive have been removed and six months later using a field experiment involving 31 schools across England.

We find that incentivizing students to choose fruit or vegetables has an overall positive effect on choice and consumption of fruit or vegetables at lunchtime in treated schools. However, the overall effect masks significant differences by age; in the piece-rate scheme year two students eat less when incentivized while there is a large positive effect for year five students. Besides stark heterogeneous differences in the effect, there are some differences by incentive type; overall the competition works better while the positive effects of the piece-rate scheme disappear after two weeks. In particular, we find that the piece-rate scheme has a discouragement effect caused by the threshold requirement of having to eat four fruit or vegetables; students know when they missed the threshold and then actively choose not to have fruit or vegetables during the remainder of the week. This discouragement effect is not present in the competitive scheme where any number of fruit or vegetables could, in principle, result in an additional reward. The differences in the treatment effects also show up when the incentive scheme is removed: students assigned to the competition treatment are more likely to continue eating healthily in the week immediately following the treatment. Six months later we do find some positive effects of the treatment for those that were affected during the incentive period.

[5]See Acland and Levy (2011) and Charness and Gneezy (2009) for examples.

Our results are broadly consistent with both the economic literature on habit formation and the health literature on how food preferences develop. Present-biased (hyperbolic) preferences, such as those discussed in Laibson (1997) and O'Donoghue and Rabin (1999), can explain the persistence of bad habits despite an individual being fully aware of the effects of poor nutrition. Individuals may over-weigh the initial costs of switching to being a healthier eater or under-weigh the longer term benefits. Thus an intervention providing an immediate benefit might be needed to get people to overcome the difference in perceived costs and benefits. Likewise the health literature discusses how neophobia (the predisposition to reject novel food) is non-monotonic with age and how children may learn not to prefer a food if they are incentivized to eat it[6]. Neophobia should be decreasing over the age of our sample meaning that the stark age effects - that year five students respond more to both incentive schemes - are consistent with the literature.

The results presented in this paper are important for policy makers and health officials trying to fight problems associated with poor nutrition. It shows that positive incentives do work in encouraging healthy dietary choices and that the results of a short term intervention can have long-lasting effects but that a "one-size-fits-all" reward scheme will not likely work. The heterogeneous effects suggest that health incentives need to be evaluated at the individual level and, consequently, different policies may have to be developed for different subgroups. Furthermore, increasing the length of time an intervention is taking place is not the only way policy makers can increase the likelihood that positive behaviours are adopted: for instance, competitions could have an effect when individual-based schemes do not.

The remaining part of the paper is structured as follows. In Section 2 we present the experimental design. In Section 3, we present a simple conceptual framework and hypotheses that guide the analysis of the results. We present the results in Section 4 and conclude in Section 5.

2. Experimental Design

We recruited schools in a three step process[7]. First we approached all 150 Local Education Authorities (LEAs) in England to ask if they would be interested in participating; 22

[6]See Birch (1999) for a good summary of the development of food preference and neophobia. Birch and Marlin (1982), Birch et. al. (1987, 1998), Sullivan and Birch (1990), and Cooke et. al. (2003) also provide strong evidence about the role of overcoming neophobia through repeated exposure to a new food or flavours.

[7]A companion paper, Belot and James (2013), documents the selection process of which schools choose to participate in this experiment. In particular they find only mild selection suggesting that the schools in the sample are representative of primary schools in England.

responded positively. Second, we provided more information about the project to LEAs that responded and set-up meetings with them to answer questions and discuss how to recruit schools. We indicated to LEAs that we were interested in testing and comparing the effectiveness of incentives schemes in increasing choice and consumption of fruit or vegetables at lunchtime and that the interventions were specifically designed to target students who were generally considered unresponsive to health interventions. After the meetings 12 LEAs agreed to let us approach their schools and provided a list of at least three schools that would consider being involved. Finally we approached all 46 schools suggested by the LEAs; 31 of them agreed to participate.

We recruited students from year two (aged 6 and 7) and year five (aged 9 and 10) in participating schools. Parents were provided with information about the project, asked to fill out a questionnaire, and were required to give consent to have data collected about their child. As agreed with the schools, all students in years two and five were included in the project. However, data about choice and consumption of fruit or vegetables were only recorded for children whose parents gave permission. Therefore, we have data on 626 students for the main part of the analysis.

Randomisation

We randomly allocated schools to one of three groups: control; competition; or piece-rate. To make sure the groups were balanced we stratified our sample based on key observable features. We were particularly careful to make sure that, ex ante, the average school in each group had roughly the same number of students and looked the same in terms of observable characteristics.

Schools were grouped by their local education authority (LEA) and, if there were at least three schools in an LEA, one was randomly assigned to each of the three treatment arms. When there were more than three schools, the others were randomly assigned to treatment arms such that the overall sample was balanced based on observables. For the purpose of balancing the three groups we used the following characteristics: (i) proportion of female pupils; (ii) number of pupils; (iii) number of pupils in class groups (year 2 and year 5); (iv) proportion of students eligible for free school meals; (v) proportion of students eating free school meals; (vi) per pupil expenditure; (vii) per pupil expenditure on catering; (viii) percent of students achieving level 4 in both English and Mathematics; (ix) average point scores of students on level 4 exams; (x) average percent of students absent on a given day; (xi) percent of students absent from the level 4 exams; (xii) school type (religious or comprehensive); (xiii) whether a school was involved in the "Food for Life"

Programme; (xiv) Ofsted School Categorization; and (xv) Ofsted Health Categorization (OfHealth).

The variables listed above were used so that the average school in each treatment arm was similar in ways that could have influenced whether the treatment scheme worked: socio-economic background; school quality; student quality; and school type. Variables (i), (ii), and (iii) relate to the demographic characteristics of the schools involved. Variables (iv) and (v) relate to the economic background of the students. Variables (vi) and (vii) relate to the financial expenditure at the school level. Variables (viii) - (xi) relate to the quality of the student body at each school. Variable (xii) denotes if a school has a religious affiliation. Variable (xiii) denotes whether the school voluntarily chose to be part of the "Food for Life" programme which involves schools agree to teach students about healthy eating[8]. Variable (xiii) is the overall classification of the school based on its Ofsted results: 1 = outstanding; 2 = good; 3 = requires improvement; and 4 = inadequate. Variable (xiv) relates to the extent to which the pupils adopt a healthy lifestyle.

Using a random number generator, schools were assigned to one of the three treatment arms based on the LEA restrictions[9]. We then checked to make sure the three treatment arms were balanced based on all 15 observable characteristics. Indeed there were no ex ante differences between the control, piece-rate, and competition groups based on the 15 variables listed above.

Treatments

In our experiment we decided to incentivise choosing fruit or vegetables instead of eating fruit or vegetables. We did this for a few reasons. First, the health literature highlights how making rewards contingent on consumption of a particular food can cause children to have a lower preference for that item (see Birch et. al. (1982, 1984) and Newman and Taylor (1992) for examples). We wanted to minimize the potential for negative effects on healthy eating. Second, we wanted the experiment to be something that was relevant to policy and simpler to implement. Rewarding for choice removes any subjective judgement of the monitor to decide what constitutes an adequate amount of food consumed to be rewarded. Furthermore, schools can require students to take a fruit or vegetable at lunch but are unlikely to be able to force them to eat the item. Therefore the results of our study are likely to be more relevant to policies that are being considered at the school

[8]See http://www.foodforlife.org.uk/ for further information about the programme.

[9]In schools with less than 75 pupils all students were invited to participate in the experiment, not just those in years 2 and 5. This was taken into account when we checked if the three treatment arms were balanced; especially with regards to variable (iii).

level now. Indeed the results of our study are especially relevant to determine if providing (or requiring a student to take) a fruit or vegetable at lunchtime has any follow through effect on consumption behaviour. Third, we also wanted the program to involve minimal costs. Monitors were already people working in the school and with the students at lunch time. While we could have considered a multi-component approach such as "Food Dudes," combining such as aspects as bringing in role models, monitoring choices for each type of fruit or vegetable chosen, etc. this would have required a larger investment of resources and likely been too expensive for many schools to adopt[10]. Finally, rewarding for choice rather than actually consuming an item negates the possibility of cheating. For example, if rewards were based eating the pupil has an incentive to dispose of the fruit or vegetable; the student may hide it, give it to a friend or try to mislead monitors regarding actual consumption.

We examine the effect of providing incentives on choosing and eating fruit or vegetables using two different interventions: a piece-rate scheme and competitive scheme. In both schemes the pupils were given a sticker for choosing or bringing in a fruit or vegetable at lunch[11]. The piece-rate scheme was chosen because it is similar to many of the other individual based incentive schemes used in the healthy eating and habit formation literature (for instance, see Charness and Gneezy (2009) or Just and Price (2013)). The competition was chosen because the literature on gender and competition suggests that boys respond more to competition than girls (see Gneezy and Rustichini (2004) and Gneezy et. al. (2003)). Given that boys tend not to respond to traditional healthy eating interventions, the competition was seen as an incentive scheme that could get boys to respond. However, gender differences in competition can vary by task (see Iriberri and Rey-Biel (2011)). Therefore if the task of choosing a healthily item is viewed as a 'favouring females' then even the competitive scheme might not get boys to choose or consume fruit or vegetables.

In both schemes students received a sticker every day they choose or brought in a fruit or vegetable at lunchtime. Then, at the end of the week (Friday afternoon), each student had the opportunity to pick a larger prize depending on the incentive scheme in which the student was enrolled. In the piece-rate scheme, if a student collected four stickers in the week she or he was allowed to choose an additional reward such as an item of stationery or a small toy from a reward box. If the student had three or less stickers,

[10]See Horne et. al. (1995, 1998)

[11]Examples of the stickers can be seen in the appendix. All students were given a list of fruits and vegetables that would be rewarded if they were included in packed lunches; the list is included in appendix B.

though, the student could not pick an additional award and the stickers did not count to earning the prize next week. In the competition, students were assigned to random groups of four, and the student with the most stickers in each group was able to select an additional reward from the reward box[12]. In the case of a tie all students with the highest number of stickers in the group were eligible for an additional reward. The groups were revealed at the end of the week so students would not engage in strategic behaviour, such as make choices based on other group member's actions or absenteeism. For example, if a pupil was absent on Monday then the others in their group would know that that pupil could only collect a maximum of four stickers. The groups were changed each week so the children could not anticipate with whom they would be competing and unused stickers did not carry over to the next week.

Timing

Before the interventions began a background survey was sent to the parents that covered information on age, gender, ethnicity, primary language, height, weight, and typical dietary habits. Then, starting the second week of October in 2011, we monitored what students ate at lunch in all 31 schools. Lunch monitors[13] recorded if a student chose a fruit or vegetable or brought a fruit or vegetable in with a packed lunch and if the student consumed none, some or more than half the item. On Friday that week students took a food knowledge test and a "spot-the-difference" test[14]. The food knowledge test required the student to identify seven pictures of different items (e.g. celery or snickers bar) and mark if each item was healthy or not. The "spot-the-difference" test was designed to test a student's concentration and required a student to compare two sets of 30 dice that were arranged in a six-by-five square. There were five differences between the two sets of dice; the student was asked to circle the five differences. Students had 10 minutes to complete each test.

The students went on half-term break for one week after the baseline data was collected. Upon returning to school the students were reminded of the project and students were monitored for the next five weeks. At control schools, the lunch monitors continued to monitor students in the same way they did during the week in October: they collected data on whether a student choose or consumed a fruit or vegetable. At the competition and piece-rate schools students were incentivized to choose a fruit or vegetable for a pe-

[12]See appendix for pictures of some of the rewards from which students were allowed to choose.

[13]Lunch monitors were dinner ladies who worked in the cafeteria or school assistants who were present at lunch time and sat with the students as usual during the lunch period.

[14]Examples of both can be seen in appendix A.

riod of four weeks[15]. Each day a student choose or brought in a fruit or vegetable with a packed lunch[16] the student received a sticker. Furthermore, as discussed above, at the end of each week, students would get a large prize based on the type of incentive scheme in which they were enrolled.

On the fourth Friday of the treatment, the students completed another food knowledge and "spot-the-difference" test and were reminded that it was the last day of incentives. The following week, immediately after the treatment, the choices and consumption of students were still monitored. This allows us to see if there was any effect on choice and consumption after the incentives were removed. To examine the longer term effects we of the incentives we also went back to schools six months later, in June 2012, and monitored the choice and consumption of the same students. Unfortunately, the week we chose did not work for all schools so only 21 of the original 31 schools participated in the six month follow-up[17].

3. Conceptual Framework & Hypotheses

The idea of using incentives to change dietary choices and potentially longer term habits relies on three insights from the health literature: (1) tastes and preferences of children can be changed by exposure to new foods; (2) children are relatively impatient and may suffer from projection biases; and finally (3) current consumption has an effect on future consumption (habit formation).

Both incentive schemes reward choice rather than consumption. This is because rewarding consumption is very intensive in terms of monitoring and because we were concerned that rewarding the consumption of a full portion of fruit and vegetables may work adversely in the longer run, in light of the evidence in the nutrition literature. The question is why do we expect consumption to change as a consequence? Children could just take the sticker and not eat the food. For them not to do that, we must conjecture there is a "cost" associated with choosing food and leaving it on the plate. Obviously, the lunch supervisors do encourage children to eat the food on their plate and thus, it is plausible that wasting the food is associated with a "moral cost" or stigma. Increased choice could then be associated with increased consumption. But in addition, the incentive scheme may exacerbate these costs because the child may feel guilty about wasting food after

[15] Just and Price (2013) incentivized students for a period of 2-3 weeks and found no longer run effects. Therefore, we chose to incentivize students for a longer period of time; 1-2 weeks longer.

[16] With the questionnaire and again at the start of the five weeks of monitoring, the parents of all students received lists of what items would count as healthy if they were included with packed lunches.

[17] Fortunately, we find no evidence of selective drop-out, i.e. the results using the data from the first 6 weeks do not change if we exclude the 10 schools for which we have no data in June.

having received a reward. Moreover, comparing across schemes, the competitive scheme may trigger even more of a moral obligation than the piece rate, since the winning child effectively prevents other children to get the additional reward. Given this framework we can set out the hypotheses that our experiment was designed to test. As in other work on incentivizing positive behaviour, we expect that our experiment will have a positive effect on choice and consumption of fruit or vegetables.

Hypothesis 1: Students will choose more fruit or vegetables when they are rewarded for taking a fruit or vegetable at lunchtime.

By providing a reward for choosing a healthy option, the benefit of taking a fruit or vegetable at lunchtime will have increased for each student. Therefore we would expect that, while the incentive scheme is running, students are more likely to choose a fruit or vegetable. This would be consistent with the work by Gneezy and Charness (2009) and Just and Price (2013). Furthermore, the effect is likely to differ by subgroups. Gender differences exist in regards to consumption of fruit or vegetables (see Muller et al. (2005), Perry et al (1998) and Kelder et al (1995)) and students from poorer families may value the prizes more. The health literature highlights ages effects with regards to food preferences and tastes (see Birch (1999) and the references therein); suggesting that there is likely to be differences in the effect of the incentive by age. Furthermore, students who eat packed lunches are particularly likely to be affected by the incentives because recent surveys have found that 99% of packed lunches failed to meet the government set nutritional standards (see Evans et. al. (2010) for more details); in the baseline, 28% of our students brought in a packed lunch every day and 41

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The behavioural literature has shown us that the default option can affect choice made by individuals (see Keller et. al. (2011), Choi et. al. (2003), and Johnson and Goldstein (2003) for examples) and even help reduce calorie consumption (Wisdom et. al. (2010)). As a result health initiatives at schools have started to require students to have a fruit or vegetable on their plate[18]. By incentivizing students to take a fruit or vegetable our experiment is likely to have a follow-through effect on consumption. Furthermore, unlike previous studies, our students have no incentive to lie or cheat regarding the amount of the fruit or vegetable they consumed; the rewards are only based on choice. This means

[18]See Dillon and Lane (1989) for an evaluation of the differences between offering and serving a fruit or vegetable and Just and Price (2013a) for the effect of requiring schools to serve healthy items.

that we can estimate the causal effect of how an increase in having a fruit or vegetable on one's lunch tray effects consumption. As with choice, there is reason to expect that the effect on consumption will vary with gender, age, and socio-economic background. Therefore we will pay particular attention to subgroup effects.

Hypothesis 3: Students will choose and consume more fruit or vegetables after the incentive is removed than before.

Given how food preferences develop, if students have been eating more fruit or vegetables during the intervention period they may have developed a preference for fruit or vegetables or developed a habit of eating fruit or vegetables at lunch time. Becker and Murphy (1988) and Becker (1992) develop a model of habit formation where the marginal utility of today's consumption is correlated with historical consumption. Therefore a small change in today's behaviour - caused by an exogenous increase in the benefit of consuming a fruit or vegetable for instance - could lead to long term changes in consumption. To measure this we look at the proportion of fruit or vegetables a student chooses in the week immediately following the intervention and six months later.

4. Results

4.1 Randomisation and pre-intervention summary statistics

We begin by comparing our treatment and control schools in the baseline period. Table 1 presents the means of the outcome variables and other covariates by control and treatment groups. The final two columns show the p-values for treatment and control differences. There are no statistically significant differences for the overall sample suggesting that, based on observables, the randomization worked as expected. Furthermore, even though they are insignificant, the size of the differences (in most cases) is less than one standard deviation, suggesting that the control and treatment groups are close to being observationally equivalent in the baseline.

The lower part of the table shows the summary statistics for the sample of pupils who chose, and consumed less than 100% in the baseline week for the dependent variables. This group is of particular interest because these are the children who had room to improve their behaviour, as opposed to those who already chose and ate a fruit or vegetable every day. Again we find no significant differences. For the background variables we present for the group who choose less than 100% of time a fruit or vegetable in the baseline period[19].

[19]Summary statistics for the background variables for the less than 100% tried and eat more than half in Table B1.

Here, we only find a difference between the control and competition schools for those who report having a special dietary requirement.

4.2 Descriptive Figures

We start with presenting three simple graphs, showing how our three main variables of interest changed over time on average. We will examine one main variable for choice, which we will label as "choice," and it will equal one if a student choose a fruit or vegetable on a given day. For consumption we will focus on two variables: "try" which will equal one if the student eats at least some of the fruit or vegetable she choose that day; and "eat more" which will equal one if the student eats more than half of the fruit or vegetable she chose that day. For the initial part of the analysis, we will look at the weekly mean outcome for a given pupil since the largest prize in each incentive scheme is based on weekly consumption. Specifically, we construct the following variables:

$$Mean(Outcome)_{isz} = \frac{\sum_{day=1}^{5} Outcome_{i,s,z,day}}{\sum_{day=1}^{5} Present_{i,s,z,day}}$$

Where $Outcome_{i,s,z,day}$ is the outcome of interest for pupil i in school s in week z on a specific day of the week. Present indicates whether the child was present at lunch or not (this allows us to take account of possible absences).

Figures 1, 2 and 3 show how the three variables of interest changed over time[20]. Figure 1 shows the trend in 'choice' for the control, piece-rate, and competition schools. We see that the percentage of healthy choices is consistently higher in both types of treatment schools than in the control schools during the interventions. However, the differences disappear immediately after the incentive is removed (week six) and six months later, we even observe a relative decrease in the competition schools. Figure 2, which shows the trends for 'try,' shows a much larger effect of the treatment schemes and a distinct pattern in piece-rate schools. There is a sharp increase in week two, both in the competition and piece rate treatments. But while this increase is sustained for the remaining weeks in the competition schools, it reverses slightly in the piece rate schools after two weeks. Six months later, we find higher rates of trying in the competition schools, followed by the piece rate schools and finally the control schools. Figure 3, which is for 'eat more' shows roughly the same pattern as Figure 2: there is a sharp increase in week two,

[20]In the piece rate scheme an interesting threshold to keep in mind is 80% which corresponds to the threshold to pass to receive an additional reward at the end of the week.

which is sustained over the period of the intervention, in week six (immediately after the intervention) and six months later. We also note an increase in the control schools six months later; this could be due to a seasonal effect or other interventions that have taken place in the schools.

4.3 Short term effects (during the intervention)

Average treatment effects on the main outcome variables

We begin by reporting the average treatment effects for the three main outcome variables of interest: 'choice,' 'try,' and 'eat more'. The treatment lasted for 4 weeks. Therefore, in the first instance, we present the results separately for each treatment by week. This allows us to see if and how the intervention may vary over the intervention period; students may become tired of the prizes and stop responding after the first few weeks.

We estimate the following linear probability model:

$$\text{Mean(Outcome)}_{isz} = \beta_0 + \sum_{z=2}^{5} \beta_z Week_z + \beta_{comp} Comp_s + \beta_{piece} PieceRate_s$$

$$+ \sum_{z=2}^{5} \beta_{z,comp} Comp_s \times Week_z + \sum_{z=2}^{5} \beta_{z,piece} PieceRate_s \times Week_z + \alpha_i + u_{ist}$$

Where $outcome_{ist}$ is the outcome of interest for pupil i in school s in week z, Week 2,5 are week dummy variables, Comp and PieceRate are dummy variables indicating whether school s is part of the competition or treatment group, and the unobserved error term is $\alpha_i + u_{ist}$. The parameters to be estimated are β_0, $\beta_{z,comp}$, β_{piece}, and βz, $\beta_{z,Comp}$, $\beta_{z,piece}$ (for z=1,5).

Since our dependent variables are bounded upwards (at 1), we estimate this specification on the whole sample and on the sample of students most likely to respond: those who did not have a mean outcome equal to one in the baseline (referred to later as "Less than 100%"). We are particularly interested in the latter group because those who are not choosing or consuming a fruit or vegetable every day is the subgroup that could most benefit from the intervention - they could be encouraged to eat healthier - whereas the group that choose and consumed a fruit or vegetable every day is already eating as healthy as possible in our framework.

The results are presented in Table 2. In the sample of all pupils, there was little effect of the piece rate scheme on all three outcomes of interest but there was a positive effect in the competitive scheme. Column [1] shows that competition increases the probability that a student choose a fruit or vegetable by 5.9 percentage points in the first week of the intervention. Thereafter the difference-in difference estimates are positive but no longer significant. There are no significant effects for the piece-rate scheme in column [1]. Column [2] we can see a similar but clearer pattern 'try:' there is an 8.5 percentage point increase in the probability of a student trying a fruit or vegetable in the first week of the intervention; a 9.5 percentage point increase in the second week of the intervention; and a 7.5 percentage point increase in the third week of the intervention. Likewise there is no significant effect for the piece-rate scheme, though, the point estimates are large in the first two weeks of the intervention. Column [3] shows the effect on 'eat more:' there are no significant differences, although the coefficients are all positive and of the same order of magnitude as those in column [2].

The picture looks slightly different in columns [4]-[6] when we consider the restricted sample, i.e. those who did not choose or consume a fruit or vegetable every day during the baseline and, thus, there was room for them to improve their nutritional habits. Roughly we see the same picture for each outcome variable of interest; the competitive scheme has a large significant effect that does not dissipate over the intervention period where as the piece-rate scheme has an initial positive effect in the first two weeks of the intervention and then drops off over the rest of the intervention period. By the last week of the intervention, the percentage of healthy choices increased by 17 percentage points, the percentage of portions tried increased by 18 percentage points and the percentage of portions eaten for more than half increased by 15 percentage points in the competitive scheme but there were no significant results for the piece-rate scheme. This means that the competitive scheme, on average, caused students to choose, try, and eat more than half of one additional fruit or vegetable per week.

These first results highlight the importance of testing different mechanisms and schemes while using incentives which a simple piece-rate scheme alone, as used in most other studies, could have missed.

Choice and consumption dynamics

Having established that there are differences in the effectiveness of the incentive schemes we now move onto explain why it might be the case the competitive scheme appears to work better in comparison to piece-rate scheme. While the previous analysis was based on

week level regression we do have data at the day level for each student. In this section we will analyse the student-day level data and examine the dynamics of choice and consumption throughout the week. In particular we will look at if there are different dynamics based on the two types of treatments.

First when looking at choice, the students who were most responsive to the treatments were those who had not chosen a fruit or vegetable 100% of the time during the baseline period. Column [1] in panel A of table 3 shows the day level regressions for that sample of students[21]. As in the weekly regressions, column [1] shows that competition had a large and significant effect on choice during treatment weeks; students assigned to the competition group were 16 percentage points more likely to choose a fruit or vegetable. There was a large imprecisely estimated effect due to piece-rate[22]. Columns [2]-[6] show the effect of the treatments for each day of the week. The effect of the competitive scheme started off very strong at the beginning of the week; on Mondays and Tuesdays students were 20 and 24 percentage points, respectively, more likely to choose a fruit or vegetable. As the week went on the effect dissipated, though; the point estimate decreased from 18 percentage points on Wednesday to 4 percentage points on Friday. Piece-rate had the opposite effect; students were more likely to choose their fruit or vegetable at the end of the week. The only significant increase in choice due to the piece-rate treatment took place on Friday when students were 25 percentage points more likely to choose a fruit or vegetable.

In the competitive scheme students did not know how many fruit or vegetables they would have to choose to get a prize at the end of the week; if they choose five fruit or vegetables, though, they were guaranteed a prize. Since students did not know who was in their group and some students did not choose a fruit or vegetable every day, a student could assign a subjective probability to winning given how many items she had chosen during the week[23]. Based on a student's subjective probability one could calculate the number of fruit or vegetables that a student would ideally want to consume each week to maximize her benefit from getting a prize subject to her disutility from having to choose

[21] There was no effect - either positive or negative - on the sample of students that had chosen a healthy item 100% of the time during the baseline week. The effect on all students is just a weighted average of these two groups.

[22] Redoing the weekly tables in the results section using day level data does not yield any qualitatively different results. The imprecision of the piece-rate estimate is primarily driven by the fact that year 5 students responded positively while year 2 students responded negatively; this will be discussed later when the heterogeneity of the effects are discussed.

[23] In fact there was an increasing probability of winning the prize based on the number of healthy items one chose. There was a small probability (under 5%) chance of winning if a student had chosen zero or one item, a 6.7% chance of winning if a student chose two items, a 21% chance of winning if a student chose three items, and a 39% chance of winning if a student chose 4 items.

a fruit or vegetable. Once a student has reached that number of fruit or vegetables she could switch back to her preferred unhealthy item. This type of pattern would explain why the effect of competition tapered off during the week.

In the piece-rate scheme the threshold to obtain the weekly prize was known and fixed. Given the exogenous pre-determined goal a student had to reach there was room for discouragement to take place; if a student had not eaten a fruit or vegetable on Monday or Tuesday then there was zero probability the student would get a prize that week. Besides having no external incentive from Wednesday onwards, a student might also feel discouraged and choose not to select a healthy option. Therefore, to examine this discouragement effect we break the sample into two groups in columns [7] and [8]. Column [7] contains students who had 'missed' the prize as of Wednesday, i.e. they had not chosen a fruit or vegetable on Monday or Tuesday. Column [8] contains those students who had chosen at least one fruit or vegetable before Wednesday. The effect of piece-rate is large and significant for those who still have a chance of getting a prize, i.e. those in column [8]. However, for those that have missed the chance of getting a prize the effect of piece-rate is estimated to be negative, though, it is insignificant. This means that as the week goes on the incentive to choose a fruit or vegetable wears off for those that miss the goal in the piece-rate scheme. However, this is not the case in the competition treatment because there is always a positive probability of winning the prize no matter how many items the student has consumed during the week[24].

These results speak to the intrinsic incentive differences between the two treatments. The external, known goal in the piece-rate can lead to a lack of incentive because of previous choice patterns. However, there is always a positive chance of winning in the competition treatment because the goal is unknown and endogenous to the system. In the habit formation literature with regards to healthy eating the goals have all been exogenous and known. Therefore, there is room to design rewards like the competitive scheme that can have a greater effect (than piece-rate) over the same period of time.

Panel B shows the effect of the treatment on consuming at least some of a chosen fruit or vegetable on any given day. Column [1] of panel B shows the same effect as the weekly results; competition has a large significant and positive effect and piece-rate has a positive effect, though, it is insignificant and less precisely estimated. Columns [2]-[6] show the daily effects and, as with choice, piece-rate only has an effect one day a week, in this case on Thursday. More importantly, columns [7] and [8] show the differential effect of piece

[24]Indeed the point estimate for competition is the same in columns [7] and [8] showing that the choice pattern before Wednesday does not change the effect that the competition treatment has from Wednesday onwards.

rate for those who have made different choices previously in the week. There is no effect of the treatment for students that have missed the chance to get a prize by Wednesday, i.e. those that have not chosen a fruit or vegetable on Monday or Tuesday; shown in column [7]. There is a large and positive effect of piece-rate for those that still have a chance of getting the prize, i.e. those that have chosen at least one fruit or vegetable on Monday or Tuesday; shown in column [8]. The dynamics around trying a fruit or vegetable are the same as choice for the piece-rate treatment.

The effect of the competitive scheme on consuming at least part of a fruit or vegetable is somewhat different than in choice. Columns [2]-[6] show a large positive effect of competition that does not dissipate over the week. Students were not incentivized to try the items therefore these results speak more to how a student behaves once a fruit or vegetable is on her plate. Since students were choosing, on average, less fruit or vegetables as the week went on, then this constant effect suggests that those who were choosing fruit or vegetables on Monday were less likely to consume them, while those choosing them on Wednesday were more likely to try them. On Friday, there was no effect of competition on choice; therefore, the large effect seen in panel B has to mean that those who did choose a fruit or vegetable definitely tried it. Friday is typically "fish and chips" day at many schools in the UK; for a student to give up chips she probably has to really like the healthy option. The main effects on try, though, are those shown in columns [7] and [8]. Again, the point estimate for competition does not vary between columns [7] and [8]. This means that previous choice patterns in the week do not effect consumption choices later in the week systematically, unlike for the piece-rate treatment.

Heterogeneity in treatment effects

We now turn to the heterogeneity in treatment effects. We will focus on looking at the effect of the two incentive schemes by gender, year-group, and free-school meal status.

Tables 4A and 4B report the estimates broken down by gender. With boys, shown in Table 4A, we find significant short run effects of the piece rate only when we consider the whole sample. But if we look at the more restricted sample, we find large and sustained effects of the competition on choosing and trying in particular and also on 'eat more.' As in the overall sample, boys initially respond to the piece rate scheme but the effects start to dissipate after the second week of the intervention. With girls, though, as shown in Table 5B we find a striking pattern: whether we consider the whole sample or not, we find that girls respond significantly to competition particularly in terms of trying a fruit or vegetable, but we find no significant effects of the piece rate, not even at the beginning

of the intervention period.

Tables 5A and 5B show the effects for year two and year five students respectively. The two groups respond quite differently to the treatments. Year two students appear to respond adversely to the piece rate, while we find very large and significant effects for students in year five. In the whole sample, columns [1]-[3], we find that the percentage of portions chosen and the percentage of portions tried are estimated to have decreased to some extent for year two, although the effects are only significant for week 4. In the restricted sample, columns [4]-[6], there is also a significant decrease for the piece-rate in week two, the first week of the intervention, for trying a healthy time. Overall - in both the restricted and entire sample - there is a small positive effect of the competition for students in year two, though. However, when looking at year five students the results are strikingly different: the piece-rate scheme increased by between 14 and 17 percentage points for choosing, 22 and 25 percentage points for trying, and 22 and 26 percentage points for eating more than half. Furthermore, with the year five students, the effect of the piece-rate does not decrease over the incentive period. When looking at the restricted sample in columns [4]-[6] the point estimates for piece-rate are even larger and significant over the entire intervention period. However the restricted sample does show that the competitive scheme also has a large significant effect that is similar in size and magnitude as that shown for the complete restricted sample in Table 2.

Next we examine the effect by two other sub-groups, those who are eligible for a free school meal (FSM) or not. The results for non-FSM students are reported in Table 6A and the results for FSM students are reported in 6B. Children eligible to receive free school meals at school usually come from lower socio-economic backgrounds. Children from lower-socioeconomic background have been shown to be much less responsive to interventions at aimed at tackling obesity and overweight (see for example Muller et al, 2005). For both of these groups it appears that the piece-rate scheme only had little or no significant effect on whether a student chose or consumed a fruit or vegetable during the intervention period. However, we find large and significant effects of the competitive scheme for both the FSM and non-FSM students on the probability of trying a fruit or vegetable. When looking at the restricted sample, we find that the likelihood that a student tried a healthy time increased by nearly 20 percentage points in the first week of the intervention both the FSM and non-FSM groups. Furthermore, the large significant effect of the competition do not disappear over time for either the FSM or non-FSM group.

The examination of the heterogeneity of the treatment effects provides key insights to

how average effects can mask potential downsides that are of particular importance when considering policy. With regards to the competition, it is clear that the overall effect is large and significant: the competition caused students to choose and consume more fruit and vegetables and those effects do not vary much by subgroup. However, looking at the average effect of the piece-rate, would mask extreme differences in the response by year groups. Table 2 suggests that the piece-rate had an initial effect on choice and consumption but that the positive effect dissipated after two weeks. This general pattern is only present for boys (table 4A) and non-FSM students (table 6A); girls (table 4B) and FSM students (table 6B) did not have a significant response to piece-rate. However, year five students did respond positively and the effect did not dissipate over time and year two students responded negatively to the piece-rate. Given that piece-rate seems to be effected by discouragement, these heterogeneous effects could be due to differential responses to discouragement. Furthermore, if healthy eating habits developed at a young age are more likely to last, then it is uncertain that a policy maker would want to introduce an individual based scheme such as the piece-rate scheme used here since it appears to discourage younger students from choosing and eating fruit or vegetables.

4.4 Medium term effects

We now turn to the post-intervention weeks and evaluate whether the changes observed during the intervention persist in the week after the incentives are removed. The results are presented in Tables 7, 8 and 9. Given that tables 3-7 allow us to see how the incentives vary over the intervention period, we now look at the overall effect of the intervention period in one summary variable, called "wk 2-5." However, our main coefficient of interest is the interaction of the incentive scheme with week six, which is the week immediately following the intervention.

Table 7 shows the effects by gender. As expected there is no discernible effect of the treatment on the whole sample. Instead we see a strong positive effect on those most likely to have responded, the restricted sample in columns [4]-[6]. With regards to the competition, there is an average increase of 18.5 percentage points in the probability of choosing a fruit or vegetable for boys, as shown in column [4]. In column [5] we see that there is a 15.4 percentage point increase in the probability of trying a fruit or vegetable. Column [6] shows no effect on eating more than half. When the incentive is removed in week six, boys are more likely to continue eating part of the fruit or vegetables on their plate. However, there is no other effect. With regards to piece-rate, boys respond positively for all three outcomes of interest but there is not carry over into week six. When

looking at girls, Table 7 panel B, we see that for the restricted sample, the significant results from the incentive period are for the competition on trying a fruit or vegetable. We also find lasting positive effects after the incentives have been removed.

Table 8 shows the effects by year group. The piece rate has a strong negative effect on choosing and trying of a fruit or vegetable for students in year two. The negative effects persist even when the incentives are removed; all the point estimates for week six interacted with piece-rate for choosing and trying in columns [1], [2], [4] and [5] are negative and significant. When looking at year five in panel B, we find very large and significant effects of the piece rate and most of them are sustained once the incentive is removed. We find a slightly different pattern for the competition. The competition, in general, effects both year groups positively, however the positive effect on choice and consumption only carries over into week six for the year two group. However, in only in one case do the positive effects of the incentive period carry over into week six for the year five group. This shows that when younger students respond to the incentive, even if it is negative, it is more likely to persist than when the older students respond to the incentives.

Finally, in Table 9, we split the sample by free school meal eligibility. Here again, we mainly find significant effects for the competitive scheme and these effects are particularly pronounced for FSM children. For non-FSM students we see that in the restricted sample there is a positive effect of the competition, columns [4]-[6] in panel A. The positive behaviour only carries over into week six, when the incentives were removed, for trying of fruit or vegetables. For FSM students, we see a positive effect of competition in columns [2], [4] and [6]. In all of the consumption estimations, the positive effects carry over into week six, refer to columns [2], [5], and [6] in panel B. There is no effect of piece-rate for either group.

As in the previous results we see that, in general, the competitive scheme works better than piece-rate. Indeed there are more lasting effects after the competition incentives are removed. However, of particular interest, is that the effects on consumption - trying and eating more than half - are more likely to persist than the effects on choice. Given that students are not more likely to choose a fruit or vegetable after the incentive is removed but are more likely to consume a fruit or vegetable, which implies that the intervention schemes have caused people who originally had fruit or vegetables as part of their meal to consume them rather than leave them on their plate. Given that people are now more likely to consume fruit or vegetables when they are given them, that could imply that a change in food preferences has occurred.

4.5 Habit Formation

To evaluate whether the effects we find lead to permanent changes in habits, we contacted the schools again 6 months later and asked them to conduct an additional week of monitoring. Given that the medium run effects suggest that our intervention was more likely to have an effect on consumption, we will focus our analysis here on the consumption variables ("try" and "eat more than half"). To evaluate whether a habit has formed, we run a two-stage least squares regression, using the treatment dummies as instruments for the mean consumption during the intervention (that correspond to the mean of "try" or mean of "eat more than half" over the four weeks of intervention). Then, in the second stage, we regress the consumption variables ("try" or "eat more than half") corresponding to each of the post-intervention weeks (immediately after the intervention (week 6) and 6 months later) on the instrumented mean consumption during the intervention.

The results are presented in Table 10. We begin by presenting the estimates for all pupils. The first stage results show a positive and significant effect of the two treatment dummies on the proportion of fruit or vegetables tried during the intervention period for week 6 and on the sample where who tried less than 100% in the first week. The first stage estimates for 6 months later are typically weaker and are below 10. This is the case for all of our remaining first stage estimates except the year 5 group. To address this we have also estimated these results using limited information maximum likelihood (LIML) which is less biased when weak instruments are used. In most cases the results do not change[25]. We find a positive and significant effect of eating fruit and vegetables in the intervention period on consumption in week 6, and therefore evidence of habit formation in the immediate period after the intervention, for all pupils and those who tried less than 100% in the first week. However, we do not find any evidence of habit formation when we examine consumption 6 months later. When examining various subgroups we find evidence of habit formation in week 6 for most groups. However, as with the entire sample we do not find any evidence of long run habit formation on trying.

Considering the outcome of eating more than half we find evidence of short run habit formation across our different groups, with LIML giving similar point estimates to 2SLS. For the longer term we find that the free school meals pupils in the less than 100% group in the first week developed a long run habit.

These results must be interpreted with caution. First, this is due to the small sample sizes of some of the groups. Second, as can be seen in Figure 2 and 3 the proportion

[25]There are two exceptions; when we run the estimation for the FSM children and boys in week 6 for the whole sample using LIML the estimates are of a similar magnitude but are less precisely estimated.

consuming fruit and vegetables remains at a similar level as it was during the treated period for the two treated groups. Therefore there is not a decay in the proportion consuming. However, there was an increase in consumption by the control group. Given the length of time between the end of the experiment period and the follow up we did not restrict what the schools could do and it is plausible that they implemented an intervention or policies to improve fruit and vegetable consumption.

4.6 Learning: Food Knowledge

One question is whether the intervention triggered a response only through the incentives, or also through learning. It could be that the intervention taught children that fruit and vegetables are healthy and that they respond to that information rather than the incentives. We are able to test for this possibility by comparing the results on a knowledge test that was conducted just before and at the end of the intervention. The test shows pictures of 7 food items, including 3 or 4 fruit or vegetables and unhealthy items (such as sweets, chips, ice cream, crisps, fish fingers). Children were asked to write what the item is and whether the item was healthy or not (see Figure A2 for an example).

On average, we find that children described 92% items correctly and identified 83% of healthy items correctly before the intervention (see Table B2 for summary statistics). After the intervention, we find that results remained very similar (92% and 85% respectively). We estimate a simple linear model with the second test score results as dependent variable and include dummies for the experimental group of the school to which the child belongs (piece rate, competition or control). We also control for the first test score results. The results are presented in panel A of Table 11 for the sample of children who tried less than 100% in the first week (panel A of Table B4 presents the results for the whole sample which are very similar). We find very little difference in the second test score results across treatment and control groups. These results indicate that knowledge was very high before the intervention and was not affected by the intervention. Children are very well informed that fruit and vegetables are healthy and the responses to the intervention are not driven by learning.

4.7 Effects on cognitive outcomes

We now turn to the effects on cognitive outcomes. Cognitive ability is difficult to measure with a single test. Also, the intervention we consider is mild (it only targets one portion of fruit and vegetables a day). This is not a major shift in diet and, therefore, it is a tough test to evaluate the effects of nutrition on cognitive ability. We chose to use a

partial measure of ability, capturing the ability to concentrate. Our conjecture is that concentration may be the dimension of ability that responds most quickly to changes in diet. These tests were given right after lunch on a Friday, both before and after the intervention.

The test is based on the well-known "spot-the-differences" puzzles (see Figure A3 for an example). Each puzzle consisted of two sets of 5 by 6 domino squares. There were five differences between each of the large squares that the pupils were required to find. They were given ten minutes to solve as many as they could up to a maximum of fourteen. Table B3 presents summary statistics on the test score results. We report the fraction of completed puzzles (i.e. where 5 differences were correctly identified with a circle). On average pupils solve 40% of the puzzles correctly. There is no gender difference and no difference according to free school meal status, but Year 5 children perform better on average than Year 2 children, as we would expect. The score of the second test is also higher on average than the first test. The important question here is whether this improvement is more pronounced in the treatment schools than in the control schools.

We estimate a linear model with the fraction of correctly solved puzzles as dependent variable (see panel B of Table 11) and include treatment dummies, as well as the score of the first test. We find a positive effect (significant at the 10% level) of the piece rate on the restricted sample but we find no effects on average on the whole sample (panel B Table B4). On the other hand, if we look at the sub-groups, we find a negative effect on boys in the competition schools (again, not precisely estimated). Thus, these results do not provide convincing evidence that the intervention lead to an improvement in concentration. Of course, we should take these results with caution as we only consider a mild intervention in diet and a very partial measure of cognitive ability.

5. Conclusion

This paper provides field evidence on the effects of incentives on the formation of new dietary habits among children. We conducted a large scale field experiment in 31 primary schools in the UK testing for the effects of two different incentive schemes: a competition and a piece rate scheme. Both schemes are targeted at children's choice of fruit and vegetables at lunch. We implemented the rewarding schemes for a period of 4 weeks and monitored their choice and consumption over that period, as well as one week before, one week after and 6 months later.

We find two main results. First, competitive and piece rate incentives have very heterogeneous effects, particularly according to age. Younger children are more responsive

to competition; older children are more responsive to piece rate incentives. Piece rate incentives work adversely on younger children (confirming some of the evidence in the literature on child nutrition). Overall, competitive incentives are more effective. This is because the piece-rate scheme contains a threshold which can create discouragement. This discouragement is not apparent in the competition scheme where the pupils, in principle, could receive an additional reward no matter how many items they had chosen. The competitive mechanism also seems to work particularly well to encourage tasting and trying fruit and vegetables among children from poorer socio-economic backgrounds. Second, we do find evidence that the intervention continues to affect behaviour after the incentives are removed. But we find that over the longer run (six months after the intervention) the changes are not sustained. One important exception relates to the children from poorer socio-economic backgrounds, for which we do find long term sustained effects. This is a notable finding given the lack of response of this group in many other school based health interventions. Finally, we do not find clear evidence of effects of the intervention on a measure of cognitive ability.

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Figures & Tables

Figure 1: Average percentage of "healthy choice" (all sample)

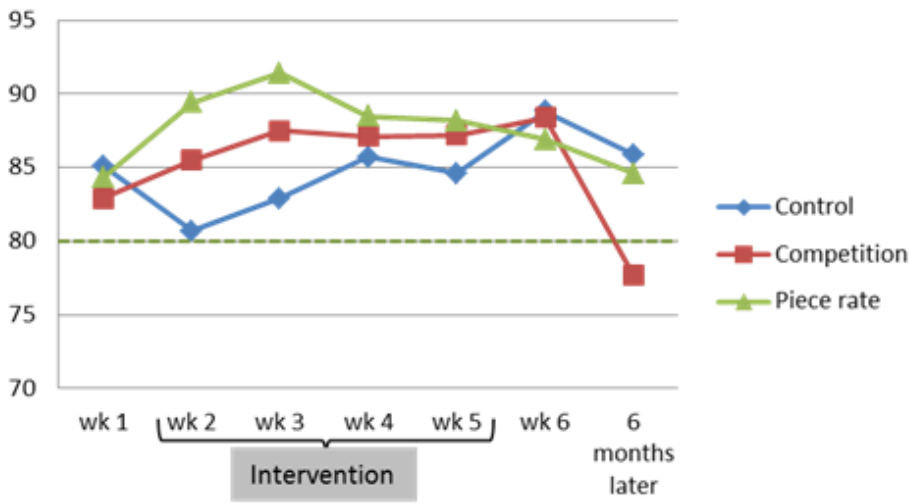


Figure 2: Average percentage of "try" (all sample)

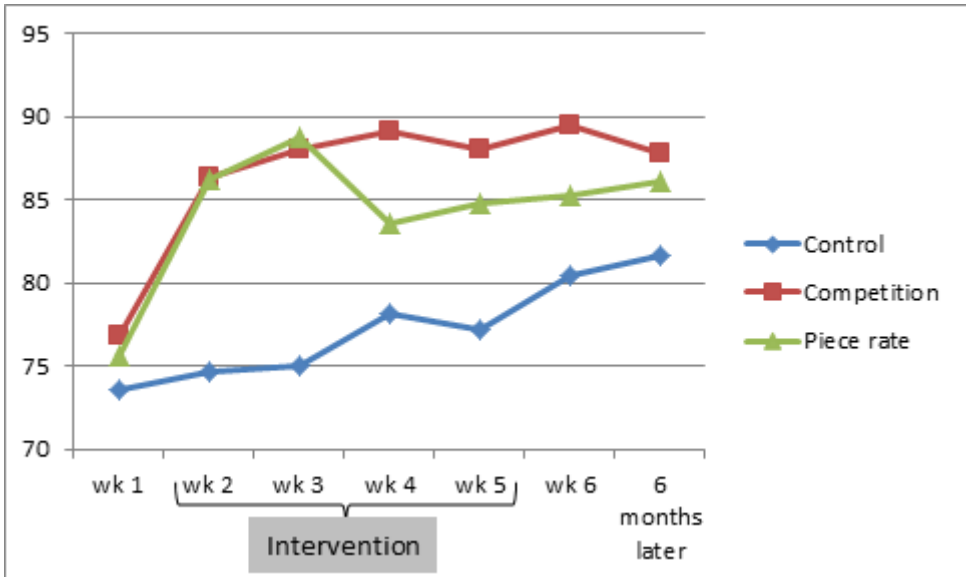


Figure 3: Average percentage of "eat more than half" (all sample)

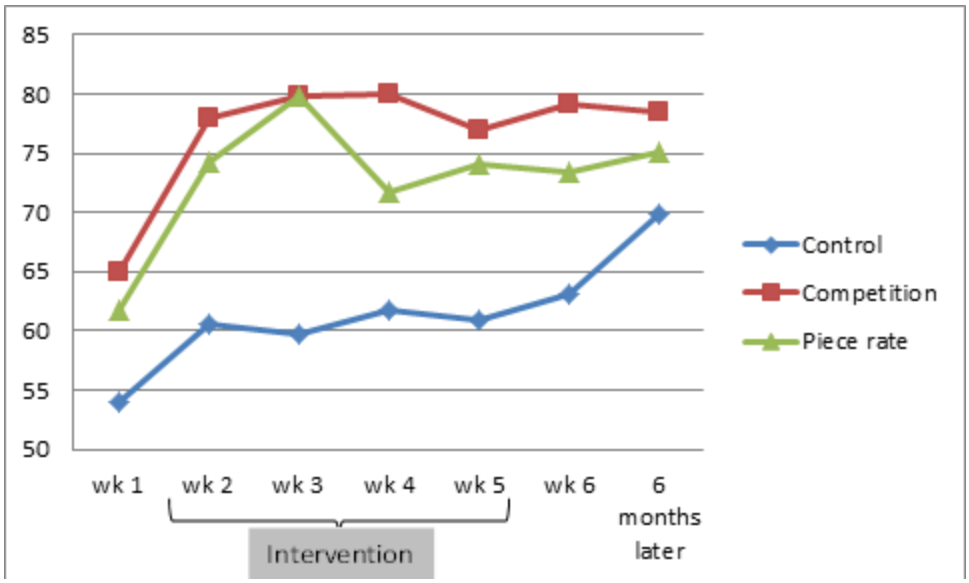


Table 1: Summary statistics Control and Treatment groups

	Control (C)	Piece Rate (T1)	Comp (T2)	p-value C vs T1	p-value C vs T2
Choice	0.851	0.843	0.829	0.910	0.706
Ate something	0.736	0.756	0.768	0.789	0.634
Ate more than half	0.54	0.618	0.65	0.295	0.281
School Dinner	0.507	0.448	0.468	0.571	0.684
Packed Lunch	0.471	0.529	0.501	0.579	0.760
Female	0.524	0.448	0.549	0.180	0.628
1st Language English	0.978	0.982	0.929	0.853	0.203
Free School Meal	0.205	0.198	0.156	0.899	0.409
School meals per week	2.458	2.448	2.52	0.988	0.895
Always School Meal	0.436	0.436	0.439	0.995	0.971
Packed lunches per week	2.547	2.552	2.48	0.994	0.888
Always Packed Lunch	0.4	0.442	0.404	0.741	0.970
White British	0.903	0.905	0.78	0.973	0.202
Special dietary requirements	0.053	0.092	0.121	0.174	0.177
Specific health cond.	0.143	0.167	0.156	0.504	0.677
Normally eats breakfast	0.973	0.969	0.955	0.811	0.332
Less than 100% (less than 100% choice for independent variable characteristics)					
Choice	0.546	0.501	0.478	0.465	0.369
Ate something	0.531	0.469	0.499	0.412	0.537
Ate more than half	0.399	0.415	0.413	0.791	0.851
School Dinner	0.445	0.355	0.539	0.566	0.533
Packed Lunch	0.527	0.625	0.446	0.536	0.583
Female	0.411	0.451	0.549	0.606	0.101
1st Language English	0.959	0.961	0.945	0.970	0.755
Free School Meal	0.151	0.1	0.164	0.590	0.841
School meals per week	2.233	1.451	2.847	0.255	0.387
Always School Meal	0.356	0.137	0.5	0.133	0.370
Packed lunches per week	2.781	3.549	2.153	0.258	0.373
Always Packed Lunch	0.384	0.51	0.361	0.552	0.883
White British	0.851	0.906	0.75	0.517	0.432
Special dietary requirements	0.027	0.098	0.181	0.101	0.031
Specific health cond.	0.178	0.22	0.125	0.642	0.423
Normally eats breakfast	0.959	0.94	0.931	0.682	0.445

notes: All variables are evaluated for the first week, before the start of the treatment. The first column shows the means for the pupils in the control school in the, the second column for schools in the piece-rate scheme and the third column in the competition schools. The fourth and fifth columns show the p-value difference in the means of each treatment compared to the control group. The p-value were calculated, to account for intra-school correlation, by regressing each baseline variable on one of the treatment indicators, and clustering the standard errors at the school level, the p-value is matches to the t-statistic on the treatment dummy.

Table 2: Average Treatment Effect: The effect of incentives on choosing a fruit or vegetable

	[1]	[2]	[3]	[4]	[5]	[6]
	All			< 100% in Week 1		
	Chooses	Tries	Eats > 1/2	Chooses	Tries	Eats > 1/2
Competition	-0.022	0.032	0.11	-0.068	-0.032	0.014
	(0.058)	(0.065)	(0.098)	(0.074)	(0.050)	(0.072)
Piece rate	-0.009	0.02	0.078	-0.045	-0.061	0.016
	(0.075)	(0.072)	(0.072)	(0.059)	(0.073)	(0.060)
Comp x Week 2	0.059*	0.085**	0.08	0.196***	0.195***	0.153
	(0.031)	(0.035)	(0.081)	(0.060)	(0.037)	(0.103)
Comp x Week 3	0.07	0.095**	0.083	0.155**	0.182***	0.172*
	(0.047)	(0.045)	(0.079)	(0.077)	(0.048)	(0.090)
Comp x Week 4	0.025	0.073	0.083	0.109**	0.170***	0.190**
	(0.033)	(0.048)	(0.083)	(0.049)	(0.049)	(0.088)
Comp x Week 5	0.041	0.075*	0.063	0.168***	0.178***	0.149*
	(0.041)	(0.044)	(0.082)	(0.062)	(0.046)	(0.084)
Piece x Week 2	0.071	0.0921	0.072	0.158***	0.203**	0.143*
	(0.047)	(0.061)	(0.068)	(0.059)	(0.091)	(0.078)
Piece x Week 3	0.0797	0.102	0.0914	0.128	0.203**	0.166*
	(0.058)	(0.064)	(0.074)	(0.078)	(0.092)	(0.087)
Piece x Week 4	0.017	0.0294	0.0324	0.0789	0.119	0.109
	(0.070)	(0.074)	(0.085)	(0.105)	(0.105)	(0.095)
Piece x Week 5	0.0202	0.0526	0.0611	0.0422	0.136	0.123
	(0.061)	(0.075)	(0.083)	(0.097)	(0.110)	(0.092)
Constant	0.851***	0.736***	0.540***	0.546***	0.531***	0.399***
	(0.047)	(0.038)	(0.048)	(0.046)	(0.029)	(0.028)
N obs.	2,768	2,679	2,679	971	1,339	1,787
N pupils	626	609	609	203	304	410

*notes: OLS regression results; including pupil random effects and with standard errors clustered at the school level. Additional controls: week dummies. Dependent variable is the pupil weekly mean. *, ** and *** indicate significance at 10%, 5% and 1% level respectively.*

Table 3: Dynamics of choice and consumption during the treatment weeks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Choice								
Competition	-0.097	-0.155**	-0.184	-0.083	-0.106	0.088	0.045	-0.008
	(0.079)	(0.071)	(0.149)	(0.113)	(0.123)	(0.100)	(0.087)	(0.089)
Piece-Rate	-0.031	0.011	0.074	-0.017	-0.050	-0.174***	0.017	-0.144***
	(0.063)	(0.121)	(0.160)	(0.105)	(0.089)	(0.067)	(0.102)	(0.036)
Comp x Week 2-5	0.166***	0.199***	0.237*	0.179*	0.121	0.037	0.007	0.067
	(0.059)	(0.045)	(0.131)	(0.098)	(0.100)	(0.096)	(0.065)	(0.077)
Piece x Week 2-5	0.097	0.028	0.050	0.071	0.061	0.254**	-0.061	0.176***
	(0.079)	(0.068)	(0.131)	(0.102)	(0.125)	(0.111)	(0.183)	(0.051)
Constant	0.520***	0.499***	0.604***	0.618***	0.612***	0.440***	0.347***	0.607***
	(0.041)	(0.022)	(0.140)	(0.087)	(0.026)	(0.031)	(0.074)	(0.045)
Observations	4,743	910	977	951	975	930	841	1,970
Number of pupils	215	212	214	215	213	213	154	202
Panel B: Try								
Competition	-0.034	-0.010	-0.118*	0.018	-0.019	-0.042	0.016	0.002
	(0.047)	(0.098)	(0.071)	(0.081)	(0.101)	(0.100)	(0.061)	(0.059)
Piece-Rate	-0.003	0.115	-0.050	0.013	-0.164	0.042	-0.049	-0.041
	(0.060)	(0.116)	(0.098)	(0.068)	(0.105)	(0.142)	(0.113)	(0.046)
Comp x Week 2-5	0.187***	0.161*	0.268***	0.159*	0.125	0.235***	0.120**	0.126***
	(0.033)	(0.091)	(0.076)	(0.089)	(0.089)	(0.070)	(0.053)	(0.046)
Piece x Week 2-5	0.120	-0.022	0.160	0.109	0.250*	0.081	0.043	0.133**
	(0.079)	(0.101)	(0.108)	(0.076)	(0.147)	(0.131)	(0.190)	(0.062)
Constant	0.517***	0.453***	0.610***	0.560***	0.559***	0.532***	0.323***	0.620***
	(0.032)	(0.082)	(0.057)	(0.049)	(0.037)	(0.076)	(0.055)	(0.040)
Observations	6,296	1,203	1,303	1,290	1,299	1,201	871	2,866
Number of pupils	333	315	328	318	315	315	175	305
Day of Week	Mon-Fri	Mon	Tue	Wed	Thur	Fri	Wed-Fri	Wed-Fri
Sample Used	All	All	All	All	All	All	Missed	Not Missed
Days of Week Controls	Yes	No	No	No	No	No	Yes	Yes
Week Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*notes: Robust Standard Errors clustered at the school level are in brackets; * sig at 10%, ** sig at 5%, *** sig at 1%. The sample used in this regression are students who did not try at least some of a healthy option 100% of the time during the baseline week. The "Missed" sample in column [7] includes only those students who had not eaten any healthy times on Monday and Tuesday of the given week. The "Not Missed" sample in column [8] includes only those students who had eaten at least one healthy item on Monday or Tuesday during the given week.*

Table 4a: Gender treatment effects (Boys) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	0.001	0.08	0.102	-0.117	-0.029	-0.009
	(0.078)	(0.068)	(0.093)	(0.107)	(0.058)	(0.072)
Piece rate	0.013	0.017	0.042	-0.096	-0.069	-0.048
	(0.093)	(0.080)	(0.075)	(0.108)	(0.086)	(0.064)
Comp x Week 2	0.034	0.037	0.071	0.224***	0.159***	0.144*
	(0.050)	(0.050)	(0.071)	(0.079)	(0.057)	(0.082)
Comp x Week 3	0.054	0.046	0.0533	0.181*	0.135**	0.130*
	(0.066)	(0.048)	(0.058)	(0.096)	(0.060)	(0.072)
Comp x Week 4	-0.002	0.02	0.054	0.108*	0.154***	0.167*
	(0.045)	(0.056)	(0.083)	(0.064)	(0.055)	(0.085)
Comp x Week 5	0.028	0.029	0.052	0.219***	0.167**	0.114
	(0.055)	(0.060)	(0.080)	(0.083)	(0.073)	(0.088)
Piece x Week 2	0.07	0.149**	0.138*	0.209**	0.275***	0.226***
	(0.060)	(0.071)	(0.072)	(0.090)	(0.098)	(0.083)
Piece x Week 3	0.084	0.153**	0.131*	0.188*	0.289***	0.229***
	(0.070)	(0.069)	(0.069)	(0.101)	(0.088)	(0.073)
Piece x Week 4	-0.004	0.033	0.04	0.095	0.135	0.11
	(0.078)	(0.083)	(0.085)	(0.126)	(0.099)	(0.086)
Piece x Week 5	0.018	0.058	0.032	0.101	0.154	0.078
	(0.067)	(0.088)	(0.080)	(0.104)	(0.117)	(0.090)
Constant	0.818***	0.711***	0.544***	0.548***	0.532***	0.419***
	(0.063)	(0.05)	(0.047)	(0.069)	(0.044)	(0.029)
N obs.	1,302	1,236	1,236	496	660	850
N pupils	299	286	286	103	148	196

notes: see notes to table 2

Table 4b: Gender treatment effects (Girls) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	-0.034	-0.006	0.117	-0.017	-0.033	0.038
	(0.053)	(0.073)	(0.112)	(0.078)	(0.065)	(0.083)
Piece rate	-0.017	0.039	0.139	0.029	-0.054	0.109
	(0.063)	(0.079)	(0.089)	(0.065)	(0.112)	(0.077)
Comp x Week 2	0.078*	0.108***	0.071	0.172**	0.188***	0.135
	(0.043)	(0.041)	(0.100)	(0.079)	(0.049)	(0.133)
Comp x Week 3	0.078	0.120*	0.088	0.095	0.181**	0.178
	(0.052)	(0.064)	(0.103)	(0.093)	(0.071)	(0.121)
Comp x Week 4	0.036	0.103*	0.09	0.07	0.152***	0.187*
	(0.043)	(0.053)	(0.090)	(0.060)	(0.057)	(0.099)
Comp x Week 5	0.038	0.096*	0.056	0.071	0.150**	0.159
	(0.061)	(0.054)	(0.098)	(0.106)	(0.067)	(0.111)
Piece x Week 2	0.067	0.031	-0.003	0.072	0.126	0.052
	(0.045)	(0.065)	(0.076)	(0.084)	(0.125)	(0.093)
Piece x Week 3	0.071	0.05	0.036	0.019	0.111	0.085
	(0.056)	(0.080)	(0.095)	(0.086)	(0.157)	(0.129)
Piece x Week 4	0.024	0.013	0.006	0.009	0.099	0.094
	(0.065)	(0.077)	(0.100)	(0.105)	(0.146)	(0.124)
Piece x Week 5	0.0088	0.032	0.064	-0.088	0.105	0.141
	(0.064)	(0.082)	(0.102)	(0.118)	(0.144)	(0.123)
Constant	0.883***	0.760***	0.541***	0.542***	0.528***	0.384***
	(0.039)	(0.037)	(0.063)	(0.047)	(0.033)	(0.035)
N obs.	1,410	1,389	1,389	439	638	896
N pupils	315	311	311	92	147	205

notes: see notes to table 2

Table 5a: Treatment effects (Year 2) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	-0.09	0.007	0.129	-0.169*	-0.017	0.042
	(0.060)	(0.058)	(0.108)	(0.087)	(0.071)	(0.098)
Piece rate	0.014	0.065	0.144**	-0.078	0.043	0.093
	(0.056)	(0.057)	(0.071)	(0.074)	(0.077)	(0.064)
Comp x Week 2	0.089**	0.085**	0.018	0.189**	0.156***	0.076
	(0.045)	(0.040)	(0.117)	(0.080)	(0.051)	(0.167)
Comp x Week 3	0.067	0.065	0.046	0.129	0.091	0.13
	(0.057)	(0.050)	(0.124)	(0.093)	(0.069)	(0.159)
Comp x Week 4	0.014	0.041	0.064	0.034	0.064	0.156
	(0.046)	(0.046)	(0.124)	(0.084)	(0.059)	(0.145)
Comp x Week 5	0.076	0.101*	0.046	0.141	0.146**	0.103
	(0.048)	(0.052)	(0.123)	(0.088)	(0.066)	(0.147)
Piece x Week 2	-2.65E-06	-0.034	-0.087	-0.064	-0.070*	-0.062
	(0.033)	(0.024)	(0.056)	(0.096)	(0.042)	(0.064)
Piece x Week 3	-0.009	-0.016	-0.032	-0.12	-0.057	-0.012
	(0.036)	(0.042)	(0.073)	(0.119)	(0.058)	(0.077)
Piece x Week 4	-0.115**	-0.124**	-0.116	-0.358**	-0.208***	-0.111
	(0.055)	(0.059)	(0.093)	(0.151)	(0.079)	(0.093)
Piece x Week 5	-0.059	-0.078	-0.06	-0.271**	-0.180*	-0.067
	(0.048)	(0.061)	(0.098)	(0.130)	(0.095)	(0.101)
Constant	0.900***	0.771***	0.518***	0.598***	0.539***	0.381***
	(0.039)	(0.038)	(0.053)	(0.051)	(0.054)	(0.036)
N obs.	1,439	1,426	1,426	416	643	949
N pupils	340	337	337	90	154	228

notes: see notes to table 2

Table 5b: Treatment effects (Year 5) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	0.055	0.054	0.096	0.039	-0.063	-0.014
	(0.067)	(0.103)	(0.119)	(0.073)	(0.072)	(0.073)
Piece rate	-0.0276	-0.044	-0.001	-0.018	-0.158	-0.076
	(0.104)	(0.118)	(0.119)	(0.076)	(0.107)	(0.100)
Comp x Week 2	0.017	0.08	0.131*	0.176**	0.220***	0.221***
	(0.064)	(0.066)	(0.069)	(0.069)	(0.073)	(0.070)
Comp x Week 3	0.072	0.127*	0.113	0.150*	0.268***	0.207***
	(0.064)	(0.073)	(0.075)	(0.088)	(0.058)	(0.075)
Comp x Week 4	0.028	0.105	0.0959	0.147**	0.265***	0.218**
	(0.057)	(0.079)	(0.089)	(0.071)	(0.069)	(0.096)
Comp x Week 5	-0.004	0.045	0.0743	0.173**	0.197***	0.189**
	(0.079)	(0.071)	(0.080)	(0.077)	(0.066)	(0.078)
Piece x Week 2	0.139**	0.247***	0.255***	0.254***	0.442***	0.380***
	(0.066)	(0.095)	(0.097)	(0.058)	(0.103)	(0.102)
Piece x Week 3	0.169**	0.251**	0.244**	0.243**	0.432***	0.382***
	(0.083)	(0.108)	(0.117)	(0.097)	(0.120)	(0.120)
Piece x Week 4	0.144*	0.219**	0.222**	0.267***	0.403***	0.378***
	(0.087)	(0.088)	(0.099)	(0.050)	(0.080)	(0.095)
Piece x Week 5	0.097	0.224***	0.220**	0.176**	0.414***	0.354***
	(0.077)	(0.085)	(0.090)	(0.078)	(0.071)	(0.088)
Constant	0.799***	0.699***	0.563***	0.512***	0.524***	0.419***
	(0.050)	(0.042)	(0.060)	(0.056)	(0.033)	(0.045)
N obs.	1,324	1,248	1,248	555	691	833
N pupils	285	271	271	113	149	181

notes: see notes to table 2

Table 6a: Treatment effects (Non-FSM) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	0	0.071	0.13	-0.04	-0.012	0.031
	(0.057)	(0.062)	(0.104)	(0.079)	(0.057)	(0.079)
Piece rate	-0.004	0.067	0.135*	-0.013	-0.02	0.049
	(0.079)	(0.062)	(0.075)	(0.050)	(0.059)	(0.058)
Comp x Week 2	0.057*	0.063**	0.09	0.193***	0.189***	0.158
	(0.034)	(0.031)	(0.077)	(0.054)	(0.031)	(0.098)
Comp x Week 3	0.066	0.062	0.067	0.129*	0.143**	0.152
	(0.051)	(0.046)	(0.083)	(0.078)	(0.060)	(0.093)
Comp x Week 4	0.023	0.048	0.074	0.090*	0.143***	0.167*
	(0.034)	(0.047)	(0.086)	(0.055)	(0.053)	(0.093)
Comp x Week 5	0.035	0.051	0.066	0.157**	0.158***	0.136
	(0.042)	(0.042)	(0.079)	(0.066)	(0.048)	(0.084)
Piece x Week 2	0.075	0.082	0.058	0.138**	0.220***	0.145**
	(0.055)	(0.055)	(0.064)	(0.069)	(0.079)	(0.074)
Piece x Week 3	0.09	0.081	0.066	0.116	0.174**	0.151*
	(0.064)	(0.054)	(0.070)	(0.079)	(0.081)	(0.084)
Piece x Week 4	0.028	0.012	0.022	0.083	0.0881	0.103
	(0.077)	(0.068)	(0.083)	(0.095)	(0.098)	(0.095)
Piece x Week 5	0.026	0.044	0.044	0.038	0.113	0.108
	(0.066)	(0.069)	(0.079)	(0.085)	(0.109)	(0.089)
Constant	0.837***	0.710***	0.528***	0.533***	0.514***	0.391***
	(0.045)	(0.036)	(0.056)	(0.051)	(0.028)	(0.034)
N obs.	2,206	2,149	2,149	796	1,059	1,397
N pupils	498	487	487	168	242	322

notes: see notes to table 2

Table 6b: Treatment effects (FSM) - All and Less than 100%

	[1]	[2]	[3]	[4]	[5]	[6]
		All			< 100% in Week 1	
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Competition	-0.112	-0.124	0.03	-0.204	-0.123	-0.033
	(0.097)	(0.106)	(0.133)	(0.151)	(0.102)	(0.099)
Piece rate	-0.005	-0.135	-0.096	-0.245*	-0.295*	-0.049
	(0.099)	(0.156)	(0.142)	(0.130)	(0.151)	(0.132)
Comp x Week 2	0.106	0.201**	0.056	0.277*	0.193*	0.117
	(0.066)	(0.086)	(0.113)	(0.165)	(0.109)	(0.160)
Comp x Week 3	0.101	0.231***	0.145*	0.313**	0.337***	0.235**
	(0.064)	(0.074)	(0.084)	(0.146)	(0.125)	(0.118)
Comp x Week 4	0.055	0.193***	0.142	0.207	0.262***	0.279**
	(0.069)	(0.071)	(0.101)	(0.135)	(0.067)	(0.113)
Comp x Week 5	0.065	0.184***	0.056	0.204	0.233***	0.19
	(0.061)	(0.068)	(0.107)	(0.131)	(0.089)	(0.129)
Piece x Week 2	0.052	0.163	0.153	0.293*	0.252	0.182
	(0.051)	(0.136)	(0.120)	(0.175)	(0.201)	(0.117)
Piece x Week 3	0.02	0.199	0.182	0.119	0.432**	0.224
	(0.039)	(0.136)	(0.134)	(0.110)	(0.213)	(0.142)
Piece x Week 4	-0.051	0.083	0.066	-0.118	0.292	0.141
	(0.061)	(0.157)	(0.163)	(0.206)	(0.241)	(0.176)
Piece x Week 5	-0.046	0.058	0.085	-0.0979	0.236	0.136
	(0.069)	(0.154)	(0.149)	(0.346)	(0.234)	(0.161)
Constant	0.903***	0.829***	0.588***	0.595***	0.608***	0.426***
	(0.071)	(0.072)	(0.094)	(0.129)	(0.069)	(0.067)
N obs.	487	462	462	140	230	335
N pupils	113	108	108	28	52	77

notes: see notes to table 2

Table 7: Medium run effects (i.e. including week 6) by Gender

	[1]	[2]	[3]	[4]	[5]	[6]
	All			< 100% in Week 1		
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Panel A: Boys						
Competition	0.001	0.080	0.102	-0.117	-0.029	-0.009
	(0.077)	(0.067)	(0.093)	(0.106)	(0.057)	(0.072)
Piece rate	0.013	0.017	0.042	-0.096	-0.069	-0.048
	(0.093)	(0.080)	(0.075)	(0.107)	(0.086)	(0.064)
Comp x Wk2-5	0.029	0.029	0.045	0.185**	0.154***	0.119
	(0.049)	(0.049)	(0.069)	(0.072)	(0.054)	(0.078)
Comp x Week 6	-0.040	0.003	0.040	0.047	0.135*	0.091
	(0.032)	(0.059)	(0.073)	(0.060)	(0.079)	(0.092)
Piece x Wk2-5	0.041	0.098	0.085	0.149*	0.213**	0.159**
	(0.063)	(0.073)	(0.069)	(0.086)	(0.091)	(0.072)
Piece x Week 6	-0.062	0.033	0.023	-0.054	0.118	0.049
	(0.062)	(0.078)	(0.075)	(0.115)	(0.102)	(0.088)
N obs.	1,565	1,490	1,490	597	794	1,025
N pupils	299	286	286	103	148	196
Panel B: Girls						
Competition	-0.034	-0.006	0.117	-0.017	-0.033	0.038
	(0.052)	(0.073)	(0.112)	(0.077)	(0.064)	(0.083)
Piece rate	-0.017	0.039	0.139	0.029	-0.054	0.109
	(0.063)	(0.079)	(0.089)	(0.064)	(0.111)	(0.076)
Comp x Wk2-5	0.060	0.109**	0.074	0.106	0.170***	0.160
	(0.045)	(0.047)	(0.092)	(0.076)	(0.048)	(0.108)
Comp x Week 6	0.033	0.077	0.063	0.056	0.108*	0.151
	(0.055)	(0.048)	(0.108)	(0.068)	(0.062)	(0.132)
Piece x Wk2-5	0.043	0.032	0.027	0.004	0.110	0.094
	(0.053)	(0.072)	(0.088)	(0.087)	(0.135)	(0.111)
Piece x Week 6	-0.009	0.007	0.042	-0.095	0.070	0.102
	(0.067)	(0.090)	(0.106)	(0.098)	(0.176)	(0.140)
N obs.	1,698	1,675	1,675	531	769	1,079
N pupils	315	311	311	92	147	205

notes:

Table 8: Medium run effects (i.e. including week 6) by Year Group

	[1]	[2]	[3]	[4]	[5]	[6]
	All			< 100% in Week 1		
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Panel A: Year 2						
Competition	-0.089	0.007	0.129	-0.169**	-0.017	0.042
	(0.059)	(0.058)	(0.108)	(0.086)	(0.071)	(0.098)
Piece rate	0.014	0.064	0.144**	-0.078	0.043	0.093
	(0.055)	(0.057)	(0.071)	(0.073)	(0.076)	(0.064)
Comp x Wk2-5	0.063	0.071*	0.031	0.127	0.113**	0.097
	(0.045)	(0.040)	(0.114)	(0.080)	(0.052)	(0.146)
Comp x Week 6	0.046	0.071*	0.068	0.067	0.144**	0.120
	(0.040)	(0.041)	(0.117)	(0.067)	(0.061)	(0.143)
Piece x Wk2-5	-0.046	-0.063*	-0.073	-0.202***	-0.129***	-0.062
	(0.034)	(0.035)	(0.072)	(0.073)	(0.045)	(0.074)
Piece x Week 6	-0.107**	-0.097**	-0.067	-0.439***	-0.162**	-0.084
	(0.043)	(0.042)	(0.084)	(0.075)	(0.078)	(0.078)
N obs.	1,743	1,727	1,727	505	779	1,151
N pupils	340	337	337	90	154	228
Panel B: Year 5						
Competition	0.055	0.054	0.096	0.039	-0.063	-0.014
	(0.067)	(0.102)	(0.118)	(0.073)	(0.072)	(0.073)
Piece rate	-0.028	-0.044	-0.001	-0.018	-0.158	-0.076
	(0.104)	(0.118)	(0.119)	(0.075)	(0.107)	(0.099)
Comp x Wk2-5	0.028	0.090	0.105	0.162**	0.238***	0.210***
	(0.060)	(0.067)	(0.074)	(0.064)	(0.054)	(0.069)
Comp x Week 6	-0.044	0.030	0.056	0.061	0.134	0.157*
	(0.073)	(0.079)	(0.090)	(0.071)	(0.082)	(0.092)
Piece x Wk2-5	0.137*	0.235***	0.237**	0.236***	0.423***	0.374***
	(0.074)	(0.090)	(0.095)	(0.061)	(0.085)	(0.090)
Piece x Week 6	0.055	0.190*	0.180	0.120*	0.336***	0.284**
	(0.084)	(0.108)	(0.120)	(0.071)	(0.109)	(0.136)
N obs.	1,582	1,498	1,498	667	828	997
N pupils	285	271	271	113	149	181

notes:

Table 9: Medium run effects (i.e. including week 6) by Free School Meal Status

	[1]	[2]	[3]	[4]	[5]	[6]
	All			< 100% in Week 1		
	Chooses	Tries	Eats > half	Chooses	Tries	Eats > half
Panel A: Non-FSM						
Competition	0.000	0.071	0.130	-0.039	-0.012	0.031
	(0.057)	(0.062)	(0.104)	(0.079)	(0.056)	(0.079)
Piece rate	-0.003	0.067	0.135*	-0.013	-0.020	0.049
	(0.078)	(0.062)	(0.075)	(0.060)	(0.059)	(0.058)
Comp x Wk2-5	0.048	0.056	0.069	0.148***	0.161***	0.143*
	(0.035)	(0.036)	(0.076)	(0.054)	(0.036)	(0.086)
Comp x Week 6	0.005	0.025	0.049	0.068	0.112**	0.114
	(0.038)	(0.043)	(0.092)	(0.042)	(0.056)	(0.108)
Piece x Wk2-5	0.054	0.055	0.048	0.094	0.149*	0.127*
	(0.061)	(0.056)	(0.068)	(0.067)	(0.082)	(0.076)
Piece x Week 6	-0.009	0.024	0.020	-0.029	0.085	0.060
	(0.067)	(0.065)	(0.083)	(0.089)	(0.104)	(0.103)
N obs.	2,661	2,597	2,597	962	1,277	1,687
N pupils	498	487	487	168	242	322
Panel B: FSM						
Competition	-0.112	-0.124	0.030	-0.204	-0.123	-0.033
	(0.096)	(0.105)	(0.132)	(0.147)	(0.100)	(0.098)
Piece rate	-0.005	-0.135	-0.095	-0.245*	-0.295**	-0.048
	(0.099)	(0.155)	(0.141)	(0.126)	(0.149)	(0.130)
Comp x Wk2-5	0.081	0.202***	0.087	0.250*	0.255***	0.184
	(0.061)	(0.070)	(0.091)	(0.132)	(0.089)	(0.119)
Comp x Week 6	0.018	0.174**	0.125	0.086	0.226**	0.215*
	(0.091)	(0.084)	(0.090)	(0.159)	(0.106)	(0.121)
Piece x Wk2-5	-0.005	0.126	0.120	0.049	0.304	0.170
	(0.046)	(0.138)	(0.134)	(0.199)	(0.211)	(0.139)
Piece x Week 6	-0.140	0.024	0.107	-0.314	0.192	0.155
	(0.107)	(0.167)	(0.150)	(0.371)	(0.247)	(0.153)
N obs.	581	552	552	168	276	401
N pupils	113	108	108	28	52	77

notes:

Table 10: Habit Formation (IV Estimation)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Try				Eats more than half			
	Week 6		6 months later		Week 6		6 months later	
	All	< 100%	All	< 100%	All	< 100%	All	< 100%
All sample	0.646**	0.637**	0.085	-0.056	0.976***	0.887***	0.1	0.095
	(0.262)	(0.268)	(0.525)	(0.546)	(0.219)	(0.221)	(0.460)	(0.398)
1st stage F-stat	10.22	12.08	7.892	5.623	5.11	5.6	4.986	6.196
Boys	0.494*	0.610***	-0.092	-0.065	0.810***	0.594***	0.484	0.559
	[0.281]	[0.225]	[0.795]	[0.576]	[0.192]	[0.207]	[0.671]	[0.416]
1st stage F-stat	3.845	4.987	2.183	3.464	5.188	6.164	1.87	4.093
Girls	0.689**	0.619*	0.028	-0.125	0.990***	1.037***	-0.228	-0.248
	[0.295]	[0.353]	[0.401]	[0.602]	[0.288]	[0.304]	[0.477]	[0.402]
1st stage F-stat	8.239	6.436	7.387	3.849	3.522	3.642	5.881	4.569
Year 2	1.354***	1.358***	1.369	1.572*	1.427***	1.452***	0.583	1.947*
	[0.295]	[0.249]	[1.213]	[0.926]	[0.345]	[0.406]	[0.689]	[1.140]
1st stage F-stat	2.988	4.531	0.588	0.222	1.139	1.045	0.742	0.813
Year 5	0.723***	0.705***	-0.044	-0.13	0.732***	0.696***	0.144	-0.044
	[0.197]	[0.149]	[0.555]	[0.478]	[0.216]	[0.206]	[0.438]	[0.367]
1st stage F-stat	26.19	34.48	19.09	27.19	14.71	17.82	8.748	15.01
No FSM	0.654**	0.609**	-0.232	-0.212	0.923***	0.822***	-0.135	-0.21
	[0.289]	[0.306]	[0.579]	[0.655]	[0.261]	[0.265]	[0.509]	[0.446]
1st stage F-stat	6.46	8.813	4.621	3.33	5.377	5.193	3.942	3.798
FSM	0.960**	0.748	0.959	0.324	1.352***	1.179***	0.471	0.868***
	[0.474]	[0.486]	[0.604]	[0.479]	[0.457]	[0.341]	[0.539]	[0.250]
1st stage F-stat	3.421	3.919	4.714	5.019	1.121	3.055	3.643	9.227

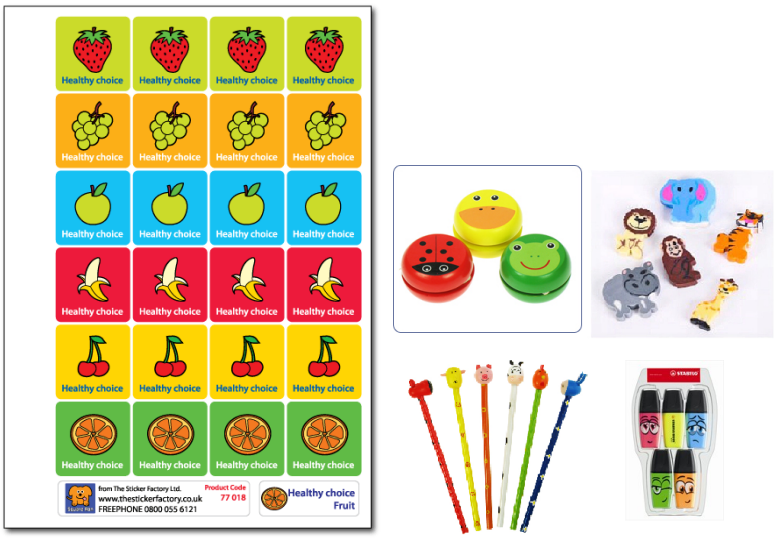
*notes: Second-stage IV estimates, standard errors clustered at the school level. The dependent variable is the mean consumption in week 6 or week 7; the coefficient corresponds to the effect of the mean consumption during the intervention (weeks 2 to 5) using the treatment (competition or piece rate) as an instrument. *, ** and *** indicate significance at 10%, 5% and 1% level respectively.*

Table 11: Food knowledge & Spot the difference tests - difference across treatment and control groups - OLS estimates (Tried less than 100% in the first sample)

	[1] All	[2] Boys	[3] Girls	[4] Year 2	[5] Year 5	[6] FSM	[7] No FSM
Panel A: Food Knowledge test 2							
Competition	-0.032	-0.002	-0.057	-0.082	0.011	-0.095	-0.017
	[0.029]	[0.050]	[0.040]	[0.053]	[0.034]	[0.078]	[0.034]
Piece rate	0.019	0.062	-0.039	-0.033	0.057	-0.118	0.045
	[0.033]	[0.049]	[0.074]	[0.078]	[0.051]	[0.244]	[0.038]
Test 1	-0.017	-0.077	0.065	-0.048	0.013	0.284	-0.1
	[0.083]	[0.107]	[0.134]	[0.126]	[0.119]	[0.196]	[0.090]
Constant	0.910***	0.936***	0.864***	0.890***	0.852***	0.709***	0.960***
	[0.067]	[0.093]	[0.120]	[0.112]	[0.092]	[0.159]	[0.082]
Observations	142	66	75	64	77	21	120
R-squared	0.072	0.094	0.082	0.046	0.03	0.259	0.074
Panel B: Spot the difference test 2 score							
Competition	-0.048	-0.085*	-0.017	0.009	-0.061	0.022	-0.062
	[0.035]	[0.047]	[0.054]	[0.048]	[0.050]	[0.086]	[0.039]
Piece rate	0.076*	0.088	0.065	0.088	0.093	0.182	0.066
	[0.043]	[0.056]	[0.070]	[0.065]	[0.058]	[0.116]	[0.047]
Test 1	0.733***	0.782***	0.691***	0.901***	0.618***	0.751***	0.718***
	[0.060]	[0.080]	[0.092]	[0.087]	[0.092]	[0.142]	[0.068]
Constant	0.302***	0.296***	0.344***	0.138***	0.374***	0.229	0.306***
	[0.053]	[0.072]	[0.068]	[0.048]	[0.071]	[0.160]	[0.058]
Observations	202	103	99	103	99	32	170
R-squared	0.599	0.646	0.565	0.534	0.38	0.709	0.572

Appendix A: Experimental Materials

Figure A1: Stickers and rewards



Appendix B: Additional Tables (not for publication)

Table B1: Additional summary statistics

	Control	Piece Rate	Comp	p-value	p-value
	(C)	(T1)	(T2)	C vs T1	C vs T2
Panel A: Tried less than 100% in the baseline week					
School Dinner	0.441	0.573	0.469	0.369	0.811
Packed Lunch	0.54	0.418	0.493	0.414	0.694
Female	0.476	0.394	0.592	0.214	0.057
1st Language English	0.969	0.97	0.913	0.969	0.285
Free School Meal	0.159	0.188	0.192	0.698	0.492
School meals per week	2.198	2.727	2.495	0.452	0.627
Always School Meal	0.365	0.485	0.426	0.469	0.672
Packed lunches per week	2.81	2.273	2.505	0.443	0.616
Always Packed Lunch	0.429	0.379	0.426	0.718	0.982
White British	0.906	0.899	0.741	0.907	0.122
Special dietary requirements	0.04	0.108	0.146	0.084	0.043
Specific health cond.	0.184	0.215	0.165	0.585	0.618
Normally eats breakfast	0.968	0.938	0.932	0.300	0.206
Panel B: Eats more half less than 100% in the baseline week					
School Dinner	0.509	0.581	0.464	0.527	0.656
Packed Lunch	0.466	0.411	0.504	0.629	0.719
Female	0.512	0.453	0.552	0.291	0.467
1st Language English	0.977	0.979	0.91	0.927	0.125
Free School Meal	0.193	0.237	0.163	0.490	0.543
School meals per week	2.43	2.926	2.515	0.408	0.874
Always School Meal	0.419	0.526	0.432	0.446	0.917
Packed lunches per week	2.576	2.074	2.485	0.402	0.865
Always Packed Lunch	0.39	0.347	0.402	0.731	0.914
White British	0.89	0.918	0.734	0.662	0.148
Special dietary requirements	0.047	0.074	0.119	0.331	0.084
Specific health cond.	0.171	0.202	0.157	0.478	0.669
Normally eats breakfast	0.97	0.947	0.933	0.285	0.168

notes: see notes to Table 1

Table B2: Summary statistics - Food knowledge test - Correct answers

	Test 1			Test 2		
All	N	Mean	SD	N	Mean	SD
What is it	460	0.922	0.14	414	0.92	0.146
Is it healthy	462	0.827	0.177	409	0.854	0.157
Boys						
What is it	219	0.911	0.155	189	0.915	0.154
Is it healthy	221	0.805	0.19	186	0.838	0.165
Girls						
What is it	235	0.933	0.124	217	0.93	0.135
Is it healthy	234	0.85	0.158	215	0.869	0.149
Year 2						
What is it	244	0.9	0.152	233	0.898	0.159
Is it healthy	245	0.802	0.193	227	0.834	0.17
Year 5						
What is it	216	0.947	0.12	181	0.95	0.12
Is it healthy	217	0.855	0.154	182	0.878	0.136
FSM						
What is it	73	0.902	0.131	69	0.907	0.139
Is it healthy	75	0.765	0.197	67	0.826	0.181
No FSM						
What is it	377	0.926	0.142	336	0.926	0.145
Is it healthy	376	0.841	0.168	333	0.859	0.152

Table B3: Summary statistics - Spot the differences test - Correct answers

	Test 1			Test 2		
	N	Mean	SD	N	Mean	SD
All	545	0.393	0.326	494	0.52	0.367
Boys	262	0.386	0.324	230	0.494	0.375
Girls	274	0.404	0.327	255	0.546	0.357
Year 2	294	0.241	0.276	273	0.364	0.333
Year 5	251	0.57	0.288	221	0.712	0.313
FSM	94	0.378	0.35	81	0.437	0.375
No FSM	440	0.394	0.319	402	0.537	0.363

Table B4: Food knowledge & Spot the difference tests - difference across treatment and control groups - OLS estimates (All pupils)

	All	Boys	Girls	Year 2	Year 5	FSM	No FSM
Panel A: Food Knowledge test 2							
Competition	-0.008	0.002	-0.013	-0.039	0.036	-0.068	0.008
	[0.023]	[0.032]	[0.026]	[0.029]	[0.028]	[0.047]	[0.022]
Piece rate	-0.001	0.018	-0.019	-0.015	0.027	-0.043	0.017
	[0.022]	[0.038]	[0.042]	[0.041]	[0.041]	[0.104]	[0.029]
Test 1	0.077	0.056	0.072	0.05	0.108	0.215	0.026
	[0.055]	[0.078]	[0.082]	[0.074]	[0.093]	[0.132]	[0.060]
Constant	0.815***	0.823***	0.829***	0.809***	0.752***	0.702***	0.843***
	[0.043]	[0.069]	[0.077]	[0.062]	[0.079]	[0.105]	[0.056]
Observations	292	136	155	160	132	45	247
R-squared	0.032	0.063	0.028	0.024	0.031	0.16	0.017
Panel B: Spot the differences test 2							
Competition	-0.007	-0.004	-0.008	0.01	0.013	0.046	-0.019
	[0.028]	[0.042]	[0.038]	[0.038]	[0.045]	[0.076]	[0.030]
Piece rate	0.022	0.051	-0.003	0.021	0.049	0.092	0.007
	[0.033]	[0.045]	[0.049]	[0.043]	[0.052]	[0.073]	[0.037]
Test 1	0.740***	0.805***	0.693***	0.823***	0.641***	0.704***	0.749***
	[0.040]	[0.057]	[0.055]	[0.053]	[0.067]	[0.089]	[0.045]
Constant	0.297***	0.267***	0.338***	0.170***	0.352***	0.208**	0.304***
	[0.040]	[0.056]	[0.053]	[0.038]	[0.053]	[0.100]	[0.044]
Observations	423	202	221	234	189	68	355
R-squared	0.546	0.572	0.525	0.479	0.353	0.547	0.544

Figure A2: Example food knowledge test

	What is it?	Is it healthy?
		Yes ☐ No ☐
		Yes ☐ No ☐
		Yes ☐ No ☐
		Yes ☐ No ☐
		Yes ☐ No ☐
		Yes ☐ No ☐

Figure A3: Example Spot the difference test