



HAL
open science

School lunch and learning behaviour in primary schools: an intervention study

Michael Nelson, Rebecca Golley, Ed Baines, Paul Bassett, Lesley Wood, Jo
Pearce

► To cite this version:

Michael Nelson, Rebecca Golley, Ed Baines, Paul Bassett, Lesley Wood, et al.. School lunch and learning behaviour in primary schools: an intervention study. *European Journal of Clinical Nutrition*, 2010, 10.1038/ejcn.2010.150 . hal-00570707

HAL Id: hal-00570707

<https://hal.science/hal-00570707>

Submitted on 1 Mar 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Title page**Full Title**

School lunch and learning behaviour in primary schools: an intervention study

Short running title

School lunch and learning behaviour

Authors

Rebecca Golley PhD,¹ Ed Baines PhD,² Paul Bassett MSc,² Lesley Wood PhD,¹ Jo Pearce MSc,¹ Michael Nelson PhD¹

Institution details

¹ School Food Trust

Moorfoot

Sheffield UK S1 4PQ

² Psychology and Human Development,

Institute of Education University of London,

25 Woburn Square

London WC1H 0AA

Correspondence

Michael Nelson

School Food Trust

Moorfoot

Sheffield UK S1 4PQ

Tel: 0844 800 9048

Fax: 0114 259 1291

michael.nelson@sft.gsi.gov.uk

Funding sources

School Food Trust

Conflict of interest

The authors disclose no conflict of interest.

Abstract

Background/Objectives: In addition to the nutritional benefits of healthier school food, anecdotes describe improvements in children's behaviour and educational outcomes when school food or the school dining room environment is improved. This study hypothesised that a school food and dining room intervention would improve pupils' learning-related classroom behaviour.

Subjects/Methods: A controlled intervention trial involving six primary schools matched in triplets and randomly assigned to a 12 week intervention (promotion of healthier school food at lunchtime and changes in the school dining environment) or 12 week waitlisted control group. Study outcome was learning-related behaviours measured in a random sample of 146 pupils in years 3-5.

Results: On-task and off-task behaviours were observed and used as proxy measures for concentration and disengagement (disruption) respectively. Teacher-pupil on-task engagement was 3.4 times more likely in the intervention schools compared with the control schools (adjusted model OR=3.40 (95% CI: 1.56, 7.36), p=0.009). However, on-task pupil-pupil behaviour was less likely in the intervention group (adjusted model OR=0.45 (95% CI: 0.28, 0.70), p<0.001). Similarly, off-task pupil-pupil behaviour was more likely in the intervention group than in the control group in both the unadjusted model (OR=2.18 (95% CI: 1.52, 3.13), p<0.001) and the adjusted model (OR=2.28 (95% CI: 1.25, 4.17), p=0.007).

Conclusions: This study offers some support for the hypothesis that a school food and dining room intervention can have a positive impact on pupils' alertness. However, if raised alertness is not channelled and supervised, it may result in increased off-task behaviour when pupils are working together.

Keywords

School lunch, behaviour, learning, primary school, UK, intervention study

Introduction

Food provided by schools at lunch and other times of the day has the potential to support children's nutrition, growth and development (School Meals Review Panel, 2005). The re-introduction of standards (School meals review panel 2005, Statutory Instrument 2000 No. 1777, Statutory Instrument 2006 No. 2381, Statutory Instrument 2007 No. 2359) and Government investment in school food in England aims to facilitate food consumption and nutrient intake in keeping with Government healthy eating guidelines.

Anecdotes from teachers and parents describe improvements in children's concentration, behaviour, learning and academic performance when healthier school food is introduced. Additionally, best practice guidance promotes improvements in the school dining environment to support children's behaviour, well being and learning (School Meals Review Panel, 2005).

These wider benefits of improved school food are not well supported by existing evidence. Studies exploring the benefits of school food generally lack clear and objective behavioural and educational endpoints; have been carried out in populations not generalisable to the wider school community; or have focused on the role of single foods, nutrient or meals in mediating educational improvements, but not addressed the way in which nutrition interventions themselves alter the environment in which children's behaviour is being evaluated, nor the potential interactions between nutritional and environmental interventions (Ells *et al*, 2008).

Only two studies cited in the University of Teeside review (Ells *et al*, 2008) explored school lunches and educational outcomes (Dunifon & Kowaleski-Jones, 2002, Gietzen & Vermeersh 1980). Neither explored the impact of better eating at lunchtime on classroom learning behaviour. A recent study (Belot & James, 2009) comparing the impact of a campaign to improve school lunches in the London Borough of Greenwich against seven similar 'control' boroughs (i.e. no campaign) showed better average academic achievement scores at age 11 in English and Science and reduced authorised absenteeism. There were no direct measures of learning behaviour.

In the present study, it was hypothesised that providing and promoting healthier school food at lunch time and improving the school dining room environment (e.g. physical setting,

lunchtime routine or lunchtime behaviour management) would result in improvements in pupils' learning-related behaviour in the classroom after lunch.

Methods

Study design

A 12-week controlled trial involving six primary schools in Sheffield, England, matched in triplets (see Figure 1) with school pairs randomly assigned to one of three treatment groups:

Nutrition first (NF): introduction and promotion of healthier school food at lunchtime over six weeks followed by changes in the school dining environment

Environment first (EF): changes in the school dining environment over six weeks followed by the introduction and promotion of healthier school food at lunchtime

Control: wait-listed schools in which there was no intervention for 12 weeks. Control schools were then provided with intervention support.

The primary study outcome was the learning-related behaviour of a randomly selected group of pupils in the post-lunch period. This was assessed by trained observers in the classroom setting.

Treatment order (nutrition first versus environment first) was randomly allocated within the design to assess their independent effects. In practice, however, the two intervention components were undertaken simultaneously (not sequentially), so analysis of their independent effects was not possible. The results have therefore been analysed as a single (multi-component) intervention at the end of 12 weeks rather than by phase of intervention delivery.

The study was approved by the University of Sheffield Research and Ethics Committee.

Study schools

Sheffield primary schools within a 10 mile radius of the School Food Trust office willing to undertaking a dining room intervention in Spring term 2007 were invited to participate. Interested schools were screened (Figure 1), with six schools selected by researchers in order to achieve three pairs of schools best matched for; baseline food provision (i.e. toward the interim food-based standards, Statutory Instrument 2006 No. 2381) and the dining environment indicating room for improvement, type of catering provider, school roll, free

school meal eligibility, Healthy School status and school meal take up. The three pairs of schools were then randomly assigned to study group.

Study intervention

The intervention comprised both nutrition and dining room components which together facilitated improvements in the provision, promotion and consumption of school food and to the dining room environment. The intervention was designed to be representative of the dining room recommendations promoted in current guidelines (North Yorkshire Business and Education Partnership, 2004) and was based on a checklist designed to assess the quality of the dining room environment. To achieve a standardised intervention, a framework was used to enable schools to implement a tailored and flexible intervention underpinned by a consistent process, content themes and timeline. Food provision was assessed against Government standards and the take up of school meals was also recorded. Intervention components were categorised in five themes under two headings; ‘nutritional characteristics’ (food provision and food promotion) and ‘environmental characteristics’ (dining space, lunchtime management and good relations) (Figure 1).

Pupil sample

Schools nominated one year four class (in one school the nominated class was a combined year 3/4 class, with two study pupils in year three) and one year five class to be observed. Parents and pupils in the study classes were sent a study information sheet and asked to participate. Within each school, 24 pupils were randomly selected via random number generation (stratified for year level, gender, attainment level and whether they were registered as taking a school meal or packed lunch; and excluding those declining participation (2%) or children with acute or chronic illness based on school records). Packed lunch pupils were included because they were potentially influenced by the interventions.

Data collection

School and pupil characteristics

Demographic information was collected at baseline (attainment level, gender, birth date, ethnicity, English as an additional language, usual type of lunch eaten (i.e. school lunch or packed lunch), free school meal registration and special needs status). Attainments were derived by converting Qualifications and Curriculum Authority (QCA) Maths national

optional test score from 2005/2006 academic year into high, middle and low ability levels (upper 25%, middle 50, lower 25%) based on the national summary of results from QCA 2005 (http://www.qca.org.uk/qca_8792.aspx).

Food and dining room environment

A 91-item checklist was developed for the study by reviewing the literature to identify factors that shape the school lunch dining service. The checklist had four sections; an interview conducted with the head teacher and head caterer, a menu checker (for compliance with standards), a pre-service observation checklist and a during-service observation checklist. Nutritional characteristics covered; food provision (compliance with the food based standards for school lunch 2006 and 2008, cooking practices and variety), menu promotion (price, menu visibility/accessibility, dining room rules/contingencies, taster sessions, parent/pupil involvement, links with packed lunches and incentives). Environmental characteristics included aspects of the dining space (appearance, layout, blockage points), lunchtime management (management of space and pupil numbers, noise levels and behaviour management) and good relations (staff training, presence, involvement and value as well as pupil ownership of the lunch service). Questions relating to either school lunch provision or school dining room were summed for nutritional and environmental sub-scores. These were totalled for the final dining room checklist score. Responses were scored with a higher score indicative of a positive dining room environment.

Systematic classroom observation

Systematic observation (SO) (Blatchford *et al*, 2006) provided a direct measure of pupil learning-related behaviours in the classroom without reliance on pupil or teacher reported behaviour. SO builds up data by recording, in real time, the incidence of clearly defined low inference behaviours.

Observation categories

The observation schedule was modified from Blatchford *et al*, 2006. It comprised categories that provided a description of time spent in different work settings (Individual, Pupil-pupil interaction, Adult led group, Whole Class, Pupil Plenary, Other), teaching topic, and social modes (interacting with their teachers, interacting with other children, not interacting). Within each of these three social modes were mutually exclusive categories that covered engagement in work, procedural, social and off-task activity. Observation categories addressed learning

behaviours of interest to the research question, looking at pupil concentration (being ‘on-task’), disengagement/ disruption (‘off-task’) and pupil mood.

Organisation of Observations

Observations of each ‘target’ child were collected over five minutes in ten 30-second blocks: 10 seconds for observers to ‘tune in’ to the target’s behaviour, 10 seconds to observe behaviour, and 10 seconds to record what took place during the observation period. After each block of ten observations, observer attention switched to the next pupil. Each observer collected observations on 12 selected ‘target’ pupils over approximately one hour in the same classroom on five consecutive days. The order in which pupils were observed differed each day.

Fieldworkers and training

Six observers were recruited from the National Centre for Social Research (NatCen), an independent UK social research institute. Over two days of training, observers focused on how to use the behavioural codes, the sampling framework and schedule. Observers practised coding (with periodic checks of accuracy and category understanding) using classroom video tape footage, followed by in-class observations. Weekly support sessions were held to discuss field visits. A retraining session was held prior to follow up visits. Observers were blinded to school study group allocation.

Fieldworker reliability checks

Initial training, inter-coder reliability coefficients for the main sets of mutually exclusive categories were good to high with Kappa coefficients ranging from 0.65 – 0.98. Reliability coefficients for the recalibration session were fair to good ranging from 0.48 – 0.87. For the ratings of observed mood, however, Kappa was low (0.23). Observed mood was not therefore included in the analytical model.

Data analysis

Data were entered in to a spreadsheet by two experienced personnel using pre-specified ranges. Five percent of cases were checked for errors and found to be within acceptable limits (less than 5% errors) and a range of validation and logical checking techniques were used to detect and remove any errors that remained. Data was imported into SPSS (SPSS Inc, Chicago, 2006) and MLWin (Goldstein, 1998) for analysis.

Multilevel statistical analysis of the systematic observation data, was undertaken appropriate for a cluster randomised trial, (Goldstein, 1995; Paterson & Goldstein, 1991). The 10-second observation interval was the unit of analysis with observation outcomes at each time point recorded as binary variables (present or absent). As a result, multilevel logistic regression was used for all analyses. Two-level models were used with individual observations nested within pupils. Observations in intervention (NF and EF combined) and control schools were compared at baseline and 12 weeks.

The model included terms for treatment group (Intervention vs. Control), visit (baseline vs. follow up), and a two-way interaction (treatment group by visit). The interaction term was of primary interest, showing whether differences in behaviours between visits varied significantly between intervention and control groups. An examination of a three-way interaction between visit, intervention and lunch type showed that results did not vary by lunch type (school lunch versus packed lunch on the day of observation), so analyses are reported only for the two way interaction effects. Two analytical models were assessed. Model 1 examined the effect of the intervention on behaviours, accounting only for differences between schools (unadjusted model). Model 2 included potentially confounding class and pupil characteristics in the analysis: class size, presence of additional adults in the classroom (yes/no), English as an additional language (EAL), free school meal eligibility (FSM), gender, special educational need (SEN) status, ethnicity (White British or 'other') and lunch type (school lunch or packed lunch) (adjusted model). These multi level logistic regression models were fitted using MLwiN software (Goldstein *et al*, 1998).

Statistics are reported as odds ratios (OR), confidence interval, and p value. An OR above 1.0 shows that the outcome is more likely in the intervention pupils than the control pupils; OR less than 1.0 shows that the outcome is less likely in the intervention pupils than the control pupils.

Results

Sample characteristics at school and pupil level are shown in Table 1. There were 96 year 3-5 pupils in the intervention schools (47 nutrition-first, 49 environment-first) and 50 year 4 and 5 pupils in the control schools; 72 girls and 74 boys; and 67 low attainment, 53 medium attainment and 9 high attainment pupils (data for the remaining 17 pupils were not available).

Gender and attainment levels were balanced across intervention and control schools. Other characteristics were similar between schools, except for FSM eligibility which was lower in the control schools (7.3%) than in the intervention schools (23.6% and 27%, NF and EF schools, respectively).

Class characteristics

Classes were of similar size (NF, 25.6; EF, 25.8; Control, 24.9), and of mixed ability. Two thirds of classes had a female teacher, 16% had another teacher, and 16% SEN teacher/support staff. The number of additional adults varied across the treatment conditions (means across all observations were: NF = 0.16, EF = 0.68, Control = 0.75), adjusted for in analytical Model 2.

Observations

A total of 17,306 observations were collected across the two time points and allowed for an analysis of reasonable power. At baseline, 5702, 10-second observations were collected in the intervention schools and 2941 in the control schools. At 12 weeks, 5811 and 2852 observations were collected, respectively. On average, 63.6 observations were collected for each 'target' pupil at each time point. Allowing for missing values, data for 132 pupils with observations at both baseline and week 12 have been included in Model 2.

Learning behaviours

On-task and off-task behaviours were observed and used as proxy measures for concentration and disengagement (disruption), respectively (Table 2). Total levels of on-task behaviour were high at around 80% in both intervention and control schools at baseline and post-intervention. Conversely, total levels of off-task were low, between 9.7% and 15.4%. The changes in on-task and off-task behaviours between baseline and 12 weeks, by intervention group and social-mode, are shown in Figures 2 and 3, respectively. The odds ratios for the three social modes ('individual', 'pupil-pupil' 'teacher-pupil') as well as for the total on-task and off-task behaviours observed are shown in Table 3.

In the unadjusted model (Model 1), there were no statistically significant time-treatment interactions for total on-task or off-task behaviours (Table 3). Thus, there was no statistically significant effect of the intervention on pupils' behaviour that was consistent across all social-modes. There were, however, significant interactions between treatment and time for specific

social-modes in both the unadjusted model and the adjusted models. Consistent with the hypothesis, teacher-pupil on-task engagement in the hour after lunch was 3.4 times more likely in the intervention schools compared with the control schools in the adjusted model (OR=3.40 (95% CI: 1.56, 7.36), p=0.009), but not in the unadjusted model. Contrary to expectations, however, on-task pupil-pupil behaviour was less likely in the intervention group compared with the control group in both the unadjusted model (OR=0.72 (95% CI: 0.54, 0.95), p=0.02) and the adjusted model (OR=0.45 (95% CI: 0.28, 0.70), p<0.001). Similarly, off-task pupil-pupil behaviour was more likely in the intervention group than in the control group in both the unadjusted model (OR=2.18 (95% CI: 1.52, 3.13), p<0.001) and the adjusted model (OR=2.28 (95% CI: 1.25, 4.17), p=0.007).

Food and environment

A 2.2% increase in the percentage take-up of school meals was observed at the end of the study, although this change occurred in both control and intervention schools. Intervention schools met, on average, 18 of 19 Government food-based standards for school lunch at the start of the study which was maintained throughout along with improvements to food presentation, choice, quality and promotion. Control schools met on average 17 standards at the start of the study and 16.5 at the end. Environmental changes were implemented by schools according to their tailored intervention plan. Over the study intervention school's implemented the following changes; newsletters to parents about school meals, behaviour management training for dining room supervisors, sticker schemes for pupils tasting new foods or eating fruit or vegetables, dining room displays and school assemblies on healthy eating, introduction of dining room rules, tasting sessions, promotion of menus at parents evening and via mail outs. Some schools also staggered lunchtime to reduce queuing, introduced music in to the dining room, changed the layout of chairs and tables, introduced 'grab and go' school lunches and involved pupils in the dining service. Planned changes to the dining room were reviewed during the intervention period and modified depending on their ongoing success. The precision of the instrument for assessing the dining room environment was valuable in deciding on which interventions were appropriate but was not adequate to show how the dining room environment changed over time when administered pre and post intervention. The impact of changes to the food and environment on children's nutritional intakes are reported elsewhere.

Discussion

The key finding suggested by these results is that a school food and dining room intervention was followed by an increase in levels of alertness (concentration/engagement) among pupils in the hour after lunch, but that the expression of this raised alertness was different in the individual, pupil-pupil, and teacher-pupil social modes. Although the odds ratios were statistically significant only for the teacher-pupil on-task and the pupil-pupil on-task and off-task analyses, the general trends observed in Figures 2 and 3 are consistent with an overall pattern of raised alertness in the intervention schools.

A high proportion of the OR for the pupil-teacher on-task findings is likely to be explained by the decrease in on-task pupil-teacher behaviour observed in the control schools compared with the intervention schools. This is reflected in part in the wide confidence intervals for the OR.

The lower levels of concentration (and higher levels of disengagement) evident during the pupil-pupil social mode may be explained in a number of ways:

- *Poorly defined peer interactive activities.* Pupil-pupil interaction is the least easily controlled by an adult (Baines *et al.*, 2003, Bennett *et al.*, 1984, Galton *et al.*, 1999, Galton *et al.*, 1980) (teacher-pupil is the most controlled). If a reduction in levels of on-task behaviour was to be expected, it is in this context where it would most likely be observed.
- *Disruption due to the intervention implementation.* Interventions often take time to have a positive impact and may cause a disruption before a positive effect becomes evident (Blatchford *et al.*, 2005). Classroom observations were made directly following the final stages of the intervention implementation, and the results could therefore reflect pupils' immediate response rather than the final impact of change.
- *Changes in alertness.* Lower levels of on-task behaviour in the pupil-pupil social-mode may be attributable to greater levels of alertness post-intervention with a greater need to interact. Teachers may not have catered sufficiently to these changes (Baines *et al.*, 2003, Hastings & Schweiso, 1995).

This greater need to interact could also be expected in the individual (working alone) mode, but this was not observed here. Rather, differences between baseline and post intervention in the individual setting, although small and not statistically significant (and potentially lacking in power), are consistent with the suggestion that pupils in the intervention group are more

alert and more likely to be on-task and less likely to be off-task compared with the pupils in the control group.

The present study examined the impact of changes in lunchtime school food provision on education-related behavioural outcomes, and its strength is the direct measures of learning-related behaviours in the classroom setting rather than indirect evidence such as attendance, exclusions, etc.

The study has limitations. It focused on 146 randomly selected pupils in six primary schools in one city, with schools selected by researchers based on their willingness and capacity to implement the study intervention. There is no reason to suspect, however, that the schools or pupils are very different from other primary schools and pupils in England. The matching of schools between study groups, pupil selection stratified for a number of characteristics, relatively large number of observations (over 17,000), the careful training and monitoring of the fieldworkers, and the 12 week intervention all support the study's generalisability to other motivated schools. While free school meal eligibility at the school level was matched, lack of pupil level data for sample selection stratified for free school meal eligibility resulted in higher eligibility in the intervention than control schools.

Any study of this kind is subject to the Hawthorne effect (short-term changes in behaviour resulting from an intervention *per se* rather than specific intervention). A second control group with some form of intervention exposure, not related to school, and a longer-term follow up would be necessary to determine a sustainable impact. The Greenwich study (Belot & James, 2009) found changes persisting after one year, supporting the interpretation of a real effect. While attempts were made to measure the impact the food and dining room intervention, this was limited due to a lack of relevant and valid assessment tools. Although the dining room check list tool was useful to assess the initial quality of the dining room environment and inform intervention development, the tool was not sensitive to be able to show any differences in environment at follow up, despite numerous changes in each school. This tool could be refined to more effectively monitor change.

Some observers may have held an understanding of the behavioural categories not consistent with training. Data were, therefore, compared to observations collected on pupils in Years 4-6 as part of the SPRinG and class size projects (Blatchford *et al.*, 2005, Baines *et al.*, 2008).

Comparisons can only be considered indicative since the present study included a limited numbers of classes observed by a small number of observers. Differences were seen in relation to setting: teacher-pupil and pupil-pupil interactions. The SPRinG/Class size data on the pupil-pupil variables showed higher levels of on-task (74% on-task in present data set compared with 56%) and lower levels of off-task. Observations in the present study were collected by a single set of observers who each worked in at least three schools (including at least one intervention and one control school), therefore, it could reasonably be assumed that any biases in observation were balanced across all schools.

Finally, because of the relatively short timescale and the inability to separate the nutrition and environment phases, it was not possible to resolve whether a nutrition-only or a nutrition-first intervention would differ from an environment-only or an environment-first intervention.

On balance, the present study offers some support for the hypothesis that a dining room intervention that changes both food provision and environment can have a positive impact on pupils' alertness, particularly during interactions between teacher and pupil which represent the majority of classroom experiences in primary schools. The findings also suggest that if that raised alertness is not appropriately channelled and adequately supervised, it may result in increased off-task behaviour when pupils are working together.

Acknowledgements

The authors would like to thank the staff and pupils of the Sheffield primary schools who participated in the study and all the organisations and individuals who contributed to its design and implementation: the Sheffield Healthy Schools Team, Sheffield PCT, Chartwells, Chaucer Catering, Sheffield Children and Young People's Directorate, Sheffield local authority and the National Centre for Social Research (NatCen). In addition, the authors would like to thank Claire Storey and Pauline Ashfield-Watt, both of the School Food Trust, for their help in revising the manuscript.

References

- Baines, E., Blatchford, P. & Kutnick, P. (2003) Changes in grouping practices over primary and secondary school, *International Journal of Educational Research*, 39, 9-34.
- Baines, E., Blatchford, P. & Kutnick, P. (2008). Pupil grouping for learning: developing a social pedagogy of the classroom, in R. Gillies, A. Ashman & J. Terwel (Eds) *The Teacher's Role in Implementing Cooperative Learning in the Classroom*, New York: Springer-Verlag.
- Belot M & James J (2009) Healthy School Meals and Educational Outcomes. London: Institute for Social and Economic Research.
- Bennett, N., Desforge, C., Cockburn, A., & Wilkinson, B. (1984). *The quality of pupil: Learning experiences*. London: LEA
- Blatchford, P., Bassett, P., and Brown, P. (2005) Teachers' and pupils' behaviour in large and small classes: a systematic observation study of pupils aged 10/11 years. *Journal of Educational Psychology*, 97, 3, 454-467
- Blatchford, P., Baines, E., Rubie-Davies, C., Bassett, P. & Chowne, A. (2006). The effect of a new approach to group work on pupil-pupil and teacher-pupil interactions. *Journal of Educational Psychology*, 98, 750-765.
- Dunifon R, & Kowaleski-Jones L. (2002). Who's in the house? Race differences in cohabitation, single parenthood, and child development. *Child Dev.* 73 (4),1249-64.
- Ells LJ, Hillier FC, Shucksmith J, Crawley H, Harbige L, Shield J, Wiggins A & Summerbell CD (2008). A systematic review of the effect of dietary exposure that could be achieved through normal dietary intake on learning and performance of school-aged children of relevance to UK schools. *Br J Nutr.* 100(5):927-36. Galton, M.J., Simon, B. & Croll, P. (1980) *Inside the primary classroom*. (London: Routledge & Kegan Paul).
- Galton, M.J., Hargreaves, L., Comber, C., Wall, D. & Pell, A. (1999) *Inside the primary classroom: 20 years on*. (London: Routledge).
- Gietzen, D & Vermeersh, J A. (1980). Health status and school achievement of children from Head Start and Free School Lunch Programs. *Public health Rep.* 95 (4), 362-8.
- Goldstein, H. (1995) *Multilevel statistical models*. (London: Edward Arnold).
- Goldstein, H., Rasbash, J., Plewis, I., Draper, D., Browne, W., Yang, M., Woodhouse, G., & Healy, M. (1998). A User's Guide to MLwiN. Multilevel Models Project, Institute of Education. University of London.

- Hastings, N. & Schweiso, J. (1995) Tables and tasks: the effects of seating arrangements on task engagement in primary classrooms. *Educational Research*, 37 (3), 279-291.
- North Yorkshire Business & Education Partnership, Business & Education South Yorkshire. (2004). The Dining Room Environment Project. Food in Schools Programme (DfES, DH).
- Paterson, L., & Goldstein, H. (1991). New statistical methods for analyzing social structures: An introduction to multilevel models. *British Educational Research Journal*, 17, 387-393.
- School Meals Review Panel (2005). Turning the Tables – Transforming School Food: The Development and implementation of nutritional standards for school lunches. http://www.schoolfoodtrust.org.uk/UploadDocs/Library/Documents/SMRP_Report_FIN_AL.pdf
- SPSS for Windows, version 15.0. (2006). SPSS Inc. Chicago.
- Statutory Instrument 2000 No. 1777. Education (nutritional standards for School Lunches) (England) Regulations 2000. London: TSO.
- Statutory Instrument 2006 No. 2381. *The Education (Nutritional Standards for School Lunches) (England) Regulations 2006*. London: TSO.
- Statutory Instrument 2007 No. 2359. *The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007*. London: TSO.

Table Legends

Table 1.

¹ Special education needs

² Free school meals

*based on 151 pupils

** from information reported by school

Table 2.

* There is the possibility of the co-occurrence of Teacher-Pupil and Pupil-Pupil contexts (i.e. these 2 contexts are not mutually exclusive). This situation is on the whole a relatively rare occurrence but may happen, for example, when a teacher is leading a reading group, when the teacher is talking to the class while a student is simultaneously talking to another student and so on. The total number of off task and not-off task in the two sections of the table are not the same because 'not on task' includes various 'off task' variables PLUS other variables (in this study procedure, social and other).

Table 3. Occurrence of On-task and Off-task behaviour overall and for each social mode separately for the Nutrition first and Environment first intervention groups combined relative to the Control group.

* Unadjusted: differences between intervention and control groups

** Adjusted: differences between intervention and control groups, adjusted for class size (number of pupils), presence of additional adults in the classroom (yes/no), EAL, FSM, Gender, SEN status, Ethnicity (White British or other ethnic group) and Lunch type (school lunch or packed lunch).

Figure 1 Study flow of school recruitment, intervention content and data collection timing

Figure 2 Percentage of on-task behaviour at baseline and 12 weeks, by intervention group and setting.

Figure 3 Percentage of off-task behaviour at baseline and 12 weeks, by intervention group and setting.

Table 1. School and pupil characteristics, by intervention group

	School roll (January 2007)			White British	English as first language	SEN ¹ plan	School meal take up	Pupils eligible for FSM ²
	<i>n</i>	<i>mean</i>	<i>Sd</i>	%	%	%	%	%
<i>Schools</i>								
Nutrition-first	2	402	60	16.0**	98.0	29.7	29.3**	23.6
Environment-first	2	471	264	6.3**	98.6	31.4	34.6**	27.0
Control	2	433	66	3.3**	98.5	29.6	18.5**	7.3
Total	6	435	128	8.5**	98.4	30.2	27.6**	19.3
<i>Pupils</i>								
Nutrition-first	47	-	-	93.5	95.7	29.8*	29.8	38.3
Environment-first	49	-	-	86.3	98.0	28.3*	29.4	25.5
Control	50	-	-	91.8	98.0	27.5*	28.6	14.3
Total	146	-	-	90.4	97.3	28.5*	29.3	25.9

Table 2. Number of observations* and percentage of time spent in specified activities, by intervention group, at baseline and post-intervention (week 12).

		Baseline				Post-intervention			
		Control		Intervention		Control		Intervention	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
On-task behaviour									
Individual	On-task	840	79.1	1187	80.3	944	77.3	1390	83.5
	Not on-task	222	20.9	291	19.7	277	22.7	275	16.5
Pupil-pupil	On-task	955	79.0	1122	72.3	1092	79.5	1021	65.7
	Not on-task	254	21.0	430	27.7	281	20.5	534	34.3
Teacher- pupil	On-task	577	86.1	2241	83.9	190	73.6	2149	82.9
	Not on-task	93	13.9	431	16.1	68	26.4	442	17.1
Total	On-task	2372	80.7	4550	79.8	2226	78.1	4560	78.5
	Not on-task	569	19.3	1152	20.2	626	21.9	1251	21.5
Off-task behaviour									
Individual	Off-task	140	13.2	209	14.1	168	13.8	194	11.7
	Not off-task	922	86.8	1269	85.9	1053	86.2	1471	88.3
Pupil-pupil	Off-task	113	9.3	239	15.4	161	11.7	414	26.6
	Not off-task	1096	90.7	1313	84.6	1212	88.3	1141	73.4
Teacher- pupil	Off-task	32	4.8	211	7.9	15	5.8	285	11.0
	Not off-task	638	95.2	2461	92.1	243	94.2	2306	89.0
Total	Off-task	285	9.7	659	11.6	344	12.1	893	15.4
	Not off-task	2656	90.3	5043	88.4	2508	87.9	4918	84.6

Table 3. Occurrence of On-task and Off-task behaviour overall and for each social mode separately for the Nutrition first and Environment first intervention groups combined relative to the Control group.

	Group (Intervention : Control)		P
	<i>Odds Ratio</i>	<i>95% CI</i>	
On-task behaviour (Concentration)			
Total on-task			
Model 1 – Unadjusted*	1.14	0.96, 1.39	0.15
Model 2 – Adjusted**	1.14	0.87, 1.49	0.86
Individual On-task			
Model 1 – Unadjusted	1.27	0.94, 1.74	0.14
Model 2 – Adjusted	1.34	0.74, 1.83	0.27
Pupil-Pupil On-task			
Model 1 – Unadjusted	0.72	0.54, 0.95	0.02
Model 2 – Adjusted	0.45	0.28, 0.70	<0.001
Teacher-Pupil On-task			
Model 1 – Unadjusted	1.44	0.94, 2.22	0.10
Model 2 – Adjusted	3.40	1.56, 7.36	0.009
Off-task behaviour (Disengagement)			
Total off-task			
Model 1 – Unadjusted	1.18	0.94, 1.46	0.15
Model 2 – Adjusted	0.83	0.74, 1.19	0.31
Individual Off-task			
Model 1 – Unadjusted	1.03	0.71, 1.51	0.84
Model 2 – Adjusted	0.71	0.37, 1.35	0.29
Pupil-Pupil Off-task			
Model 1 – Unadjusted	2.18	1.52, 3.13	<0.001
Model 2 – Adjusted	2.28	1.25, 4.17	0.007
Teacher-Pupil Off-task			
Model 1 – Unadjusted	1.50	0.71, 1.51	0.29
Model 2 – Adjusted	1.09	0.35, 3.45	0.89

Figure 1

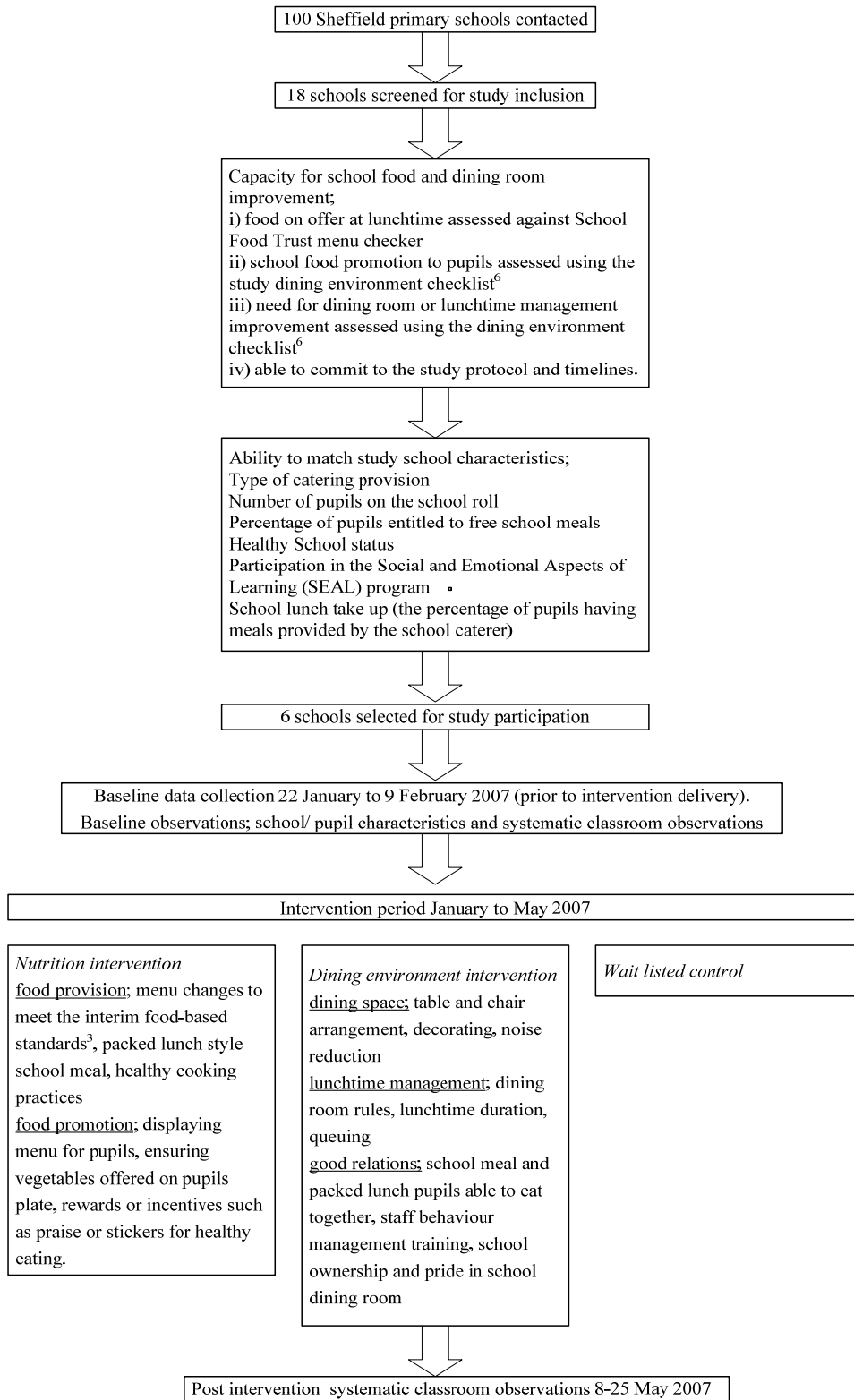


Figure 2.

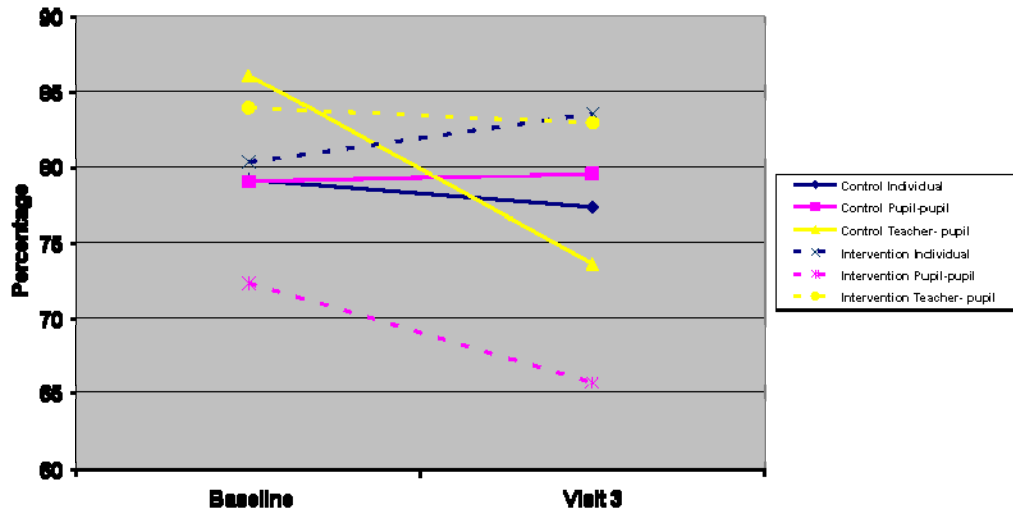


Figure 3.

