Switch-on Analysis Plan

1.1 Introduction

This pre-analysis plan sets out the detail of the analysis planned for the cluster-randomised controlled effectiveness trial of Switch-on, a reading intervention.

Switch-on is an intensive ten-week literacy intervention targeted at children not demonstrating age-expected levels at primary school. It aims to enable children to '*participate more fully in the classroom by becoming more confident, active and independent readers, who can use a range of effective reading strategies in order to achieve their full reading potential*' (Nottinghamshire County Council Switch-on training manual). Switch-on is delivered by specially trained teaching assistants (TAs) in daily 20-minute sessions.

The trial runs two versions of the intervention, implemented through a scaled-up delivery model. Both versions aim to improve reading skills. However, *Switch-on Reading* includes only reading exercises, while *Switch-on Reading and Writing* combines the teaching of reading skills with a focus on writing. Otherwise the two interventions are the same: both have the same amount of TA-pupil contact, the same amount of TA training and deliver a similarly designed intervention. The delivery model minimises the involvement of the intervention developers by cascading the training of teaching assistants through trained trainers, so that this model more accurately reflects the conditions of scale up.

1.1.1 Primary hypotheses

The primary hypotheses (**H1**) is that pupils participating in *Switch-on* will have better reading outcomes than pupils not participating in the programme, but receiving business-as-usual support for their reading. The main hypothesis will compare the two interventions separately against the control.

1.1.2 Secondary hypotheses

Four secondary hypotheses will be examined, as set out below. These hypotheses will be considered preliminary and indicative.

- **H2**: Pupils participating in *Switch-on Reading* will have different (better or worse) outcomes than pupils participating in *Switch-on Reading and Writing*.
- **H3**: Non-participating *eligible* pupils in the same class as pupils who participate in *Switch-on Reading* or *Switch-on Reading and Writing* will have better reading outcomes than eligible pupils in classes without pupils who participate in either *Switch-on* programme.
- **H4**: Non-participating *ineligible* pupils in the same class as pupils who participate in *Switch-on Reading* or *Switch-on Reading and Writing* will have better reading outcomes than *ineligible* pupils in classes without pupils who participate in either Switch-on programme.
- **H5**: *Switch-on Reading* and *Switch-on Reading and Writing* (separately considered) will have a different (higher or lower) impact on pupils participating in the intervention and eligible for free school meals.

1.2 Sample

The 184 schools participating in this trial were recruited by the 21 trainers whose role it is to train the teaching assistants. Each trainer aimed to recruit nine schools in their local area in England[1], although some trainers only successfully recruited eight schools.

No selection or exclusion criteria were set on school type, size, denomination, etc., but schools with an existing whole-school implementation of Reading Recovery principles were ineligible. Trainers were also asked to prioritise recruiting schools with higher levels of deprivation.

Participating pupils include all pupils in Year 3 of recruited schools (9332 pupils aged 7 and 8 years, of which 202 opted out). Pupils fall into two groups: 'core-trial pupils' were designated, prior to randomisation, to receive the intervention if the school was allocated to a treatment condition. If the school was allocated to the control group, the allocated pupils formed part of the core trial control group. 'Spill-over pupils' were not pre-allocated to receive the intervention and were included in the trial to measure potential spill-over effects.

To select core-trial pupils, each school designated, prior to randomisation, between two and four teaching assistants that would deliver Switch-on if the school was assigned to a treatment condition. Each school then matched each teaching assistant with between two and four eligible pupils to receive the intervention, so that in each school between four and 16 pupils were designated to receive the intervention subject to the randomisation.

The trial thus includes all pupils that schools have capacity to teach, as they would in a non-trial setting, and thus all eligible pupils when eligibility is conceptualised as including schools' capacity constraints.

1.2.1 Power calculations

For the primary hypothesis test, Table 1 presents the MDES when comparing *Switch-on Reading* only with the control (the same MDES would apply for comparing *Switch-on Reading and Writing* with the control). All calculations assume 80% statistical power and 0.05 statistical significance for a two-tailed test.

The table presents a range of MDES for different assumptions about the intraclass correlation coefficient (ICC), i.e. the degree to which intervention effectiveness clusters within schools, and for the predictive power of covariates. Estimates from recent studies show that ICC values of 0.1 are frequently obtained, but 0.2 presents the conservative estimate. Adjusting analysis for baseline outcomes reduces heterogeneity in outcomes and thus increases power. Bloom (2007) estimates that these range from 0.12 to 0.31 for individual and from 0.18 to 0.73 for school level variance explained by individual level baseline measures two years prior to the intervention. For simplicity, the same value was assumed for both individual and school level variances in the table below.

The MDES thus ranges from 0.15 in the most optimistic scenario (ICC of 0.1 and 60% of variance explained by covariates) to 0.26 (ICC of 0.2 and no variance explained by

[1] The trial took place in seventeen local authority areas: Birmingham, Bristol, Buckinghamshire, Cambridgeshire, Cheshire, Coventry, Derbyshire, Northamptonshire, Kent and Medway, Lincolnshire, Stoke on Trent, Sandwell, Walsall, Warrington, Wiltshire and Yorkshire

covariates). For our study, we are assuming an ICC of 0.15 and an R^2 of 0.4 as conservative but realistic scenario, with an MDES of 0.22 standard deviations.

Table 1: Minimum detectable effect sizes: SO Reading only				
		Intraclass correlation		
		0.10	**0.15**	**0.20**
Proportion of variance explained by covariates	**0.0***	0.27	0.29	0.30
	0.2*	0.24	0.26	0.27
	0.4*	0.21	0.22	0.24
	0.6*	0.17	0.18	0.19

1.2.2 Randomisation

The randomisation was carried out independently by NatCen Social Research. Schools were randomly assigned to *Switch-on Reading*, *Switch-on Reading and Writing* or the control condition using a stratified randomisation. The single stratification factor was 'trainer', indicating the trainer employed by the programme that trains teaching assistants in a particular geographical region. This was done in order to ensure a set number of treatment schools per trainer. Where the number of schools linked to a trainer was not divisible by three, the remainder was allocated by simple random allocation.

1.3 Data

1.3.1 Outcome

The outcome measure for the trial is raw reading score, as measured by the Hodder Group Reading Test (HGRT).

1.3.2 Data sources

The analysis will use data from four sources, as set out in Table 2:

Table 2: Data sources	
Source	**Data**
School baseline survey	• Participating core-trial and spill-over **pupils**, such as their name, Unique Pupil Number (UPN) and date of birth • Information on why pupils were selected for the Switch-on intervention

	• **Data on disability and SEN status** in an anonymised, school-aggregate format
Registers	• Information on take-up, drop-out and dosage of each individual core-trial pupil
Pupil test	• Reading outcome – Hodder Group Reading Test
National Pupil Database (NPD)	• pupil Key Stage 1 reading scores, as baseline outcome • **Pupil level information:** • Establishment number of the school attended as assigned by the DfE. • Age of pupil at start of the academic year (in full years). • Month part of age of pupil at start of the academic year. • Deprivation indicator - IDACI score • Is pupil known to be eligible for FSM? • Flag to indicate if pupil has been recorded as eligible for free school meals in any termly School Census, AP Census or PRU Census in the last 3 years • Flag to indicate if pupil has ever been recorded in any Spring Census as being eligible for free school meals • Flag to indicate if pupil has been recorded as eligible for free school meals in any termly School Census, AP Census or PRU Census in the last 3 years • Flag to indicate if pupil has ever been recorded in any Spring Census as being eligible for free school meals • Gender. • Institution type generated by AAT. • Reading attainment point score.

	• Writing attainment point score. • Average Reading and Writing attainment point score • Number of sessions possible for the academic year. Based on termly sessions for all schools except special schools for which annual sessions data will be used. • Number of sessions missed due to authorised absence during the academic year. Based on termly sessions for all schools except special schools for which annual sessions data will be used. • Number of sessions missed due to unauthorised absence during the academic year. Based on termly sessions for all schools except special schools for which annual sessions data will be used. • **School level information:** • Establishment number as assigned by the DfE. • Number of Pupils • Number of school places collection • Indicator showing whether a school is in an urban or rural area • Percentage of pupils known to be eligible for FSM • Percentage of pupils with special needs with statements • Percentage of pupils with special needs without statements • IDACI Band • Percentage of pupils classified as white British ethnic origin • Percentage of pupils whose first language is known or believed to be other than English • Pupil teacher ratio • Full time Pupils • Total full time equivalent of

	teaching assistants • Total Pupils at level 2 or above in reading • Total Pupils in reading • Denominator for APS - all pupils reading

1.4 Analysis

1.4.1 Baseline characteristics

Baseline characteristics will be summarised for core-trial pupils by intervention group across schools and pupils. Variables available at pupil level will be presented at that level, otherwise at school level.

Continuous variables will be summarised with descriptive statistics (n, mean, standard deviation, range and median).

At school level, the comparison will cover:

- School type
- Urban / rural status of schools
- English as additional language (EAL) status
- Special Educational Needs (SEN) status

At the pupil level, the following baseline comparisons will be presented:

- FSM eligibility
- Gender
- Birth term
- KS1 reading outcome

A summary of baseline characteristics will be presented in the additional analysis section of the report, covering the two spill-over pupil groups.

1.4.2 Trial completion

CONSORT diagram will be used to present summary of the flow of core-trial pupils and their schools from recruitment through baseline assessment, randomisation, post intervention assessment and analysis. The number of pupils and schools included or excluded at each stage will be clearly stated and the reasons for exclusion will also be stated.

In addition, the flow of spill-over analysis pupils will be presented separately.

1.4.3 Main hypothesis

The main and preliminary analyses will be conducted on an intention-to-treat basis and will include all core-trial pupils pre-designated to receive treatment subject to randomisation status for which outcome data has successfully been collected.

The model analysed will be a random effects model which allows for school effects on reading attainment:

$$Reading_{ij} = \beta_0 + \beta_1 baseline_{ij} + \beta_2 intervention + u_j + e_{ij}$$

where *j* presents the school and u_j is the group effect. The intervention effect is estimated by β_2. In line with the EEF Analysis guidance, other covariates will not be taken into account at this stage.

The calculation of effect sizes will follow the methodology for Hedges' *g*, using the differences in means between treatment and control groups as numerator and the pooled standard deviation based on the total variance from a multilevel model as denominator. The effect size calculation will be based on Hedges' (2007) approach assuming unequal sample size per school.

The analysis will run in *R* version 3.2.1, and at its core use EEF's analytical package for education trials, *eefAnalytics*, in the latest available version.

No adjustment will be made for multiple comparisons, as the outcomes of the two interventions are considered to be highly correlated and findings in one intervention is likely to support the finding in the other (Schulz and Grimes, 2005).

1.4.4 Sensitivity analyses

A range of sensitivity analyses will be carried out to explore the robustness of the main finding. The following analyses will be carried out:

- Including a wider range of prognostic covariates to increase power: Including school-level proportions of pupils with SEN and disability, school-level urban/rural indicator and individual-level indicators of English as Additional Language, free school meal eligibility, gender and birth term, as additional co-variates;
- CACE analysis: We will label any (core-) trial participants that has not participated in at least 50% of sessions as non-compliant and estimate a complier average treatment effect (CACE).
- A second CACE formulation of compliance will add TA training to the definition, so that only pupils attending at least 50% of sessions *and* taught by a TA that has been trained by Switch-on trainers will be considered compliant;
- If baseline imbalance is found, an analysis adjusting for baseline imbalance will be carried out.

1.4.5 Secondary analyses

Secondary analyses will explore hypotheses H3 – H5 set out above. All analyses will include the full set of predictive covariates set out in the sensitivity analysis.

Hypothesis H3 is a spill-over analysis that explores whether pupils who were eligible but not selected for Switch-on were impacted by the participation of their peers. This may occur, for example, because these pupils may now receive less support from their

teaching assistant(s). The analysis will merge *Switch-on Reading* and *Switch-on Reading and Writing* on the assumption that any spill-over effects arise through the use of teaching assistants in an intensive intervention rather than due to the intervention content.

Hypothesis H4 is an extension of the spill-over analysis H3, and covers pupils not eligible to receive *Switch-on* support. It will be carried out in the same way as H3.

Hypothesis H5 is a requirement for analysis in all EEF trials and explores the impact of the intervention on pupils eligible for free school meals. The analysis will be comparable to the main analysis, but include all predictive covariates (in order to increase power) and merge *Switch-on Reading* and *Switch-on Reading and Writing* (also for power reasons).

A final exploratory analysis will examine whether there is any indication that treatment effects differ for smaller and larger schools (on the assumption that smaller schools have less scope to deal with the disruption caused by the intervention and the intervention may thus be less effective) and, separately, for schools in which a smaller and larger proportion of employed teaching assistants were involved in implementing the intervention (on the assumption that schools in which a smaller proportion of TAs implement the intervention have a greater ability to ringfence these TAs' time, thus increasing intervention effectiveness).

1.4.6 Attrition

We expect an overall low rate of attrition. At the individual level, we expect to lose around 10% of pupils due to moves and other external factors influencing participation in the final outcome testing. Given that we include only a database-driven baseline measure and no other co-variates in the main analysis, we do not expect further losses due to lack of data.

If loss-to-follow-up can be predicted using existing covariates, multiple imputation will be used to infer the likely results of those lost to follow-up, and these imputed data will be included in the analysis.

1.5 References

Bloom, H. S. et al. (2007) Using covariates to improve precision for studies that randomize schools to evaluate educational interventions. *Educational Evaluation and Policy Analysis*. [Online] 29 (1), 30–59.

Hedges, L. V. (2007) Effect sizes in cluster-randomized designs. *Journal of Educational and Behavioral Statistics*. 32 (4), 341–370.

Schulz, K. F. & Grimes, D. A. (2005) Multiplicity in randomised trials I: endpoints and treatments. *The Lancet*. [Online] 365 (9470), 1591–1595.