Department for Education

Multiple disadvantage and KS4 attainment: evidence from LSYPE2

Research report

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Carli Lessof, Andy Ross and Richard Brind - Kantar

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Report overview

This research report, based on data from the Longitudinal Study of Young People in England Cohort 2, focuses on the academic attainment of young people in year 11. This is the point at which most sit their GCSE exams (or equivalents), which are also referred to as key stage 4 (or KS4) qualifications.

The findings presented here build on those from an earlier report, "*Understanding KS4 attainment and progress: evidence from LSYPE2*" [1]. The earlier findings highlighted the extent to which coming from a less privileged personal or family background is associated with lower educational attainment and, by extension, is likely to impact on young people's life chances in the future.

The earlier report hypothesised that disadvantage cumulates – that the more disadvantages a young person faces, the greater the impact on their KS4 attainment is likely to be. In this report we investigate this hypothesis further, looking to better understand the answers to the following questions:

- To what extent are different disadvantages associated with young people's attainment, both individually when considered alone, and uniquely when considered together?
- To what extent is the number of disadvantages a young person experiences associated with their educational attainment?
- Does this vary by gender or ethnicity?
- Do certain disadvantages co-occur more than others?
- What is the prevalence of certain combinations of disadvantage within the broader population of young people?
- How do different measures of disadvantage which are associated with lower KS4 attainment interact with each other?
    - Do certain combinations exacerbate the total negative impact on attainment?
    - Is the penalty of other combinations less than expected given their individual effect on attainment?

[1] Read: https://www.gov.uk/government/publications/understanding-ks4-attainment-and-progress-evidence-from-lsype2

Analysis which examines how different factors interact with one another necessitates a focused list of input variables. The analyses in this report are accordingly based on seven specific disadvantages that have been shown to be independently predictive of KS4 attainment. They which are distributed across four broad domains as outlined below:

- **Personal characteristics**
  - Special Education Needs (SEN)
- **Family background**
  - Eligibility for Free School Meals (FSM)
  - Maternal qualifications
- **Home environment**
  - Parental engagement in young person's education
  - Relationship of main parent with young person
  - Access to an internet connected computer
- **School environment**
  - Ofsted rating

Our primary measure of educational attainment is the "Best 8" test score; the young person's capped total points score based on their highest eight GCSE grades (including equivalent qualifications). The Best 8 metric is a continuous scale with the upper limit equating to eight GCSEs with an A* grade. As a general rule of thumb we can treat each 6 points on the Best 8 scale as a grade. So, a difference of 6 points can be seen as moving up or down one grade in one subject and a difference of 18 could be seen, for example, as a 3-grade difference in one subject or a 1-grade difference in three subjects.

We refer to our second measure of attainment as the "Level 2 English and maths threshold". This level is achieved if the student gains both English and maths GCSEs at grade A*-C.

The analyses in the report are based on samples of 7,908 to 9,035 young people drawn from the cohort of young people in England who completed year 11 in 2015.

Key findings

Introduction

Given the requirements of the statistical methods employed in this report, we focus on the seven specific disadvantages described above, which together explain around a third (35.4%) of the total variation in attainment.

As such, the findings in this report provide nuanced insights into the complexities of multiple disadvantage and bring new insight and understanding of how disadvantages interact to influence outcomes of importance. Nevertheless, it is important to bear in mind the fact that young people may also experience other types of disadvantage which are not specifically examined here. Discussion of many of these may be found in an earlier report, "*Understanding KS4 attainment and progress: evidence from LSYPE2*"[2].

To what extent are different disadvantages associated with young people's attainment?

Of the seven examined disadvantages, **having Special Educational Needs (SEN) was associated with the largest penalty by far**, accounting for an attainment deficit of around 17 grades at KS4 after controlling for the other six disadvantages. **Each of the other six disadvantages were, nevertheless, associated with substantial attainment deficits** (ranging from about 3 to about 6 grades)[3].

The attainment deficits for the different types of disadvantage were much larger when they were examined in isolation than when the effect of the other six was also taken into account. **This substantial interplay between the measures supports the notion that a young person's circumstances and needs should be considered holistically.**

SEN was an exception in this respect - there was relatively little difference in the penalty associated with SEN regardless of whether or not the other six disadvantages were controlled for. Compared with the other six disadvantages, less of the apparent SEN penalty is attributable to the effect of other overlapping disadvantages.

As an example of the interplay between disadvantages, young people who had a poor relationship with their parents and parents who were less engaged with their education had attainment around 9 grades lower than those with more supportive parents (controlling for the effect of the other disadvantages).

To what extent is the number of disadvantages a young person experiences associated with their educational attainment? And does this vary by gender or ethnicity?

Overall, around a third of young people had none of the disadvantages, a further third experienced one of the disadvantages and the remaining third experienced two or more disadvantages. While the majority of young people experience at least one of the

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[2] Read: https://www.gov.uk/government/publications/understanding-ks4-attainment-and-progress-evidence-from-lsype2

[3] Grade differences are across all subjects or eligible qualifications taken. So, a rise or fall of 3 grades could be seen, for example, as a 3-grade change in one subject or a 1-grade change in three subjects.

disadvantages measured here, the proportion of young people experiencing a high number of the selected disadvantages was relatively low – around one in twenty had to contend with four or more.

In general, **the greater the number of disadvantages experienced by a young person, the lower their Key Stage 4 attainment. The relationship between a simple count of the number of disadvantages a young person experiences and the size of their attainment deficit was near linear.** A young person experiencing one type of disadvantage had significantly lower attainment on average than a young person with none of the disadvantages. This attainment deficit approximately doubled among young people experiencing two rather than just one of the disadvantages, approximately trebled among those experiencing three, and so on. **However, there is further complexity underlying the relationship between multiple disadvantage and attainment - different specific combinations of disadvantage can be associated with very different attainment deficits.** In particular, combinations of disadvantage involving SEN tend to result in greater attainment deficits.

There were variations in the numbers of disadvantages experienced by gender and ethnicity. Boys were likely to experience slightly more of the selected disadvantages than girls, an effect that was primarily driven by the higher incidence of SEN among boys.

Compared to White young people, young people from an Indian background had fewer disadvantages on average. Those from Pakistani, Bangladeshi, Black African and Black Caribbean ethnic minority groups had a relatively high incidence of multiple disadvantage in comparison to both young people from a White background and young people from an Indian ethnic background.

Do certain disadvantages co-occur more than others?

The most common co-occurrence amongst the seven key disadvantages was between FSM status and maternal qualifications – **households where the mother had no qualifications were also likely to have been eligible for free school meals** (suggesting they had been disadvantaged in the labour market)**. There was also a relatively strong relationship between SEN and eligibility for free school meals.**

Nearly all (94%) of those who experienced two or more types of disadvantage either had SEN or have been eligible for Free School Meals. Nevertheless, even based on the reduced set of seven disadvantages that we examine here, there is a small group of young people (around one in twenty of all young people) who experience some type of multiple disadvantage and fall outside these two prominent administrative measures of educational disadvantage.

What is the prevalence of certain combinations of disadvantage within the broader population of young people?

While many different combinations of disadvantage were experienced, none constituted a large proportion of young people. Further, the more types of disadvantage experienced, the lower the prevalence in the population. **This serves to highlight the diversity of varieties of disadvantage, as experienced by young people.** Any new approaches to supporting young people who have multiple disadvantages will need to consider this heterogeneity.

Nevertheless, some combinations of disadvantage are far more common than others. In particular, around one in ten young people had been eligible for free school meals and also attended a less effective school (a relatively high prevalence in this context). However, this pairing of disadvantages was also associated with a less severe attainment penalty than many of the others and, as such, may be less of a clear priority than lower incidence pairings with a higher associated penalty.

In general, the attainment deficit was most pronounced where a pair of disadvantages included SEN. Again, the SEN pairing with the highest incidence (SEN coupled with FSM eligibility, which was experienced by around one in twelve young people) had a smaller attainment deficit than other less common SEN pairings. Young people with SEN who also had parents who were less engaged in their education or who had more challenging parental relationships saw larger attainment deficits, as did those whose mother had no qualifications or who did not have access to an internet connected computer at home.

When considering three-way disadvantages, the incidence of each was, inevitably, lower still. The most widespread was SEN accompanied by eligibility for FSM and attendance at a lower quality school (which affected around one in thirty young people).

How do different measures of disadvantage which are associated with lower KS4 attainment interact with each other?

While the effect of experiencing multiple disadvantage is broadly cumulative in terms of the associated attainment penalty, sometimes the total penalty is more (or less) than we might expect had we just added the two associated attainment penalties together i.e. there appears to be exacerbating or mitigating interaction between some types of disadvantage. Here are the exceptions we found;

Having both Special Educational Needs and parents who are less engaged with education was associated with a larger penalty (4 grades larger) than would be expected given the sum of the respective penalties associated with each (all other disadvantages held equal).

In contrast, **the cumulative penalty associated with both having been eligible for FSM and having a mother with no qualifications, or being both enrolled in a less effective school and having Special Educational Needs, was lower than would be expected** from the sum of their respective penalties (between 1.5 and 2.5 grades lower).

Inverse interpretations also apply - for example, young people who had *not* been eligible for FSM and whose mothers had no qualifications had *lower* attainment than might be expected**.**

Methodology

The analyses in this report are based on data from LSYPE2, a longitudinal study of young people in England, supplemented with administrative information. This is the second cohort of LSYPE, which began in 2012/13 and tracks a sample of 13,100 young people in England from the age of 13/14 annually.

The data in this report are primarily drawn from the second wave of LSYPE2 which was conducted in 2014, when the young people were aged 14/15. Supplementary information was drawn from administrative data sources where applicable.

This report is based only on young people in schools in the maintained sector and young people who attended special schools.

The base sample for this study is n=9,035. Where necessary, we excluded 1,127 individuals who had one or more missing values for the seven key disadvantages, leaving a complete cases sample (n=7,908).

A range of statistical methods were used, including multivariate linear and logistic regression modelling and correlation analysis.

The data were weighted to take account of the initial sampling strategy for the study and attrition. Full details of the LSYPE2 methodology are available in the published Technical Reports[4].

[4] Published here:
http://doc.ukdataservice.ac.uk/doc/7813/mrdoc/pdf/7813technical_report_wave_1.pdf
and here:
http://doc.ukdataservice.ac.uk/doc/7813/mrdoc/pdf/7813technical_report_lsype_wave_2_and_3_v6.pdf

Chapter 1 Introduction

Our earlier work

In an earlier report, "*Understanding KS4 attainment and progress: evidence from LSYPE2*" [5], we showed that coming from a less privileged personal or family background is associated with lower educational attainment and, by extension, is likely to impact on young people's life chances in the future. For example, even after controlling for many other factors, those living with neither of their biological parents had lower attainment than those living with both biological parents. Those whose mother held a degree level qualification had higher attainment than those with less qualified mothers. Those in below median income households performed less well than those with higher income. Those living in the most disadvantaged neighbourhoods had lower attainment than those in the most advantaged neighbourhoods. The list of life circumstances, experiences, behaviours and attitudes which are associated with poorer educational outcomes at Key Stage 4 is long and extends well beyond the examples cited here (Lessof et al, 2018).

Given the limits to the time and resource we had available, and the methodology chosen for the analysis presented in our 2018 report, we focused on the 'unique' effect that each of these different measures had on young people's attainment and the amount of variation in attainment that we were able to explain by examining this substantial set of measures, taken as a whole. We hypothesised about the potential implications of experiencing not just one but several of these circumstances, attitudes or behaviours, and tested an example of what the "layering effect of disadvantage on attainment" might be, showing the potentially extreme educational penalty experienced by young people who face multiple disadvantages.

Building on these foundations

However, in this earlier report, we were unable to draw firm conclusions about the impact of experiencing multiple disadvantages because we had not assessed whether there were any "interaction effects" which affect the penalty associated with each combination of disadvantages. Put more simply, there is a possibility that certain combinations of disadvantage may have a greater or lesser effect than a simple sum of their parts. Before simply "adding up" all the penalties associated with different disadvantages, we need to establish whether certain combinations of disadvantage exacerbate each other, or whether having one specific disadvantage may overshadow another, for example, so that

[5] Read: https://www.gov.uk/government/publications/understanding-ks4-attainment-and-progress-evidence-from-lsype2

the cumulative effect is less pronounced. Understanding these interaction effects better should make it possible for policy makers to take account of not just the separate sources of disadvantage, but the likely effect of facing combinations of multiple disadvantage, with greater confidence.

As a result, the Department for Education commissioned this follow up study, to look more closely at the important issue of multiple disadvantage. For this report, we have used an almost identical sample to that examined in our earlier work but have selected a very much smaller number of disadvantages to focus on (just seven). This more tightly defined focus has made it practically possible to examine all possible combinations of these disadvantages - even for seven measures there are a total of 128 combinations to consider.

Our areas of investigation and where they lead

Following this approach, we were able to carry out a technical investigation to identify any significant interaction effects between two-way, three-way or multi-way interactions between the seven disadvantages we considered.

Our findings are detailed throughout the report and more fully summarised in the Executive Summary. In brief, we found that for the most part, the seven different disadvantages we studied were *additive*, as was our working theory in the earlier report. There were a handful of interesting interaction effects that we did detect, and we report on these in chapter 5, some of which may suggest specific policy attention. Of particular note is the fact that having both Special Educational Needs and parents who are less engaged with education was associated with a larger penalty than would be expected given the sum of the respective penalties associated with each. On the other hand, young people whose mothers did not have qualifications and were eligible for FSM, or those enrolled in a less effective school and having Special Educational Needs, saw smaller penalties than might be expected from the component deficits.

It is important to acknowledge that interaction effects are hard to identify and it is possible that others exist in the population. The incidence of specific combinations of disadvantage is often very low, meaning that extremely large starting samples would be necessary to provide the statistical power required to detect certain interaction effects.

We were also able to estimate the size of the population of young people who face different combinations of disadvantage, and to estimate the relative level of attainment for any given combination of disadvantages. Here, we need to keep in mind that many of these combinations affect small numbers of young people so the confidence intervals around such estimates are relatively large.

In addition, we were able to look at the relationship between attainment and the number of disadvantages that a young person faced and how this varied.

Current policy targets young people for additional support based on specific classifications such as FSM status and having Special Educational Needs (SEN). Additional resource is directed to young people who are classified in either of these two ways, amongst others, in the case of FSM through the Pupil Premium and in the case of SEN students through additional provision such as specialist teaching support or attendance at a special school[6]. In this study, we were able to look at how many young people are multiply disadvantaged, but do *not* fall into either of these groupings. Our findings raise the question of whether additional policy tools should be used to identify and support any such multiply disadvantaged young people who may currently fall outside the existing supplementary support criteria.

Research into multiple disadvantage, deprivation or risks

A number of previous studies have examined what happens when individuals face multiple or multidimensional challenges. These have been couched variously in terms of multiple disadvantage, multiple deprivation and multiple risks but essentially attempt to unpick similarly complex processes. Past studies have focused on a range of outcomes such as cognitive and behavioural developments of young children (Sabates and Dex, 2012), educational achievement in early adulthood (Sacker et al, 2002), the likelihood of living in a family or household without any employment (Berthoud, 2003), occupational attainment in adulthood (Bynner et al, 2000) and poverty (Wood et al, 2012, Barnes et al 2012[7]). There is little consistency in what domains or measures they identify or how they define them, in part because they differ in focus and use different data sources (Sabates and Dex, 2012). These studies have also used a wide range of analytical and statistical methods. Some rely on a simple count of disadvantages, acknowledging that this can obscure important differences between combinations and does not aid an understanding of the different processes that might lead to negative outcomes (Masten and Sesma, 1999) while others use more complex methods such as factor or latent class analysis (Barnes et al, 2012). Although by necessity we have taken a different path, we have been strongly influenced by two approaches: Sabates and Dex (2012), who show the benefit of

[6] Other examples of circumstances which attract supplementary funding, include:
Looked After Children. Read:
https://www.gov.uk/guidance/pupil-premium-information-for-schools-and-alternative-provision-settings
Children with high needs. Read:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736052/High_needs_national_funding_formula-Technical_note.pdf

[7] For example: Barnes, M. Brown, A., Morrell, G., Rahim, N., Ross, A., Sadro, F. and Tipping, S. (2012) Multi-dimensional Poverty: A research methodology to create poverty typologies.

a simple approach of mapping multiple risks in the Millennium Cohort Study and, at the other end of the complexity spectrum, Berthoud (2003) who combined data from nine years of the Labour Force Survey to tackle the difficult task of identifying multi-way interaction effects.

Methodology

Longitudinal Study of Young People in England 2 (LSYPE2)

The analyses in this report are based on data from LSYPE2, a longitudinal study of young people in England, supplemented with administrative information. This is the second cohort of LSYPE, which began in 2012/13 and tracks a sample of 13,100 young people in England from the age of 13/14. The data in this report are primarily drawn from the second wave of the study, which was conducted in 2014 when the young people were aged 14/15. Supplementary information was drawn from the National Pupil Database and other sources of administrative data where applicable (e.g. KS4 attainment data, eligibility for Free School Meals (FSM) and school Ofsted ratings). These data pre-date the introduction of the new GCSE grading system and our analyses are therefore based on the legacy A*-G scale.

This report is based only on young people in schools in the maintained sector and young people who attended special schools. Our starting sample for this study (n=9,035) is slightly smaller than the one used in our earlier report because 41 cases without administrative data were removed. The data were weighted to take account of the initial sampling strategy for the study and attrition. Where possible, estimates were based on the maximum available sample for the specific question being examined. In some of our analyses, we excluded 1,127 individuals who had one or more missing values for the seven key disadvantages, leaving a complete cases sample (n=7,908, 12.5%).

Full details of the LSYPE2 methodology are available in the published Technical Reports[8].

Analytical steps taken

The first step was to determine the definition of the sample. For example, given the nature of analysis being undertaken it was decided that young people in special schools should be included and the 41 young people for whom we had no administrative data

[8] Published here:
http://doc.ukdataservice.ac.uk/doc/7813/mrdoc/pdf/7813technical_report_wave_1.pdf
and here:
http://doc.ukdataservice.ac.uk/doc/7813/mrdoc/pdf/7813technical_report_lsype_wave_2_and_3_v6.pdf

should be excluded. The next stage involved identifying the measures of disadvantage which would be used in the report and agreeing the threshold which would be used to distinguish those we would define as disadvantaged from those we would define as relatively advantaged. Having identified seven key measures of disadvantage, we then derived indicators for every combination of disadvantages and estimated the prevalence of, and average educational attainment associated with, each combination. Two different measures of attainment were examined, as described below. We used several approaches to look at the relationship between disadvantages. Most simply, we examined the correlation of pairs of disadvantages. We also counted the number of disadvantages experienced by each individual and examined whether the count varied by gender and ethnicity. Finally, we carried out complex analysis using a series of multiple linear regression models to determine whether we could observe significant two-way, three-way or multi-way interaction effects, having controlled for the presence or absence of all other disadvantages.

Outcome variables

Our primary measure of educational attainment is the "Best 8" test score; the young person's capped total points score based on their highest eight GCSE grades (including equivalent qualifications). The Best 8 metric is a continuous scale with the upper limit equating to eight GCSEs with an A* grade. As explained in the previous report, as a general rule of thumb we can treat each 6 points as a grade. So, a difference of 6 points can be seen as a difference of one grade in one subject and a difference of 18 could be seen, for example, as a 3-grade difference in one subject or a 1-grade difference in three subjects (Lessof et al, 2018)[9].

The mean Best 8 score for the surveyed sample was 320.2 (SD=93.6). This is slightly higher than the contemporaneous national average of 312.7 (a difference equivalent to slightly more than a single GCSE grade). Some of the analysis in this report is based on a smaller sample where we have removed cases for whom data relating to one or more of the seven disadvantages is missing. For this 'complete cases' sample (n=7,908) the mean Best 8 score = 325.3 (SD=89.2). As discussed in Chapter 3, there appears to be a slight under-representation of disadvantage in the complete cases sample when compared to the total surveyed sample – this is likely to account for at least some of the difference in Best 8 scores.

We refer to our second measure of attainment as the "Level 2 English and maths threshold". This level is achieved if the student gains both English and maths GCSEs at

[9] More specifically, each grade is converted into points on the scale A*=58, A=52, B=46, C=40, D=34, E=28, F=22, G=16. For example, if a student achieved 2Bs, 4Cs, 3Ds and an F, we would include the 2Bs, 4Cs and 2 of the Ds as the Best 8 results. The capped points score would be (2*46)+(4*40)+(2*34)=320.

grade A*-C (or an equivalent qualification). Overall, the majority of young people in the LSYPE2 cohort (61.9%) were found to have achieved this threshold, slightly higher than the national average (59.2%)[10]. For the complete cases sample (n=7,908) the proportion was slightly higher (63.9%).

Outline of the report

In chapter 2 we describe the seven disadvantages which form the focus of this report, estimate their prevalence and the size of the associated penalty in terms of Best 8 score, and the percentage of young people who attained the Level 2 English and maths threshold. We compare the attainment of young people experiencing these disadvantages with information about the educational attainment of the group of young people who did not experience any of these disadvantages.

In chapter 3 we show the proportions of young people who faced different numbers of disadvantages and assess whether knowing this information alone was sufficient to predict their overall educational attainment. We look at how the distribution in number of disadvantages varies by gender and ethnicity.

In chapter 4 we identify the combinations of two, three or more disadvantages which are most prevalent in the population and estimate the penalty associated with each.

In chapter 5 we establish whether experiencing multiple disadvantages has an additive effect (equivalent to adding up the unique educational penalty associated with each individual disadvantage in a multiple regression) or whether there is an interaction between certain disadvantages that either increases the educational penalty (so that it is more than the sum of the parts) or decreases the educational penalty (so that it is less than the sum of the parts).

[10] This is the weighted percentage based on the full sample of 9,076 individuals

Chapter 2 Seven key disadvantages

Summary findings

The analysis in this chapter focuses on seven disadvantages which were identified as being important to attainment at KS4. Together, the seven selected measures of disadvantage explain 35.4% of the total variation in Best 8 attainment.

Of these seven, having Special Educational Needs (SEN) was clearly associated with the largest penalty, accounting for an attainment deficit of around 17 grades at KS4 after controlling for the other six disadvantages. Each of the other six disadvantages were, nevertheless, associated with substantial attainment deficits (ranging from about 3 to about 6 grades)[11].

There were large differences between the deficits identified when each disadvantage was examined in insolation and the (smaller) deficits identified after controlling for the other disadvantages. This suggests that 'holistic' consideration of disadvantage may be beneficial given the substantial interplay between many of the individual markers of disadvantage.

SEN was an exception in this respect - there was relatively little difference in the penalty associated with SEN, regardless of whether or not the other six disadvantages were controlled for – the 'face value' attainment deficit identified when looking at SEN in isolation serves as a good proxy for the more nuanced calculation which takes account of the effect of other overlapping disadvantages.

As an example of the interplay between disadvantages, young people who had a poor relationship with their parents and parents who were less engaged with their education had attainment around 9 grades lower than those with more supportive parents (controlling for the effect of the other disadvantages).

The most common co-occurrence amongst the seven key disadvantages was between FSM status and maternal qualifications – households where the mother had no qualifications were also likely to have been eligible for free school meals (suggesting they had been disadvantaged in the labour market). There was also a relatively strong relationship between SEN and eligibility for free school meals.

[11] Grade differences are across all subjects or eligible qualifications taken. So, a rise or fall of 3 grades could be seen, for example, as a 3-grade change in one subject or a 1-grade change in three subjects.

Chapter introduction

In this chapter we set out the rationale for focusing on the seven specific disadvantages explored in this report. We introduce each in turn, explaining how the measure is defined and the threshold used to determine which young people are treated as disadvantaged and which are not. We provide an estimate of the prevalence of each and the size of the associated penalty in KS4 attainment, measured in terms of Best 8 and the percentage of young people who achieved the Level 2 English and maths threshold.

Having introduced each disadvantage in turn, we briefly show how they compare, set alongside evidence about the size and educational attainment of the group of young people who do not experience any of these disadvantages. We then begin to explore the extent to which these disadvantages overlap, by examining the correlations of each pair of disadvantages.

It should be noted that the multivariate regression analysis in this chapter, which tells us the unique penalty associated with each disadvantage having adjusted for the other six does not take account of any possible interaction effects between disadvantages. Instead, it assumes that the relationship between multiple disadvantage and attainment is simply additive. In other words, to calculate the attainment penalty associated with two or more disadvantages you need only add the unique penalties associated with each. A weakness of this approach is that it doesn't account for any possible additional penalty associated with experiencing multiple disadvantages - over and above the sum of the unique penalties associated with experiencing each. Nor does it tell us whether there is any diminishing impact of experiencing further disadvantages. We turn to this in the later chapters.

Defining disadvantage

In our earlier report, Understanding KS4 attainment and progress: evidence from LSYPE2 (Lessof et al, 2018), we analysed a very large number of variables to understand which of these best explained attainment. These were organised in broad categories: personal characteristics, family background, home environment, attitudes and behaviours, health and wellbeing, school and area.

However, for the analysis in the current report, it was important to focus instead on a small number of indicators, with a view to examining each of them in greater depth and understanding how some of the key deprivation indicators overlap or interact. Inevitably, reducing the list proved challenging and we set aside many variables that are also important in understanding disadvantage. Ultimately, we selected those which are relevant to policy, are sufficiently common in the population (affecting 7% or more of the population) and are associated with a reasonably large educational penalty (about 4 grades at KS4 or more). We chose a combination of factors relating to social structure

and to individual agency such as behaviours or attitudes but avoided any measures where there was significant ambiguity about the causal pathway. For example, although parents' with low expectations for university is a strong indicator of educational disadvantage, it is difficult to disentangle where this lies on the causal pathway (i.e. whether lower expectations are a cause or an outcome of lower attainment).

We can portray the final selection of seven measures as a set of concentric circles which start with a tight focus on the young person themselves and then spread to encompass broader factors such as their educational environment. Starting with the young person's **personal characteristics**, we took account of whether they had Special Educational Needs. We included two measures relating to **family background** – Eligibility for Free School Meals within the past 6 years and maternal qualifications. We included three measures of the young person's immediate **home environment**: a composite measure of parental engagement in the young person's education (based on whether they discussed school reports, attended parents' evenings and talked about the young person's plans for future studies); a measure of the relationship between the main parent and child based on the frequency of arguments between them; and whether the young person had access to an internet connected computer. Finally, we included the Ofsted rating of the young person's school, with a view to ensuring that **school environment** was taken into account.

Inevitably, there were many measures we did not include, including personal characteristics such as gender, ethnicity, term of birth and illness or disability, and measures such as family composition and parental working status.

We excluded factors which were particularly ambiguous in terms of their role in the causal pathway between disadvantage and educational attainment. These included measures such as: parental aspirations and expectations (since these could both influence a young person's attainment and be moderated by it); whether the young person received paid-for tuition (since this could reflect differences in the young person's educational needs in addition to their family's income or parental engagement in their child's education); and whether their parent felt involved in school life or the family had regular meals together (both of which had a mixed relationship with pupil attainment). Similarly, we did not include measures relating to the young person's own attitudes and behaviours, which we would interpret here to be a consequence of disadvantage.

During the development stage of the study, we initially included three further measures of economic disadvantage to FSM status- NS-SEC, tenure and IDACI. These are highly correlated and the inclusion of all four weighted the study too much towards economic

disadvantage. Ultimately, FSM was selected as the most appropriate candidate from these four.[12]

A number of school-related factors which were identified as important in explaining attainment in the previous report also had to be excluded on practical grounds. These include attending a non-selective school, truanting and failing to comply with homework.

Special Educational Needs

Whether or not the young person is classified as having Special Educational Needs (SEN) is known to be a key determinant of their attainment in education. In one sense, SEN is a marker that supports policy intervention. Schools must provide an education for all pupils, regardless of their ability or special needs, since every child's education is equally important. Being identified as having Special Educational Needs should help ensure that pupils are given appropriate support to achieve their potential. However, it should also be recognised that SEN is an indicator that young people are, on average, likely to achieve significantly lower scores at KS4 than their non-SEN counterparts (all other things being equal).

In this report, we used the most inclusive definition of SEN, incorporating pupils who were identified as statemented, School Action or School Action Plus[13]. This measure was based on administrative data from the NPD School Census Pupil Level dataset. It is important to note that, in general, pupils within these different categories of Special Educational Needs have different levels of Key Stage 4 attainment. Just 11.9% of pupils with a SEN statement (or an EHC plan) achieved 5 A*-C grades at GCSE or equivalent in 2014/15, compared with 31.7% for those with SEN but without a statement[14]. Findings throughout this report relate to all pupils with Special Educational Needs, rather than specifically young people with statements or young people with School Action (Plus). Although it would have been interesting to examine young people who were statemented as a standalone group, this was not possible because of limits to sample size. To ensure that we had sufficient individuals who were classified as having SEN, we included special schools in our analyses, although we cannot draw conclusions about special schools *per se*.

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[12] Any issues with multicollinearity would have been identified during the regression analysis and in the work that was conducted for our earlier LSYPE report. Fundamentally, multicollinearity would only be a problem if conceptually identical (or almost identical) measures of disadvantage had been included in our analysis and care was taken to avoid this.
[13] These classifications have been superseded by Education, Health and Care Plans (EHCPs) and Special Educational Needs and Disability (SEND) Support Plans, reflecting reforms in 2014.
[14] DfE National Statistics: SFR01/2016: GCSE and equivalent results in England 2014/15 (Revised)

Based on the LSYPE2 study, 19.2% of young people were classified as having SEN (n=1,979)[15]. Using the largest possible sample for whom we have information about SEN status (n=9,035) and ignoring all other disadvantages, those who were classified as having SEN had an educational attainment (in terms of Best 8) which was an average of 121.2 points lower on average than those without SEN (95% CI=-127.2, -115.2, p<0.001). This was by far and away the factor associated with the largest penalty in average attainment; equivalent to approximately 20 GCSE grades. Indeed, when considered alone, SEN explained 26.0% of the variation in pupil attainment[16,17].

To get a better understanding of the unique contribution of SEN to pupil attainment we also adjusted for the contribution of our six other selected disadvantages. It was quite plausible that some the attainment penalty associated with SEN was a consequence of presence of other disadvantages, which may be more likely among pupils who are classified as having SEN. Because of missing data on our other six disadvantages we first re-estimated the individual effect of SEN before adjusting for other disadvantages (-117.2, 95% CI= -123.6, -110.8, p<0.001, n=7,908). After adjusting for the effect of the six other disadvantages, the educational penalty associated with SEN reduced by 12.9% to -102.1 points (95% CI= -108.2, -96.0).

We also examined the educational penalty in terms of the Level 2 English and maths threshold (the achievement of A*-C in both English and Maths GCSEs). The percentage of young people who were classified as having SEN and attained the Level 2 English and maths threshold was 23.8% (+/- 2.2%)[18]. This is far lower than the 71.0% among pupils who did not experience this disadvantage (47.2% lower).

Eligibility for Free School Meals

The first of two measures capturing aspects of the young person's family background was eligibility for Free School Meals. This is a key indicator of economic disadvantage used in education to direct resources towards young people who are deprived. The eligibility criteria for FSM are relatively complex but relate primarily to the parent or

[15] This is a little higher than the proportion of pupils with SEN in the admin data (16.3%). In SFR 25-2015, Special educational needs in England: January 2015, Table 4D (Year 11 Total number of pupils with SEN)

[16] The penalty associated with SEN is higher than would be expected if the sample had excluded young people in special schools and includes both young people who are statemented and those who are designated School Action or School Action Plus.

[17] A table summarising the incidence and attainment associated with each of the seven selected disadvantages is provided in Appendix A Table 2.

[18] Throughout the report, where we quote +/- figures, these indicate the confidence interval around the central estimate at a 95% level of certainty. In the case above, the central estimate is 23.8% and we can estimate that the true value (at a 95% level of confidence) lies between 21.6% (i.e. 23.8% - 2.2%) and 26% (i.e. 23.8% + 2.2%).

guardian's eligibility for a range of means tested state benefits[19]. The definition used in this study is that any young person eligible for FSM at the time of the interview or during the previous six years are classified as disadvantaged. This will capture a fairly broad range of economically disadvantaged families. The FSM measure is drawn from administrative data (the NPD School Census Pupil Level dataset). Over one quarter, 27.3% of the population of young people, were disadvantaged in this way (n=3,456). Based on the largest possible sample for whom we have information about FSM status (n=9,035) and ignoring all other disadvantages, the estimated educational penalty associated with FSM eligibility, in terms of Best 8 points score was -63.9 (95% CI = -68.2, -59.5, p<0.001), equivalent to over 10 GCSE grades. FSM status alone explained 8.7% of the variation in attainment scores.

When we adjust for the effect of our other six selected disadvantages, the magnitude of the penalty reduces from -61.8 points (95% CI = -66.5, -57.1) in the complete cases sample to -31.8 points (95% CI = -36.1, -27.5). This is a reduction of 48.6% which suggests that a substantial proportion of the effect that is associated with FSM status is a consequence of the presence of other disadvantages, which are more likely among pupils who are eligible for FSM. We can express this in another way. Once we adjust for the effect of the other specified disadvantages that FSM eligible pupils are more likely to experience, the effect that is unique to FSM eligibility is smaller, or -31.8 (95% CI = -36.1, -27.5) as reported earlier.

The percentage of young people who were eligible for FSM at the time of interview or within the previous six years and attained the Level 2 English and maths threshold was 43.2% (+/- 1.8%). This was 25.8 percentage points lower than those who did experience this disadvantage (69.0% +/- 1.3%).

Maternal qualifications

A second indicator of disadvantage relating to family background was maternal education. This has been identified as a key driver of educational attainment[20], both indirectly because it is an indicator of economic hardship, and directly because it is a mechanism by which educational disadvantage can be transmitted (given that mothers without qualifications may be less able to support their children in their own learning or may not themselves be motivated towards or model educational aspiration)[21]. For this study, we have treated having a mother with 'no qualifications' as being disadvantaged

[19] Further details can be found at:
https://www.gov.uk/apply-free-school-meals
[20] For example, read:
https://www.ucl.ac.uk/~uctppca/MS2307_revised_manuscript.pdf
[21] For further discussion of the relationship between maternal education and children's attainment, read:
https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1542-4774.2012.01096.x

and having a mother with any qualifications as the normative group. This results in a very wide normative category which spans from low level qualifications all the way through to post-graduate qualifications. This measure was drawn from survey data and it was necessary to exclude young people whose mothers were not present at the time of interview as well as those who did not provide this information (n=334).

Based on this definition, 10.8% of young people were disadvantaged (n=1114). Using the largest possible sample for whom we have information on maternal qualifications, the estimated educational penalty associated with this status, in terms of Best 8 score, was -63.8 (95% CI = -70.9, -56.7), equivalent to over 10 GCSE grades. Maternal qualifications alone explained 4.6% of the variation in attainment scores.

When we adjust for the effect of our other six disadvantages, the magnitude of the penalty reduces from -66.0 (95% CI = -73.7, -58.2) in the complete cases sample to -28.4 (95% CI= -35.1, -21.7), the equivalent of approximately four and a half GCSE grades. This reduction, by 57.0%, shows that a substantial proportion of the effect that was associated with maternal qualifications was a consequence of the presence of other disadvantages, which were more likely for this group of young people.

Among young people whose mothers had no qualifications, 37.6% (+/- 3.1%) attained the Level 2 English and maths threshold. This was lower than the 65.3% among pupils who did not experience this disadvantage (by 27.7 percentage points).

Parental engagement in young person's education

Parental engagement in the young person's education is the first of the three selected measures relating to the home environment. The measure is based on the answers to three survey questions, with young people classified as disadvantaged if two of three related responses suggested lower parental engagement. The first question, which measured how frequently the parent discussed school reports with the young person and we identified anything less than 'always' (9.5%) as less engaged. The second question related to attended parents evening; parents who did not attend were treated as less engaged (also 9.5%). The third question asked whether the young person talked about plans for studying in the future with their parent; the parent was treated as less engaged if the young person's response was 'a little', 'not very often' or 'not at all' (48.2%).

Based on the 'two out of three' definition, 10.6% of young people had parents who were less engaged in their education (n=1,008). Based on the sample of all young people for whom we have full information about parental engagement in education (n=8,824, missing=211), the estimated educational penalty associated with having less engaged parents was -63.3 points (95% CI = -71.0, -55.5) which is equivalent to just over 10 GCSE grades. Considered alone, parental engagement in education explains 4.4% of the variance in Best 8 attainment.

When we adjust for the effect of our other six disadvantages, the magnitude of the penalty reduces from -63.3 points (95% CI = -71.7, -54.9) in the complete cases sample to -35.5 points (95% CI = -42.3, -28.7). Again, this reduction of 43.9% suggests that a substantial proportion of the effect that is associated with having a parent who is less engaged with the young person's education is a result of the presence of other disadvantages which are experienced by this group of young people.

The percentage of young people with parents who were less engaged in their education attaining the Level 2 English and maths threshold was 40.7% (+/- 3.3%). This is 24.3 percentage points lower than the 65% (+/-1.3%) among pupils who did not experience this disadvantage.

Parental relationship

The second measure relating to the young person's home environment concerns the quality of the relationship between the parent and young person, again drawing on survey data. This was based on how often the main parent or guardian (usually female) reported arguing with the young person, with 'arguing most days' defined as representing a poorer quality relationship. In the development of this study, two other measures were considered: how well or badly the main parent said they got on with the young person; and the frequency of family meals taken together. Only a small percentage (1.3%, n=104) said they got on fairly badly or very badly, and frequency of meals taken together was not consistently related to attainment. As such, these were not included in our final analysis.

In total, 9.7% of young people had a parent who reported that they argued with their child most days (n=870) and were therefore treated as having a poor relationship for this study. Based on the sample of all young people for whom this data was available (n=8,528) the educational penalty associated with having a poor relationship with your parents was -43.8 points (95% CI = -51.5, -36.0), the equivalent of around 7 GCSE grades. Alone, it explains just 1.9% of the variance in Best 8 attainment.

When we adjust for the effect of our other six disadvantages, the magnitude of the penalty reduces from -39.9 points (95% CI = -47.7, -32.1) in the complete cases sample to -21.4 points (95% CI = -27.7, -15.1), approximately three and a half grades at KS4. This reduction (by 46.3%) shows that some of the effect that is associated with parental relationship is a consequence of the presence of other disadvantages, which are more likely among young people who have a poorer relationship with their parent.

Finally, the percentage of young people who experienced a poor relationship with their parent based on frequency of arguments and attained the Level 2 English and maths threshold was 48.8% (+/- 3.6%). This is lower than the 64.1% (+/-1.3%) among pupils who did not experience this disadvantage (a difference of 15.2 percentage points). This is a comparatively modest reduction compared to the other disadvantages described so far.

Internet-connected computer

A final measure of disadvantage relating to home environment was whether the young person had an internet-connected desktop or laptop. Not having an internet-connected desktop or laptop was treated as having a disadvantage given that this was strongly associated with lower KS4 attainment in our earlier report (Lessof, 2018). We know from their other survey responses that some of these young people had access to alternative technologies which were enabled for the internet (such as a tablet or smartphone), but these were not included in our definition of disadvantage. It is likely that the absence of a computer is a measure of material disadvantage and/or level of income, but it also represents a resource that may be beneficial to a young person's attainment, akin to having a quiet place to do homework.

Of the seven disadvantages included in this study, the absence of an internet-connected computer represented the smallest disadvantaged group, comprising just 7.6% of young people (n=731). Based on the sample of all young people for whom this data was available (n=8,798), the educational penalty associated this disadvantage was -74.7 points (95% CI= -84.0, -65.4), equivalent to around ten and a half GCSE grades. This measure explains 4.7% of the variance in attainment in terms of Best 8.

When we adjust for the effect of our other six disadvantages, the magnitude of the penalty reduces from -72.5 points (95% CI = -82.1, -63.0) in the complete cases sample to -38.5 points (95% CI = -46.0, -30.9). This reduction (by 47.0%) again shows that some of the effect that was associated with the absence of having an internet-connected computer was a consequence of the presence of other disadvantages with a higher prevalence among young people in this group.

The percentage of young people who did not have an internet-connected computer who attained the Level 2 English and maths threshold was 35.4% (+/- 4%). This is 29.6 percentage points lower than those who did not experience this disadvantage (65.0% +/- 1.3%*)*.

Ofsted rating

The final of our seven measures of disadvantage is intended to capture the broader context in which the young person is studying - the effectiveness of their school. We considered other measures of school effectiveness but ultimately selected Ofsted rating because of its clear policy relevance and simplicity. Young people were considered disadvantaged if they attended a school defined as requiring improvement or inadequate. Clearly, the effectiveness of the school a young person attends can have a direct effect on their attainment, but it may also indirectly reflect economic disadvantage, since less effective schools tend to function in poorer geographical areas and have more

disadvantaged intakes of young people[22]. This measure was based on administrative data.

Using this definition, a substantial 30.9% of young people were classified as disadvantaged in terms of the school they attended (n= 2854). Based on the largest possible sample of young people for whom we have information, the educational penalty for young people in less effective schools was -26.8 points (95% CI = -33.4, -20.2). This penalty, equivalent to around four and half GCSE grades, is relatively low compared to some of the others considered, and only explains 1.8% of the overall variance in Best 8.

When we adjust for the effect of our other six disadvantages, the magnitude of the penalty reduces from -27.4 points (95% CI = -33.7, -21.0) in the complete cases sample to -18.4 points (95% CI = -23.6, -13.3). This reduction (by 32.6%) shows that some of the effect that was associated with attending a less effective school was a consequence of the presence of other disadvantages, which were more likely among these young people.

The percentage of young people who attended less effective schools and attained the Level 2 English and maths threshold was 52.4% (+/- 2.4%). This is 13.8 percentage points fewer than the 66.3% (+/-1.5%) who did not experience this disadvantage, again a meaningful but comparatively small difference.

Comparing the penalty of the seven disadvantages

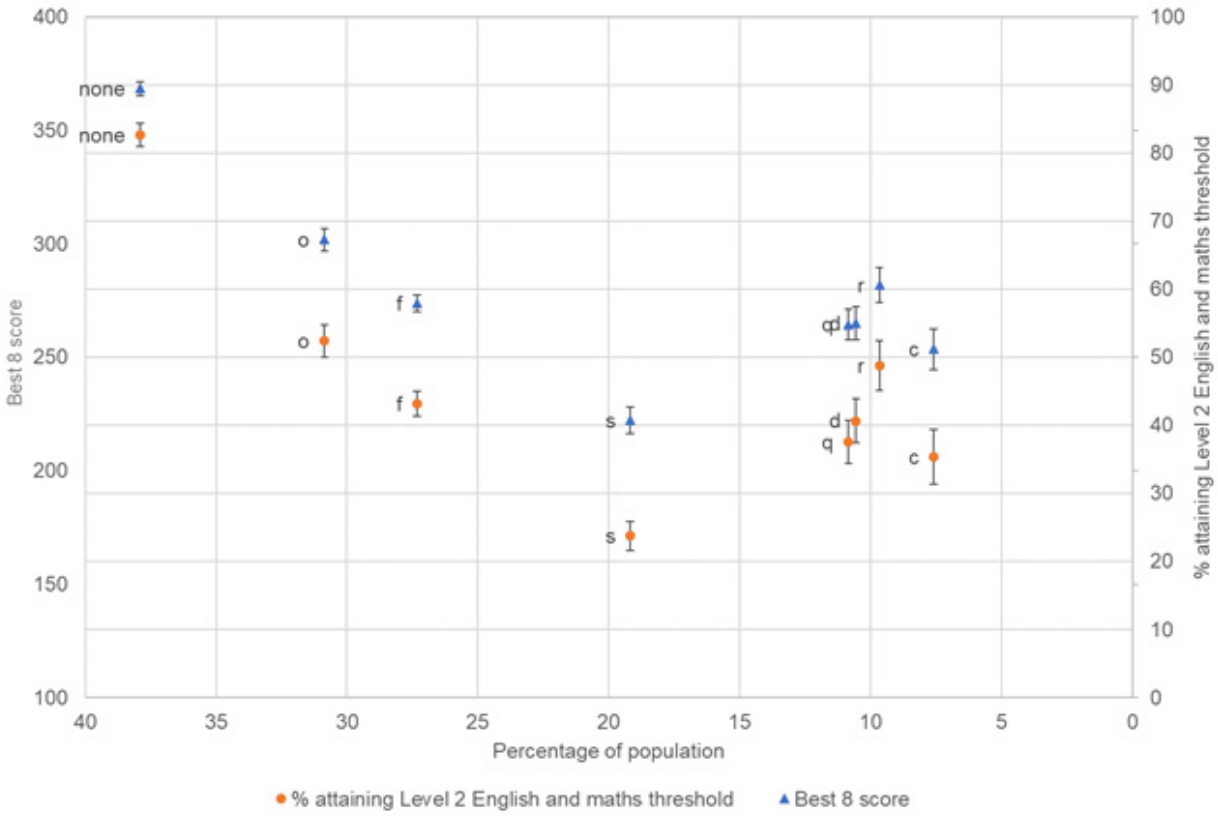
Figure 1 allows us to compare the relative size and penalty for young people experiencing each of the selected disadvantages when we do not control for the other six. It also allows us to compare those experiencing each of the seven disadvantages with young people who experienced none of them (depicted by the markers at the top, left of the figure)[23,24].

[22] For example, the relationship between Ofsted rating, progress and the incidence of White British pupils eligible for FSM is discussed here: https://educationinspection.blog.gov.uk/2018/06/22/deprivation-ethnicity-and-school-inspection-judgements/

[23] It is worth noting that the number of young people affected by each disadvantage is determined by decisions made about how each measure of disadvantage should be defined and the threshold chosen to demarcate disadvantage. For example, there would have been fewer young people disadvantaged by the effectiveness of their school if we had defined this category solely as young people attending 'inadequate' schools i.e. not including 'requires improvement'. The educational penalty this group experienced would also have been greater.

[24] Appendix A Table 2 provides the detailed figures underlying this chart ordered by the size of the population affected and then by the size of the educational penalty in terms of Best 8 attainment.

Figure 1 Size and educational penalty associated with each disadvantage



Note: o=less effective school; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

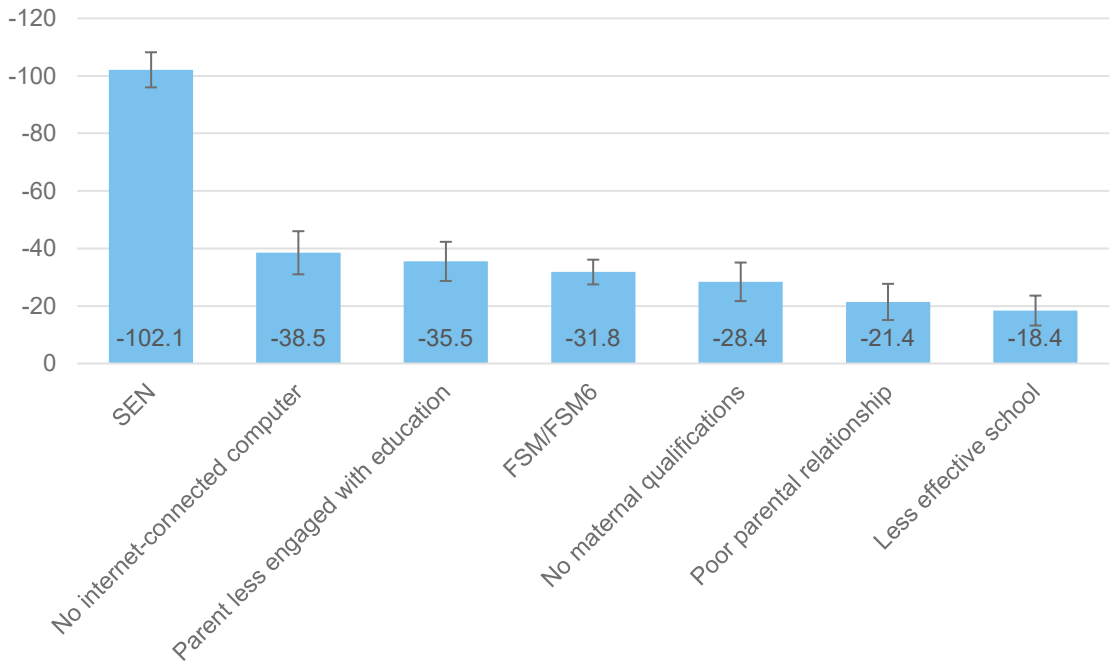
The horizontal axis shows the estimated prevalence of each disadvantage in the population, with the largest groups shown on the left of the chart (e.g. those with no disadvantages) and the smallest on the right (e.g. those with no internet-connected computer). The average predicted level of attainment associated with each disadvantage is presented both in terms of Best 8 score (shown by the blue markers, which should be read in conjunction with the left-hand vertical axis) and in terms of the percentage of young people who attained the Level 2 English and maths threshold (indicated by the orange markers, which should be read in conjunction with the right-hand vertical axis). Overlaying the different measures of attainment demonstrates a very similar pattern of association between the measured disadvantages for both Best 8 and the Level 2 English and maths threshold.

Figure 1 shows that young people who experienced none of the seven disadvantages constituted 37.9% (+/-2%) of the population of young people and had a substantially higher educational attainment on average than those experiencing any of the seven selected disadvantages. This was the case both in terms of Best 8 (368.4 points +/- 3.2), indicated by the blue marker, and in terms of Level 2 English and maths with 82.6% (+/- 1.7%) achieving this threshold (indicated by the orange marker). The relative position of different disadvantages is also visible. For example, attending a less effective school has a smaller educational penalty but effects a larger group of young people while SEN has

the greatest impact and affects about one-fifth of the population. Having a mother without qualifications, having parents who were less engaged with the young person's education, having a poor-quality relationship and lacking an internet-connected computer, all affected smaller proportions of the population and were associated with a penalty broadly equivalent to having FSM status. We return to these findings in Chapter 4 to illustrate the size and educational penalty experienced by young people with different combinations of disadvantage.

Figure 2 below shows the seven disadvantages more holistically[25]. Here, we see the results of a multivariate linear regression of the seven disadvantages based on the sample for whom data for all seven measures was available (n=7,908). This shows the unique effect of each disadvantage in a model which takes account of all seven disadvantages.

Figure 2 The individual attainment penalty associated with each of the seven disadvantages (from a multivariate regression)



By way of example of the interplay between disadvantages and the cumulative nature of individual disadvantages, young people with parents who are less engaged with their education (a penalty of 35.5 points +/- 6.8) and who further have a poor relationship with their parents (a penalty of 21.4 points +/- 6.3) have attainment around 57 points lower (equivalent to around 9 grades) than they might have with more supportive parents.

[25] More detailed information is provided in Appendix A Table 1.

As highlighted at the start of the chapter, disadvantage stems from many factors and it has not been possible to take account of all of these given the nature of this analytical exercise. Together, the seven selected measures of disadvantage explain 35.4% of the total variation in Best 8 attainment.

Pairwise relationships between disadvantages

Table 1 presents the correlation[26] between each pair of disadvantages, based on the maximum sample available.

Table 1 Correlations between disadvantages

	SEN	Engag.	Relat.	Comput.	Mat qual.	FSM	Ofsted
SEN	1						
Engag.	0.22	1					
Relat.	0.18	0.14	1				
Comput.	0.29	0.20	0.22	1			
Mat qual.	0.29	0.34	0.08	0.24	1		
FSM	**0.41**	0.32	0.19	0.32	**0.52**	1	
Ofsted	0.04	0.13	0.04	0.17	0.14	0.17	1

Strength of correlation, key:	**0.5**	**0.4**	0.3	0.2	0.1	0

Note 1: Figures in grey are not significant
Note 2: Base = maximum sample size for each pair

The results show a range of small to medium correlations between the disadvantages[27]. The exception to this is the relationship between FSM status and maternal qualifications, which has a correlation of 0.52 (SE=0.02). This shows that households where the mother has no qualification are also likely to be disadvantaged in the labour market and in receipt of qualifying benefits for free school meals. Unsurprisingly, as an indicator of household income, FSM eligibility also has a moderate correlation with whether or not the young person has an internet-connected computer (0.32, SE=0.02). There is also a reasonable overlap with parental (educational) engagement and a not insignificant overlap with child-parent relationship. The correlation between FSM eligibility is also quite

[26] These are tetrachoric correlations, which are appropriate for assessing the correlation between binary measures (i.e. measures that have a value of either zero or one).
[27] As a rule of thumb, a correlation of 0.1 is considered small, a correlation of 0.3 is considered medium and a correlation of 0.5 or higher is considered large.

high relative to other correlations in the table, which indicates a higher incidence of SEN classification among low income families.

SEN also typically pairs with other measures; with FSM status (correlation 0.41, SE=0.02); with the absence of maternal qualifications (0.29, SE=0.02); and, to a lesser extent, with the parents' engagement in the young person's education (0.22, SE=0.02). Alongside underlying learning difficulties, this may be constructed somewhere in the interface between a young person's ability to engage with school, their experience of early learning and development in the home and, perhaps, the alignment between home and school environments[28].

There are also moderate correlations between the absence of maternal qualifications and; whether the main parent was engaged in the young person's education (0.34, SE=0.02); and whether the young person had an internet-connected computer (0.24, SE=0.03). However, the link between maternal qualifications and parent-child relationship is, perhaps unsurprisingly, weak (0.08, SE=0.03).

School effectiveness has the lowest correlations with other disadvantages overall, which is to some extent expected given that this measure of disadvantage encompasses a larger, and thus broader, range of young people. Nevertheless, there is some overlap with material disadvantage in terms of FSM eligibility (0.17, SE=0.02), and whether the young person has access to an internet connected computer (0.17, SE=0.02). There are also weaker links with maternal qualification and parental (educational) engagement.

It is important to remember that this table says nothing about the level of attainment of young people, it just provides a measure of the strength of the overlap of disadvantages in the population.

In the next chapter we consider we consider the *number* of disadvantages that young people face and examine whether the number of disadvantages alone is useful to understanding the variation in disadvantaged young people's educational attainment. We then go on to look at more complex combinations of disadvantage and their overlaps, as well as the educational penalties experienced for these smaller groups.

[28] For example, the influence of child, family, home factors and pre-school education on the identification of special educational needs at age 10 is discussed here: https://educationinspection.blog.gov.uk/2018/06/22/deprivation-ethnicity-and-school-inspection-judgements/

Chapter 3 Number of disadvantages experienced and the cumulative effect of multiple disadvantage

Summary findings

The analysis in this chapter uses a count of the disadvantages experienced to investigate how many of our seven examined disadvantages were typically experienced by young people and how this related to their KS4 attainment.

Overall, around a third of young people had none of the disadvantages, a further third experienced one of the disadvantages and the remaining third experienced two or more disadvantages. The proportion of young people experiencing a high number of the selected disadvantages was relatively low – around one in twenty had to contend with four or more.

Boys were likely to experience slightly more disadvantages than girls, an effect that was primarily driven by the higher incidence of SEN among boys.

Young people from an Indian background had fewer disadvantages on average than White young people. Those from Pakistani, Bangladeshi, Black African and Black Caribbean ethnic minority groups had a relatively high incidence of multiple disadvantage compared to both young people from a White background and young people from an Indian ethnic background.

Nearly all (94%) of those who experienced two or more types of disadvantage either had SEN or have been eligible for Free School Meals. Nevertheless, even based on the reduced set of seven disadvantages that we examine here, there is a small group of young people (around one in twenty) who experience some type of multiple disadvantage, such as having a mother with no qualifications and attending a less effective school, and fall outside these two prominent administrative measures of educational disadvantage.

The relationship between a simple count of the number of disadvantages a young person experiences and the size of their attainment deficit was near linear. A young person experiencing one type of disadvantage had significantly lower attainment on average than a young person with none of the disadvantages. This attainment deficit approximately doubled among young people experiencing two rather than just one of the disadvantages, approximately trebled among those experiencing three, and so on. However, as we go on to discuss in later chapters, there is further complexity underlying the relationship between multiple disadvantage and attainment - different specific combinations of disadvantage can be associated with very different attainment deficits. In particular, combinations of disadvantage involving SEN tend to result in greater attainment deficits.

Chapter introduction

So far, we have looked at each of the seven disadvantages individually and have briefly compared young people experiencing each disadvantage with young people who experienced none. We also touched on how pairs of disadvantages overlap.

In this chapter we use a simple count of the total number of disadvantages experienced by each young person as a straight forward approach to assessing the impact of *multiple* disadvantage. This approach helps overcome the problem of small sample sizes associated with each unique combination of disadvantages, particularly when the total number of disadvantages experienced is large and the prevalence of some combinations is rare.

Working with a count of disadvantages allows us to look in a straightforward way at whether there is a multiplicative penalty associated with the experience of additional disadvantages, or alternatively, whether the cumulative attainment deficit is actually smaller than might be expected.

As well as plotting the total number of disadvantages by attainment and assessing the relationship visually (see Figure 4), we also assess the relationship formally by using a linear regression and testing the significance of an additional quadratic term.

The number of disadvantages experienced

Figure 3 shows the proportion of young people experiencing between none and seven of the selected disadvantages. The red circles show data based on the complete cases sample but it should be noted that, in practice, young people for whom we have complete information are slightly more advantaged than those with some missing data. As such, we have also calculated values based on the full sample in which we have either treated missing responses as if the young person did not experience that disadvantage (the blue squares) or as if the young person did experience the disadvantage (the green triangles). These two calculated values provide a range within which a 'true' estimate for the full sample is likely to fall, adjusting for the missing information[29].

Taking these ranges into account, we see that approximately one third of young people experienced no disadvantages (between 33.7% and 35.7%) and between 31.3% and 35.2% experienced multiple disadvantage. More specifically, one third had one disadvantage (between 33.0% and 33.1%), between 18.3% and 18.5% had two disadvantages, between 8.5% and 9.8% had three disadvantages and between 4.4%

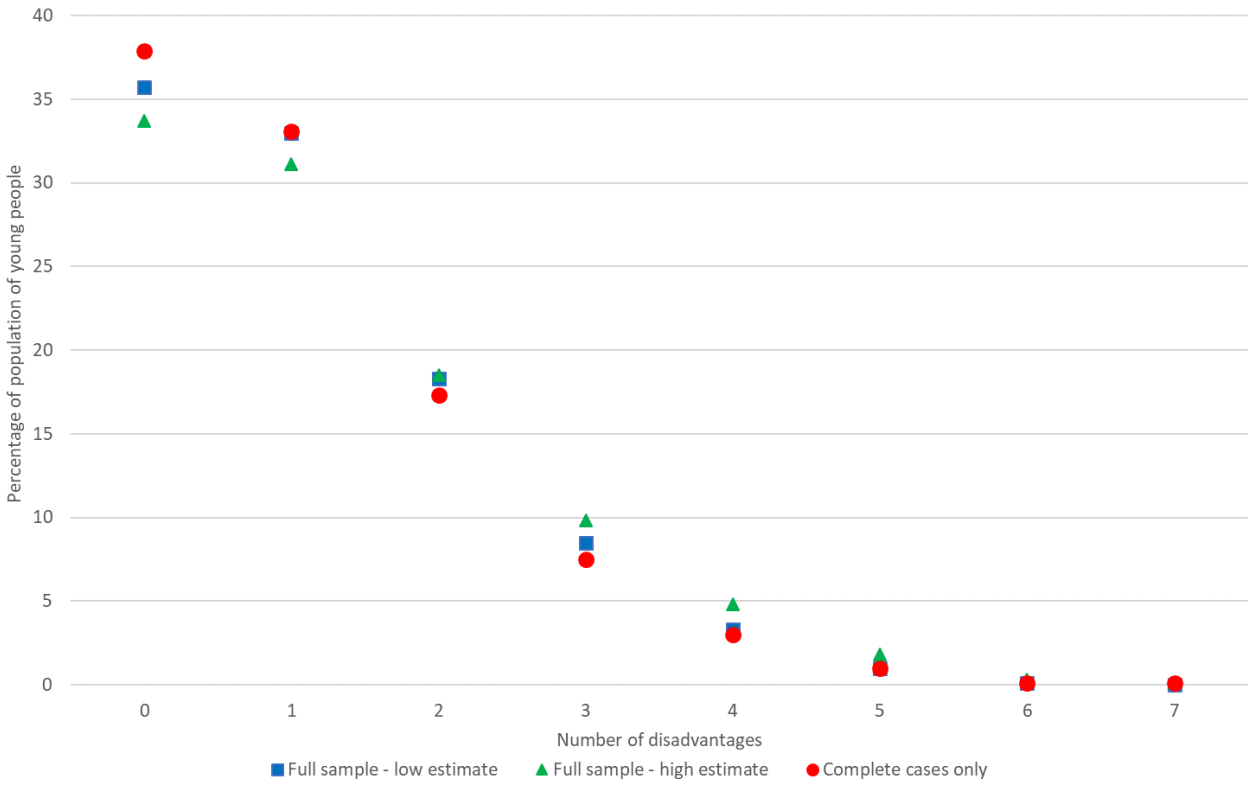
[29] The data and base sizes underlying Figure 3 can be found in Appendix A Table 3.

and 7.0% had four or more. The mean number of disadvantages was between 1.15 (SD=1.17) and 1.28 (SD=1.29).

The estimate based on the complete cases sample gives slightly higher estimates of the proportion of young people with no or few disadvantages, and slightly lower estimates of the proportion of young people with between two and four disadvantages. The numbers of young people with five, six or seven disadvantages is very low and the estimates very similar.

Regardless of how we treat missing information, the distribution is highly skewed with a small proportion experiencing multiple disadvantages. For the remainder of this chapter we focus on the complete cases sample, acknowledging that this may provide a slight underestimate of the number of young people with multiple disadvantages.

Figure 3 Number of disadvantages based on different methods of counting

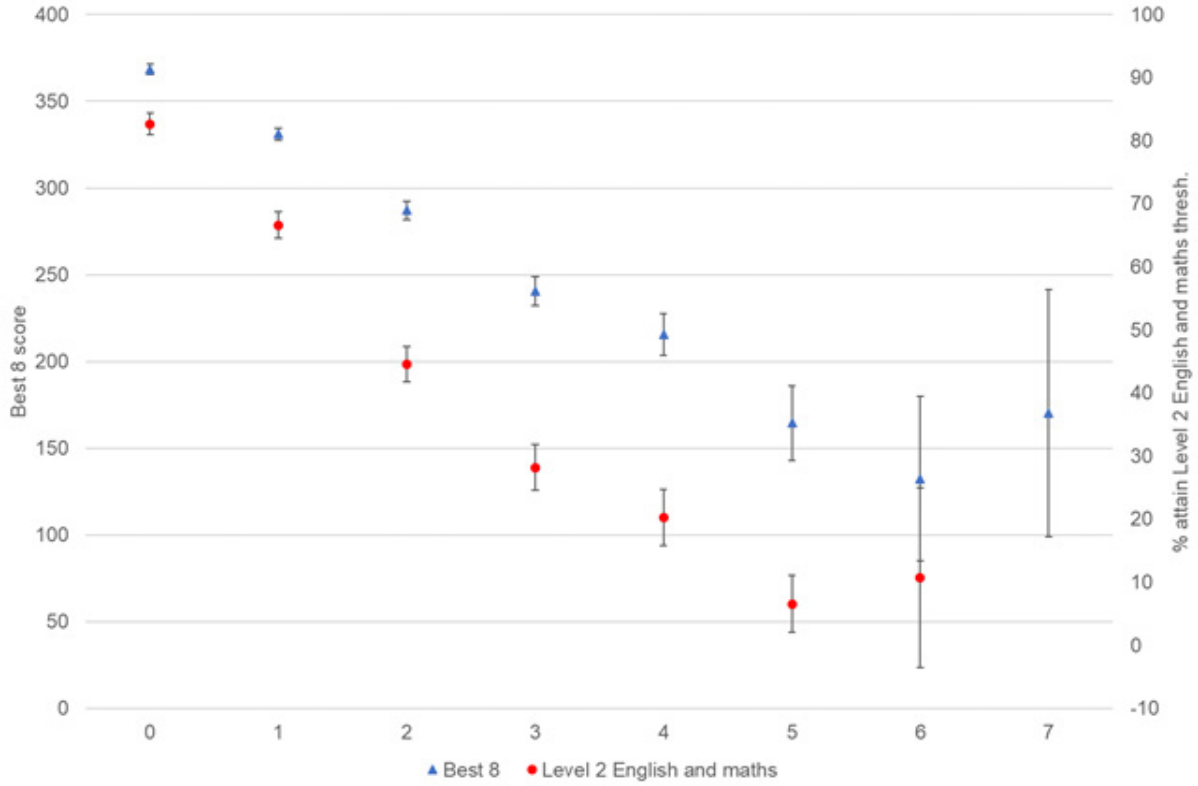


The motivation for counting disadvantages is that it allows us to assess whether – putting aside for the moment any differential penalties associated with different kinds of disadvantages – the penalty of having additional disadvantages is constant, regardless of how many disadvantages the young person already has. In other words, whether the association between attainment and the number of disadvantages a young person has is linear. Some of the literature, based on the impact of family disadvantages on children's outcomes, suggests that while it may be possible to absorb the effect of one or two types

of disadvantage without major impact, experiencing multiple types of disadvantage could have a very strong effect (Cabinet Office, 2007).

Figure 4 below suggests that this hypothesis does not hold for young people's educational attainment based on the disadvantages we have chosen. We see a near linear relationship between the increase in number of disadvantages a young person experiences and the reduction in their attainment, both measured in terms of Best 8 (the blue squares in Figure 4 below) and the Level 2 English and maths threshold (the red circles). The sample of young people with six or seven disadvantages is too small for our estimates to be reliable (well under 50) and in fact cannot be calculated for the Level 2 threshold measure. As such, the slight upwards tick at the end of the distribution does not alter our conclusion.

Figure 4 Number of disadvantages and variation in educational attainment



A regression analysis was carried out to estimate the penalty associated with having additional disadvantages. The results suggest that for each additional disadvantage that a young person experiences there is an additional penalty of -40.5 points (+/-1.9). In addition, we assessed whether the linear relationship between the number of disadvantages a young person had and their predicted attainment was linear, as suggested in Figure 4 above. An additional quadratic term for number of disadvantages was non-significant suggesting the relationship was indeed linear.

In constructing a simple count of the total number of disadvantages young people experience, we treat the seven disadvantages as synonymous in terms of their penalty on attainment. However, as we have already shown in chapter 2, this is not a complete picture of the relationship between disadvantage and attainment - some of the disadvantages are associated with a much greater penalty for young people's attainment than others. This difference is also evident in terms of the amount of variance in young people's Best 8 attainment that we are able to explain. When we use a simple count of disadvantages we are able to explain 27.0% of the variation in young people's attainment. This is somewhat less effective than when we considered the disadvantages individually as having their own unique penalty on attainment (which, as reported earlier, together explained 35.4% of the variation). Nevertheless, the simple count approach still has considerable explanatory power and produces clear results.

We also found we could significantly improve our model if we treated SEN, which has a significantly larger attainment penalty than the other disadvantages, separately. When SEN status is included in a model alongside a count of the six remaining disadvantages, we can explain 35.0% of the variation in Best 8 attainment, which is only fractionally less than the 35.4% found for the model with all seven disadvantages were included separately. This is because SEN is a very strong predictor of a young person's attainment. Considered alone, it explained 26% of the variance in young people's attainment, compared to the other disadvantages which together can explain 17.1% of the variance. Knowing whether a young person has SEN gives us an insight into their likely attainment over and above the other disadvantages we examine. As a consequence, if we distinguish young people's SEN status from a count of their other disadvantages we are better able to predict their attainment. In this revised model, from a starting score of 369.4 points (+/-2.9), the educational penalty associated with having SEN is -103.7 points (+/-6.2) and the penalty for each of the other disadvantages experienced is -28.0 points (+/-2.0).

Number of disadvantages by gender and ethnicity

So far, we have shown the number of disadvantages experienced by all young people and differences in their average predicted attainment in terms of Best 8 and the Level 2 English and maths threshold. Here, we briefly compare the number of disadvantages experienced by girls and boys and by pupils from different minority ethnic backgrounds.

Girls experienced, on average, fewer disadvantages than boys, with 60% having at least one disadvantage compared to 64.1% of boys, and more boys experience four or more

disadvantages (4.7%) compared to girls (3.7%)[30]. A chi-square test shows that these distributions are significantly different. The mean number of disadvantages is also lower for girls (1.03) than for boys (1.14); a difference that is statistically significant (p=0.0021). However, it should be noted that these differences are almost entirely driven by gender differences in the prevalence of SEN, which is much more common among boys (24.2% of boys had SEN compared to 14.0% of girls) and, as we have seen, has a severe penalty on attainment. The number of disadvantages experienced by girls and boys does not differ significantly when we do not include SEN.

We also observe some differences in the number of disadvantages experienced by young people from different ethnic groups. It is important to note that the sample sizes for some of these groups are small and the results are therefore less certain. In brief, young people who have Indian ethnicity had fewer disadvantages[31]. Young people whose ethnic group is Pakistani were more likely than White students to have three or more disadvantages and two or more disadvantages. Young people from the Bangladeshi, Black African and Black Caribbean ethnic minority groups were also more likely than White students to have two or more disadvantages.

While the number of disadvantages a young person experiences is clearly important, not all disadvantages are equal, as shown in chapter 2 and in Figure 5 below. In the next chapter we explore different combinations of disadvantages in more detail.

Figure 5 Illustration of how a simple disadvantage 'count' may under or over-estimate attainment penalties

The simple 'count' method is particularly likely to over or underestimate attainment deficits in cases where the differential penalty associated with different kinds of disadvantages is broad.

For example, we can demonstrate this by examining the estimated penalty associated with a combination of two high-penalty disadvantages (SEN and lacking an internet-connected computer) and two low-penalty disadvantages (attending a less effective school and having a poorer quality relationship with a parent).

Using the count approach (where the average penalty for each disadvantage was -40.5 +/-1.9), we would predict that pupils experiencing either combination would have a

[30] A relatively small number of young people experience five, six or seven disadvantages, and these numbers are smaller still when we consider sub-groups such as girls or boys, hence our focus on 'four or more' here. Further details can be found in Appendix A Table 3.

[31] This is based on a logistic regression of number of disadvantages by ethnicity. Young people from the Indian ethnic group are less likely to have four or more disadvantages, less likely to have three or more disadvantages and less likely to have two or more disadvantages than young people who are defined as White.

penalty of -81.0. This underestimates the penalty associated with experiencing the first combination (-140.6 as calculated from our multiple regression presented in Chapter 2) and overestimates the penalty experienced by the second (-39.8).

Our estimates are significantly improved if we treat SEN separately from our count of disadvantages (whereby a penalty of -103.7 is assumed for SEN and an average of -28.0 for all other disadvantages). Based on this moderated count, we predict an average penalty of -131.7 for those experiencing the two high-penalty disadvantages and an average penalty of -56.0 for those experiencing the two low-penalty disadvantages.

Number of disadvantages without FSM or SEN

An important question for policy makers is whether young people who are most likely to experience educational disadvantage are effectively identified and targeted for support by the current system. Young people who are most likely to be experiencing economic hardship should be classified as eligible for free school meals which brings additional resource to the school through the Pupil Premium. The question we address here is how many young people experience multiple disadvantages and have significantly reduced educational attainment but are not identified as in need of policy intervention through their FSM status.

On the left-hand side of Table 2 we first separate out the 24.4% of young people who were identified as being eligible for free school meals at the time of the interview or within the previous six years. The table then shows the proportion of young people with each number of the remaining disadvantages, up to a maximum five[32]. If we simply sum those with two or more disadvantages, we see that a sizeable 11.0% of the population of young people experience multiple disadvantages, not including FSM status, and so would not be picked up for policy intervention based on FSM alone.

[32] Although logically possible, in practice none had six disadvantages excluding FSM.

Table 2 Count of disadvantages excluding FSM (left) or FSM and SEN (right)

	Unwtd N	Wtd %	Mean Best 8	+/-		Unwtd N	Wtd %	Mean Best 8	+/-
	1+ disadvantage including FSM					1+ disadvantage incl FSM or SEN			
FSM	2729	24.4	278.6	4.1	FSM or SEN	3430	35.3	268.4	4.0
	Disadvantages excluding FSM					Disadvantages excluding FSM/SEN			
None	2638	37.9	368.4	3.2	None	2638	37.9	368.4	3.2
1	1830	26.7	330.9	4.2	1	1475	21.3	346.0	3.7
2	564	8.6	281.6	8.3	2	323	4.8	318.8	7.4
3	120	1.9	213.1	19.2	3	37	0.6	276.3	27.5
4	22	0.4	213.9	40.6	4	5	0.1	270.8	54.1
5	5	0.1	195.1	81.4					
Total	7908	100			Total	7908	100		

These young people do experience a significant educational penalty; those with just two disadvantages (but who are not eligible for FSM) attain an average Best 8 score of 281.6 +/-8.3 which is not dissimilar to the average attainment of young people with one or more disadvantages *including* FSM, 278.6 (+/-4.1). Young people with three, four or five disadvantages (but who are not eligible for FSM) have even lower attainment.

It is possible, of course, that the relatively low attainment of young people with multiple disadvantage who are not eligible for FSM is explained by the large proportion of young people with special educational needs within the 'non-FSM' group, since SEN is strongly associated with low attainment. Indeed, being identified as someone with special education needs is one of the key ways that young people can be targeted for additional support to help address the disadvantages they face. With this in mind, we extend the analysis by establishing how many young people experience multiple disadvantages and have significantly reduced educational attainment but are not identified as in need of policy intervention through either their FSM status or by having recognised special educational needs[33]. On the right-hand side of the table we show that 35.3% of the population of young people are either eligible for free school meals or have special

[33] It should be noted that other streams of funding support are also available (e.g. for looked-after young people and those with high needs). However, given the relatively high incidence of FSM and SEN compared to these other support triggers, and the likely overlap between them, this remains a useful exercise.

educational needs. Their average Best 8 attainment of these young people is 268.4 +/- 4.0. The rows below show the number of disadvantages faced by young people who were neither eligible for FSM at the time of interview or in the previous six years, nor had special educational needs. In total, 5.5% of these young people had two or more disadvantages, a smaller but still substantial group. Unsurprisingly, the average attainment for these young people was higher than for the FSM or SEN group; for example, those with two non-FSM/SEN disadvantages had an average attainment of 318.8 +/-7.4 and the attainment for those with three non-FSM/SEN disadvantages is 276.3 +/-27.5.

This analysis is indicative but is not an entirely fair test: By design, we use a subset of all disadvantages with only one, FSM eligibility, representing economic hardship. Had we included other measures which are most closely associated with economic disadvantage such as tenure, IDACI or household NS-SEC, we would probably have identified more young people who were at risk economically, but not eligible for FSM. Similarly, we have chosen disadvantages with different magnitudes of educational penalty. Our finding that young people with disadvantages not related to SEN have higher average attainment than those who have SEN is unsurprising given what we know about the importance of this single marker of disadvantage.

Chapter 4 Combinations of disadvantage

Summary findings

Among those who experience disadvantage, there is a very broad range of possible, specific circumstances – even when we focus only on the seven disadvantages examined in this report, there are 128 possible combinations.

While many different combinations of disadvantage were experienced, none constituted a large proportion of young people. Further, the more types of disadvantage experienced, the lower the prevalence in the population. Approaches to supporting young people who have multiple disadvantages should be correspondingly flexible to the wide variety of life circumstances experienced by young people.

Nevertheless, some combinations of disadvantage are far more common than others. In particular, around one in ten young people had been eligible for free school meals and also attended a less effective school. However, this pairing of disadvantages was also associated with a less severe attainment penalty than many of the others and, as such, may be less of a clear priority than its relatively high incidence would suggest.

In general, the attainment deficit was most pronounced where a pair of disadvantages included SEN. Again, the SEN pairing with the highest incidence (SEN coupled with FSM eligibility, which was experienced by around one in twelve young people) had a smaller attainment deficit than other less common SEN pairings. Young people with SEN who also had parents who were less engaged in their education or who had more challenging parental relationships saw larger attainment deficits, as did those whose mother had no qualifications or who did not have access to an internet connected computer at home.

When considering three-way disadvantages, the incidence of each was, inevitably, lower still. The most widespread was SEN accompanied by eligibility for FSM and attendance at a lower quality school (which affected around one in thirty young people).

Chapter introduction

In the last chapter we showed that the number of disadvantages young people experience is a strong indicator of the magnitude of the educational penalty they face. However, it is also clear, based on the evidence presented thus far, that the educational penalty of the seven selected disadvantages differ, and that combinations of these disadvantages are likely to be associated with different educational outcomes. For example, we have shown that having a combination of two high-penalty disadvantages (e.g. SEN and lacking an internet-connected computer) was associated with a lower level

of attainment than having a combination of two relatively low penalty disadvantages (e.g. attending a less effective school and having a poorer quality relationship with a parent).

In this chapter, we look descriptively at different combinations of two, three and four or more disadvantages. It is partly because of issues to do with sample size that we do this in terms of those who have each combination and any more disadvantages (as opposed to those who had *only* those two, three or four disadvantages). We also believe this approach makes sense conceptually. It provides us with the estimated penalties associated with having combinations of disadvantages regardless of whatever other additional disadvantages the young person might be experiencing. This is particularly important considering that there are many other disadvantages which young people may face that we were unable to include in this study.

We examine two metrics in parallel: the prevalence of each combination of disadvantages among the population of young people; and the size of the educational penalty associated with that combination. Both prevalence and size of the penalty are, in one sense, an artefact of the way each disadvantage is defined. Nevertheless, they are both important to policy given that making decisions about where to target interventions relies not only on knowing how severe a problem is, but also how many young people are likely to be affected.

Combinations of disadvantage experienced by young people

We estimate the likely prevalence of all 128 possible combinations of the seven disadvantages in the population[34], whilst noting that the estimates for more common combinations will be more accurate than the estimates for rare combinations with small sample sizes. For the purpose of maximizing our sample sizes we use all the available sample for each combination, rather than a complete cases sample in which cases are removed if they are missing any one of the seven disadvantages. We present the most prevalent combinations of disadvantage in Table 3 below. We then present a selection of the findings graphically, in order to map both prevalence and penalty in terms of Best 8 attainment, both for two-way combinations (in Figure 6) and three-way combinations (Figure 7). The complexity of drawing out patterns of multiple disadvantage is highlighted in Figure 8 which presents combinations of four or more disadvantages. We provide additional figures in Appendix A and, in Appendix B, provide the key results for all for the 128 possible combinations of disadvantage which underlie these figures. This allows readers interested in particular combinations to find the estimated size of any

[34] This set of 128 combinations comprises: 1 x no disadvantages; 7 x one disadvantage; 21 x two disadvantages; 35 x three disadvantages; 35 x four disadvantages; 21 x five disadvantages; 7 x 6 disadvantages; and 1 x 7 disadvantages.

combination of interest, alongside the predicted mean attainment measured in terms of Best 8 score, and the predicted mean percentage who would achieve the Level 2 English and maths threshold. It is worth reiterating that the sample sizes in some instances are especially small. Furthermore, it should be borne in mind that young people may appear in several categories. For example, someone who experiences three disadvantages, related to FSM, less effective school and SEN, will appear as part of three two-way combinations: FSM-SEN; FSM-less effective school; and SEN-less effective school.

Prevalence of common combinations

Table 3 below shows the most common combinations of disadvantage, identifying all the combinations which are experienced by 2% of the population of young people, or more. These groups are not mutually exclusive; for example, there is an overlap between the 10.3% (Two-way, Block 1, Row 1) who had been eligible for free school meals and attended a less effective school, the 8.4% who had been eligible for free school meals and had special educational needs (Two-way, Block 2, Row, 1) and the 6.0% who had special educational needs and attended a less effective school (Two-way, Block 3, Row 1). Indeed, 3% of young people fall into all three of these groups (Three-way, Block 1, Row 1).

Table 3 Prevalence of the most common combinations of disadvantage (above 2 per cent)

Combination of disadvantages	N	Wei %	+/-
Two-way combinations [brackets show associated 3-ways]			
FSM-Less effective school [1,3,4]	1297	10.3	1.1
FSM-No maternal qualifications [2, 3]	810	6.5	0.5
FSM-Parent less engaged with education [4]	597	4.9	0.4
FSM-Poor parental relationship	428	3.6	0.4
FSM-No internet-connected computer	444	3.5	0.4
FSM-SEN [1,2]	1198	8.4	0.5
SEN-Less effective school [1]	658	6.0	0.8
SEN-No maternal qualifications [2]	396	3.5	0.4
SEN-Parent less engaged with education	338	3.1	0.4
SEN-Poor parental relationship	278	2.7	0.3
SEN-No internet-connected computer	287	2.6	0.3
Less effective school-No maternal qualifications [3]	440	4.2	0.6
Less effective school-Parent less engaged with education [4]	400	4.2	0.6
Less effective school-Poor parental relationship	295	3.2	0.5
Less effective school-No internet-connected computer	312	3.2	0.5
No maternal qualifications-Parent less engaged with education	258	2.5	0.3
Three-way combinations [brackets show associated 2-ways]			
[1] FSM-SEN-Less effective school	441	3.0	0.4
[2] FSM-SEN-No maternal qualifications	319	2.3	0.3
[3] FSM-Less effective school-No maternal qualifications	326	2.6	0.4
[4] FSM-Less effective school-Parent less engaged with education	254	2.1	0.3

Note: Numbers in the square brackets highlight where overlaps lie.
Note: The table is not organised strictly by prevalence of any given combination. Where necessary it is reordered to show the patterns of combinations which involve FSM, SEN and less effective school.

Two-way combinations

There are 21 possible two-way combinations and these are depicted in Figure 6. The prevalence of young people experiencing each pair of disadvantages is shown on the horizontal axis (ranging from zero to 12%) and their predicted average attainment in terms of Best 8 is shown on the vertical axis. The error bars represent the 95% confidence intervals around the estimation of mean attainment[35].

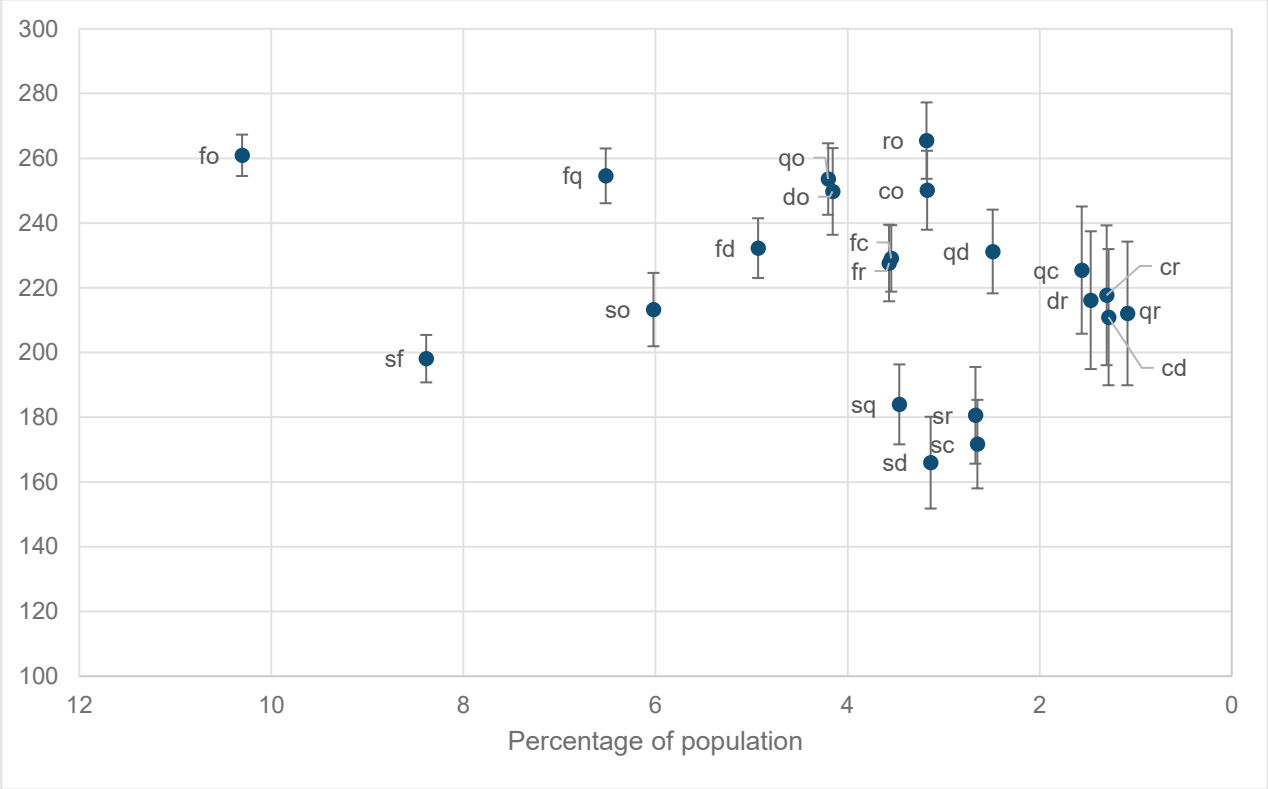
Figure 6 reveals some interesting patterns:

- Only four of the two-way combinations of disadvantages occurred in over 5% of the population of young people. The largest was FSM-less effective school (10.3% +/-1.1%), followed by FSM-SEN (8.4% +/-0.5%), FSM-maternal qualifications (6.5% +/-0.5%) and SEN-less effective school (6.0% +/-0.8%). The next most common combination, found in just under 5% of the population, was FSM-parent less engaged in education (4.9% +/-0.4%).
- All six of the two-way combinations which include SEN cluster towards the bottom of the chart, which reflects the relatively large attainment penalty associated with having SEN. Nevertheless, there are notable difference depending on its combination with other disadvantages. Relatively speaking, young people with SEN in combination with either attending a less effective school, or being eligible for free school meals, had a slightly higher level of attainment (with Best 8 scores of 213.3 +/-11.3 and 198.1 +/-7.3 respectively) than those where SEN was paired with having a mother with no qualifications (184.0 +/-12.4), a poor relationship with a parent (180.6 +/14.9), the lack of an internet-connected computer (171.7 +/-13.7) or parents who are less engaged in their education (166.0 +/-14.2). The difference in attainment between the combination of SEN-less effective school and the four lowest attaining SEN combinations in particular is quite clear. It should be noted that relatively small groups of young people experienced the four lowest attaining SEN combinations, ranging from 2.6% +/-0.3% for SEN-Computer to 3.5% +/-0.4% for SEN-maternal qualifications).
- Five of the six two-way combinations which include less effective school have relatively lower attainment penalties and, accordingly, sit higher up in the chart. The exception is SEN-less effective school which, as already noted, represents a relatively large group of young people (6.0% +/-0.8%).

[35] An equivalent plot showing attainment in terms of the Level 2 English and maths threshold is provided in Appendix A Figure 1.

The smallest groups which cluster on the right of the chart, and which are almost indistinguishable from each other in terms of attainment and incidence in the population, all combine a disadvantage related to family background (having a mother with no qualifications) and/or disadvantages relating to the home environment (having a parent unengaged in the young person's education, the lack of an internet-connected computer and/or a poor parental relationship). Young people in these groups were moderately disadvantaged in terms of educational attainment, relative to the other two-way combinations of disadvantage.

Figure 6 Two-way combinations, Best 8



Note: o=lower school effectiveness; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

Three-way combinations

Figure 7 plots the prevalence and associated attainment penalty for the 35 possible combinations of three disadvantages[36]. The prevalence of young people who have three or more disadvantages is much lower, between zero and 4% of the population, so we have increased the scale of the horizontal axis.

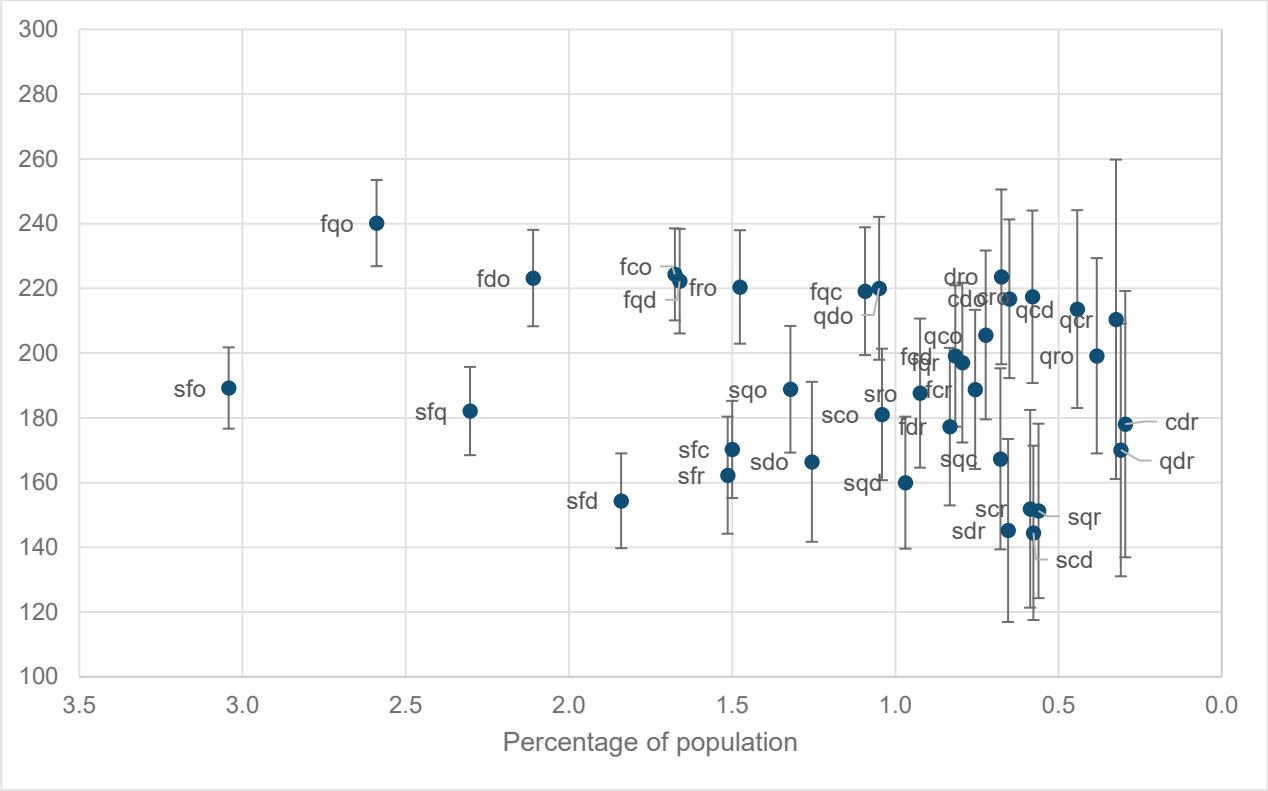
- Only the most prevalent of these combinations, SEN-FSM-less effective school, was experienced by 3% of the population (3.0% +/-0.4%). Three further combinations

[36] Appendix A Figure 2 shows the equivalent information for Level 2 English and maths threshold.

were experienced by over 2% of young people: FSM-maternal qualifications-less effective school (2.6% +/-0.4); FSM-maternal qualifications-SEN (2.3% +/-0.3); and FSM-less effective school-parent less engaged with their education (2.1% +/-0.3).

- As was the case with two-way combinations, the three-way combinations which include less effective school generally appear near the top of the chart, indicating relatively high levels of attainment, and those which include SEN are lower, indicating worse attainment. However, some combinations do not fit this pattern. For example, the combination of FSM-maternal qualifications-parent less engaged with education (1.7% +/-0.3% of the population with a Best 8 score of 222.2 +/-16.2) had similar scores to those combinations which included less effective school. The same applies to the FSM-maternal qualifications-Internet-connected computer combination (1.1% +/-0.2% of the population with a Best 8 score of 219.1 +/-19.7).
- Similarly, a number of relatively small groups without SEN appear to be as disadvantaged as those whose combinations did involve SEN. These include the FSM-parent less engaged with education-poor parental relationship combination (0.8% +/-0.2% of the population, Best 8=177.3 +/-24.3); the maternal qualifications-parent less engaged with education-poor parental relationship combination (0.3% +/-0.1% of the population, Best 8=170.1 +/-39) and the no internet-connected computer-parent less engaged with education-poor parental relationship combination (0.3% +/-0.1% of the population, Best 8= 178.1 +/-41.1).
- Figure 7 also suggests that when SEN combines with disadvantages such as parental disengagement from education, poor parental relationships or an absence of an internet-connected computer, the attainment deficits are particularly pronounced.

Figure 7 Three-way combinations, Best 8



Note: o=lower school effectiveness; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

Because all these combinations have small sample sizes, the confidence intervals are relatively large and are overlapping. Based on this descriptive analysis alone we cannot be certain whether there is an actual difference in attainment scores.

Combinations of four or more disadvantages

Figure 8 shows the results for combinations of 4 or more disadvantages in terms of Best 8 attainment[37]. It includes 35 four-way combinations (in blue), 21 five-way combinations (in orange), 7 six-way combinations (in grey) and one seven-way combination (in yellow). This is not intended to provide detailed information but shows, more generally, that the size of each specific combination of disadvantage is small and the differences in attainment are hard to distinguish. Indeed, the figure illustrates some of the difficulties of exploring the educational penalty associated with the 64 combinations of disadvantage illustrated.

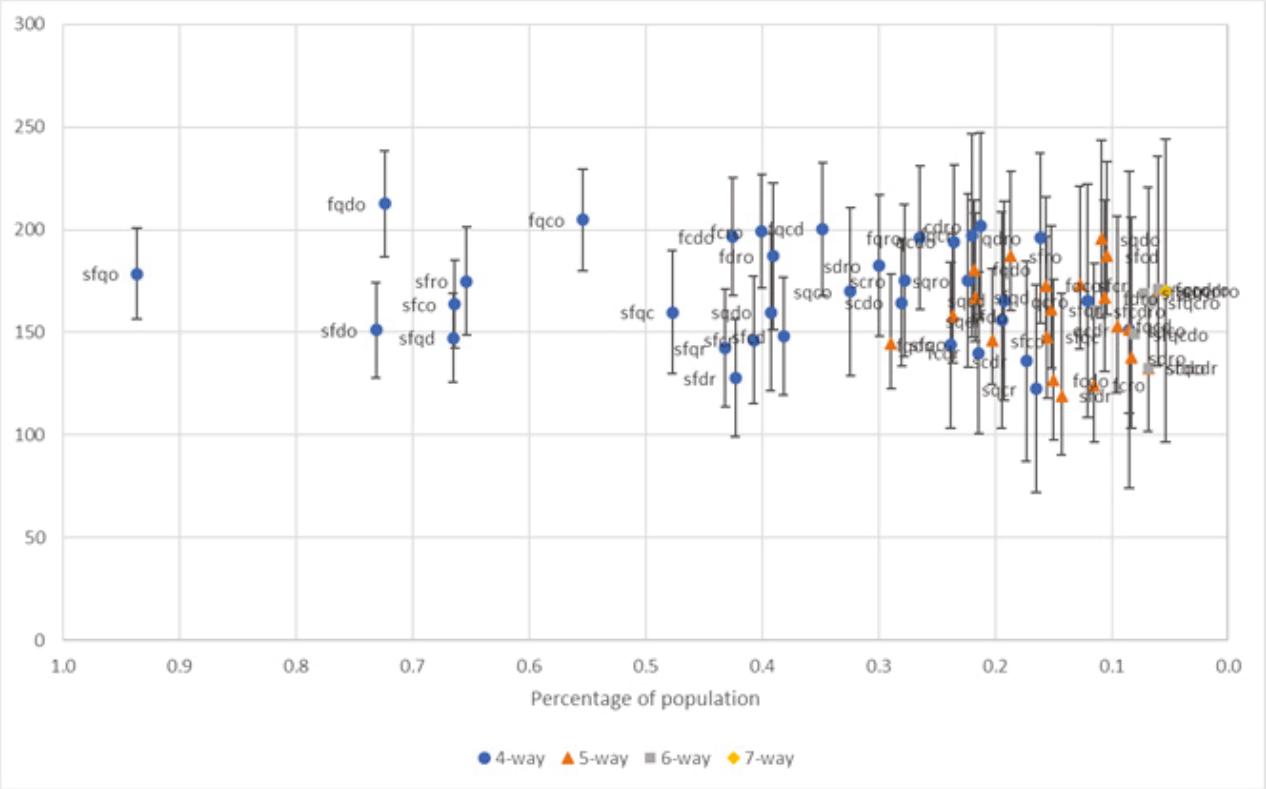
[37] Appendix A Figure 3 does the same for the Level 2 English and maths threshold. This only includes combinations which have sufficient data to estimate these values.

- A key issue is that the sample sizes are small, with the most prevalent combination of young people (described below) affecting just 132 members of the LSYPE2 cohort. The rarest combinations, such as having all seven disadvantages (n=7), are extremely small. Indeed, 51 of the 64 combinations have fewer than 50 cases and 11 combinations have ten or fewer. Consequently, our estimates of the average attainment of young people with the combinations of disadvantages shown in this figure are far less certain, as indicated by the larger error bars. Furthermore, the horizontal axis has had to be rescaled to between zero and 1% to make the groups distinguishable.
- Although the detail is hard to see, the experiences of these complex combinations are important. The largest set of young people identifiable here, who had four or more disadvantages, was 0.9% +/-0.2% of the total population. These were young people whose disadvantages included (but were not limited to): SEN; FSM at the time of the interview or the past six years; mothers with no qualifications; and attendance at a less effective school. This combination of disadvantages clearly had a marked impact on educational attainment (Best 8=178.7 +/-21.9), with only 9.9% (+/-4.9%) attaining the Level 2 English and maths threshold.
- There are some other useful points to note. We still generally see young people with SEN having lower attainment than those without, but the distinction is less clear. While the combination labelled ‘fqdo’ (FSM-maternal qualifications-parent less engaged with education-less effective school) appears to have higher attainment than a similar combination labelled ‘sfdo’ which includes SEN rather than the absence of maternal qualifications, many similar combinations have overlapping estimates.

Because of the nature of the analysis of the Level 2 English and maths threshold, we cannot provide reliable estimates for many of the smallest groups. Figure 8 provides information where estimates for those experiencing four or more types of disadvantage are possible. Again, the detailed data here is not sufficiently robust to report in great detail, but the striking finding is that even among the sub-groups with the highest attainment, only 24.8% +/-7.4% achieve the Level 2 English and maths threshold (the FSM-maternal qualification-Internet-connected computer-Poor relationship group). For the majority of the sub-groups experiencing four or more types of disadvantage, the proportion achieving the Level 2 English and maths threshold is below 20% (and, in many cases, even below 10%).

To understand the implications of these combinations further, we need to use more systematic analytical techniques. We turn to this in the final chapter.

Figure 8 Four, five, six and seven-way combinations of disadvantage, Best 8



Note: o=lower school effectiveness; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

Note: The different combinations of disadvantage cannot be clearly distinguished in this figure but demonstrate the complexity of young people's circumstances and the limitations of sample size in these multiply disadvantaged groups

Chapter 5 Do different disadvantages interact?

Summary findings

While the effect of experiencing multiple disadvantage is broadly cumulative in terms of the associated attainment penalty, sometimes the total penalty is more (or less) than we might expect had we just added the two associated attainment penalties together i.e. there appears to be exacerbating or mitigating interaction between some types of disadvantage.

Having both Special Educational Needs and parents who are less engaged with education was associated with a larger penalty than would be expected given the sum of the respective penalties associated with each (all other disadvantages held equal).

In contrast, the cumulative penalty associated with both having been eligible for FSM and having a mother with no qualifications, or being both enrolled in a less effective school and having Special Educational Needs, was lower than would be expected from the sum of their respective penalties.

Inverse interpretations also apply - for example, young people who had *not* been eligible for FSM and whose mothers had no qualifications had *lower* attainment than might be expected.

Chapter introduction

In previous chapters we looked at each disadvantage individually, the number of disadvantages young people experience, and the prevalence and educational penalty associated with the different combinations of disadvantages that occur in the population. The key question addressed in the present chapter is whether experiencing multiple disadvantages has an additive effect (equivalent to adding up the unique educational penalty for each disadvantage – as estimated in a multivariate regression[38]) or whether there are instances where the educational penalty of having a combination of disadvantages is multiplicative (more than the sum of the individual penalties) or reduced, with the additional disadvantage having less impact in the presence of other disadvantages (less than the sum of the individual penalties).

[38] The results of this multivariate regression were presented in Figure 2 in chapter 2 which shows the 'unique' penalty associated with each disadvantage taking account of all seven disadvantages and assumes that there are no interaction effects between disadvantages.

We estimate this using interaction effects, which assesses whether the effect of one or more disadvantages varies in the presence of another disadvantage.

Following an approach used in Berthoud's study of multiple disadvantage in employment (2003), we add additional parameters, stepwise, to our original multivariate regression assessing the unique associations between pupil attainment and our seven disadvantages. First, we add 21 parameters, representing the interactions of all possible pairs of disadvantages, followed by a further 35 parameters for all possible combinations of three disadvantages. Ideally, we would continue by adding interactions for every possible combination of 4, 5, 6 and 7 disadvantages. However, because of the limitations of sample size we can only go as far as estimating all three-way interactions. Interactions were only considered if they were statistically significant at $p<.05$ and of a minimum sample size (50 cases or more). If we had a larger sample, it's quite probable that we would have identified further interactions to those we describe below.

Two-way interactions

There are 21 possible pairs of disadvantages. Three interactions between pairs of disadvantages were statistically significant, which are described below.

In summary, there was:

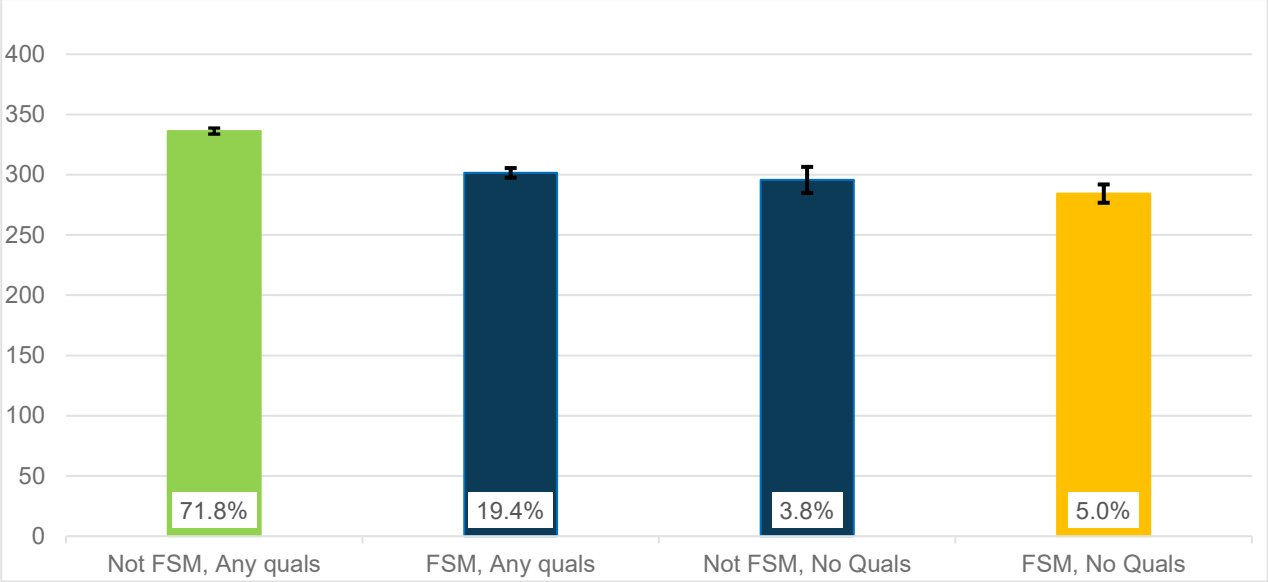
- A significant interaction between being eligible for free school meals and having a mother with no qualifications. This was positive (+23.3, $p = .002$) suggesting that the educational penalty experienced by young people who had both these disadvantages was *less* than the sum of the individual penalties associated with each.
- A significant interaction between having SEN and attending a less effective school. This was also positive (+20.0, $p=0.010$) again suggesting that the joint educational penalty experienced was *less* than the sum of their parts.
- A significant negative interaction between having SEN and having a parent who was less engaged in the young person's education (-29.2, $p = 0.001$), suggesting that the educational penalty associated with having both disadvantages was *greater* than the sum of their individual penalties.

Below, we further describe the meaning of these interactions and how they might help us understand the relationship between disadvantage and young people's attainment.

FSM and maternal qualifications

Figure 9 below shows the predicted average attainment for the four population sub-groups, based on our final model[39], and represents the four possible combinations of these two disadvantages. The average Best 8 attainment of young people with neither disadvantage was 336.0 (green bar, representing 71.8% of young people). Those who were eligible for free school meals (at the time of interview or within the previous six years) but whose mother had educational qualifications had an average attainment of 301.5 points (first blue bar, 19.4% of young people), and those who were not eligible for free schools meals but whose mother had no qualifications had an average attainment of 295.7 points (second blue bar, 3.8% of young people). Young people with both disadvantages, however, had an average attainment that was higher than expected given the sum of the penalties associated each individual disadvantage: 284.3 (yellow bar, 5.0% of young people).

Figure 9 FSM and maternal qualifications: size and attainment



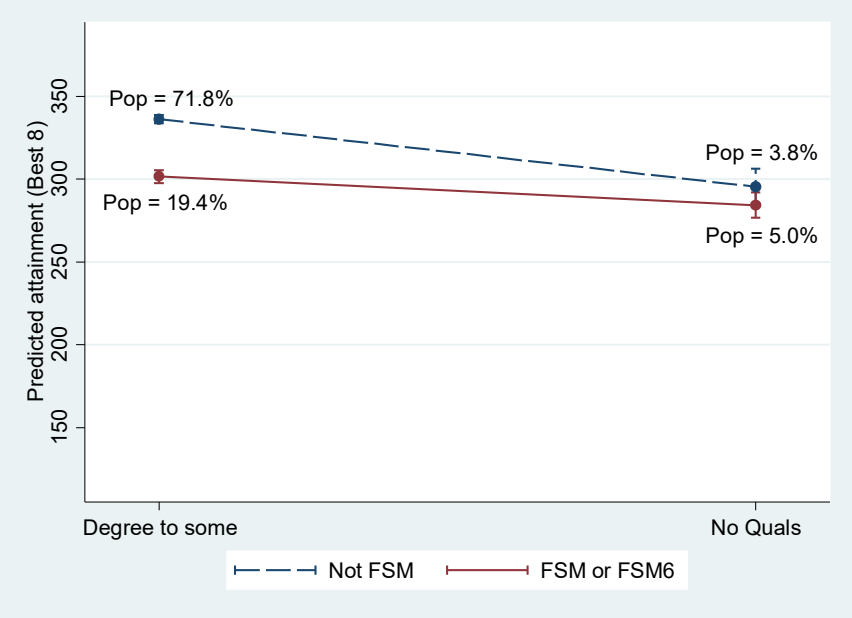
This effect is better demonstrated in Figure 10 below, which presents this same information in a way that visualises the interaction. The *slope* of the two lines represents the attainment penalty associated with having a mother with no qualifications. The *gap* between the lines represent the penalty associated with free school meal eligibility. Taken together they illustrate the interaction between the two. Parallel lines (or parallel slopes) would indicate that the penalty associated with maternal qualifications did not change according to the young person's free school meals eligibility. Similarly, the gap indicating the penalty associated with FSM would be the same, regardless of whether the

[39] A final model in which pupil best 8 attainment was regressed on our seven disadvantages and the three statistically significant two-way interactions described in this Chapter.

young person's mother had educational qualifications or not. In other words, the penalty of having both disadvantages would simply be the sum of the individual penalties associated with each.

However, the gap between the lines narrow towards the right, which suggests the attainment penalty associated with eligibility for free school meals was smaller among young people whose mother had no qualifications (-11.4), compared to those whose mother had at least some qualifications (-34.7). The upper slope is also steeper than the lower slope, which shows the corollary, that the penalty associated with maternal qualifications is greater among young people who are not eligible for free school meals (-40.5), and smaller among young people who are eligible for free school meals (-17.2).

Figure 10 Interaction effect: FSM and maternal qualifications



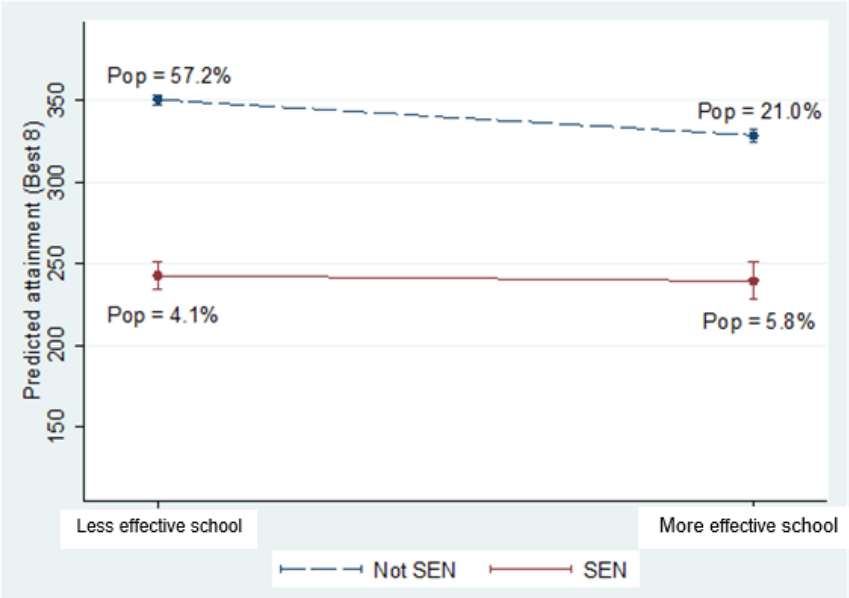
A plausible interpretation of this finding is that having a mother with no qualifications adds less (almost four GCSE grades less) in the way of an additional attainment penalty for young people in families who are already on very low incomes. A second interpretation is that this might indicate that additional support, which schools receive when pupils are eligible for free school meals (the pupil premium), mitigates some of the penalty associated with having a mother with no qualifications. Taken from this perspective we might then also consider whether the attainment penalty associated with having a mother with no qualification might be further mitigated if the pupil premium – or a similar policy intervention – was extended to the 3.8% of pupils not already receiving it. However, without further evidence we cannot say with any certainty what is causing this effect and can only speculate on the outcomes of possible policy changes.

SEN and less effective school

Figure 11 below illustrates the interaction between having a special educational need and attending a less effective school. As we saw in the previous figure, the gap between the lines, which here represents the attainment penalty associated with having a special educational need, narrows toward the right, illustrating that the joint penalty of experiencing both SEN and attending a less effective school is less than the sum of the penalties associated with each (interaction: +20.0, p=0.010).

The attainment penalty associated with SEN was smaller among young people attending a less effective school (-87.1), compared to those attending a more effective school (-107.1). The upper slope is again, steeper than the lower slope, which shows that the penalty associated with attending a less effective school is greater among young people who are not SEN (-22.0), than those who have SEN (-2.0).

Figure 11 Interaction effect: SEN and attending a less effective school



A plausible explanation for this interaction is that on average, attendance at a less effective school has little additional impact for a child already dealing with having a special educational need.

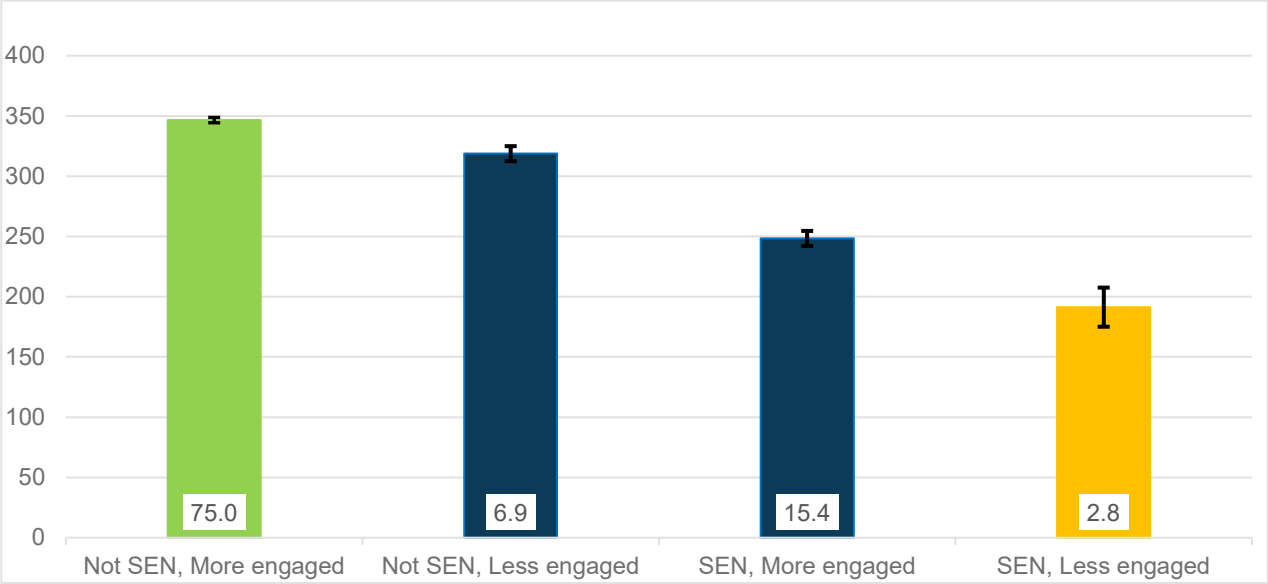
SEN and parental engagement with young person's education

In the examples presented so far, the interaction effect indicates that the penalty is *less* than the sum of its parts. However, there was also an instance where the interaction between two disadvantages compounds the penalty or is multiplicative.

Figure 12 below shows the predicted average attainment for the four population sub-groups, based on our final model, and represents the four possible combinations of these

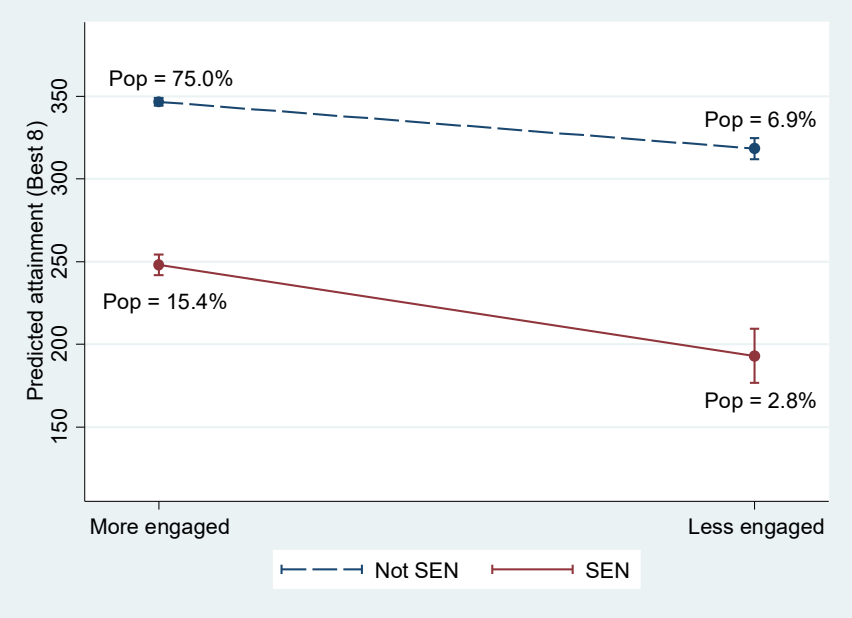
two disadvantages. The average Best 8 attainment of young people with neither disadvantage was 346.6 (green bar, representing 75.0% of young people). Those whose parents were less engaged in their education but who did not have SEN had an average attainment of 318.7 points (first blue bar, 6.9% of young people), and those who had SEN but whose parents were more engaged in education had an average attainment of 248.4 points (second blue bar, 15.4% of young people). Young people with both disadvantages, however, had an average attainment that was lower than expected given the sum of the penalties associated each individual disadvantage: 191.3 (yellow bar, 2.8% of young people).

Figure 12 SEN and parental engagement in education: size and attainment



In Figure 13 below the gap between the lines illustrates the substantial penalty associated with having SEN status, while the slope represents the penalty associated with parental engagement in education. The gap between the lines widens towards the right, illustrating that the penalty associated with having both disadvantages is *greater* than the sum of the parts (the interaction is -29.2, p = 0.001).

Figure 13 Interaction effect: SEN and parental engagement in education



The associated attainment penalty of having a parent who was less engaged with their child's education was -57.0 for those who had special educational needs, compared to -27.9 for those who did not.

Without additional evidence we cannot say with any certainty what the cause of this finding is. However, we can offer some considered interpretation. For example, parental engagement may be of particular importance for young people with SEN, helping them overcome some of the educational challenges they face. It could also highlight the specific importance of contact with the school, which is the measurement of parental engagement used here. This might enable a parent to relay important information about the young person's needs so that the school is better equipped to help with their education, or vice versa so that the parent is better equipped to support the young person in their studies. It could also represent an effect of parents pushing the school to engage more effectively with their child[40].

Three-way interaction

Of a total of 35 possible three-way interactions, only one was statistically significant. This was an interaction between FSM eligibility, parental engagement with the young person's education and the quality of the relationship between the parent and young person (-45.2, p = .040). However, in a final step, which involves re-estimating the model in

[40] The effect of parental involvement on children's attainment is discussed further here: https://dera.ioe.ac.uk/6305/

which only the significant two-way and three-way interactions are retained, the interaction was no longer statistically significant (-33.2, p = .111)[41].

It is worth noting, that many of the combinations of three disadvantages have small sample sizes which means that we may lack the statistical power required to detect other interactions that may nevertheless exist in the population. It is quite possible, for example, that the three-way interaction noted would have been significant with a larger sample. On the other hand, identification of multiple interactions requires the estimation of a large number of tests, in our case, 21 two-way and 35 three-way interactions, increasing the risk that some of our results might be significant by chance alone (Bonferroni, 1936). The solution to this would be significantly larger samples and more stringent tests of statistical significance.

Is it necessary to take account of interaction effects?

From a policy perspective, given the usual restraints of sample size in the analysis of non-administrative data, an important question of interest is the extent to which we might over or underestimate the average penalty associated with having multiple advantages, if we simply treated them as additive. This is a hypothetical question because we were unable to estimate all 128 possible interactions. However, what we can do is to compare the estimated penalties from a model in which we include the two-way interactions we were able to estimate, with the penalties estimated from a model in which the interactions were excluded, and in effect ignored.

Table 4 compares the estimated penalties of experiencing each pair of disadvantages where there was a significant interaction, using the two different approaches just noted.

[41] This regression analysis included all main (singular) effects for the seven disadvantages, three two-way interactions between FSM and maternal qualifications, SEN and school effectiveness, and SEN and parental educational engagement, and one three-way interaction between FSM, parental educational engagement, and quality of parent-child relationship.

Table 4 Average predicted attainment (a) with interaction effect and (b) ignoring interaction effect

Two-way combinations	(a) With interaction	(b) Interaction ignored	(c) Difference (grades)
FSM eligible and has a mother with no qualifications	317.2	307.9	-9.3 (-1.5)
SEN and attends a less effective school	262.8	247.5	-15.3 (-2.5)
SEN and has a parent(s) that is less engaged in their education	207.7	230.5	+22.8 (+3.8)

In terms of the two-way interactions the comparison confirms what we already know. If we proceed by ignoring the interactions, then we would overestimate the penalty for those young people with the first two pairs of disadvantages (by 1.5 and 2.5 grades respectively) and underestimate it for those with the third pair (by 3.8 grades). What the comparison also demonstrates is the extent to which we deviate from the true estimate varies considerably depending on the interaction in question. The difference in estimates is real but not large. It ranges from the equivalent of one and a half grades for the two-way interaction between FSM eligibility and having a mother with no qualifications, to almost four grades for the two-way interaction between SEN and parental education engagement.

There is further discussion of differences in estimates according to statistical method in Appendix C.

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Appendix A Supplementary tables and figures

Appendix A Table 1 The individual attainment penalty associated with each of the seven disadvantages (from a multivariate regression)

Core variables	Categories	Penalty (coeff)	SE	Signif. p-value	95% CI (lower limit)	95% CI (upper limit)
SEN	Not SEN	0.0				
	SEN	-102.1	3.1	0.000	-108.2	-96.0
Parental engagement	More engaged	0.0				
	Less engaged	-35.5	3.4	0.000	-42.3	-28.7
Parental relationship	Argues less frequently	0.0				
	Argues on most days	-21.4	3.2	0.000	-27.7	-15.1
Computer	Has desktop/laptop	0.0				
	No internet-conn desktop/laptop	-38.5	3.8	0.000	-46.0	-30.9
Maternal qualifications	Degree or equiv. to Other quals	0.0				
	No qualifications	-28.4	3.4	0.000	-35.1	-21.7
FSM status	Not FSM	0.0				
	FSM/FSM in past 6 years	-31.8	2.2	0.000	-36.1	-27.5
Ofsted rating	Excellent/Good	0.0				
	Requires improve./Inadequate	-18.4	2.6	0.000	-23.6	-13.3
Constant		368.1	1.5	0.000	365.1	371.0

Note: Overall, the relationship is significant p<0.001, R squared = 0.3538. Sample = complete cases (n=7,908)

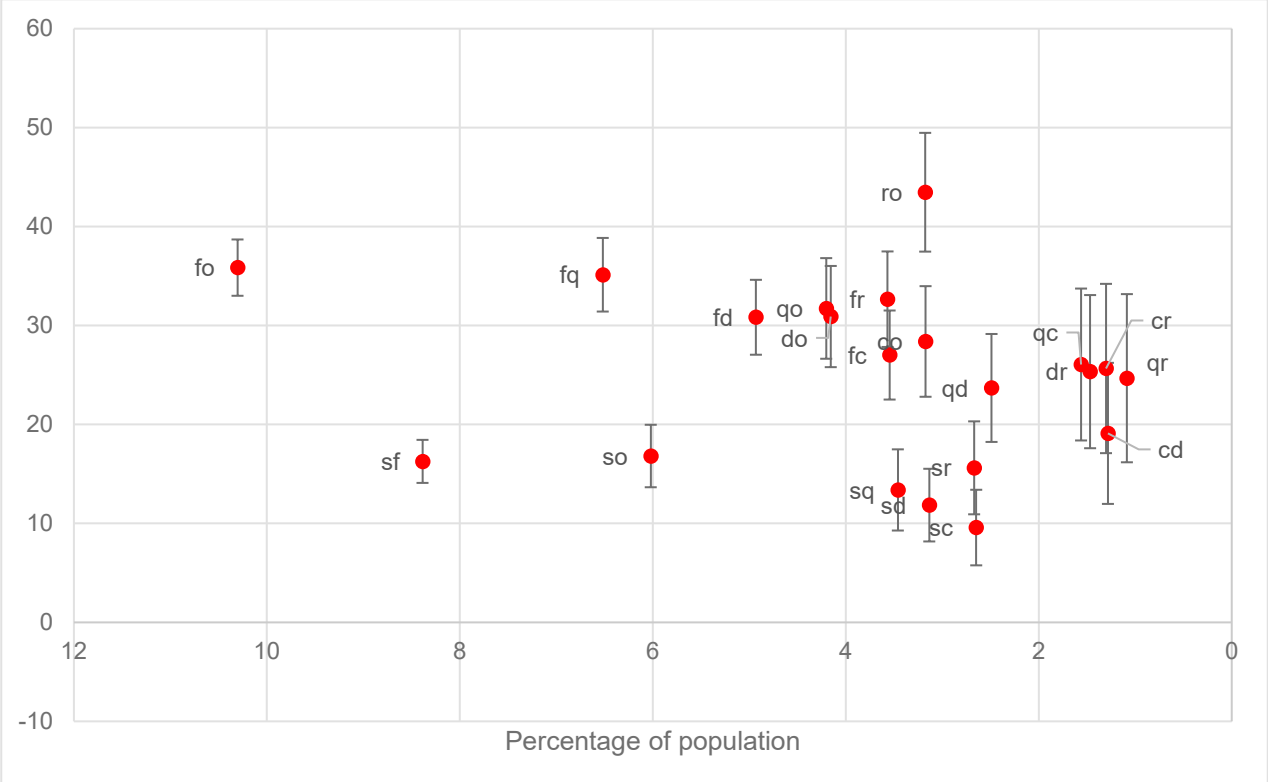
Appendix A Table 2 The largest and most educationally penalised groups

Largest of disadvantaged groups (or none)						Highest educational penalty					
	Size %	Best 8	+/-	Level 2 English and maths threshold	+/-		Size %	Best 8	+/-	Level 2 English and maths threshold	+/-
None	37.9	368.4	3.2	82.6	1.7	SEN	19.2	222.2	5.9	23.8	2.2
Less effective school	30.9	301.8	4.9	52.4	2.4	Computer	7.6	253.5	8.9	35.4	4.0
FSM	27.3	273.7	3.7	43.2	1.8	Maternal Qual.	10.8	264.4	6.8	37.6	3.1
SEN	19.2	222.2	5.9	23.8	2.2	Engagement	10.6	265.0	7.4	40.7	3.3
Maternal Qual.	10.8	264.4	6.8	37.6	3.1	FSM	27.3	273.7	3.7	43.2	1.8
Engagement	10.6	265.0	7.4	40.7	3.3	Relationship	9.7	281.7	7.7	48.8	3.6
Relationship	9.7	281.7	7.7	48.8	3.6	Less effective school	30.9	301.8	4.9	52.4	2.4
Computer	7.6	253.5	8.9	35.4	4.0	None	37.9	368.4	3.2	82.6	1.7

Appendix A Table 3 Number of disadvantages experienced by young people

Number of disadvantages	Estimate of number of disadvantages					
	Complete cases Exclude missing		Low estimate Treat missing as 0		High estimate Treat missing as 1	
	Unw N	Wei %	Unw N	Wei %	Unw N	Wei %
0	2638	37.9	2790	35.7	2638	33.7
1	2508	33.1	2818	33.0	2635	31.1
2	1535	17.3	1864	18.3	1811	18.5
3	755	7.5	978	8.5	1081	9.8
4	334	3.0	426	3.3	583	4.8
5	114	1.0	133	1.0	231	1.8
6	17	0.1	19	0.1	45	0.3
7	7	0.1	7	0.0	11	0.1
Total	7908	100	9035	100	9035	100
Missing	1127					
Mean	1.08	(SD=1.15)	1.15	(SD=1.17)	1.28	(SD=1.29)

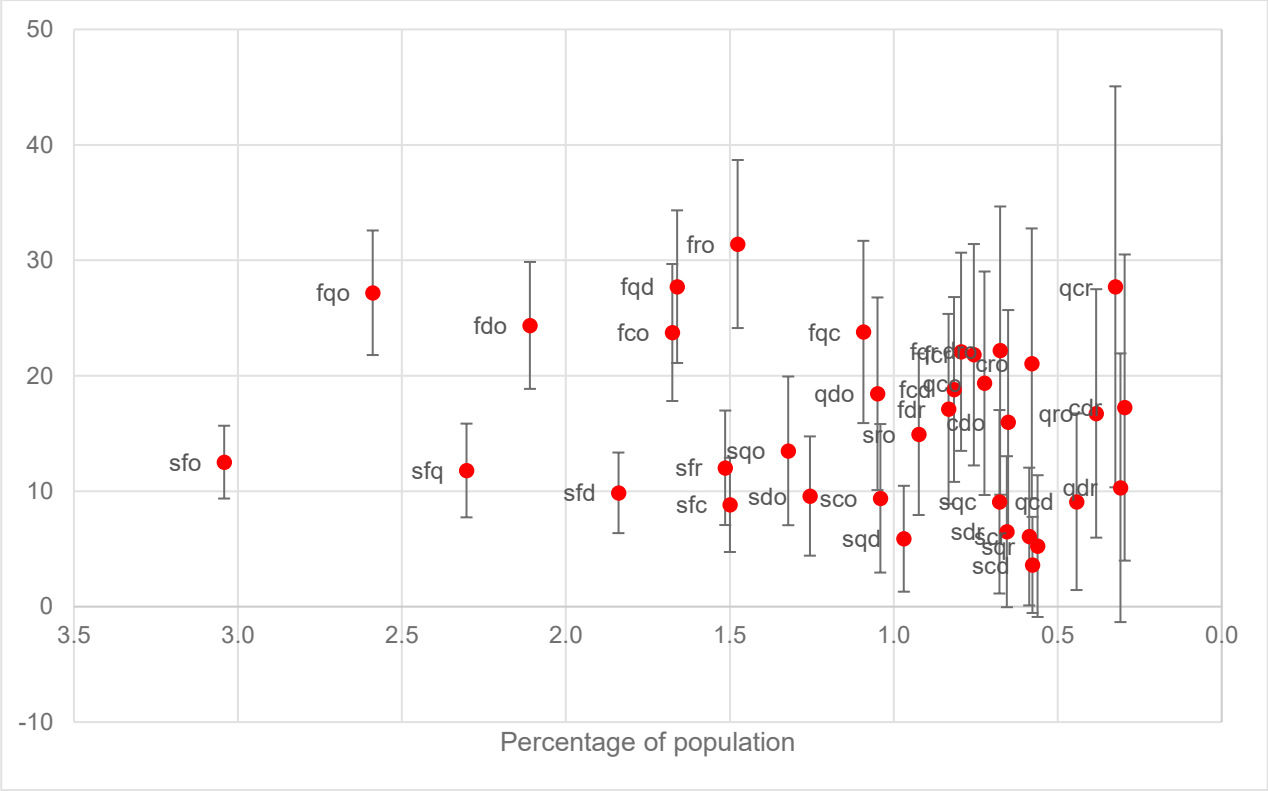
Appendix A Figure 1 Two-way combinations, Level 2 English and maths threshold



Note: o=less effective school; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

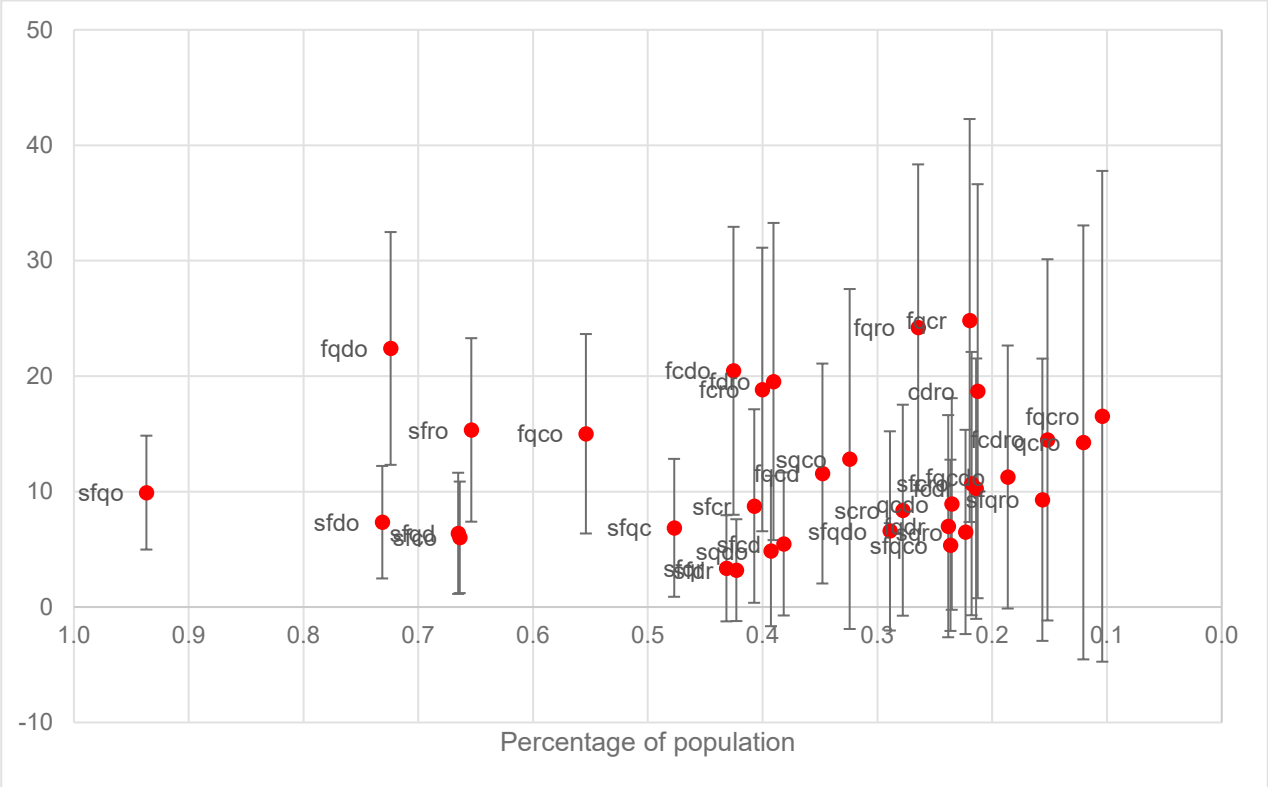
The Y-axis minimum value is deliberately set below zero, to ensure consistency with later charts where some error bars cross the zero threshold

Appendix A Figure 2 Three-way combinations, Level 2 English and maths threshold



Note: o=less effective school; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

Appendix A Figure 3 Four, five, six and seven-way combinations, Level 2 English and maths



Note: o=less effective school; f=eligible for FSM/6; s=SEN; q=no maternal qualifications; d=lower parental engagement in education; r=poorer quality relationship; c=no internet-connected computer

Appendix B Estimated results for all 128 combinations

The table below provides key data for all possible combinations of the seven disadvantages. These are (1) for no disadvantages (2) for 7 single disadvantages described in chapter 2 (3) 21 pairs of disadvantages (4) 35 three-way combinations (5) 35 four-way combinations (6) 21 five-way combinations (7) 7 six-way combinations and (8) one seven-way combination. The table presents estimates of size, attainment in terms of Best 8 score and Level 2 English and maths threshold, where this can be estimated.

Number of disadvantages	Combination	Lower school effectiveness (o)	Poorer quality relationship (r)	Lower parental engagement (d)	No int-conn computer (c)	No maternal qualifications (q)	Eligible for FSM/6 (f)	SEN (s)	Unweighted N	Weighted %	+/-	Best 8	+/-	Level 2 English and maths	+/-
0	None								2638	37.9	2.0	368.4	3.2	82.6	1.7
1	o	*							2854	30.9	3.1	301.8	4.9	52.4	2.4
	r		*						870	9.7	0.6	281.7	7.7	48.8	3.6
	d			*					1008	10.6	0.7	265.0	7.4	40.7	3.3
	c				*				731	7.6	0.6	253.5	8.9	35.4	4.0
	q					*			1114	10.8	0.7	264.4	6.8	37.6	3.1
	f						*		3456	27.3	0.9	273.7	3.7	43.2	1.8
	s							*	1979	19.2	0.8	222.2	5.9	23.8	2.2
2	ro	*	*						295	3.2	0.5	265.5	11.8	43.5	6.0
	do	*		*					400	4.2	0.6	249.8	13.4	30.9	5.1
	dr		*	*					140	1.5	0.3	216.2	21.3	25.3	7.7
	co	*			*				312	3.2	0.5	250.1	12.2	28.4	5.6
	cr		*		*				128	1.3	0.2	217.7	21.6	25.7	8.6
	cd			*	*				136	1.3	0.2	210.9	21.0	19.1	7.1
	qo	*				*			440	4.2	0.6	253.6	11.0	31.7	5.1
	qr		*			*			116	1.1	0.2	212.1	22.2	24.7	8.5
	qd			*		*			258	2.5	0.3	231.2	12.9	23.7	5.5
	qc				*	*			160	1.6	0.3	225.5	19.7	26.1	7.7
	fo	*					*		1297	10.3	1.1	260.9	6.4	35.9	2.8
	fr		*				*		428	3.6	0.4	227.7	11.8	32.7	4.8
	fd			*			*		597	4.9	0.4	232.2	9.2	30.8	3.8
	fc				*		*		444	3.5	0.4	229.1	10.3	27.0	4.5
	fq					*	*		810	6.5	0.5	254.6	8.5	35.1	3.7
	so	*						*	658	6.0	0.8	213.3	11.3	16.8	3.2
	sr		*					*	278	2.7	0.3	180.6	14.9	15.6	4.7
	sd			*				*	338	3.1	0.4	166.0	14.2	11.9	3.7

2	sc				*			*	287	2.6	0.3	171.7	13.7	9.6	3.8
	sq					*		*	396	3.5	0.4	184.0	12.4	13.4	4.1
	sf						*	*	1198	8.4	0.5	198.1	7.3	16.3	2.2
3	dro	*	*	*					63	0.7	0.2	223.6	27.0	22.2	12.5
	cro	*	*		*				60	0.6	0.2	217.4	26.6	21.1	11.7
	cdo	*		*	*				70	0.7	0.2	216.8	24.5	16.0	9.7
	cdr		*	*	*				33	0.3	0.1	178.1	41.1	17.2	13.3
	qro	*	*			*			42	0.4	0.1	199.2	30.2	16.7	10.8
	qdo	*		*		*			110	1.0	0.2	220.0	22.1	18.4	8.3
	qdr		*	*		*			31	0.3	0.1	170.1	39.0	10.3	11.6
	qco	*			*	*			78	0.7	0.2	205.6	26.1	19.3	9.7
	qcr		*		*	*			32	0.3	0.1	210.4	49.3	27.7	17.4
	qcd			*	*	*			46	0.4	0.1	213.6	30.6	9.1	7.6
	fro	*	*				*		175	1.5	0.3	220.4	17.5	31.4	7.3
	fdo	*		*			*		254	2.1	0.3	223.2	14.9	24.4	5.5
	fdr		*	*			*		97	0.8	0.2	177.3	24.3	17.1	8.2
	fco	*			*		*		209	1.7	0.3	224.3	14.2	23.7	5.9
	fcr		*		*		*		91	0.8	0.2	188.8	24.6	21.8	9.6
	fcd			*	*		*		104	0.8	0.2	199.1	21.8	18.8	8.0
	fqo	*				*	*		326	2.6	0.4	240.2	13.3	27.2	5.4
	fqr		*			*	*		98	0.8	0.2	197.1	24.7	22.1	8.6
	fqd			*		*	*		201	1.7	0.3	222.2	16.2	27.7	6.6
	fqc				*	*	*		131	1.1	0.2	219.1	19.7	23.8	7.9
	sro	*	*					*	108	0.9	0.2	187.6	23.0	14.9	7.0
	sdo	*		*				*	136	1.3	0.3	166.4	24.7	9.6	5.2
	sdr		*	*				*	67	0.7	0.2	145.2	28.3	6.5	6.5
	sco	*			*			*	118	1.0	0.2	181.1	20.3	9.4	6.4
	scr		*		*			*	65	0.6	0.2	151.9	30.5	6.1	6.0
	scd			*	*			*	67	0.6	0.1	144.5	26.9	3.6	4.2
	sqo	*				*		*	159	1.3	0.3	188.8	19.6	13.5	6.4
	sqr		*			*		*	66	0.6	0.1	151.2	26.9	5.2	6.1
	sqd			*		*		*	109	1.0	0.2	160.0	20.4	5.9	4.6
	sqc				*	*		*	74	0.7	0.2	167.3	28.0	9.1	7.9
	sfo	*					*	*	441	3.0	0.4	189.2	12.6	12.5	3.2
	sfr		*				*	*	199	1.5	0.2	162.3	18.1	12.0	5.0
3	sfd			*			*	*	249	1.8	0.2	154.4	14.6	9.9	3.5
	sfc				*		*	*	209	1.5	0.2	170.2	15.0	8.8	4.1
	sfq					*	*	*	319	2.3	0.3	182.1	13.6	11.8	4.1
4	cdro	*	*	*	*				24	0.2	0.1	201.8	45.3	18.7	17.9
	qdro	*	*	*		*			16	0.2	0.1	196.0	41.4		
	qcro	*	*		*	*			14	0.1	0.1	165.4	56.6	14.3	18.8
	qcdo	*		*	*	*			26	0.2	0.1	194.2	37.6	8.9	9.2
	qcdr		*	*	*	*			10	0.1	0.1	151.3	77.2	0.0	0.0
	fdro	*	*	*			*		45	0.4	0.1	187.2	35.8	19.5	13.7

	fcro	*	*		*		*		48	0.4	0.1	199.3	27.8	18.8	12.3
	fcdo	*		*	*		*		55	0.4	0.1	196.6	28.8	20.5	12.5
	fcdr		*	*	*		*		27	0.2	0.1	140.0	39.4	10.3	11.3
	fqro	*	*			*	*		35	0.3	0.1	196.1	34.7	24.2	14.1
	fqdo	*		*		*	*		88	0.7	0.2	212.7	25.9	22.4	10.1
	fqdr		*	*		*	*		27	0.2	0.1	143.8	40.3	7.0	9.6
	fqco	*			*	*	*		67	0.6	0.1	204.9	24.8	15.0	8.6
	fqcr		*		*	*	*		26	0.2	0.1	197.3	49.4	24.8	17.5
	fqcd			*	*	*	*		41	0.3	0.1	200.4	32.4	11.6	9.5
	sdro	*	*	*				*	32	0.3	0.1	182.6	34.7		
	scro	*	*		*			*	34	0.3	0.1	175.3	37.1	8.4	9.1
	scdo	*		*	*			*	34	0.3	0.1	164.5	31.2		
	scdr		*	*	*			*	21	0.2	0.1	136.0	48.7		
	sqro	*	*			*		*	27	0.2	0.1	175.3	42.1	6.5	8.8
	sqdo	*		*		*		*	46	0.4	0.1	159.8	38.5	4.9	6.5
	sqdr		*	*		*		*	21	0.2	0.1	156.0	52.5		
	sqco	*			*	*		*	36	0.3	0.1	169.8	40.8	12.8	14.7
	sqcr		*		*	*		*	17	0.2	0.1	122.6	50.5		
	sqcd			*	*	*		*	22	0.2	0.1	165.5	48.6		
	sfro	*	*				*	*	89	0.7	0.1	175.0	26.5	15.3	7.9
	sfdo	*		*			*	*	100	0.7	0.2	151.1	23.1	7.3	4.9
	sfdr		*	*			*	*	52	0.4	0.1	127.9	28.8	3.2	4.4
	sfco	*			*		*	*	93	0.7	0.2	163.8	21.4	6.0	4.8
	sfcr		*		*		*	*	53	0.4	0.1	146.3	31.1	8.7	8.4
	sfcd			*	*		*	*	54	0.4	0.1	148.1	28.5	5.5	6.2
	sfqo	*				*	*	*	132	0.9	0.2	178.7	21.9	9.9	4.9
4	sfqr		*			*	*	*	58	0.4	0.1	142.4	28.8	3.4	4.6
	sfqd			*		*	*	*	89	0.7	0.1	147.3	21.6	6.4	5.2
	sfqc				*	*	*	*	62	0.5	0.1	159.9	30.0	6.9	6.0
5	qcdro	*	*	*	*	*			8	0.06	0.0	170.9	65.1		
	fcdro	*	*	*	*		*		20	0.15	0.1	161.1	41.0	14.5	15.6
	fqdro	*	*	*		*	*		13	0.11	0.1	166.7	47.8		
	fqcro	*	*		*	*	*		13	0.10	0.1	187.2	45.8	16.5	21.3
	fqcdo	*		*	*	*	*		23	0.19	0.1	187.3	41.0	11.3	11.4
	fqcdr		*	*	*	*	*		10	0.08	0.1	151.3	77.2		
	scdro	*	*	*	*			*	16	0.13	0.1	173.0	48.2		
	sqdro	*	*	*		*		*	12	0.11	0.1	195.5	47.9		
	sqcro	*	*		*	*		*	10	0.08	0.1	137.7	68.2		
	sqcdo	*		*	*	*		*	12	0.10	0.1	153.1	53.4		
	sqcdr		*	*	*	*		*	8	0.07	0.1	132.7	88.0		
	sfdro	*	*	*			*	*	27	0.22	0.1	167.1	41.2		
	sfcro	*	*		*		*	*	30	0.22	0.1	180.6	33.6	10.7	11.4
	sfcdo	*		*	*		*	*	29	0.20	0.1	145.9	34.9		
	sfcdr		*	*	*		*	*	19	0.15	0.1	126.6	49.2		

	sfqro	*	*			*	*	*	23	0.16	0.1	172.7	43.3	9.3	12.2
	sfqdo	*		*		*	*	*	39	0.29	0.1	144.3	34.3	6.6	8.6
	sfqdr		*	*		*	*	*	18	0.14	0.1	119.2	49.7		
	sfqco	*			*	*	*	*	30	0.24	0.1	158.1	40.1	5.3	7.4
	sfqcr		*		*	*	*	*	14	0.11	0.1	124.3	59.4		
	sfqcd			*	*	*	*	*	20	0.16	0.1	147.8	48.8		
6	fqcdro	*	*	*	*	*	*		8	0.06	0.0	170.9	65.1		
	sqcdro	*	*	*	*	*		*	7	0.05	0.0	170.2	73.8		
	sfcdro	*	*	*	*		*	*	15	0.11	0.1	160.5	47.7		
	sfqdro	*	*	*		*	*	*	10	0.07	0.0	169.2	54.9		
	sfqcro	*	*		*	*	*	*	9	0.07	0.0	164.9	59.8		
	sfqcdo	*		*	*	*	*	*	11	0.08	0.0	149.2	63.0		
	sfqcdr		*	*	*	*	*	*	8	0.07	0.1	132.7	88.0		
7	sfqcdro	*	*	*	*	*	*	*	7	0.05	0.0	170.2	73.8		

Appendix C Further discussion of analytical methods

Throughout this report we have reported the penalties from multiple disadvantages using a progression of four methods:

- Chapter 2: Multiple regression analysis (providing insight into the unique attainment penalty associated with each disadvantage, adjusting for the fact that our disadvantages overlap).
- Chapter 3: Counts of the number of disadvantages young people experience (providing a straightforward indication of whether the experience of multiple disadvantage has any additional penalty of its own and how this varies when SEN and/or FSM are not taken into account)
- Chapter 4: Calculation of the attainment deficit associated with specific combinations of disadvantage (giving a measurement of the size of the attainment deficit associated with each combination without adjusting for others)
- Chapter 5: Calculation of interaction effects (providing a more nuanced understanding of how specific combinations of disadvantage may serve to increase or reduce the impact of disadvantage on attainment).

Again, it is worth noting that to calculate interaction effects comprehensively requires substantially larger samples than can be provided by LSYPE2 or, indeed, the majority of survey data sources available.

Table 1 below shows how our estimates of the attainment penalty differ depending on which approach is taken. To illustrate these differences, we use five examples, all of which represent pairs of disadvantages. The first two examples were used as illustrations in the summary of chapter 3; one involves two high-penalty disadvantages (SEN and no internet connected computer) and the other involves two low-penalty disadvantages (less effective school and poor parent relationship). The remaining three examples are the pairs which were identified as having a significant interaction term in chapter 5.

The results in column (1) are based on our ‘best’ model which, given the limitations of sample size, takes account of three two-way interactions and adjusts for the effect of all seven disadvantages as discussed in chapter 5. The results in column (2) are the estimates which come from the standard multiple regression without interactions, which we presented in chapter 2. The results in columns (3) and (4) are based on two approaches using a count of the number of disadvantages experienced presented in chapter 3. Column (3) is a simple count and column (4) treats SEN separately alongside a count of the remaining disadvantages. Column (5) is the estimated mean attainment among young people with each disadvantage pair; the approach taken in chapter 4.

Appendix C Table 1 Alternative methods for estimating the penalty associated with example pairings

	1	2	3	4	5
	Includes Interaction (Chapter 5)	Excludes interaction (Chapter 2)	Simple count (Chapter 3)	SEN and count (Chapter 3)	Pair only or 'plus' model (Chapter 4)
SEN and no internet connected computer	-143.0	-140.6	-81.0	-131.7	-152.4
Less effective school and poor parent relat.	-43.3	-39.9	-81.0	-56.0	-56.4
FSM eligible and mother has no qualifications	-51.9	-60.2	-81.0	-56.0	-70.0
SEN and less effective school	-106.3	-120.5	-81.0	-131.7	-113.7
SEN and parent(s) less engaged in education	-161.3	-137.6	-81.0	-131.7	-159.1

Where there was no evidence of an interaction between a pair of disadvantages (SEN and computer access; school effectiveness and poor parental relationship) the estimates were very similar between the model that includes interactions (1) and excludes interactions (2), as we might expect. However, if we ignore an interaction where one exists, this will lead to the under or overestimation of the penalty, in this case, by between one and four GCSE grades. Given the substantially larger penalty associated with SEN compared to the other six disadvantages, our original count model, shown in column (3), misses the mark considerably. However, if we allow for the separate estimation of the penalty for SEN this approach performs much better (4), although in most instances a standard regression (2) performs better still. Finally, assuming our sample is representative, we can always estimate, with good accuracy, the average attainment of those experiencing each pair of disadvantages, model (5). However, what we won't know, is how much of the estimated penalty is attributable to the other, overlapping, disadvantages examined in this report.

Based on these findings there is no steadfast rule for accurately depicting the relationship between multiple disadvantage and attainment. If the sample is sufficiently large then a multiple regression, including all significant interactions is ideal. However, in most instances, samples sizes will be too limited. In this case, exploration using a range of different approaches provides a good insight into the nature of the overlap between disadvantages and their combined association with attainment. In the end, a judgement must be made regarding how accurate the estimates can and need to be.

Appendix C. Table 2 Two-way interactions

	Combination	Coefs.	p	95%CI ll	95%CI ul	N
main effects	s (SEN)	-105.0	**0.000**	-114.5	-95.4	1619
	c (No internet connected computer)	-44.8	**0.000**	-55.6	-34.1	644
	q (No maternal qualifications)	-38.7	**0.000**	-50.6	-26.7	814
	f (FSM)	-35.7	**0.000**	-41.8	-29.7	2729
	d (Parent less engaged in education)	-28.7	**0.000**	-38.2	-19.2	827
	o (Less effective school)	-21.7	**0.000**	-27.4	-16.0	2474
	r (Poor parental relationship)	-20.1	**0.000**	-28.4	-11.9	793
two-way interactions	sd	-30.7	**0.002**	-49.8	-11.5	265
	qf	21.7	**0.005**	6.7	36.7	567
	so	20.1	**0.012**	4.4	35.7	548
	sc	-11.6	0.234	-30.7	7.5	242
	sr	-10.4	0.255	-28.2	7.5	240
	rf	-7.7	0.302	-22.2	6.9	369
	fo	-4.6	0.342	-14.1	4.9	2729
	qo	-4.3	0.554	-18.4	9.9	341
	sq	-2.7	0.758	-19.6	14.3	284
	df	-1.0	0.884	-14.8	12.8	464
	do	-0.2	0.977	-14.9	14.5	339
	cq	1.6	0.889	-20.5	23.6	137
	dr	2.3	0.817	-17.5	22.1	124
	rc	3.8	0.715	-16.5	24.0	122
	dq	4.0	0.656	-13.6	21.6	194
	rq	5.1	0.651	-17.2	27.4	103
	dc	5.6	0.639	-17.7	28.8	119
	co	7.3	0.316	-7.0	21.5	283
	ro	7.9	0.258	-5.8	21.5	265
	sf	10.6	0.101	-2.1	23.3	918
	cf	11.9	0.147	-4.2	28.1	379
	Constant	369.3	**0.000**	366.1	372.4	

Note: to calculate the estimated penalty associated with having two disadvantages (a+b) : constant + main effect a + main effect b + two-way interaction ab

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