The impact of poor numeracy skills on adults

Research review

Prepared for NIACE by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC) at the Institute of Education (IOE), University of London

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Executive Summary

I. This report provides an overview of existing research on the impacts of poor numeracy on adults and the impacts of improving numeracy skills in adulthood. It was undertaken by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC) as part of a suite of studies on numeracy commissioned by the National Institute for Adult and Continuing Education (NIACE).

II. It takes place in the context of the 2011 Skills for Life survey which found that the overall numeracy skills levels in the adult population in England are not rising despite the year on year increases in the number of adults participating in and achieving in numeracy courses. NIACE’s current initiative, Maths4Us, aims to provide more opportunities and resources for adults to re-engage with maths learning, and follows on from a national inquiry by NIACE which advocated a cultural shift in attitudes towards numeracy and maths.

III. Evidence in considered in three areas:

- The economic impact of poor numeracy skills, that is, the impact on individual earnings, on individual employment, and on personal finances;
- The social impact on the individual, that is, on adults’ family lives and daily activities, on social capital and active citizenship; and on criminal justice;
- The health impact on the individual, that is, physical health, mental health, health literacy, and on well-being – how people feel about their own lives.

IV. This review found high quality evidence on the economic impacts of poor basic skills on adults. Evidence on the impacts of improving numeracy skills in adulthood is smaller and less certain; in general evidence of the social and health impacts of poor numeracy skills and improved numeracy skills is limited. This said, two British birth (1958 and 1970) cohort studies provide rich longitudinal panel data, allowing researchers to explore how poor literacy and numeracy affect individuals through the lifecourse.

V. Adult numeracy skills in England are weaker than adult literacy skills. Data from the 2011 Skills for Life survey were extrapolated to the general population to conclude that 8.1 million adults in England have low numeracy skills, a rise from 6.8 million in 2003. A quarter (24%) of respondents – one in every four adults in England – scored below Entry
level 3 in numeracy, the level defined as the threshold for functional numeracy skills.

VI. Research shows that fear of maths and lack of confidence play a major role in preventing adults from participating in maths improvement programmes; adults with poor numeracy are also more likely to have had negative experiences at school, which demotivate them from reengaging with education.

VII. In general, men outperform women in numeracy assessments, a finding that appears linked to employment; women are more likely to spend time out of the labour market due to childcare responsibilities. People who are economically active, and people who work in higher occupational categories, have higher basic skills. Adults with full-time jobs have better numeracy skills than adults with part-time employment.

VIII. A number of studies conducted since the publication of the Moser Report in 1999 show adults with higher literacy and numeracy earn more in the labour market than those with lower skills. One study found the wage premium from having Level 1 or above numeracy skills to be 8-10%, even when a wide range of factors that might be correlated with numeracy are controlled for.

IX. As skills improvement is both hard to measure and relies on longitudinal data, less evidence is available on the returns to skills improvement. The available studies find evidence of some wage returns to improved numeracy, but the more fine-grained analysis point to different impacts at different skills levels. For numeracy the key seems to be to get skills to an acceptable level, while for literacy, the gains will go on rising as skills continue to be improved (at least for males).

X. Participation in numeracy courses is not the same as improving skills. A large study of Skills for Learners found no effect on wages of participation in courses; however, a recent study drawing on large-scale administrative data sets did find wage returns to numeracy when qualifications were gained and that these returns increased steadily over time.

XI. In terms of improvements to employment status, numeracy is a greater determinant than literacy and the correlation is one that is stronger and often statistically significant. Adults who are out of work lose their skills, and such loss tends to be more acute, and to start sooner after loss of employment, for numeracy than for literacy. This can create a vicious circle, in which poor numeracy contributes to limited employment, which leads to poorer numeracy, which makes it harder to find and keep employment.
XII. It can take time for adults to see the employment benefits of taking courses to improve their skills. Again the evidence of impact appears stronger when qualifications are gained. Attainment in Skills for Life has been found to have strong and positive returns in terms of the proportion of time an individual is in employment.

XIII. People with poor numeracy tend to take longer to leave the family home if they are men; women with poor numeracy have children younger in life; adults with poor numeracy are more likely to live in disadvantaged housing and to experience homelessness. Some trends are replicated in subsequent generations – people with poorer numeracy tend to come from larger families and go on to have larger families themselves.

XIV. In this vein, there is evidence also that the children of parents with poor numeracy have lower numeracy skills over and above the effect of parental education and ability and other factors. There is debate in the literature about whether measures to improve parental numeracy skills will have an impact on their children’s skills and cognitive development; this issue is complicated by the finding that participation in learning gives adults a range of skills that may improve their children’s learning.

XV. An extensive array of evidence, including quality self-report evidence from the low skilled adults themselves, finds that courses to improve adult numeracy skills improve the confidence and self-esteem of learners, both at the individual level, and in the social capital adults have in their relationships with friends, family and wider society. An influential study of learners in Scotland hypothesises that these changes amount to a virtuous circle of social capital built on the fact that a changing learner identity, where the individual moves from non-competent to capable, is accompanied by a growth in confidence which impacts on familial, social and work relationships.

XVI. Recent research finds that low adult numeracy in both men and women is associated with worsening health limiting conditions; in older adults, across a broad set of health indicators, low basic skills were associated with poorer health outcomes. Women with poor numeracy are more likely to be depressed than those with higher skills. Research from the relatively new field of health numeracy highlights the disadvantages adults with poor numeracy can experience in understanding health information and communication, leading to a negative impact on health outcomes.
1. Introduction

1.1 About this report

This report provides an overview of existing research on the impacts of poor numeracy on adults and the impacts of improving numeracy skills in adulthood. It was undertaken by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC) as part of a suite of studies on numeracy commissioned by the National Institute for Adult and Continuing Education (NIACE).

1.2 Scope of this report

This evidence review considers the impacts of poor numeracy on individual adults. It draws mainly on literature from the United Kingdom, but also includes some international research. It does not look beyond individuals expect to look at the family lives of those with poor numeracy skills. It does not consider the wide body of evidence on the impacts of low basic skills on employers, on the economy, or on society as a whole.

Low literacy skills are, however, discussed where findings form an interesting counterpoint to those on low numeracy. Some important evidence on low basic skills does not disaggregate findings on numeracy from those on literacy; moreover, some learners (especially in international contexts) take combined literacy/numeracy courses rather than one-subject provision.

Evidence in considered in three areas:

i. The economic impact of poor numeracy skills, that is, the impact on individual earnings, on individual employment, and on personal finances;

ii. The social impact on the individual, that is, on adults’ family lives and daily activities, on social capital and active citizenship; and on criminal justice;

iii. The health impact on the individual, that is, physical health, mental health, health literacy, and on well-being – how people feel about their own lives.

Some words of caution. Most of the evidence reviewed below reports on the association between low numeracy skills and a range of economic, social and health implications. This is evidence of correlation, not causation. Furthermore, for many adults, low basic skills are but one aspect of the disadvantages they experience, all of which have the potential to impact on their life chances across the areas under review.

Although there is good evidence on the impacts of poor basic skills on adults, evidence on the impacts of improving those skills in adulthood is more limited and we know very little about the ways in which skills proficiencies develop.
and decline as people get older. Although improvements in numeracy skills may be correlated with improvements in other areas of life, causality may work in both directions (job improvements may lead to better numeracy) and other characteristics (such as high personal motivation), not all of them observed, may be at play. Another factor limiting evidence on improvement is that those with the lowest skills are the least likely to experience education or training.

This review draws heavily on analysis of the longitudinal panel data provided by two British birth cohort studies, the National Child Development Study (NCDS), which follows a sample of children all born in Great Britain in one week in March 1958, and the British Cohort Study (BCS70), which follows children born in one week in April 1970. Data for both studies were collected when the babies were born, and members of each cohort (about 17,000 in each) are surveyed at intervals. Of particular interest are the literacy and numeracy skills assessments which were administered to subsamples (10%) of NCDS members at age 37 and BCS70 members at age 21, as well as a whole cohort basic skills assessment of BCS70 in 2004. Because each cohort dataset contains a rich body of background data, researchers can use NCDS and BCS70 to explore how poor literacy and numeracy affect individuals through the lifecourse. In some instances, the longitudinal nature of these studies allows causal inferences to be drawn.

Additional valuable evidence comes from the English Longitudinal Study of Aging (ELSA), a large-scale study of adults over the age of 50 which began in 2002. As well as gathering data on health, well-being, quality of life and economic and social circumstance, short literacy (wave 2) and numeracy tests (wave 1) have been administered to cohort members. It is worth noting that most studies consider younger adults, and most provision to improve skills is targeted at younger adults, despite the fact adults over the age of 55 have been shown to have lower basic skills than other age bands in assessments of the skills of working age adults.

### 1.3 What is numeracy?

The word “numeracy” derives from the term “numerical literacy”. At its simplest level, “numeracy” is the ability to understand and work with numbers; however, definitions of numeracy which are skills-based, for example, the ability to add, subtract, multiply and divide numbers, are often considered to offer too narrow an interpretation.

Broader definitions of numeracy, such as that below developed by Coben (2000) and accepted and used by NIACE, view number skills in relation to the purpose, function or context in which these skills are used:
To be numerate means to be competent, confident, and comfortable with one’s judgements on **whether** to use mathematics in a particular situation and if so, **what** mathematics to use, **how** to do it, what **degree of accuracy** is appropriate, and what the answer **means** in relation to the context.

Definitions are further complicated when “numeration” is considered in relation to “mathematics”. For many adults, and also sometimes for policy makers, numeracy is the basics; mathematics is more complicated, and not something that happens in everyday life. Coben describes a tendency for individuals to categorise the number work they do in real life as “just common sense” (Coben, 2003); mathematics is both invisible and something individuals believe they cannot do.

### 1.4 Why does numeracy matter?

Evidence consistently shows that British adults are more likely to have poor numeracy than poor literacy. For example, the most recent evidence shows that six in ten adults perform better in literacy than in numeracy and only one in ten higher in numeracy than in literacy (BIS, 2012). However, adults are more likely to take courses to improve their literacy than to improve their numeracy.

It has been assumed that behind this paradox lies the fact that being numerate is less important to people in their lives and work than being able to read and write well; moreover, not being able to do maths carries far less stigma than not being able to read. Adults tend to address their poor skills only when their regular coping strategies cease working; change or crisis – sudden unemployment, the end of a relationship, the need to help children, poor health – prompts adults to take up learning. As Baxter et al (2006) argue, “the adult population of England may not be deluded in thinking that their measurement skills are adequate to their needs, if those needs are cast in terms of ‘everyday’ (outside education) life: it is when their numeracy is tested, or they want to help their children with school work, that their skills are inadequate.” However, research shows that fear of maths and lack of confidence also play a major role in preventing adults from participating in maths improvement programmes; adults with poor numeracy are also more likely to have had negative experiences at school, which demotivate them from reengaging with education (NRDC, 2008).

Even before the publication in 1999 of the Moser Report on tackling the UK’s basic skills deficit (DfEE, 1999), the problem of poor numeracy was flagged as particularly important. A 1997 report for the Basic Skills Agency used NCDS data to examine the value of numeracy given rapid changes in the workplace environment which pointed to a numeracy skills gap. Its authors, Bynner and
Parsons, asked: “Is literacy the fundamental problem which overrides any effects of poor numeracy? Or does numeracy present a significant problem in its own right?” (Bynner & Parsons, 1997).

The conclusion of this report – namely that, in relation to employment problems, “numeracy deficits appear to be a significantly bigger problem than literacy deficits” (p. 9) – led the authors to predict with confidence that those with numeracy problems would “feel the squeeze most when the economy contracts. And as the nature of employment changes, these are the workers who are going to have to struggle hardest to obtain and hold on to jobs, and to advance their positions in them” (p. 19).

Throughout the life of the Skills for Life strategy, launched by the New Labour government in 2001 to raise the basic skills of the adult population in England, concerns have been raised that the initiative has struggled to meet its targets in relation to numeracy as compared to literacy. For example, a 2009 report on Skills for Life from the House of Commons Public Accounts Committee, warned that “far less progress has been made tackling poor numeracy skills compared with literacy skills” (p. 3). Although participation in numeracy courses has been rising year on year, the National Audit Office estimated in 2008 that only one in ten of those whose numeracy skills were below functional level have taken part in a course (NAO, 2008). At the same time, emerging research detailed the close links between poor numeracy skills and negative life outcomes: individuals with poor numeracy earn less and are much more likely to be unemployed than those with good numeracy, and adults with poor numeracy tend to have worse health and are less likely to be socially engaged than those with good numeracy. The most recent data on adult numeracy skills in England have not allayed fears. Not only are numeracy skills levels in the population still far less strong than literacy skills, for the youngest age group, numeracy skills are far poorer in 2011 than they were in 2003, a trend that cannot wholly be accounted for by the increase in non-native English speakers.

On the back of these challenges, NIACE launched an independent inquiry into adult numeracy learning. The resulting report made a series of recommendations advocating a cultural shift in attitudes towards numeracy and maths, including a recommendation for the adoption of a broader, practice and behaviour sensitive definition of numeracy. In 2013, NIACE, along with over 20 partner organisations, launched the Maths4us initiative. Supported by the Department for Business, Innovation and Skills (BIS), Maths4Us aims to provide more opportunities and resources for adults to re-engage with maths learning. Measures include (i) training 8,000 Maths Champions to encourage adults to face up to maths and improve their skills and (ii) a programme of Family Learning that focuses on getting parents and carers to feel confident in their own maths and helps children to grow up
feeling positive about maths and their ability to use and apply it; (iii) new learning resources such as apps and MOOCs (massive open online courses). The Maths4Us initiative has five messages:

- Everyone uses maths everyday – and everyone can get better at it.
- Better maths means you can make your money go further.
- Improving your maths is infectious: children, grandchildren and friends will learn from you.
- The more able and confident you are with maths, the stronger your job prospects.
- Learning maths as an adult is different to how you learnt it at school.

1.5 Assessing adult numeracy skills

1.5.1 Functional numeracy

Government policy has been clear on the level of numeracy skills it judges adults to need: Entry level 3 has been identified as the level of numeracy required to be fully functional in the modern British economy. These threshold levels for functionality were defined under New Labour in the Leitch review (Leitch, 2006) and are still referred to in discussions about numeracy skills, although under the Coalition government the threshold targets are no longer the focus of Public Service Agreement targets.

But how do we assess adult numeracy skills and what does Entry Level 3 mean?

Skills for Life courses in language, literacy and numeracy are those leading to qualifications on the five lowest levels of the National Qualifications Framework (NQF): Entry level 1 (EL1), Entry level 2 (EL2), Entry level 3 (EL3), Level 1 (L1) and Level 2 (L2). EL3 is the national school curriculum equivalent for attainment at ages 9-11. Adults with skills below EL3 may not be able to understand price labels on pre-packaged food or pay household bills (BIS, 2012). Those with very low numeracy skills, at Entry levels 1 and 2 might not be able to select floor numbers in lifts or use a cash machine to withdraw money. L1 and L2 skills are at an equivalent level to GSCEs, at grades D-G for L1 and A*-C at L2. Although EL3 is defined as functional numeracy, adults with this level (and higher) skills might struggle to read bus timetables or work out household budgets.

Drawing on both policy discourse, and previous research, this evidence review generally uses the classifications: poor/low numeracy skills (EL2 and below), fair numeracy skills (EL3) or good numeracy skills (L1 or above).
There have been two major (and linked) surveys of basic skills levels in England in recent years: the Skills for Life surveys of 2003 (SFL2003) and 2011 (SFL2011), both commissioned by the governments of the day (see BIS, 2012 and DfES, 2003). In addition to questionnaires gathering background data, these surveys used identical tools to assess the literacy and numeracy skills of a sample of adults aged 16 to 65: SFL2011 established numeracy levels for 5,823 individuals representative of the broader population in England. SFL2003 reported the numeracy levels of 8040 adults.

Both the 2003 and the 2011 surveys found that adult numeracy skills in England are weaker than adult literacy skills. Data were extrapolated to the general population to conclude that in 2011, 8.1 million adults in England had low numeracy skills (a rise from 6.8 million in 2003) and 5.2 million adults (5.1 million in 2003) had low literacy (Entry level 2 or below). The eight years between the two surveys witnessed a downward shift in numeracy skills, with fewer people skilled at Level 2 or above (21.8% of respondents in 2011 compared to 25.5% in 2003) and slightly more with skills falling below Entry level 2 (6.8% compared to 5.5%). A quarter (24%) of respondents – one in every four adults in England – scored below Entry level 3 in numeracy. When analysts looked at SFL2011 data for the numeracy sub-skills (numbers, measure, shape and space) they found that across the range of skills, respondents from SFL2003 displayed higher levels of skills than their 2011 equivalents.

1.5.2 Self-reported numeracy skills

Most surveys of adult numeracy skills identify a gap between people’s perceptions of their skill level and the level at which the survey instrument assesses their skills to lie. In SFL2003 fewer than one in ten (8%) respondents rated their numeracy skills as being below average. Individuals with poor numeracy tended to rate their skills much higher than their performance indicated: 28% of individuals with poor numeracy, for example, rated their numeracy as “very good” while 54% rated it as “fairly good”. Only 13% of adults with Entry level 2 numeracy rated themselves as “below average” with a mere 5% categorising themselves as “poor”. Adults with very poor (Entry 1 or below) numeracy were more likely to rate themselves as very good (15%) than poor (13%). SFL2011 reported that people were generally aware of their basic skills weaknesses and strengths, and perceived and actual strengths were reflected in everyday practice. However, three in ten of those with skills below Entry level 3 over-estimated their skills to the extent of claiming to be “very good” at maths, representing an increase from a quarter of respondents in SFL2003. Those who thought their number skills were weak tended to not check their bills and bank statements.
The same trend is apparent from analysis of both the NCDS and BCS70 datasets, with evidence that the gap between perceived and assessed skills is larger for numeracy than for literacy. Analysis of NCDS data found that only 9% of respondents with poor numeracy scores recognised or acknowledged their difficulty, a figure which compared to 19% of those with poor literacy scores (Bynner and Parsons, 2006). In both cohort studies, a fairly consistent proportion (3-5%) self-reported problems with numeracy in fieldwork waves between 1981 and 2000. However, when in 2004, BCS70 members were not simply asked about their general difficulties with numbers but rather about their capacity to perform specific operations such as multiplication and division, this rose to 11% for English respondents. This would suggest that while individuals are very comfortable with their skills when they think of numeracy in abstract terms, they are somewhat less confident when they focus on specific numerical operations. Furthermore, the significance of respondents’ reluctance to report general problems with numeracy indicates that many people believe that, despite some specific problems such as division, their overall numeracy skills do not present significant hurdles, even when, objectively assessed, those skills are very poor.

As this suggests, there can be a considerable difference between self-appraisal of general skills and of specific skills illustrated by everyday examples. In an online survey of 2,006 adults aged 18 and over, conducted in 2008 by YouGov for the Every Child a Chance Trust, more than a quarter of respondents reported difficulties with mental arithmetic and the same proportion said they sometimes struggled to add up prices in their heads when shopping (Every Child a Chance Trust, 2009). Nearly half (47%) wished they had learnt more maths at school and 51% of mothers said they struggled to answer the mathematical questions their children asked them. Women reported greater difficulties than men – 34% said they had trouble working out sums in their heads, compared with 18% of men – which the authors speculate came from lower confidence on the part of women, or perhaps more honesty when reflecting on their skills.

Older adults were more confident in their maths skills than younger adults. In the 25-34 age range, one in five felt that greater ability in maths would help them get further on in their careers. Although adults with lower social economic status reported more numeracy difficulties, the survey found difficulties with maths across the whole social spectrum.

But the gap between perceived and actual numeracy is more complicated than people simply not recognising their numeracy difficulties. Parsons and Bynner (2005) suggest that, rather than being a solely objective appraisal of performance, self-reporting on skills is linked to self-concept and identity. The key question may not be “How good are my skills when compared to the population at large?” but, as Bynner and Parsons write, “Do I see myself as
poor against the standard that I set for myself in the context of my everyday life?"

1.6 Who has poorer skills?

By looking more closely at data from the Skills for Life surveys and the birth cohort studies, a general picture emerges of the backgrounds that characterise adults with poor numeracy.

1.6.1 Skills for Life surveys

As with almost every survey and assessment of numeracy skills, males in SFL2011 out-performed females (80% of men with functional numeracy compared to 73% of women), although less markedly than in SFL2003. Age was not found to be important (which is consistent with other findings that numeracy skills do not decline markedly in working life), but region had some impact in that London was the only region to experience sizeable decline in numeracy performance between SFL2003 and SFL2011 (a fall from 81% to 75% reaching EL3 numeracy or above).

Those who leave education when they are young and who do not pursue qualifications are more likely to have poor numeracy; unsurprisingly, those with a Maths GCSE at grade C or above performed better at numeracy. Respondents whose parents who did not stay on in education also had weaker skills, although respondents’ education plays a larger role, unless they have lower or no qualifications.

People who are economically active, and people who work in higher occupational categories, have higher basic skills. Adults with full-time jobs have better numeracy skills than adults with part-time employment. In part the difference between men and women in number skills can be put down to differences in economic activity; men were more likely to be in employment. This could mean that poor numeracy skills are a bar to employment or are sustained and improved in employment. Occupational status also has a role to play: men are more likely to be employed in managerial and professional occupations and these people outperform those in lower status occupations. Women also hold fewer qualifications.

Adults who live in more deprived areas tend to have lower numeracy skills. People with lower socio-economic status (SES) have lower skills.

Weak performance (below EL3) on the numeracy assessment in SFL2011 was associated with (greatest predictor first) these fixed characteristics:

- Not having English as first language, especially for some ethnic groups
- Having a (self-assessed) learning difficulty
- Neither parent staying in education beyond the age of 16
- Being female
- Being aged 16 to 24 or aged 55 and older

The biggest difference between this and the model for literacy is the inclusion of gender. Women were much more likely than men to be categorised below Entry Level 3 in the numeracy assessment.

Weak performance (below EL3) on the numeracy assessment in SFL2013 was associated with (greatest predictor first) these acquired characteristics:

- No Maths GCSE/equivalent A*-C
- Highest qualification is rated at Level 2 or below
- Infrequent or zero computer use
- Working in particular industry sectors (although the patterning is unclear)
- Working in lower supervisory or semi-routine and routine occupations (or long-term unemployed)

1.6.2 Birth cohort studies

Parsons and Bynner (2007) analyse data from numeracy assessments completed by BCS70 cohort members at the age of 34 (in 2004) to explore the backgrounds of those whose numeracy skills were rated poor in assessments (EL2 or below) and compared them to cohort members who had good numeracy skills (L1 or above) and fair numeracy skills (El 3).

Adults with poor numeracy skills were more likely to be born into large families (three of more children) and were more likely than those with good numeracy skills to have been born to a mother in her teens (24% compared to 14%). Higher social class in childhood was also associated with better numeracy skills in adulthood: 9% of individuals who would go on to have poor numeracy skills were born into families in which the father’s job was classified as “professional/managerial” compared to 22% of those who would go on to have good skills. Those who would go on to have poor numeracy as adults were also more than twice as likely as those who would go on to have good skills to have received free school meals at age 10 and to have had parents or carers who received unemployment benefits.

Those with poor numeracy skills as adults were 1.5 times more likely to have mothers with no post-compulsory education than individuals with good
numeracy skills in adulthood. The parents of cohort members with poor skills were also considerably more likely than the parents of those with good skills to have left education without qualifications: 69% compared to 44% (mothers) and 61% compared to 37% (fathers).

Bynner and Parsons found a strong association between the numeracy skills at age 34 and the attitudes cohort members’ parents held towards education when the cohort members were aged 10, as reported by class teachers in 1980. For example, only 19% those with poor skills in adulthood had parents who were reported to be very interested in their child’s education compared to 41% of those with good numeracy skills in adulthood. They also found an association between the aspirations parents held for cohort members’ educational future when they were children and numeracy performance in adulthood: those with poor numeracy skills at the age of 34 were more than twice as likely to have had parents who in 1980 wanted their children to leave school at 16 (58% compared to 28%).

Bynner and Parsons compared the result of the 2004 numeracy assessment with cognitive development tests cohort members completed when they were 5. Those who would go on to have poor numeracy skills were more likely to have performed poorly on these childhood assessments.

This finding, however, should be regarded with some caution as there is evidence that socioeconomic status (SES) has a potent impact on educational performance. Using developmental tests (intellectual, emotional and personal) in the same dataset (BCS70) Feinstein (1998) examined the associations between preschool development and the qualifications cohort members gained by the age of 26 and found in the early tests a powerful guide to future educational progress. Furthermore, Feinstein’s analysis demonstrated that SES at birth (based on parental occupation) appears to have a powerful influence. Low SES greatly increased the likelihood that high-skilled children would produce progressively poorer cognitive performances and that among children who performed very poorly in cognitive assessments at 22 months, those from low SES families continued performing poorly over the following years, while those from high SES families steadily improved their results.

Parsons and Bynner (2007) found that very few (11%) of those adults who would go on to have poor numeracy at age 34 were receiving remedial help in maths at age 10 and only half were identified by their teachers as having “below average” or “very limited” maths skills at age 10 (although they were still four times more likely to be identified as having problems as 10-year-olds than those with good skills aged 34). Parents made similar judgements about their children’s skill levels to teachers: of those with poor skills aged 34, 50% of parents felt that their child had some difficulty with maths, while 9% felt their child had great difficulty with the subject. In other words, two out of five of
those who would go on to have poor skills were not identified by their parents as having difficulties at age 10. It is likely that difficulties were missed by parents and teachers as the children themselves were more likely to recognise problems: just over half (55%) of 10-year-olds who would go on to have EL3 skills reported having problems with maths.

Half (50%) of male cohort members and 42% of female members had left full-time education by the age of 16. Females who would go on to have good numeracy skills at age 34 were the least likely (30%) to leave full-time education at age 16. Six in ten females who would go on to have poor numeracy had left school by age 16. At age 16, males and females who would have good numeracy as adults were more positive and ambitious than any other group, including those who would go on to have good literacy as adults. Roughly 70% of men who would go on to have poor or fair numeracy skills left school at age 16, compared to only 40% of men who would go on to have good skills. Men and women with fair or poor numeracy skills in adulthood were five to six times less likely to want to do A-levels (when asked at age 16): 6% of men and 10% of women with poor skills; 5% of men and 16% of women with fair skills and 37% of men and 50% of women with good skills.

Adults with poor numeracy are much less likely to have qualifications: 29% of male cohort members with poor numeracy skills at age 34 did not have any qualifications by this age, while 5% had a degree or its National Vocational Qualification (NVQ) equivalent (Bynner and Parsons, 2006). Men with very poor numeracy were 10 times more likely than those with Level 2 or above numeracy to have no qualifications. While women with very poor numeracy skills were more likely than men to have a qualification or even a degree at age 34, the ratios between skill levels were similar across genders. Women with poor numeracy skills were approximately 10 times more likely than those whose numeracy skills were at Level 2 or above to have no qualifications at age 34, and were only a sixth as likely to have a degree or its equivalent.

Those with poor numeracy skills were unlikely to have had post-compulsory education or education and training opportunities in their working lives. Just over 40% of men with Entry level numeracy skills at age 34 gained all their qualifications while still in their teens (Parsons and Bynner, 2007). However, a sizeable minority (more than 20%) gained all the qualifications they had while in their 20s and 30s, suggesting a pattern of dissatisfaction with compulsory education, leaving school with no qualifications, but then gaining initial and further qualifications later on.

1.6.3 Older adults
In the ELSA dataset, men are more proficient at numeracy: of the four banded groups of numeracy proficiency, some 18% of women are in the lowest group, compared to only 9% of men, and over 18% of men are in the highest group, compared to only 6% of women. This is in contrast to literacy, where women in the ESLA study tended to outperform men. Older adults do less well at numeracy. (Jenkins et al, 2011).
2. **Economic Impacts**

One of the five messages of the Maths4Us initiative is: the more able and confident you are with maths, the stronger your job prospects. In actual fact, the evidence base shows that not only are job prospects better for those with higher numeracy skills, numeracy skills are also associated with a range of labour market outcomes where those with poorer skills are disadvantaged. As well as purely economic benefits in terms of salary increases or upward movement in employment status (for example moving from part-time to full-time contracts), better basic skills have been shown to improve an individual's job prospects through, for example, increasingly job search skills through increased confidence to apply for jobs, confidence to think that you will get a job and increased aspirations, motivation to look actively for a job.

Early research on the NCDS dataset by Bynner and Parsons for the Basic Skills Agency (1997) suggested that adults with poor numeracy skills could be characterised by particular employment trajectories:

- Leaving full-time education early and with no qualifications
- Patchy employment with periods of casual employment and unemployment
- Jobs that were low skilled, poorly paid and offered few chances of training and promotion.

Each of these trajectories carries negative economic impacts for the individual. At a national level, numeracy skills are reported to have a profound effect on the average productivity of the workforce and to explain a significant proportion of the difference in economic performance between nations (DfEE, 1999).

There is also evidence that numeracy carries a larger penalty in the labour market than literacy. For example, data from the International Adult Literacy Survey (IALS) showed that those with poor basic skills earn less, and this difference is greater for those with poor numeracy skills (OECD, 1997).

Moreover, the changing nature of the workplace may increase this financial penalty. Hoyles et al (2002) argue that numeracy is increasingly important to people’s jobs. By investigating the level and nature of mathematical skills required in seven different occupational sectors – electronic engineering and optoelectronics; financial services; food processing; health care; packaging; pharmaceuticals; and tourism – the authors found an increase in the average level of skills required in every sector: “mathematical skills in the workplace are changing, with increasing numbers of people engaged in mathematics-related work, and with such work involving increasingly sophisticated mathematical activities” (p. 5).
The following section looks at three aspects of the economic impact of poor numeracy skills on adults: on earnings; on employment; and on savings/financial health. Evidence on the impact of poor numeracy on individual earnings is particularly robust. Following the publication of the Moser report, which spelled out the financial costs to the nation of the basic skills deficit, a number of high-quality studies have made progress in attempting to quantify these costs and improve understanding of the problem of poor basic skills, and the costs of tackling this problem, in economic terms. Returns to earnings are easier to measure than returns to skills, which are hard to measure and to classify (Grinyer, 2005).

It is worth bearing in mind when reviewing the following research, especially that drawn from cohorts of people born in the 1950s, that the educational and labour-market experiences of men and women are no longer as different to each other as once they were. So, although poor numeracy emerges as a particular concern in economic terms for women, this gender gap may narrow over time.

2.1 Earnings

Looking generally at basic skills, adults with higher literacy and numeracy earn more in the labour market than those with lower skills. At some skill levels, the wage returns observed for higher numeracy skills are over and above any returns on earnings associated with an individual’s background, ability or qualifications (Ananiadou et al, 2003). For example, Bynner and Parsons (2006) found that at the age of 30, men with poor numeracy in the NCDS and BCS70 datasets had the lowest hourly rates of pay, and overall, poor numeracy rather than poor literacy was associated with low economic well-being at this age.

The following section looks specifically at numeracy and at two aspects of the wage impact – the impact of having poor skills in adulthood and the impact of improving those skills in adulthood.

2.1.1 Impacts of poor numeracy

Data on gross earnings for a representative sample of the English population were gathered by SFL2011. As was also the case in SFL2003, those with stronger numeracy skills on the survey assessment experienced higher earnings, except where annual earnings were less than £5000 pa. (This sub-sample – with a very small base size – had the same skills as those in the higher earning categories in 2011 but not in 2003.) A third (34 per cent) of full-time workers who achieved Entry Level 2 or below earned £20,000 or more in the survey’s 12 months reference period; of those with numeracy skills at Entry Level 3 or above, 63 per cent earned this amount. At the other end of the scale, only eight per cent of these respondents earned less than £10,000.
compared to 14 per cent who achieved Entry Level 2 or below. Data from ELSA also shows that those with low numeracy skills are paid less. Those in lower numeracy groups were less likely to agree that their salary was adequate than older adults in higher numeracy groups (Jenkins et al, 2011).

Data on income in SFL2003 and SFL2011 were collected in different ways (income bands in the former, raw values in the later) so cannot be compared. In detailed analysis of the SFL2003 results, Grinyer (2005) found large earnings effects for numeracy skills, at some levels: that is, the greatest earnings effects were at the extremes of the scale. Although the earnings effects of having Level 1 numeracy skills was 6 per cent, and the effect of Level 2 skills was statistically insignificant, Grinyer found a 13% earnings effect for Entry level 3 numeracy skills and a 19% effect for having numeracy skills that were above Level 2. Disaggregating the data by gender showed the returns for EL3 were significant (13%) for men but not for women, but insignificant for men at L1 whilst significant (10%) for women. Turning to age, the earnings effects for L1 numeracy for those under 30 are small or negative (unlike in literacy where the earnings effect was strongly positive).

Secondary analysis of the birth cohort studies, as well as other survey data, provides rich data on the links between skills levels and earnings. McIntosh and Vignoles (2000) found that employed individuals in the International Adult Literacy Survey (IALS) and NCDS datasets with Level 1 numeracy skills (BSA standards) earned between 15 and 19 per cent more than UK workers with numeracy skills below this level, taking account of no other factors that might influence earnings. Controlling for family background and other demographic characteristics, this premium fell to 11 per cent, but as both datasets gave the same figure, the finding appears robust. Disparities between the two sets of data, especially for literacy, did exist when gender was added to the model. A more detailed look at the results from NCDS showed that women earned a higher premium from better numeracy than did men in most scenarios, with the exception that men had a slightly higher return from Level 1 numeracy. The IALS results showed higher returns for women than men from Level 2 numeracy, but higher returns for men than women from Level 1 numeracy.

This time using data from NCDS and BCS70, the same authors (McIntosh and Vignoles, 2001) found larger effects in the NCDS, principally because this analysis compared those with numeracy skills below Level 1 to those with skills at Level 1 or above. Without controls, the wage returns associated with Level 1 or above numeracy skills were on average 26% in the NCDS results and 16% in the BCS70. Controlling for Mathematics and reading ability on entry into school (age 7), social class and parental interest, type of school, and region, the returns fell but were still significant at 8 per cent for NCDS and 10% for BCS.
Machin et al (2001) extended this analysis on NCDS by considering also the role of soft skills (attitudes to school and life at age 16, teacher and parental assessments at age 16, self-perceptions age 37). This analysis found a wage premium of 9% for men and 4% for women for Level 1 numeracy over Entry level, when these soft skills as well as ability and highest qualification, were controlled for.

De Coulon et al (2007) used BCS70 data to analyse the relationships between basic skills and individual earnings. The raw wage premium from having Level 1 numeracy was found to be greater in the 2004 labour market than in 1991, implying that the increase in the numeracy skills of the population has been matched or even outstripped by the demand for these skills. Controlling for early ability and family background, an additional standard deviation in numeracy results in 12% higher earnings (compared to 14% for literacy); disaggregating this model by gender, an extra standard deviation of numeracy yielded 15% higher earnings for men and 13% women.

In a report by the Institute for Fiscal Studies for Centre for Analysis of Youth Transitions/Department of Education, Crawford and Cribb (2013) also used data from BCS70 to investigate the relationship between maths skills in childhood and earnings at ages 30, 34 and 38. They found that children who were good at maths tended to earn more in their thirties than did those whose maths skills as children were poorer. Controlling for a rich set of background variables, a one standard deviation increase in age 10 maths scores was associated with earning between 10.2% and 10.8% higher at age 30. Children in the top 15 per cent for maths at age 10 earned 7 per cent more on average (equivalent to an extra £2,100 a year) at age 30 than those who achieved middle-ranking scores. Maths test scores were found to have a greater direct association with earnings aged 30 than reading test scores, suggesting to the authors that employers may value maths skills more than reading skills, and that maths skills are rewarded with higher wages. These associations remained the same at ages 34 and 38.

2.1.2 Impacts of improving numeracy

Turning to the impact of improving numeracy skills in adulthood, the body of evidence is smaller and less certain, especially when drawing causal relationships. There is no conclusive evidence either that adult basic skills courses have an impact on earnings, or that they have no impact; the limited evidence is insufficient to warrant a clear conclusion. This is in large measure due to the paucity of data on skills improvement; some research is reliant on creating proxies for skills improvement or extrapolating beyond the evidence, other research on self-report data. Furthermore, participation in courses to improve numeracy skills cannot itself be assumed to lead to actual skills improvements.
As part of their examination of the IALS and NCDS datasets, McIntosh and Vignoles (2000) estimated the potential impact on earnings of improving the literacy and numeracy skills of adults. In this analysis, an attempt was made to identify “improvement” by looking at adults’ numeracy levels compared to their educational achievement levels at the point of labour market entry. Under these conditions, the earnings premium stayed numerically high (although not statistically significant) at 6-7% (down from 15-19% with no controlling factors). In other words, the authors state, “two individuals who start out with the same achievement level at age 16 and who acquire the same education level, the individual who ends up with Level 1 numeracy skills still earns around 6% more than the person who ends up with lower level numeracy skills” (p. 11). Data from NCDS and BCS70 were also interrogated by McIntosh and Vignoles (2001) in the same way: allowing for education level, individuals with Level 1 or better numeracy skills earned 12% (BCS) or 13% (NCDS) more than individuals with the same level of education but poorer numeracy skills. The measurement for improved skills used here, however, is far from perfect, as no longitudinal data on numeracy skills were available.

Also using NCDS data, Machin et al (2001) used similar models to those of McIntosh and Vignoles, but tried to identify more clearly the impact of improvements in adult numeracy skills. Four measures were used: whether respondents had taken a basic skills course; whether there had been a change in test scores between the ages of 16 and 37; qualifications gained as adults, and self-reported improvements in skills. Individuals who reported that their skills had improved generally earned more at age 37 than those who did not believe their skills had improved. For example, males who claimed to have improved their numeracy skills earned 3% more than those who did not make such a claim; for women this figure was higher at 11% for those self-reporting improvement.

Although good numeracy skills (Level 1 and above) appear to have a greater effect on earnings than good literacy skills, when it comes to skills improvement between 16 and 37, literacy skills have a greater wage effect, for men at least, and if the male was initially at the upper end of the skills distribution at age 16. Machin et al argue that for adults with very low basic skills, improving numeracy to at least Level 1 will have a greater effect on earnings than improving their literacy. Adults who already have a good grounding in basic skills will see the greatest wage gains from further increasing their literacy rather than their numeracy skills. Thus, for numeracy the key seems to be to get skills to an acceptable level, while for literacy, the gains will go on rising as skills continue to be improved (at least for males).

*Impact of participation in numeracy courses*
Grinyer (2005) analysed data on the subsample of SFL2003 respondents without higher education who had participated in basic skills courses since leaving school. He found the impact of numeracy skills on earnings to be larger and more robust that the impacts of literacy. In particular Grinyer reports that that statistically significant impacts on earnings were to be found where the basic skills course had been taken over three years ago – for example, that participation on a numeracy course is correlated with economic returns: three years after non-graduates were on a course, they were on average earning 13% more than matched individuals who had not attended a course – leading him to speculate that where a course had been taken less than three years ago, wage data were more likely to pick up the impact of the shock that led the respondent to participate in training, meaning that the effects on wages were generally negative, large and statistically insignificant.

In the UK, the main study on the impacts of Skills for Life courses is a longitudinal study undertaken by Metcalf et al (2009). Literacy and numeracy “learners” (N=2012) taking Further Education qualification-bearing courses in 2002 and 2003 were matched to a group (N=2255) of “non-learners” (people with low or no literacy or numeracy qualifications who did not take a Skills for Life course) and comparisons made over four waves of data collection, including on their earnings and employment. Metcalf et al found that between waves 1 and 4 “learners” experienced an increase in net annual earnings of £560 compared to £542 for “non-learners”. This difference was small and not statistically significant. However, this lack of evidence on wage returns is not conclusive evidence of no wage return: attrition rates (77-79%) were high meaning that there is the possibility of bias; moreover, no data were gathered on whether “learners” actually improved their skills.

Using learner attainment information for 2002/3 and 2005/6 from the Individual Learner Record (ILR) and data on annual earnings (between 2003/04 and 2009/10), Patrignani and Conlon (2011) found a sizeable earnings return to gaining Skills for Life qualifications at Level 1. In the short to medium term the returns to literacy learning aims were greater than to numeracy (in excess of 7% in the first three years post completion compared to 3% for numeracy) but the returns to numeracy qualifications increased steadily over time (from 3% in year one to approximately 12% in year six). In numeracy, the earnings returns to Level 2 learning aims were “immediate and persistent” (p. 16), starting at approximately 1.7% immediately post attainment and rising to more than 13.7% at the end of seven years, while those attaining Level 2 literacy qualifications saw a negative impact on earnings for the first four years after attainment (around -2.5%) before returns of between 2.7% and 8.8% in the fifth to seventh years post attainment. Those attaining both literacy and numeracy qualifications at Level 2 also experienced a positive return on earnings after an initial dip in the first year post attainment. In years
six and seven, the earnings return of gaining both literacy and numeracy at Level 2 is approximately 10%.

There is also some international evidence on this subject, although findings are conflicting. Gleeson (2005) used the Longitudinal Survey of Australian Youth 1975 Cohort dataset and the United States National Longitudinal Survey of Youth 1979 to assess the economic returns of education and training for adults with low basic skills. His analysis found that when adults with very low levels of numeracy had greater opportunities for work experience, there were earnings returns. In the US data he found that, for adults with very low or low levels of numeracy, participation in on-the-job training programmes led to positive and significant impacts on their earnings.

In contrast, Cunha et al (2007) found that, in the US, at historically funded levels, public job training programmes and adult literacy and educational programmes, like the General Educational Diploma (GED), have a low economic return and produce meagre effects for most individuals. However, American research (Tyler, 2004) on young school dropouts lacking qualifications found that better skills did matter. Looking at the numeracy skills (as ascertained through a maths test) of young dropouts entering the American job market in the late 1990s and in 2002, estimates indicate that a standard deviation increase in numeracy scores is associated with 6.5% higher average earnings over the first 3 years in the labour market.

2.2 Employment

Evidence on the wider employment impacts of low basic skills is less well developed than the evidence on wage returns; in general there is less evidence on the long term impacts on employment of poor basic skills, as even longitudinal studies have not gathered data over a long timescale.

The evidence indicates, however, that in terms of employment, numeracy more of a determinant than literacy and the correlation is one that is stronger and often statistically significant. For example, De Coulon et al (2008) found that men with higher levels of numeracy have significantly higher employment rates: numeracy seems to be important in determining the likelihood of being in full-time employment.

2.2.1 Impacts of poor numeracy

Entry to the labour market

In the BCS70, men and women with poor numeracy skills tended to enter the workforce earlier than those with good (Level 1 or above) numeracy (Bynner and Parsons, 2007). In keeping with data on early school leaving, 67% of men and 70% of women who had poor (Entry 2) numeracy skills at age 34 had
entered the workforce by age 17, compared to only 51% of men and 44% of women who had good skills. Patterns of workforce entry for those who had Entry 3 skills were similar to those of individuals whose skills were at Entry 2 or below.

*Employment status*

Early research by Bynner and Parsons (1997) for the Basic Skills Agency reported that individuals in the NCDS with poor numeracy skills experienced the lowest levels of full-time labour market participation: numeracy skills had more impact on employment than literacy skills. Men with poor numeracy were the most prone to unemployment. However, of those women who were not in full-time work, those with poor numeracy tended to be in part-time jobs while those with poor literacy were not employed outside the home but looked after house/family instead.

As part of their analysis Bynner and Parsons compared the employment trajectories of individuals with poor numeracy and/or poor literacy to test which skills deficit had the greater impact and in what combination. They found that:

- 17% of men with poor numeracy + competent literacy were out of the full-time labour market – unemployed, sick, other – compared with 10% of those with competent numeracy + poor literacy. Of those with poor numeracy + poor literacy, 31% were not in full-time employment.

- Only one in four (26%) women with poor numeracy + poor literacy, or poor numeracy + competent literacy skills, held a full-time job, compared with over two fifths (40%) of women with competent numeracy.

- 52% of women with poor numeracy + competent literacy were in part-time employment compared with 30% of those with competent numeracy + poor literacy.

For men, poor numeracy was a bigger problem for maintaining full employment to their mid-twenties than poor literacy; after this age competent literacy skills took on more importance. After their mid twenties, women in the poor numeracy + competent literacy left full-time employment in much larger numbers than those with competent numeracy + poor literacy and poor numeracy + competent literacy. By the time they had reached their late twenties they were barely distinguishable from those in the poor numeracy + literacy group (Bynner and Parsons, 1997).

Bynner and Parsons (2006) analysed NCDS and BCS70 data and found:
Both men and women with poor literacy and numeracy were in full-time employment between ages 16 and 29 less than those with higher skills. Men with poor numeracy men particularly hit by 80s recession: in general it is individuals with poor numeracy skills who are likely to suffer most as the economy contracts (Bynner and Parsons, 1997).

There is strong evidence that the gap between poor and fair numeracy (that is, the gap between entry levels 2 and 3) is particularly significant. At the age of 30, men and women with poor numeracy were more than twice as likely to be unemployed as those with competent numeracy.

At age 34, 95% of males with Level 2 or better numeracy skills were in full-time employment, compared to 92% of males at Level 1, 88% at Entry 3 and 85% of those with poor (Entry 2 or below) skills (Bynner and Parsons, 2006).

The relationship between numeracy skills and likelihood of being in full-time work holds for women as well, with one exception. Women with the poorest numeracy skills were the least likely to be in full-time work: in the BCS70, 34% of those with poor (Entry 2 or below) numeracy were in full-time employment at age 34, compared to 39% of women at Entry 3 numeracy and 51% of women with good (Level 1) numeracy. However, women with Level 2 or above numeracy skills were slightly less likely (48%) than those with Level 1 to be in full-time employment. The reason for this is unclear.

Between the ages of 16 and 34, men in the BCS70 who had poor numeracy skills were twice as likely as those with good (Level 1 or above) and numeracy to experience three or more spells of unemployment (Parsons and Bynner, 2007). During the same years, men with poor (Entry 2) numeracy spent an average of 13 months unemployed, compared to only four months for those with good skills. These ratios hold even when only comparing school leavers, indicating that it is not just education level that matters but basic skills. Between ages 16 and 34, women with poor numeracy experienced three times as much unemployment as those with good numeracy (6 months versus 2 months).

From analysis of the IALS and NCDS datasets McIntosh and Vignoles (2000) found that individuals with Level 1 numeracy skills are around five percentage points more likely to be employed (not taking into account other factors). Even in the full model which conditions for a person’s education level, Level 1 numeracy skills are still associated with having a 2-3 percentage point higher probability of being in employment.
Machin et al (2001) found that, taking no account of any other factors, males in the top quintile of mathematics ability at age 16 have a 6.6 percentage point higher probability of being employed than those in the bottom quintile. This is reduced to 5.5 percentage points if ‘soft skills’ are added to the model, and to 4.8 percentage points if the person’s qualification level is included. For women, reading is a more important determinant of employment, although the results are generally insignificant once the person’s qualification level is added to the model.

Data from SFL2003 show that respondents in full-time employment scored at higher levels in the numeracy assessment than all other groups, and the gap between those employed part-time and those not employed was smaller than that observed in the literacy assessments (DfES 2003). Data on gender and employment also suggests both that poor numeracy skills were a major barrier to labour market entry and that employed people make more use of their numeracy skills and keep them fresher. In SFL2011, two fifths of those who rated their maths skills negatively felt that their weaknesses with numbers had had a negative impact on their job prospects, even if only a little. Those who felt it had had a more profound effect were more than averagely likely to be out of work.

From more detailed analysis of SFL2003, Grinyer (2005) concluded that literacy (especially at Level 1) appeared to have the greatest effect on labour market participation and finding employment for women. Numeracy skills appeared to have an additional positive effect, though the results are not statistically significant. Men at Entry level 3 were 8% more likely to be economically active than men with lower numeracy skills. Level 1 numeracy skills increased this likelihood by a further 3%.

De Coulon et al (2007) found that having better basic skills was significantly associated with the likelihood of BCS70 members being in employment and full time employment at ages 33 and 34. De Coulon et al found a positive and significant relationship between numeracy and employment. An additional standard deviation of numeracy was associated with a two percentage point higher probability of being most employed at age 33/34.

An Irish study tracked a sample of 27,000 unemployed individuals between 2006 and 2008: in addition to completing a background questionnaire, respondents provided self-assessment data on any difficulties they experienced with literacy and/or numeracy. (Data on literacy and numeracy were not collected separately.) Kelly et al (2012) found that ‘the likelihood of a newly registered unemployed individual (regardless of gender) having a literacy and/or numeracy difficulty declined with age, educational attainment and good health’ (p. 26). Having a basic skills difficulty increased the likelihood of an unemployed person becoming long-term unemployed (that is,
unemployed for over 12 months): males with basic skills difficulties were 7.6% less likely to have left the unemployed register and females 7.3% less likely.

**Occupation**

Bynner and Parsons (1997) found that numeracy affected occupation, with those with poor numeracy skills more likely to be employed in manual occupations. No men with poor numeracy skills had professional occupations but 11% of men and 8% of women with poor numeracy skills had management jobs. Outside of professional and managerial occupations, jobs in selling and clerical / secretarial jobs – where women comprise the majority of the workforce – were those most likely to require numeracy skills, yet women are generally less proficient at numeracy than men. BCS70 data show that men with better numeracy skills are less likely to do work classified as “plant/machine” and are much more likely to have employment classified as “professional” (Parsons and Bynner, 2007). This is true for those who left school at 16 as well as those who stayed on longer.

The two Skills for Life surveys provide information on the occupations of individuals with low skills. SFL2003 found that lower levels of numeracy skills were associated with socio-economic deprivation and lower socio-economic status (DfES, 2003). More than 6 in 10 of those in routine or semi-routine jobs had Entry 3 or lower level numeracy skills. The majority (57%) of individuals in “higher managerial and professional” roles had numeracy skills at Level 2 or above, compared to 38% of those in lower managerial and professional occupations. The literacy skills gap between these two occupation levels was markedly smaller. Data from SFL2011 showed a reduction in the proportion of respondents reaching Entry level 3 or above in the managerial and professional categories.

**Skills decline**

Research shows that for both men and women, skills decline if not used in employment, which may partly account for the fact that large numbers of adults with numeracy problems were not identified as having problems while at school (Bynner and Parsons, 1998). Adults who are out of work lose their skills, and such loss tends to be more acute, and to start sooner after loss of employment, for numeracy than for literacy. This can create a vicious circle, in which poor numeracy contributes to limited employment, which leads to poorer numeracy, which makes it harder to find and keep employment. ICT use also appears to play a role in this process, as will be discussed in section 3 of this report.

People are more likely to ‘lose’ their numeracy skills if they are employed in jobs that do not require their use. Speculation is made in the report on
SFL2003 that young men with very low numeracy do not improve these skills as they get older but those with medium-low or medium numeracy do improve with age. This is probably associated with available occupations: individuals with even medium-low numeracy may have much broader work options than those with very low numeracy (DfES, 2003).

Training and promotion in the workplace

Early research by Bynner and Parsons (BSA, 1997) found that poor numeracy restricted access to job opportunities within the place of work. Men and women with both poor literacy and poor numeracy were the least likely ever to have had work-based training, followed by those with poor numeracy and competent literacy. Those with competent numeracy were the most likely to receive any training between ages 16 and 23. After this age the differences between the groups reduced, suggesting that it is in first and early employment that numeracy problems are particularly associated with lack of training. This was supported by their later analysis of BCS70 data (Parsons and Bynner, 2007). Among men born in 1970, 18% of those with poor (Entry 2 or below) numeracy received work-related training, compared to 26% of those with fair (Entry 3) skills, 31% of those with good (Level 1) numeracy and 38% of those with Level 2 or above. For women this pattern was less consistent. Seventeen per cent of women with poor numeracy received work-related training, as did 16% of those with their numeracy, 22% of those with good numeracy and 26% of those at Level 2 or above.

A look at promotion saw this picture change. Women with poor numeracy and/or poor literacy were indistinguishable in terms of access to promotion; and for men, poor literacy was the determining factor in restricting promotion, both in terms of getting it once and getting it more than once (Bynner and Parsons, 1997). However, subsequent analysis (Parsons and Bynner, 2007) showed that men with poor numeracy were much less likely to have been promoted at any time (38% versus 58%). Only one-third of women with poor numeracy had been promoted, compared to more than half of those with good skills.

Atkinson and Williams (2003), in a study of employer perspectives on the recruitment, retention and advancement of low-paid, low status employees in the UK, found that the vast majority of individuals in unskilled jobs received no training at work. Further, although having poor literacy or numeracy is not always a barrier to entry level employment, it can and does hamper advancement.

Employment and older adults
NRDC: Impact of poor numeracy on adults (June13)

Once allowance has been taken of a range of background variables, there is no evidence of a relationship between literacy and numeracy and an older adult being in work and little evidence that moving out of work and into retirement with literacy and numeracy levels (Jenkins et al, 2011). Older people with low skills in the ELSA dataset were not less likely to be in work over waves of the study. Older men with poor numeracy tended to have more out of work spells than those with higher skills, although skills were not a determinant of the hours worked for those who were in employment. The same trends were not significant for those with low literacy.

Those in the lower groups were less likely to agree that their jobs provided them with opportunities to develop new skills (just over half in the lowest group, over three-quarters in the highest group). This suggests that older adults with lower numeracy skills are more likely to work in jobs of relatively poor quality.

2.2.2 Impacts of improving numeracy

If evidence that changes in the workplace are increasing the need for better literacy and numeracy is correct, skills improvements are likely to be increasingly valuable in the workplace. The impacts of improvements can be wide ranging, from reduced absenteeism to increased productivity and improved job satisfaction (Ananiadou et al, 2003 reporting on Krueger and Rouse 1994, 1998). For example, half of respondents to a longitudinal survey of basic skills learners in the Armed Forces conducted by NIACE/NRDC for BIS and the MOD reported that attending courses in had given them more confidence (Vorhaus et al, 2012). More than half also felt that the basic skills training encouraged them to take another personal development course, suggesting that literacy and numeracy training gives Service personnel the confidence and motivation to engage in additional learning opportunities that will potentially benefit the Service and their careers.

In detailed analysis of BCS70 data, Parsons and Bynner (2007) compared outcomes, including employment related outcomes, for two groups: those who had poor numeracy skills at age 21 and continued to have poor skills at age 34 (“non-improvers”) and those who had poor numeracy skills at age 21 but had good numeracy skills at age 34 (“improvers”). Those in the first category were categorised as “non-improvers” and the latter as “improvers”. Male improvers were twice as likely to have received work-related training from their employer (36% versus 19%); 65% of male improvers used a PC at work, compared to 48% of non-improvers. There were more associations between improved numeracy and improved life outcomes among women than among men, suggesting once again that numeracy matters more to female well-being than to male well-being. For example, 43% of female improvers were in a full-
time job at age 34, compared to 27% of non-improvers and female improvers were more likely to have used a computer at work (80% versus 61%).

Machin et al (2001) drew a similar conclusion, finding that males who improve their numeracy skills between the age of 16 and 37 have a greater probability of being employed.

**Impact of participation in numeracy courses**

Metcalf et al's(2009) study of the impact of Skills for Life courses found that at wave 4 there was no statistically significant difference in the change in the proportions of those in paid employment between learners and non-learners. From this the authors conclude that those undertaking literacy/numeracy courses can take time to move into paid employment. This theme is consistent with the findings of other studies which have been able to look at the impact of programmes over a longer term than is normally possible within an evaluation programme (for example, an evaluation of welfare to work programmes in the US by Hamilton et al [2001]).

Patrignani and Conlon (2011) found pronounced impacts on employment (in terms of the proportion of the financial year for which an individual was in employment) for Skills for Life attainment at Level 2 compared to Level 1, although all Skills for Life learning aims were found to have strong and positive employment returns. Drawing on data provided by HM Revenue and Customs analysed in conjunction with ILR data, Patrignani and Conlon found that learners completing a numeracy learning aim at Level 1 registered a 2.1% employment boost within two years of qualification completion, increasing to approximately 6.5% by the end of year seven. At Level 2, those completing numeracy courses saw an immediate 3.5% increase in employment outcomes compared to non-completers. This employment effect increases steadily over time to almost 10% after seven years. Once again, the effects for numeracy were stronger than for literacy.

This report also used data from the Department of Work and Pensions to assess the impact of qualification attainment on benefit dependency, where the outcome measure was the proportion of time an individual was in receipt of particular benefits including Job Seekers Allowance (JSA) and/or Incapacity Benefit (IB). Their analysis found an immediate and relatively persistent impact of literacy and numeracy attainment on JSA benefit dependency and, as with their findings on employment returns, the impact was found to be stronger at Level 2 than at Level 1. Attaining a Level 1 numeracy learning aim reduced the proportion of the financial year in receipt of JSA by approximately 1.6%; the impact of attaining Level 1 literacy learning aims was greater in the short term (2.5%) though eroded by the end of the seven year period. At Level
2, the difference in JSA dependency between completers and non-completers stands at 2.2% and 2.7% for literacy only and numeracy only, while the impact of attaining both literacy and numeracy qualifications stands at 2.5%. Over the seven year period, only 25% of this reduction in benefit dependency was observed to have eroded.

Government programmes for the young and longer-term unemployed often include basic skills courses (where attendance is sometimes voluntary and sometimes not). Wolf (2011) reported that these courses either make no significant difference, or that this approach is less effective, in terms of employment outcomes, than some others (notably those involving direct work placements). One major evaluation of work-based learning for adults (Speckesser and Bewley 2006) used extensive controls to adjust for differences between participants and comparison populations, and found that Basic Employability Training, which offered up to 26 weeks of basic literacy and numeracy instruction, had no impact on levels of benefit receipt but did seem to increase numbers in employment 40 months later compared with a matched population.

### 2.3 Savings and Wealth

Banks et al (2010) analysed the ELSA data with the aim of assessing two aspects of the relationships between numeracy skills and retirement saving trajectories:

- whether saving and wealth trajectories vary across groups with different numerical ability, using changes in study members' wealth between 2002 and 2006, with a focus on the years immediately prior to retirement and the years immediately following;

- whether ELSA evidence supports the assertion that correlations between numerical ability and wealth, and between numerical ability and saving, translate into differences in outcomes in retirement that might be thought to be more fundamental to welfare. These include income and consumption replacement rates, the degree to which prior expectations of the future are fulfilled, changes in subjective measures of well-being and the extent to which concerns about having enough resources to meet needs become more or less acute as individuals retire.

In exploring these questions, these authors were working in the context of evidence which suggests that numerical ability impacts on life-cycle wealth and retirement outcomes. Higher ability individuals tend to be more patient, less risk averse, more able to be precise when thinking about options, able to exercise more self-control and less swayed by temptation. Taking these
behaviours together, adults with higher ability may be able to process information and make optimal decisions in a more timely way; furthermore, “what is striking is the role of numeracy over and above other dimensions of cognitive abilities” (p. F384)

Banks et al found a strong correlation in the ELSA dataset between numeracy and financial wealth; wealth levels for the higher skilled are substantially higher than for the lower skilled. Their results also suggest that numeracy is associated with financial wealth accumulation behaviour. However, evidence on the importance of numeracy to financial outcomes such as replacement rates (that is, the rate at which salary is replaced on retirement, by a private pension, state pension or other money) or accuracy of expectations (about future employment status) is weak.

Commenting on the findings that differences in behaviour between those of different skills levels are not matched by differences in the trajectories of some retirement outcomes, the authors speculate that, “the vast majority of retirement resources for low numeracy individuals does not come from privately saved (non-pension) financial assets and hence portfolio differences have little consequences for differences in broader retirement outcomes. Put simply, the fact that the less numerate hold systematically different portfolios may well be only of second order importance for determining retirement outcomes since the latter are driven much more strongly by state pensions, other components of the welfare system, informal insurance mechanisms, and perhaps housing” (p F407).

Bynner and Parsons (1997) found that participation in a company pension scheme was less likely for men with poor numeracy even when their literacy was good. From subsequent analysis of NCDS and BCS70 data, Bynner and Parsons (2006) found evidence of strong relationships between improving basic skills and income-related outcomes. Compared with women who had a poor grasp of literacy or numeracy at both age 21 and 34, women who had improved their literacy or numeracy by age 34 were more likely to be generally better off and to have savings and investments. Compared with men who had a poor grasp of literacy or numeracy at both age 21 and 34, men who had improved their literacy or numeracy by age 34 were more likely to own their own home, and they were less likely to be living on state benefits and to have borrowed money from a friend, family member or other source. A third (33%) of men who improved their numeracy skills had investments at age 34, compared to 15% of non-improvers.
3. **Social Impacts**

The British cohort studies provide some rich evidence on the social impacts of having poor numeracy skills; other research on the non-economic impacts of low basic skills tends to be small-scale and qualitative, often drawing on self-report data.

3.1 **Family Life**

3.1.1 **Impacts of poor numeracy**

*Leaving the family home*

Men with poor basic skills have a higher likelihood of continuing to live in the family home well into adulthood (Parsons and Bynner, 2007). Analysis of BCS70 showed that, at the age of 25, more than 40% of men with poor or fair (EL2 and EL3) numeracy skills were still living in the family home, compared to roughly 30% of men with good (L1 or above) numeracy skills. This trend continued: at age 30, almost 25% of men with poor numeracy skills still lived in the family home compared to 12% of men with good skills. At age 34, the proportions were 22% of men with EL3 numeracy compared to 10% with good skills.

On the whole, women in BCS70 moved out of the family home at an earlier average age than did their male peers. And although there were some skills-related differences in the age at which women left the family home, these were much smaller and did not vary much over time. This was particularly true for low skilled women. For example by age 25, roughly 80% of women with entry level numeracy had left the family home, compared to 60% of men with the same skills.

*Living arrangements*

Between the ages 16 and 34, men and women in the BCS70 cohort lived in an average of five different homes. Men and women with Entry level skills were more likely to live in disadvantaged housing conditions and rented and/or overcrowded accommodation. They were also less likely to have moved house for reasons to do with work. By the age of 34, 33% of men and women with good (L1 or above) numeracy skills had moved home for work-related reasons, compared to 20% of men and 16% of women with poor (EL2) numeracy and 22% of men and 21% of women with fair (EL3) numeracy.

Overall, 6% of men and 5% of women in the BCS70 cohort reported having experienced at least one spell of homelessness by the age of 34. Having poor numeracy doubled the likelihood of a woman in this cohort experiencing
homelessness. At 34, women with poor numeracy were about twice as likely as those with good numeracy to have a child but not in live-in partner (17% compared to 9%).

**Becoming a parent**

By age 34, 55% of men in the BCS70 cohort had become a father (Parsons and Bynner, 2007). Only 2% became fathers as teenagers and teenage fatherhood was highest (5%) among men with poor (EL2) numeracy skills. Among women, more than three-quarters (77%) of those with poor numeracy had a child by age 34, compared to 68% of those with good (L1 or above) skills. Compared to women with good numeracy skills, women with poor or fair numeracy at 34 were more than twice as likely to have had their first child while still in their teens: 13% of those with EL2 numeracy, 12% of those with EL3 and only 5% of females with L1 or above numeracy.

Women with poor numeracy not only had children earlier, they had more: women at Entry 2 or below were three times as likely as those with good (Level 1 or above) numeracy to have four or more children by age 34 (6% versus 2%), and were much more likely to have at least three children (18% compared to 11%). Looking at patterns of parenthood, then, there were strong indications of a cyclical intergenerational transfer of disadvantage. Just as individuals who would go on to have poor skills at 34 were the most likely to be born into large families and of young mothers in 1970, women with Entry level skills were much more likely to have children early and to have more children.

**Intergenerational transfer**

Is this intergenerational transfer of disadvantage also evidenced in the cognitive outcomes of the children of parents with poor numeracy and literacy skills? What do children learn from family members and in the home learning environment?

Analysis of BCS70 (Parsons and Bynner, 2007) found that among cohort members with children under the age of six, there were no skills-related differences in the amount of support that parents offered to help children learn basic numbers and the alphabet, or to recognise colours, shapes and sizes. The figure for parents who did not help with any of these activities – 12% – was consistent across skills levels. However, cohort members’ skills were closely associated with the number of books that children possessed. While only 18% of individuals with good (Level 1 or above) numeracy reported that their children (up to the age of 16) had fewer than 20 books, 25% of parents with fair (Entry 3) numeracy reported this to be the case, as did 33% of parents with poor (Entry 2) numeracy. There is a body of research which
suggests that improvements to parents’ basic skills make them feel better able to help their children with their homework and given them increased confidence to engage with their child’s school and talk to teachers.

Some evidence shows that the intergenerational transfer of numeracy skills is less marked than it is for literacy; so low numeracy levels amongst parents are less likely to be repeated in their children (Carpentieri, 2007).

However, this finding is disputed by the research of Brown et al (2009) who analysed NCDS data for evidence of an intergenerational relationship in educational attainment in reading and in mathematics. This relationship could result from a genetic component (more able parents have more able children), from direct transfer of knowledge (better educated parents are more able and more motivated to support children in their education) and from income and lifestyle (being able to buy materials or access better performing schools).

Brown et al explored the link between cohort members’ literacy and numeracy test scores at age 7 and their children’s test scores (in 1991, when the children were 5 or above, and scores were standardised and measured relative to children of their own age). Put simply, researchers were testing if any positive relationships between the two scores were explained by nature or nurture. Characteristics of the child (state of health; number of siblings) and family (house ownership, educational attainment of cohort member) were controlled for in some specifications, as were exogenously determined variables for cohort members, such as items connected to their formal schooling that were determined by the LEA.

Brown et al found that controlling only for the gender of the child, one standard deviation increase in parent’s maths score age 7 was associated with a one tenth standard deviation in their child’s maths score, relative to children of the same age. Although this association was far weaker than those observed for reading tests scores, it was still statistically significant. In other words, the performance of a parent in maths as a child has a positive association with their child’s performance, but less strongly than in reading. Adding child and family controls did not change the relationship.

However, when the exogenous variation was isolated, the coefficient was substantially reduced, becoming highly statistically insignificant. If any exogenous increase in parental maths skills (for example those associated with when cohort members started school and the ways in which they learned maths) was not passed onto their children, Brown et al hypothesise that genetic effects may be the dominant source of the inter-generational correlation in maths scores. As this was not the case with reading scores, upbringing and parenting styles are considered to play a role in the intergenerational relationship. If genetic effects are important to the intergenerational transmission of numeracy skills, Brown et al speculate that
then raising the skills of one generation is unlikely to have an additional positive effect on the next.

De Coulon et al (2008) used the BCS70 dataset to examine the relationship between parents’ basic skills (as per test scores at age 34) and the early (ages 3-6) cognitive development of their children. Their results showed parents’ basic skills in literacy and numeracy (which were not treated separately) at age 34 to have a positive significant effect on their children’s test scores, over and above the positive effects of parental education and ability. If these results are interpreted as causal then the implication is the opposite of that in Brown et al (2009): policies aimed at increasing the basic skills of low-qualified parents may well have a positive impact on the cognitive development of their children.

3.2 Social capital

At the age of 30, women in the BCS70 cohort with poor numeracy were more likely to have low self-esteem, and more likely to feel they lacked control over their lives. A number of research studies have produced findings that suggest that improving basic skills, and improving numeracy, can have positive effects on individual identity and in turn on social capital. Social capital can be defined as ‘the networks, values and understandings which facilitate cooperation within and amongst groups’ (see Balatti et al., 2006, p. 6). Social capital, therefore, goes beyond the personal to look at relationships between individuals and groups of individuals. To measure an individual’s social capital, researchers enquire into attitudes (for example, measures of trust, like feeling safe) and behaviours (for example, participation in civic activities, such as volunteering) (see Bynner at al, 2003). Such a focus emphasises learning as a social activity, predicated on the identity the individual has as a learner. For adult basic skills learners, many of whom have negative educational experiences and low confidence in themselves as learners, it can be hard to shake off a negative identity as a non-competent learner.

As summarised in a review of adult basic skills carried out for the CfBT (Lord et al, 2010) the personal impacts of improved basic skills for individuals across a range of health and wellbeing measures, include increased self-confidence and the confidence to try new things; increased self-esteem, self-worth and positive self image; enhanced belief in own abilities and sense of personal achievement; reduced sense of embarrassment or stigma at having low basic skills; better physical and mental health; more positive attitude towards life; increased social networks and increased socialisation and reduced isolation (getting out the house more); and increased confidence to take up volunteering opportunities and engage in society.
In the NRDC Effective Practice Study in numeracy, Coben et al. (2007) found that, once numeracy learners overcame initial anxiety about their courses and mathematics, the courses could have positive effects on confidence and self-esteem, and enable learners to develop positive dispositions towards learning. From the self-appraisal measures, including changes in self-esteem, perceptions of literacy and numeracy skills, and commitment to education and training, Metcalf et al (2009) found convincing and statistically significant patterns of improvement, and a large and significant difference between learners and non-learners.

Using data from over six hundred literacy and numeracy learners in Scotland, Tett and Maclachlan (2007) analysed changes in self confidence and in social capital. For the purposes of their research, these authors focused on two types of social capital: bonding (that is, the links between like-minded people) and bridging (the building of connections between heterogeneous groups). They looked at the role of the development of a stronger learner identity in the building of learner confidence and social capital. The focus is not on how those with higher social capital (like those with higher levels of skills) are more likely to participate in learning, although this is the case, but rather on the impact of learning and learner identity on social capital.

Tett and Maclachlan measured learners’ identification with and attitudes towards the neighbourhood; social and civic engagement; feelings of safety and belonging; and social contacts and supportive networks, at two points in time (with a gap of about a year) to identify any links between participation in adult basic skills learning and changes in individuals’ views about themselves, their communities and their networks: in effect they measured “distance travelled”.

In combined data for all learners, Tett and Maclachlan found that between the two points in time there had been an increase in social activity but not in civic activity. The changes in social activity for female learners and for older learners were statistically significant. Learners also become clearer about what they did and did not want to do, with regard to participating in local activities. There was a statistically significant increase in the proportion of learners reporting that they were able to access help from friends and family in their locality (again, especially so for older learners); relationships with tutors and with fellow students were also stronger.

Between the two question points, more learners also achieved a higher overall confidence score (from a range of scenarios, including making enquiries on the phone, speaking up in groups): engagement in learning is associated with increased confidence. Learners reported that they had increased self-esteem and better health, were more able to voice their opinions, had a growing sense of their own potential, and importantly, a
greater sense of their achievements and growing skills. To the authors these changes amount to a virtuous circle of social capital build on the fact that a changing learner identity, where the individual moves from non-competent to capable, is accompanied by a growth in confidence which impacts on familial, social and work relationships.

3.3 Active citizenship

Bynner and Parsons (2006) found from BCS70 data that at the age of 30 men with poor numeracy were more likely to have little interest in politics than those with higher skills, regardless of their skills level in literacy. Women with poor numeracy were less likely to be interested in politics and less likely to vote.

Comparing males in the BCS70 sample who had improved their numeracy skills between the ages of 21 and 34 with non-improvers, Parsons and Bynner (2007) found that

- male improvers were nearly twice as likely to disagree with the statement "I am not at all interested in politics" (28% versus 13%).
- female improvers were almost twice as likely to have signed a petition or been on a rally or demonstration (31% versus 17%)
- female improvers were more likely to be involved in social or community organisations (55% versus 41%)

3.4 Criminal Justice

3.4.1 Impact of low numeracy

There is clear and established evidence that the prison population is characterised by basic skills levels that are lower than those of the general population. Figures included in a report published by the Social Exclusion Unit in 2002 records that the initial Basic Skills Agency assessment offered to all prisoners at the start of custodial sentences indicates that over two-thirds (65%) of prisoners have number work difficulties, that is, they are at or below Level 1 in the adult national qualifications framework. A quarter of juveniles in custody have a numeracy age below that of the average seven-year-old (Social Exclusion Unit, 2002).

In a 2002 report for the Basic Skills agency, Parsons analysed NCDS and BCS70 data to explore the relationship between the literacy and numeracy skills of adults aged 42 and 30 (that is, data collected from both cohorts in 2000), other circumstances in their lives, and criminality. Parsons found a significant association between self-reported police contact or repeated
offending and poor literacy or numeracy scores, particularly among men and in the younger cohort. For women in the BCS70 cohort, poor numeracy skills were significantly correlated with the number of times they reported having been arrested, even after controlling for social disadvantage, poverty, disruptive family environment, poor education experiences and early signs of emotional and behaviour problems. So for women, having poor numeracy skills directly increased the risk of offending. For men, poor literacy skills increased the risk of offending: the links between men with poor numeracy and criminality lost their statistical significance when the controls were added to the model.

3.4.2 Impact of improving numeracy skills

There is some evidence on the short and longer term impacts of improving the numeracy skills of adults in the criminal justice system. Looking specifically at young people, Brazier et al. (2010) found limited evidence on the effectiveness of education programmes aimed at reducing recidivism, both in Britain and internationally (Utting and Vennard, 2000). A Canadian study (Poporino and Robinson 1992) followed offenders who had participated in Adult Basic Skills Education (ABE), and found that recidivism rates for those who completed their courses were lower (30%), as compared with those released before completing (35.5%) or who withdrew from the course (41.6%).

4. Impact on health and well-being

There is very little evidence which quantifies the health benefits of adult basic skills specifically, although there is a wide body of evidence on the health benefits of education in general.

4.1 Physical health

It is not clear from the data whether poor numeracy skills contribute to poor health or whether poor health leads to poor numeracy skills, or if the relationship is more complex, with causation running in both directions, or whether a third unobserved factor produces both outcomes.

4.1.1 Impacts of poor numeracy

The first Skills for Life Survey (DfES, 2003) found links between respondents’ self-reported health and numeracy levels. Individuals with entry level numeracy were far more likely than those with better numeracy to report having a long-standing illness or disability (56% of individuals with entry level numeracy, compared to 22% of those with better numeracy). Survey respondents were also asked to rate their health as poor or very poor, fair,
good, or very good. Although individuals with entry level numeracy made up less than half of survey sample (47%), they accounted for 70% of self-reported cases of poor or very poor health. They were also statistically less likely to report being in very good health. Some of this effect can be explained by the fact that poor health was more common among older respondents, and this group was also more likely to have poor numeracy skills. In his analysis of this dataset, Grinyer (2005) reports that although poor health is correlated with 1/5th of a level lower literacy, poor health is not associated with significantly worse numeracy skills.

In SFL2011 performance on both the literacy and the numeracy assessment varied depending on how people rated their health: those who rated their health to be poor or very poor were less likely to have functional numeracy, and the better a respondent’s health the higher their level of numeracy skills. Four in five (81%) of those with very good health had numeracy skills at Entry level 3 or above compared to just over half (52%) of those with poor or very poor health.

Individuals with poor (Entry 2) numeracy are much more likely to report being out of the labour market because of illness than those with somewhat better (Entry 3) skills (Parsons and Bynner, 2007). In the BCS70 cohort, poor numeracy for women was an independent predictor of poor physical health (Parsons and Bynner, 2005). Women in the BCS70 sample who improved their numeracy skills between the ages of 21 and 34 were less likely to report that they never exercised (14% versus 31%).

In a recent report which used BCS70 data to report on the health outcomes of cohort members at the ages of 34 and 38, Sabates and Parsons (2012) worked from a starting point that basic skills impact on adult health in terms of:

- personal agency, by increasing self-efficacy and confidence – this can help people to make decisions on health behaviour such as quitting smoking or cutting down on alcohol consumption
- capabilities (helping people to progress), on social relations, including improved social interactions with family and other people, and creating conditions in which health can improve through social behaviours such as getting involved in clubs and organisations.

Sabates and Parsons analysed cohort data to see whether the adult basic skills had an impact on health beyond and above the impacts of early ability and educational qualifications, and tested whether the effects were different for literacy and numeracy, and for men and for women. Cohort members assessed their health on a five point scale from excellent to poor, reported on
any limits their health placed on their daily activities, reported on health behaviours, including current smoking habits, and provided information on their mental health (depression).

Sabates and Parsons found evidence that men and women with poor numeracy self-reported deteriorating health between the ages of 34 and 38: men with Entry level 2 and 3 numeracy were 0.06 percentage points more likely to report deteriorating health between these ages than men with Level 2; women with entry 2 were 0.05 percentage points more likely to report deteriorating health between these ages than women with Level 2. Moreover, low adult numeracy was associated with worsening health limiting conditions: both men and women with low numeracy skills were almost three times as likely to show deteriorating health limiting conditions. Among cohort members whose health did not limit their daily activities, 11.8% had Entry level 2 numeracy; for the group whose health was limiting their daily activities, the figure was 23.1%.

4.1.2 Health of older adults

Analysis of ELSA data by NRDC (Jenkins et al, 2011) found that adults in lower literacy and numeracy groups tended to give lower evaluations of their own health, more likely to report that it was poor and less likely to report that it was good or very good. They were more likely to be current smokers (20% in the lowest numeracy group and 13.8% in the highest) and across a broad set of health indicators, low basic skills were associated with poorer health outcomes. However, Banks et al (2010) reported from ELSA data that correlations between numeracy and changes to health and wellbeing on retirement are weak.

4.2 Mental health

There is an established association between the symptoms of depression with poor basic skills, particularly among women.

4.2.1 Impacts of poor numeracy

In the BCS70 cohort, a far higher proportion of men and women with poor (Entry 2) numeracy skills (Entry level 2) reported four or more symptoms of depression out of a possible nine (Bynner and Parsons, 2006). The presence of (four or more) depressive symptoms followed a skills gradient, with each lower level of numeracy associated with a higher likelihood of depressive symptoms. Other analysis by Parsons and Bynner (2005) using the same data found that men with poor numeracy were at greater risk of experiencing depression, and that this was not related to their level of literacy skills.
Likewise, poor numeracy for women was an independent predictor of depression. Women in the BCS70 sample who improved their numeracy skills between the ages of 21 and 34 were much less likely to report that they never got what they wanted out of life (12% of improvers versus 20% of non-improvers).

However, in more recent research, Sabates and Parsons (2012) found no evidence in BCS70 from data gathered when cohort members were 34 and 38 associating low basic skills with depression.

4.2.2 Mental health of older adults

Analysis of ELSA data by NRDC (Jenkins et al, 2011) found that adults in lower literacy and numeracy groups scored relatively highly on a measure of the presence of depressive symptoms (using the CES-D scale) – 38% of the older adults on the lowest numeracy group had depressive symptoms compared to 12% of the highest. After controlling for a wide range of explanatory variables this observation still held good – those in the lowest group had odds two-thirds higher of reporting depressive symptoms.

4.3 Health literacy

Health literacy is defined as the ability to read and understand materials encountered in health care settings and to obtain the knowledge necessary for positive health outcomes (Nurss, 1998; Roman, 2004, cited in Jenkins et al, 2011). Health literacy is a relatively new research field, with its origins in the United States, and to date the main research focus has looked narrowly at literacy skills, and even more specifically to reading comprehension skills; this is unsurprising given that US research has shown that health materials are written at a level that exceeds the reading skills of an average high school graduate.

As cited in Apter et al (2008), the evidence for links between numeracy skills and health outcomes is far more limited than the evidence on literacy skills, but research from the US has associated limited numeracy with poorer self-management of diabetes and a higher incidence of visits by adults with asthma to hospitals and emergency departments.

Limited numeracy may affect the individual’s a) ability to communicate with health care professionals (HCPs), b) understanding of health information and c) ability to make decisions relating to health and health care, as well as d) health outcomes. Apter et al point out that numeracy is increasingly relevant to health literacy as ‘the promotion of shared decision-making and the use of electronic information have increased the amount of quantitative information patients must comprehend’ (Apter et al, 2008, p.2117).
The number skills individuals need for health-related activities include those related to taking/administering medicines (timing, scheduling and dosage) and to understanding and following the recommendations of HCPs as well as using higher numerical concepts such as estimation, probability, problem-solving (the ability to decipher when and how to apply numerical skills), understanding variability and error in measurement, and risk assessment. As Rita Rudd explains, terms like risk, likelihood, probability and norm are all difficult mathematical concepts and sophisticated numerical skills are needed to understand health messages delivered using them.

4.4 Well-being

The adults are thought to be reluctant to engage with numeracy learning because of fear of maths, often a fear that stems from negative school experiences, demonstrates the impact of poor numeracy can have on individual well-being; indeed, high quality numeracy provision responds to the sensitivities of adults in this regard. Parsons and Bynner (2005) found that poor numeracy for women was an independent predictor of a belief that they lacked control over their own lives.

In the United Kingdom, there is an increasing commitment to measuring wellbeing across a number of domains including quality of life measures and measures of subjective well being. Although this review contains elements of evidence on the relationship between numeracy and elements of well being, there is little research that looks specifically at wellbeing across a range of indicators.

The ELSA, however, includes a subjective wellbeing measure created for older adults. The CASP-19 quality of life indicator asks respondents 19 questions in 4 areas: the need to act freely in one’s own environment (control); the need to be free from undue interference (autonomy); the need for self-realisation; and the need to enjoy oneself (pleasure). Analysis by Jenkins et al (2011) found substantial and statistically significant differences in quality of life by numeracy level; however, as this effect was no longer significant when all the explanatory variables were added to the model, the authors conclude that, “Insofar as numeracy had an impact on quality of life, then, it appeared to do so via its influence on earnings and perhaps educational attainment" (p. 73).
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