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1. INCOME, AND EDUCATION, AND HEALTH AND MORTALITY

1.1. INTRODUCTION

Life expectancy at birth for humans 100 000 years ago was estimated at 25 years, and it had reached 37 by 1700. Thus, the biggest increase has been in the 20th century (Cutler et al 2006).

Historically, the key factors in extending life are (Cutler et al 2006):

i) Improved nutrition - both in quantity of food (calories) and quality.

ii) Public health improvements - macro-changes (eg: clean water, sanitation systems) and micro-changes (eg: washing hands, protecting food from insects).

iii) Vaccination programmes - eg: measles (introduced in 1964) (Cutler et al 2006).

iv) Medical treatments - eg: discovery of anti-biotics; medical technology for premature births.

So, the mid-18th to mid-19th centuries benefited particularly from (i), mid-19th century onwards by (ii), and the 20th century by (iii) and (iv) (Cutler et al 2006).

The issues today are differences in mortality between rich and poor countries, and the differences in mortality within countries.

Kawachi et al (2010) began: "Both education and income appear to be robustly associated with health status. Whether these associations represent causation has proved harder to demonstrate because of the practical constraints on randomising groups of people to receive different levels of money or schooling" (p56).

Establishing the causality between income and education, and health faces two main threats (Kawachi et al 2010):

a) Reverse causation - ie: health status causes educational attainment or income.

b) Confounding third variable - eg: IQ.

Three main methods are used to establish causality (Kawachi et al 2010):

i) Experiments - Income or education is manipulated by the researchers.

For example, cash payments to poorer families to invest in the health and education of their children in Mexico (PROGRESSA/Oportunidades programme) was associated with less parent-reported illness compared to controls (Gertler 2004). "It is unclear, however, to what extent these results are driven by the cash income as compared to other components of the programme such as required well child care and health education sessions" (Kawachi et al 2010 p61).

ii) Quasi-experiments - Researchers take advantage of naturally occurring groups.

For example, lottery winners have an improved health in a Swedish study (Lindahl 2002 quoted in Kawachi et al 2010).

iii) Longitudinal, observational studies - Groups are followed over time with little intervention.

1.2. INCOME

It is proposed that access to material resources, like better food and housing, and/or symbolic resources (eg: status) lead to better health [1]. In terms of absolute

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[1] This is also seen in the pattern of infant mortality. It is noticeably higher than average in six Southern US states (eg: Mississippi, Alabama), and higher still among African Americans than Whites in these states. These states all have high levels of poverty (Adler 2007).

income, there is a level where the basic needs are met, but after that added income does not improve health (Kawachi et al 2010) [2] [3].

Alternatively, there is relative income (ie: income in comparison to others), and "the greater the gap, the poorer one's health" (Kawachi et al 2010). Similar to this concept is relative deprivation, which "focuses on the gap between ones own income and incomes of those richer than oneself, but ignores information on the magnitude of the income gap compared to those poorer than oneself" (Kawachi et al 2010 p57). Relative deprivation is associated with higher adult male mortality, increased smoking and BMI, higher stress, and seeking help for mental health problems, for instance (Kawachi et al 2010).

Yet another similar concept is relative rank, which "posits that an individual's level of health is determined by the relative position within a hierarchy that a given income confers on that individual" (Kawachi et al 2010 p58). For example, the higher an individual scored themselves on the MacArthur Scale of Subjective Social Status, the better their health (eg: civil servants; Singh-Manoux et al 2003). This is a subjective measure of social rank, and there are issues over the measurement of the concept. Redelmeier and Singh (2001), for instance, concentrated on the acting profession in

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[2] Accurate measurements of wealth, particularly in the developing world, are difficult to obtain. For example, fourteen African countries did not carry out representative surveys of poverty between 2000 and 2010 (Jean et al 2016).

Alternative ways to measure economic activity, include satellite images of luminosity at night, or mobile phone data (Jean et al 2016). Jean et al (2016) used machine learning to recognise indicators of economic activity, wealth and poverty from daytime satellite imagery (eg: assets like size of house; type of roof).

[3] Metz (2016) described the understanding of poverty as having undergone three major shifts in the English-speaking world in the last half a century:

i) Initially it was "common to think that poverty more or less essentially is the lack of a certain amount of money, whether understood in absolute or relative terms" (p133).

ii) Then, in the 1970s and 1980s, the "dominant view among theorists became that poverty is essentially the inability to live well by virtue of economic want, with lack of money viewed merely as a proxy of that condition, one that could be easily measured" (p133).

iii) Since the 1990s, the Capabilities Approach (Nussbaum 1990) has become prominent. Here "poverty is best understood as the economic incapacity to function in myriad ways deemed to be objectively desirable for a human being" (Metz 2016 p133).

"Capabilities theorists typically believe that distributive justice, at least at the national level, is at the core a matter of the state ensuring that people have the internal and external abilities to live in a variety of ways that are objectively good for their own sake. The capabilities are distinguished in the first instance from functionings; they are opportunities to live in particular ways and not the actual ways of living, which focus appears apt as a way to respect people's capacity for choice. Specifically, capabilities are opportunities to live in 'objectively good' ways, not merely in ways that would enhance subjective well-being (appendix 1A). Capabilities theorists reject the idea that society ought at bottom to be organized according to whatever people happen to want or believe to be valuable, and instead contend that there are certain ways of life that people ought to want or to believe to be valuable" (Metz 2016 p136).

terms of nominees for an Academy Award (OSCAR). Those who won subsequently lived longer than unsuccessful nominees. This study has been criticised, however (Sylvestre et al 2006) (appendix 1B).

Kawachi et al (2010) highlighted three issues to consider:

i) Distinguishing temporary income changes from permanent ones [4].

ii) At what stage of life does income have the greatest effect on health?

iii) The type of society - eg: welfare provisions or not.

From a slightly different angle, globalisation refers to the increase in international trade, among other things, and this has consequences for health. Owen and Wu (2007), for example, found that greater international trade was associated with increased life expectancy, particularly in low- and middle-income countries. Other research has contradicted this finding to give "mixed evidence on the relationship itself" (Burns et al 2016) [5].

Thus, Burns et al (2016) performed a systematic review of quantitative studies on the subject, and sixteen relevant articles were found. Three studies used health data at an individual level, three studies at country level, and the remainder global comparison data.

The majority of articles found that countries with more international trade had better population health, but there were variations between studies. A bidirectional relationship between trade and health could not be ruled out.

1.3. EDUCATIONAL ATTAINMENT

In terms of educational attainment and health, a better or higher education gives the individual skills to prevent or fight disease, as well as better jobs, income and status. The benefit of health does level off after twelve years of education (Kawachi et al 2010). Other relevant issues include what aspects and kind of education benefit health, and the age when education has

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[4] There is a high correlation between median income experienced during youth and adulthood, "suggesting that income contexts are an extremely rigid dimension of social structure" (Goldsmith 2016 p2) (appendix 1C).

[5] Massey (2010) pointed out that "some are more on the receiving end of globalisation than others" (Jackson 2014).

the greatest impact on future health (Kawachi et al 2010) [6].

Applying the difference to longevity, for example, in the year 2000 in the USA, life expectancy at age 25 was 5-8 years longer for more than less educated individuals. While it has been established that one year of college would reduce roughly eight times as many deaths as medical advances in the USA in 1996-2002 (Montez and Friedman 2015) [7].

The longevity gap has widened in the USA in the last 25 years. Montez and Friedman (2015) asked: "Why has education become an increasingly important predictor of these outcomes? Are the widening inequalities 'real' and 'causal'? In other words, has higher education become more critical for accessing health-enhancing resources, such as fulfilling jobs, economic security, social ties, and safe neighbourhoods? Or do the widening inequalities reflect compositional changes within the education distribution? In other words, has the least-educated segment of the population become more negatively selected on health-related characteristics? Or are both of these processes occurring...?" (p1).

Spittel et al (2015) put the benefits of education for health into perspective. For example, White males in the USA with no high school education (ie: no educational qualifications) have a life expectancy of twelve years less than those with a university degree. While the difference in life expectancy between high and normal cholesterol levels is six months, and between women receiving a Pap smear every year versus once every three years is one day. Put another way, if everybody in the USA had a high school diploma at least, there would be 240 000 fewer deaths per year compared to 12 000 if no homicides or 30 000 if no automobile-related deaths (Spittel et al 2015).

In trying to make sense of the causal relationship between health and education, Montez and Friedman (2015) observed that "the association is contingent on broader contextual factors. For instance, educational attainment may have little to no effect on health within environments where it is unknown how to avoid disease;

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[6] Among adolescents, gaining academic qualifications is linked to political engagement and participation, and so as low socio-economic status adolescents are more likely to have less qualifications, lack of political participation will be "felt disproportionately among the group of socially disadvantaged students" (Hoskins and Janmaat 2016 p73).
[7] Hayward et al (2015) stated that "when controlling for early life conditions such as childhood socio-economic disadvantages, childhood health problems and IQ, educational attainment's association with adult mortality appears to be highly robust in the older American population in the latter part of the 20th Century" (p10).

during early stages of epidemiological transitions when risky behaviours such as smoking and high-fat diets are more common among advantaged sub-groups; in socio-political contexts with near universal access to health-enhancing resources such as income and medical care; and during economic booms when good jobs and opportunities for a living wage are plentiful. In other words, at any point in time the association - its existence, direction, strength, causality - is inextricably linked to the broader socio-historical environment" (p2). This contingent relationship is described in fundamental cause theory (FCT) (Phelan and Link 2005) [8] [9]. Thus, Montez and Friedman (2015) proposed that there should be a "move away from the long-standing dichotomous question (Is education casually related to health?) and instead explore a more nuanced question: Under what conditions is education causally related to health?" (p2).

Education can have an affect on the different way in which groups vary in health and longevity (Masters et al 2015):

i) Biological differences in disease susceptibility - eg: find information about ways to deal with risk.

ii) Structural and interpersonal discrimination - eg: problem-solving or coping skills.

iii) Differences in early-life conditions and subsequent health as an adult - eg: good job that gives money to pay for ways to compensate for poor childhood conditions.

iv) Differences in health risk behaviours - eg: learn about risks.

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[8] Health and longevity differences based on social class, status, or education, for instance, are seen in differences in personal and flexible resources, like money, knowledge, prestige, and social connectedness (Masters et al 2015).

   A prediction of the theory is that differences in health and longevity should be larger between social or educational groups where there is greater human control because personal resources "can be used to attain health-related knowledge, access helpful and/or needed services, and/or purchase preventative and curative technologies. Furthermore, such resources embed individuals in social contexts (eg: workplace, neighbourhood, peer networks) that might also contribute to differential exposures to both health-related threats (eg: hazardous working conditions, higher rates of smoking among friends/co-workers) and protections (eg: safer neighbourhoods, increased health-related knowledge among friends). Conversely, these resources and social contexts should garner only minimal protection against causes of death that are highly random and/or less preventable or treatable" (Masters et al 2015 pp19-20). These resources are embedded in socio-economic status (Phelan et al 2004).

   Masters et al (2015) found larger differences between education groups for death from "preventable" diseases than less preventable ones, using US data for 1986-2004.

[9] FCT has been criticised for the "ambiguous use of the term 'resources'" including "put to use wherever it fits best" (eg: to mean "personal agency") (Oversveen et al 2017).

v) Differential exposure to stress - eg: good job to pay for stress reduction aids.

Introducing a special issue of "Social Science and Medicine", Montez and Friedman (2015) summarised the papers in six themes:

1. "As the social and technological capacity for population health increases, the education-health association appears increasingly stronger and causal".

2. "Favourable economic contexts may suppress the education-health association".

3. "The health benefits of compulsory schooling are more apparent in disadvantaged contexts".

4. "The mechanisms which explain the education-health association may differ across regional contexts and the education distribution".

5. "More years of schooling appears to suppress genetic risks for preventable health conditions".

6. "The education-health association is often small or non-existent among monozygotic twins".

Summing up about education and health, Spittel et al (2015) said: "The strength of this relationship is not evidence of causality, and many contributing factors related to education and mortality need to be considered, but the magnitude of the relationship and the consistency across studies and databases of this finding between education and health make this relationship a critical focus of research efforts to ultimately eliminate health disparities" (p204).

1.3.1. Theme 1

The Epidemiological Transition describes the change in cause of death in populations in nations and over history (ie: the four stages of disease burden): (i) pestilence and famine, (ii) receding pandemics, (iii) chronic and human-caused diseases, and (iv) delayed chronic diseases (Smith et al 2015). Developed countries today are in stages (iii) and (iv) with obesity- and smoking-related diseases (human-caused), and stage (iv) with cancer, for example, in old age. Less developed countries today are passing from stages (i) and (ii) to (iii) (eg: tuberculosis declining vs HIV/AIDS increasing) (Smith et al 2015).

Hayward et al (2015) argued that technological

changes in the late 20th century on the USA that have improved health and longevity were taken advantage of by higher than lower educated individuals. The changes included the availability of medical technology and health information [10].

"At the population level, the educational attainment of a society reflects not only the aggregate stock of human capital but also the 'institutional, physical capital, and educational requirements for the technology of disease control' (Easterlin 1997) - the social capacity for population health. The rising educational attainment in a population signals improvements in a broad spectrum of technological knowledge that can help human survival and enhance health, which coincide with other health-related infrastructural changes in communities" (Hayward et al 2015 p10). Fogel (2004) referred to "technophysio evolution" to describe the idea that scientific knowledge and technology "have gained unprecedented control over their environment. This control has made possible the extraordinary improvements in body size, longevity, and the 'robustness and capacity of vital organ systems' (Fogel 2004)" (Hayward et al 2015 p10).

Hayward et al (2015) outlined three theoretical mechanisms to explain the changing relationship between education and health/mortality:

i) Selection - Changes in the characteristics of individuals who make up the highest and lowest education groups.

ii) Human capital - Each year of education lowers mortality risk through indirect benefits of education like access to information and problem-solving skills.

iii) Credentialism - Educational qualifications open up opportunities for better jobs and income.

Hayward et al (2015) analysed data from the National Health Interview Survey Linked Mortality Files (NHIS-LMF) for 1986 to 2006 in the USA, and found support for a "combined credentialist-human capital model".

So, formal education can be a "social vaccine" for human-caused diseases (positive effect) and a risk factor (negative effect). Smith et al (2015) commented: "Instead of assuming these contradictory results are inconsistent or spurious,... they are likely part of a predictable systemic interaction among multiple mediating effects of education on individuals' health and the health

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[10] This is called "health capital" (ie: factors that improve health).

environment of the population" (p30).

Smith et al (2015) found forty relevant studies for their meta-analysis of education level and health. From these, it was calculated that education reduced the likelihood of chronic disease by about one-sixth, but education had no effect on diseases with a genetic basis.

Education for individuals from low- and middle-income countries increased the risk of contracting a chronic disease, whereas education was a "social vaccine" in upper middle- and high-income countries. Tobacco use is an interesting example of this relationship. In the first half of the 20th century in the USA, smoking was higher in well-educated groups, but over recent years smoking is lowest among the higher educated (Smith et al 2015).

Smith et al (2015) explained it thus: "the material and status benefits enhanced by education can propel access to overconsumption of sweets and fats, smoking, and sedentary life-styles that are desirable, before their connection to chronic disease is widely known and clearly understood. At these early stages, because prevalence rates of diseases are not yet a visible social problem and information on risk is not readily available in the environment, educated individuals cannot take advantage of their higher ability to understand and prevent risk... [Later] where disease prevalence becomes visible and information diffuses in the social environment, educated individuals are the first to change their decision making patterns to restrict their consumption of risky goods and adopt safer health practices, thus prolonging onset of chronic disease" (p35).

The faster decline in smoking, in particular, among higher education groups has contributed to the widening gap in mortality between high and low education groups. Pampel et al (2015) explained: "Educational disparities in smoking reflect the lack of resources among disadvantaged groups but involve a diverse set of mechanisms... The fewer resources of disadvantaged groups produce a set of cumulative consequences: they increase stress that makes smoking an attractive coping strategy, limit access to health information, give groups with high mortality risks overall less incentive to avoid the harm of smoking, are associated with more limited time horizons, reduce the social capital available for help in avoiding smoking, and make it harder to quit" (pp41-42).

Pampel et al (2015) analysed survey data from three countries - France in 2010, Germany 2009, and the USA 2010 - on smoking uptake and habits. Three age cohorts were defined - 50-64 years old (born 1946-60), 35-49 years old (born 1961-75), and 18-34 years old (born 1976-92), and four categories of education level.

Overall, for the older cohort, smoking uptake was

greater for the highest education group, but among the youngest cohort, up to five times as many lowest education group members smoked than highest education group members.

1.3.2. Theme 2

Mackenbach et al (2015) found differences in the strength of the relationship between education and mortality in nineteen European populations. Mortality data for adults in the 2000s were collected, and twenty-four causes of death were classified into four groups of "preventability" (table 1.1).

Category	Example
B - amenable to behaviour change	Lung cancer
M - amenable to medical intervention	Appendicitis
I - amenable to injury prevention	Road traffic accident
N - non-preventable	Liver cancer

(Based on Mackenbach et al 2015 table 2 p54)

Table 1.1. - Examples of four categories of "preventability" of diseases.

Mackenbach et al (2015) summarised their findings thus: "Although an overwhelming majority of Relative Risks indicate higher mortality risks among the lower educated, the strength of the education-mortality relation is highly variable both between causes of death and populations. Relative inequalities in mortality are generally larger for causes amenable to behaviour change, medical intervention and injury prevention than for non-preventable causes. The contrast between preventable and non-preventable causes is particularly large for causes amenable to behaviour change, but absent for causes amenable to injury prevention among women. The contrast between preventable and non-preventable causes is larger in Central & Eastern Europe, where resource inequalities are substantial, than in the Nordic countries and continental Europe, where resource inequalities are relatively small, but they are absent or small in Southern Europe, where resource inequalities are also large" (pp56-57).

Cutler et al (2015) investigated the health benefits of education across the lifespan by comparing cohorts of individuals graduating in good and bad economic times. Because part of the benefits of education are via income

and employment [11], health gaps in the population based on education will be greater in bad economic times as university graduates are often less likely to be unemployed as compared to individuals with less qualifications. In good economic times, all education groups have jobs and so the health gap is predicted to be smaller between high and low education individuals.

Data from thirty-one European countries between 1997 and 2012 [12] were analysed by Cutler et al (2015). This included self-rated health (1-5; very good - very bad), obesity, smoking and drinking, education, and unemployment rate.

Overall, it was found that "higher unemployment at graduation is associated with lower household income, poorer general health, lower life satisfaction, and higher probability of obesity, smoking and everyday drinking later in life. Furthermore these negative effects are substantially smaller for those with more education" (Cutler et al 2015 pp71-72). Depending on the country, the authors calculated that between 15-70% of differences in health between education groups could be explained by economic conditions at the time of graduation [13].

1.3.3. Theme 3

The variation between countries in mortality can also be seen in studies that compare the age of compulsory schooling and mortality. Requiring children to stay at school longer (ie: better educated) is associated with lower adult mortality over time in the USA, for example, but not in England or France, and Sweden is ambiguous (Cutler et al 2015).

Gathmann et al (2015) found improvements in mortality for men, but not women with increases in compulsory schooling in eleven European countries in the 20th century. The mortality of cohorts prior to an

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[11] Per year of schooling can increase wages by 3-20% (Cutler et al 2015).

[12] Eurobarometer surveys every two years (http://zacat.gesis.org/webview/).

[13] Concentrating on the relationship between socio-economic status (SES) and health, Alvarez-Galvez (2016) suggested that it could be bidirectional or it "might be dynamic, multiple and, possibly, context-dependent".

Alvarez-Galvez (2016) explored this with data from 29 European countries from the European Social Survey (2002-8). The countries were divided into five groupings based on welfare state regimes - liberal/Anglo-Saxon (eg: UK), social-democratic/Scandinavian, conservative/Bismarckian (eg: Germany), Mediterranean/southern (eg: Greece), and post-communist/eastern (eg: Bulgaria). The key variables were self-rated health, and four measures of SES (eg: occupational status; income).

The relationship between SES and health varied between the five groupings. For example, income was the main determinant of health in the liberal grouping (via age), but occupational status was more important in the social-democratic countries, while educational inequalities influenced health most in southern countries.

increase in schooling age were compared to the cohort experiencing the reform.

Overall, increased schooling reduced mortality by 3% for men, but no change for women. The authors speculated about the reason for the findings: "Men are traditionally overrepresented in blue-collar jobs. After the compulsory schooling reforms, they might have found white-collar jobs instead and are therefore, less exposed to hazardous working conditions" (Gathmann et al 2015 pp80-81).

Earlier 20th century reforms in schooling had a greater effect on mortality than later changes. Gathmann et al (2015) argued that this may explain the contradictory findings from other studies above.

The most striking individual country was Belgium where compulsory schooling was increased by five years in 1919, and mortality was reduced by about 5% overall.

Li and Powdthavee (2015) focused on the increase in compulsory schooling in Australia, and found consequent improvements in some health habits. In the early 1900s school-leaving age was set at fourteen years old, and raised to fifteen just after World War II. The health behaviours covered were diet, drinking alcohol, exercise, and smoking.

Longer schooling was associated with better diet, more regular exercise, and moderate alcohol consumption in adulthood, but had no effect on avoiding smoking.

The demand-for-health model (Grossman 1972) argues that more schooling "leads to more efficient use of a given set of health inputs by improving decision-making abilities (productive efficiency) and improving the 'allocative efficiency' among various health inputs by increasing a person's ability to acquire and process health information" (Li and Powdthavee 2015 p83).

Fletcher (2015) found that increased schooling in the USA improved, in particular, self-reported health, heart attacks, and BMI using data from a survey of over half a million 50-69 year-olds in eight states.

Johnston et al (2015) looked at increases in compulsory schooling in the UK [14] and increased health knowledge [15]. The UK Health and Lifestyle Survey (HALS) asked respondents about the main causes of ten common health conditions (eg: high blood pressure, migraine). Data from the 1984-5 and 1991-2 waves of HALS were analysed (ie: over 10 000 18-99 year-olds).

The researchers concluded that "additional schooling

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[14] The minimum school leaving age increased from 14 to 15 years old in 1947 and from fifteen to sixteen years old in 1972 (Johnston et al 2015).

[15] Increased education may improve health knowledge in two ways - through information on the school curriculum (directly) or indirectly through greater skills to access health information (Johnston et al 2015).

does not significantly and directly improve health knowledge. However, it is possible that additional schooling provides skills that allow individuals to better access health information when required and to better process conveyed health information" (Johnston et al 2015 p98).

Some studies have concentrated on specific health benefits of education. For example, Behrman (2015) studied the reduction in adult HIV among young women in Malawi and Uganda based on completion of primary school (appendix 1D). The assumption is that greater knowledge of risks and thus preventative behaviours (eg: condom use) will come with more schooling. Schooling also delays the onset of sexual activity, marriage, and child-bearing (Behrman 2015).
Universal Primary Education runs from 6 to 13 years old in Malawi and Uganda, though many children start late and them and others do not complete, particularly girls. Data on HIV status in both countries were collected in nationally representative surveys in 2010 and 2011.
It was calculated that a one year increase in schooling decreased the risk of testing positive for HIV by 3-6% as compared to not attending that year.

Pre-kindergarten programmes have been linked to improved adult health. Muennig (2015) summarised two in particular in the USA that have been evaluated in the long-term.

i) Perry Pre-School Programme - 123 disadvantaged African-American 3-4 year-olds received two years of special tutoring or not (beginning in 1962). By age forty, the treated children had significantly less unhealthy behaviours than controls (Muennig et al 2009). However, overall health benefits were "less clear" (Muennig 2009).

ii) Carolina Abecedarian Project - 111 very low-income African-American infants received pre-kindergarten tuition or not. The treated children had lower rates of depression, health problems, and hospitalisation as adults than controls (Muennig et al 2011).

1.3.4. Theme 4

Smith-Greenaway (2015) found that literacy [16] specifically was the key aspect of education that

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[16] Literacy is often used interchangeably with educational attainment, but in low-income countries, this may not be so because of varying quality in education. Self-reports of literacy can be better, if direct testing is not possible (Smith-Greenaway 2015).

influenced adult health in a study in southern Malawi. Around 1500 15-25 year-olds were interviewed in 2009 and two years later. Directly assessed literacy [17] predicted self-rated health, and prolonged sickness (longer than five days). An increase in one unit of literacy skills (on a four-point scale) was associated with 16% higher odds of better self-rated health and 25% lower odds of prolonged sickness.

Using data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) from 2002 to 2011, Luo et al (2015) identified three underlying mechanisms between educational attainment and mortality. These were other socio-economic attainments (eg: higher status occupation; higher income), more supportive social relationships and activities (eg: gaining increased sense of personal control; more psychosocial resources), and positive health behaviours (eg: more exercise; not or quitting smoking).

The CLHLS includes over 65s in randomly selected areas in twenty-two provinces in mainland China (over 16 000 respondents). Overall, education negatively correlated with mortality. There were gender differences, however: "while men with primary education have lower mortality risk than men without education, women with primary education are not significantly different from women without education. This gender pattern holds for both the young old and the oldest old. The lack of health benefits of a primary education for older women is puzzling and deserves more research in the future" (Luo et al 2015 p140).

Lower educational attainment predicts risk of coronary heart disease (CHD). Along with unhealthy lifestyle, the underlying mechanism proposed is that lower socio-economic status, as a consequence of less education, produces physiological stress reactions (sometimes called "allostatic load") which increases the risk of CHD (Groffen et al 2015).

Groffen et al (2015) hypothesised that this relationship would be seen in higher cortisol levels in lower educated individuals. They used data from the Age Gene/Environment Susceptibility (AGES)-Reykjavik Study in Iceland, which covers a cohort of around 20 000 inhabitants of the capital born between 1907 and 1935.

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[17] An individual was shown a picture with five sentences beneath it. They had to read aloud the sentences and then choose the one that described the picture. For example, a picture of a girl dancing while two boys playing drums with the sentences: "the boys are dancing together", "the girl is playing the drum", "the children are singing", "the girl is dancing and the boys beat the drums", and ""the girls and boys are dancing together". The responses were scored as "no reading skills" (1), "some reading skills and some comprehension" (2), "some reading skills and full comprehension" (3), or "full reading skills and full comprehension" (4) (Smith-Greenaway 2015).

The study began in 1967, and data on 5700 individuals between 2002 and 2006 were analysed by these researchers.

The hypothesis about cortisol was not supported, though individuals with less education had a 46% higher risk of CHD than those with more education.

1.3.5. Theme 5

Liu et al (2015) showed that education influenced lifestyle which interacted with the genetic risk of obesity and type 2 diabetes. The genetic risk of these conditions can be modified by quality of medical care, type of food eaten, level of stress, and amount of physical activity, all of which are influenced by education.

Data from the Health and Retirement Study (HRS) in the USA were used. It is a biennial survey of a nationally representative sample of over 50s began in 1992. In 2006 and 2008 DNA samples were also taken. The current study used the data from over 8000 non-Hispanic Whites.

More years of schooling offset the genetic risk of the two conditions. This fits with the social trigger model (Shanahan and Hofer 2005) - ie: "certain types of inherited health risk may be responsive to social environments and become more readily apparent under specific circumstances" (Liu et al 2015 p155).

Boardman et al (2015) also analysed data from the HRS (over 4000 non-Hispanic Whites), but to explore whether "it is possible that some of the association between education and health is due, in part, to common genetic influences. In particular, pleiotropic effects, the effect of a single gene on multiple traits, could lead to a form of omitted variable bias in estimates of causal effects if genes are ignored in studying the relationship between education and health" (Boardman et al 2015 p171) [18].

Boardman et al (2015) made the following assumptions based on previous work:

• Educational attainment is moderately heritable (eg: 40%

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[18] Boardman et al (2015) distinguished between "mediation pleiotropy" and "biological pleiotropy". They stated: "Assuming for the present that improved education is a cause of better health, mediation pleiotropy would imply that a genetic region affects health solely through that region's impact on education. That is, the gene influences education directly and health only indirectly. In this scenario, a causal analysis of the effect of education on health would not suffer from omitted variable bias if it ignored genotype since the effect of genotype on health is captured by controlling for education. On the other hand, biological pleiotropy (in which a common gene is directly influencing both education and health), poses a greater threat to causal inference, since a failure to control for genotype in causal analyses will often lead to omitted variable bias" (Boardman et al 2015 p178).

of difference between individuals in number of years of schooling completed is attributed to genetic variance).

- Health outcomes are moderately heritable (eg: 40% of difference between individuals for self-rated health, and depression, and 75% for BMI).

It was found that some of the correlation between depression and education, and between self-rated health and education (but not BMI and education) "is due to common genetic factors associated with one or both traits" (Boardman et al 2015 p171). Put another way, it was shown that "low education and poor mental health and poor self-rated health as they co-occur within certain individuals can be partially explained by genetic similarity" (Boardman et al 2015 p178).

Cook and Fletcher (2015) reported a similar type of study, but looking at the interaction between a variant of a gene for Alzheimer's Disease and education in terms of cognitive decline. They stated that "the likely mechanisms of education are most consistent through changing brain processes (ie: 'how we think') and potentially building cognitive reserves, rather than alleviating old age cognitive decline through the channels of higher socio-economic status and resources over the life course" (Cook and Fletcher 2015 p159) [19]. This conclusion was based on data from the Wisconsin Longitudinal Study in the USA, which has followed a groups of individuals graduating high school in Wisconsin in 1957. Siblings were added to the study subsequently. Cook and Fletcher (2015) used data from the 2011 wave on 467 sibling pairs (ie: one sibling was more educated than the other) [20].

1.3.6. Theme 6

Amin et al (2015a) questioned the causal relationship between education and health referring to confounding effects of unobserved genetic and social endowments (eg: parental/own preferences, abilities, and cognitive functioning). One way to overcome these factors is the comparison of identical (monozygotic; MZ) twins (within-MZ design) with different schooling. Both twins share the same genetic make-up and family-rearing

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[19] "Education may enhance future health through the acquisition of financial and social resources that are important for maintaining health (eg: income, health insurance, strong peer networks) and/or it may enhance future health through structuring and restructuring brain development and activity that is helpful for health and wellbeing" (Cook and Fletcher 2015 p159).

[20] Fletcher and Frisvold (2009) used sibling data to show that the more educated sibling is more likely to use multiple types of preventive health care.

environment, and so the difference in schooling's effect on adult health can be isolated [21].

The limited number of studies using this method have produced mixed results (Amin et al 2015a). But samples tend to be small as there are not that many twin pairs where schooling varies [22].

This led Amin et al (2015a) to include information from three twin datasets in the USA:

• Mid-Atlantic Twin Registry (MATR) - twins in Virginia, and North and South Carolina.

• Minnesota Twin Registry - all twins born in 1936-55 in Minnesota.

• NAS-NRC Twin Registry of WWII Military Veterans - White male twins born in 1917-27 who served in armed forces.

Overall, there was "almost no association between schooling and adult health once unobserved confounders were controlled" (Amin et al 2015a). Only self-rated health was associated with education. So, "the links between education and health are either significantly reduced, or completely eliminated, using the within identical twins approach" (Boardman and Fletcher 2015).

Amin et al (2015a) used a mixture of data. For example, self-rated health was measured on a five-point scale by MATR in response to "how would you rate your health in the past twelve months", and to "how would you rate your health at the present time" by the Minnesota Twin Registry.

Using the within-MZ design with data from the Chinese Adults Twin Survey (CATS), Behrman et al (2015) found that more education was associated with better mental health, less smoking and overweight. The CATS covers twins in five cities in 2002.

This study and others like it are using data that has been collected by other researchers with different purposes in mind. Thus, it does not include all measures that would be interesting to these researchers (eg: blood

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[21] However, MZ twins are not necessarily identical in every aspect. For example, Raj et al (2010) reported female MZ twins who were raised together, but had differences in behaviour/characteristics (phenotypic variation). The researchers "attribute this phenotypic variation to stochastic processes outside of the two 'fixed' genetic and environmental components. They show epigenetic differences in response to otherwise random variation that may have important implications for health, longevity, and other measures of fitness" (Boardman and Fletcher 2015 p199).

[22] A smaller sample reduces the precision of the estimate of heritability of a behaviour or characteristic. "That is, a comparably sized coefficient may be rendered statistically indistinguishable from zero simply because the reduction in sample size inflates the standard error. Thus, the risk of type II error may be enhanced simply because of the reduction in sample size" (Boardman and Fletcher 2015 p199).

pressure). "Moreover, the available indicators may be subject to measurement error. If any measurement error is random, it does not bias the estimates though it may increase imprecision. If measurement error is systematic, such as would be the case if more-schooled respondents report greater health problems for a given objective health status, the absolute values of the schooling-health associations are downward biased in both the cross-sectional and within-MZ estimates" (Behrman et al 2015 pp195-196).

The within-MZ design is not the same as a randomised controlled trial because each twin cannot be randomly assigned to different levels of schooling. The following assumption is required, Boardman and Fletcher (2015) stated: "We would need to believe that any within-twin differences in schooling are as-good-as (conditionally) randomly determined; they are uncorrelated with any unobserved (to the researcher) within-twin factors (eg: motivation, time preference, etc) that might be related to both health and educational outcomes" (p199).

Amin et al (2015b) countered: "No empirical method is assumption-free. Randomised controlled trails (RCTs) are thought to be gold standards, but have limitations... RCTs of schooling do not exist and would be challenging and perhaps unethical. RCTs of schooling determinants exist, but they permit obtaining estimates of causal impacts of schooling only under assumptions that such factors work only through schooling even though there may be, eg: effects through resources or attitudes" (p201).

Other issues with the use of MZ twins include that twins may be treated differently to singletons, and that a co-twin may adjust their behaviour to the other co-twin (ie: "a twin's educational achievement and attainment may have direct causal effects on her co-twin's achievement, as is sometimes found in the peer effects literature on classmates"; Boardman and Fletcher 2015 p200). This is classed as a spillover or interference across observations. So, "if twins seek to differentiate/rebel against one another in educational attainments, the twin-differenced results will be biased upward but if twins conform to each other, the results of within-twin difference empirical exercises will be biased downward" (Boardman and Fletcher 2015 p200).

Furthermore, twins are a small sub-sample of the general population, and those on twin registers may be even more unrepresentative (eg: military veterans) (Boardman and Fletcher 2015).

1.4. APPENDIX 1A - OBJECTIVITY

Sen (1994) distinguished "positional objectivity" as "acceptance and extensive use of variability of

observations with the position of the observer" (quoted in Kleinman 1997), and "transpositional objectivity", which builds on it. "Subjectivity, in contrast, pertains to the inward looking nature of subjective judgments and to interpersonal variance" (Kleinman 1997 p71).

Applying the ideas to health and disease, establishing absolute objectivity is not possible, and so comparisons between groups is limited. Berger and Luckmann (1967) emphasised the social construction of reality, and so objectivity is "at least in part, a projection of internalised but socially derived categories onto the external world, where they are 'felt' to be 'objective' structures of reality, because personal experience, through a grand tautology, does indeed match public definition" (Kleinman 1997 p78).

Kleinman (1997) used the example of chronic fatigue syndrome: "Are we talking about the same thing when we observe the fatigue noted by an otherwise healthy long-distance runner with post-viral syndrome; a middle-class single father in a North American suburb with chronic fatigue syndrome associated with grieving for a dead wife; a desperately poor mother of six malnourished children living in a hovel in a favela in north-eastern Brazil who has experienced chronic starvation; or an elderly man who has struggled with the disabling lifetime effects of childhood polio, to which his body is now giving in?" (p74).

1.5. APPENDIX 1B - OSCAR WINNERS

Redelmeier and Singh (2001) used the list of nominees for seventy years up to the 21st century, and matched winners and losers based on age, and non-nominated controls were also included (eg: actors in the same film as the winner). The overall life expectancy was 3.9 years greater for winners (n = 235) over unsuccessful nominees (n = 527), and 5.9 years for winners over controls (n = 887).

Sylvestre et al (2006) pointed out that treating a winner as such throughout their lives is an "immortal time" bias (Walker 1991) [23]. In other words, if the status of winning an Oscar improves life expectancy, then it occurs after the win and does not include the period before that. Taking this bias into account, Sylvestre et al's (2006) reanalysis of the data reduced the life expectancy differences to statistically non-significant figures (eg: one year between winners and non-winners).

The way to overcome the "immortal time" bias is to

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[23] van Walraven et al (2004) called it a "'baseline immeasurable' time-dependent variable", Zhou et al (2005) "survival bias", and Glesby and Hoover (1996) as "survivor treatment selection bias".

"start the clock" at the point of winning. Abel and Kruger (2005) did this in a study of former baseball players inducted into the Baseball Hall of Fame in the USA. Post-induction survival for inductees was five years shorter than for non-inducted players (mean 18 vs 23 years). The researchers compared 143 players inducted into the Hall of Fame while alive (up to 2002) to 3430 age-matched players.

Redelmeier and Singh (2006) updated their data to March 2006, and still found the advantage for Oscar winners. They did admit, however, that "the survival advantage depends on the analytic method chosen".
Goodman and Sax (2006) summed up the debate: "The central issue is how best to analyse a sudden change in risk due to some life event (becoming ill, starting a high-risk behaviour, or starting a treatment). In this case, the event is a salutary one: winning an important prize. The question is exactly when to 'start the clock' in assessing whether the prize changes the winner's subsequent risk profile, and how to do that analytically" (p392).

1.6. APPENDIX 1C - LIFETIME SOCIO-ECONOMIC STATUS

Higher lifetime socio-economic status (SES) is associated with better health. However, the protective nature of higher SES is not the same across ethnicity or gender. Furthermore, SES can vary across the lifespan.
Walsemann et al (2016) explored four theories of SES and health (figure 1.1):

i) Sensitive period - SES at a key period in life (usually early years) has the greatest impact on later health, though subsequent experiences can reverse or modify the impact.
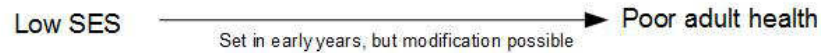
ii) Pathways model - The SES during childhood and adolescence sets an individual on a pathway to continued advantage or disadvantage that impact adult health.

iii) Accumulation model - Multiple periods of advantage or disadvantage over the lifespan based on SES impact health.
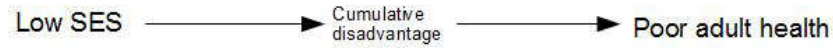
iv) Social mobility - Though early SES is important, later changed SES can be more influential for health.

Walsemann et al (2016) used data from the National Longitudinal Study of Adolescent and Adult Health (Add Health) in the USA with these theories, concentrating on 2008 data, ethnic and gender differences, and cardiovascular disease (CVD). SES was measured by a
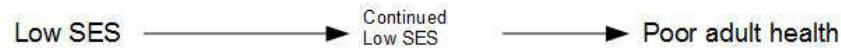
Sensitive period model

Low SES $\longrightarrow$ Poor adult health
Set in early years, but modification possible

Pathways model

Low SES $\longrightarrow$ Cumulative disadvantage $\longrightarrow$ Poor adult health

Accumulation model

Low SES $\longrightarrow$ Continued Low SES $\longrightarrow$ Poor adult health

Social mobility model

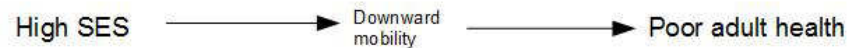High SES $\longrightarrow$ Downward mobility $\longrightarrow$ Poor adult health

Figure 1.1 - Relationship between low SES and poor health according to four models.

combination of income level and poverty, occupation, and educational qualifications of the family and the individual.

Evidence was found to support all four theories, but the support varied based on ethnicity and gender. These differences included:

a) White men - eg: "upwardly mobile white men did not receive a health benefit from their upward mobility and actually reported higher CVD risk than consistently disadvantaged white men. Conversely, downwardly mobile white men continued to receive a health benefit from living in high SES families during adolescence" (Walsemann et al 2016 p153).

b) White women - all four theories supported.

c) Black men and women - no support for any of the four theories. "The fact that there were no resultant health benefits of upward mobility for black men or women in terms of lowered CVD risk points to the very real possibility that chronic life course exposure to racism is not easily overcome through hard work and places black men and women at significant early adult CVD risk" (Walsemann et al 2016 p153). Note that "race related stressors" were not measured.

d) Latino women - the pathways model most supported by data.

e) Latino men - life course SES unrelated to CVD risk.

Salway et al (2016) found that policies to reduce health inequalities based on ethnicity in the National Health Service (NHS) in England were marginalised. The researchers stated that "ethnic equity was a peripheral concern within national healthcare policy; poorly aligned with other more dominant agendas. Locally, consideration of ethnicity was often treated as a matter of legal compliance rather than integral to understanding and meeting healthcare needs" (Salway et al 2016 p102). These findings were based on interviews with managers in the NHS in 2010-12.

Connell (2007) argued that those in power are indifferent or resistant to marginalised populations.

1.6.1. Theory

Researchers have distinguished "downstream factors" (eg: individual behaviours, health policy) and "upstream factors" (eg: socio-economic structure of society) in the relationship between SES and health (Oversveen et al 2017). The latter are the "causes behind the causes" (Marmot 2006).

Oversveen et al (2017) offered alternative theories of health inequalities, including:

- Cultural-behavioural - differences in health-related behaviours between social classes explain overall health inequalities.

- Materialist - income (and what that accesses) determines health inequalities.

- Psychosocial - stress from position in the social hierarchy influences biology and consequently health.

- Life course - accumulation of inequalities over the lifespan.

Oversveen et al (2017) argued that Gidden's (1984) structuration theory is helpful as it combines "actor's practices, social systems and structure". "Rather than conceptualising SES or social determinants as determining causes existing outside and prior to human action, research on health inequalities could focus on how social determinants are produced by human practices structured by general patterns of power and inequality. Utilising Giddens' structuration theory in empirical research entails paying attention to how people's practices

produce and reproduce the environments in which they live and work, how these practices are embedded in nested social systems of varying size and complexity, and how they are enabled and constrained by virtual structural orders of rules and resources" (Oversveen et al 2017 p107).

Add to this the ideas of neo-materialist theory (eg: Latour 2005), which "move away from the tendency to see social structure, resources and agency as fixed entities and instead argue that these phenomena should be understood as emergent properties arising from the complex interaction between populations of diverse materials" (Oversveen et al 2017 p108). Thus, SES, health and even the relationship between them would be seen as more dynamic and fluid (Oversveen et al 2017).

1.6.2. Defining Social Class

Social class (or SES) is often based on occupation [24], but Savage (2016) noted problems with this measure, including:

i) In some parts of the world, formal employment or employment outside the home is less common. Individuals who are unemployed, retired, disabled or economically inactive do not fit into this model.

ii) Different economic classes are lumped together – eg: "professions" includes doctors and lawyers. Weeden and Grusky (2012) argued for "microclass" to distinguish between such occupations.

iii) Occupational status and income/wealth do not necessarily go together.

An alternative approach to social class is the "capitals, assets and resources" (CARs) perspective (Bourdieu 1984). This sees class as "an emergent property of different 'capitals' – these allow people to accumulate resources over time so that their relative advantages over others rise" (Savage 2016 p477). The three main "capitals" are economic, cultural, and social.

Economic capital is income and wealth [25], while

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[24] Feminists, for example, have argued that this "occludes the more complex ways that class operates symbolically and culturally, through forms of stigmatisation and marking of personhood and value" (Savage et al 2013 p222).

[25] Milanovic (2016) commented on terminology - eg: income inequality is different to poverty, and income covers earnings which is different to wealth ("the sum of all marketable goods currently owned"). Income inequality is often measured by the Gini coefficient, which compares each individual's income with every other individual in the population. A Gini coefficient of 0 means that all individuals have the same income, whereas 1 means all the income of the population belongs to one person.

cultural capital covers "cultural" experiences, like listening to classical music, which for children introduces abstract ideas and concepts that benefit in educational success. Social capital refers to relationships that give individuals an advantage (eg: "old school tie" system) (Savage 2016).

Criticisms include that "conflating class with cultural and social dimensions leads to imprecision" (Savage 2016 p478).

Based on a survey run by the BBC (with over 160 000 respondents), Savage et al (2013) distinguished seven classes in the UK today (table 1.2):

- Elite (6% of population) - eg: chief executives, barristers and judges, directors.

- Established middle-class (25%) - eg: electrical engineers, police officers, professionals.

- Technical middle-class (6%) - eg: aircraft pilots, physical scientists, higher education teachers.

- New affluent workers (15%) - eg: postal workers, plumbers, housing officers.

- Traditional working-class (14%) - eg: van drivers, electricians, secretaries.

- Emergent service workers (19%) - eg: bar staff, chefs, customer service operatives.

- Precariat (Standing 2011) (15%) - cleaners, care workers, cleaners.

Savage et al (2013) concluded: "our new model of class offers a powerful way of comprehending the persistence, yet also the remaking of social class divisions in contemporary Britain. Our multi-dimensional analysis reveals the polarisation of social inequality (in the form of an elite and a precariat), and the fragmentation of traditional sociological middle and working-class divisions into more segmented forms" (p246).

Class	Economic	Social	Cultural
Elite	Very high	High	Very high highbrow
Established middle-class	High	High	High highbrow
Technical middle-class	High	Very high	Moderate
New affluent workers	Moderate	Poor	Moderate highbrow
Traditional working class	Poor	Low	Low highbrow
Emergent service workers	Poor	Moderate	Low highbrow
Precariat	Poor	Lowest	Lowest

(Based on Savage et al 2013 table 5 p230)

Table 1.2 - Seven classes and types of capital [26].

1.6.3. Structure and Bourdieu

Crammond and Carey (2017) noted: "It is now well understood that many of the most powerful influences on health are 'structural' in nature; that is, they derive from the social, economic and political structures and are beyond the control of most (if not all) individuals... The precise conceptualisation of structure and its deployment within public health discourses remains, however, contested" (p85).

The individual's position in the social structure is based on their position in the hierarchies of income level, occupational status, and educational level, say, and this influences proximal or intermediate causes of ill health, like tobacco smoking. This is the neo-Weberian conception or "fundamental causes account" (Crammond and Carey 2017). But this does not "reveal the social mechanisms that explain how individuals arrive at different levels of economic, political and cultural resources" (Solar and Irwin 2007 quoted in Crammond and Carey 2017).

Nor does it explain the differences in health and health-related behaviours within a social class or a social position group (Crammond and Carey 2017). Taking the example of tobacco smoking, there is a clear "social gradient" with smoking and social disadvantage going together. For example, in Australia, 21% of the most disadvantaged quintile (one-fifth of adult population) smoke compared to 5% of the least disadvantaged quintile

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[26] Highbrow cultural capital garners "prestige" or what Bourdieu (1984) called "distinction".

(Crammond and Carey 2017). "That is, since smoking prevalence decreases as disadvantage decreases, disadvantage is deemed as the fundamental cause of smoking inequalities. Whatever the individual reasons a person has for smoking, at a population level the fundamental cause of higher smoking prevalence among the disadvantaged is their lower social position... As a result, reducing economic disadvantage is now described as a public health intervention to encourage smoking cessation" (Crammond and Carey 2017 p88).

But this ignores the fact that 79% of the most disadvantaged quintile do not smoke. For these individuals, it appears they are "making decisions about tobacco smoking that run contrary to the predominant structural conditions: disadvantage is not so much a social determinant of smoking as a weak influence" (Crammond and Carey 2017 p88).

Crammond and Carey (2017) suggested asking something different: "The question for smoking reduction must then be rephrased from, 'Why are disadvantaged people more likely to smoke than those with privilege?' to, 'Why do people in any social position smoke when so many others in that same social position do not?'" (p88).

To answer this new question, Crammond and Carey (2017) referred to Bourdieu's (1984) idea of "habitus" ("internalised form of class condition"), which is highly stable and resistant to change as it is "below the level of consciousness and language, beyond the reach of introspective scrutiny or control by the will" (Bourdieu 1984 quoted in Crammond and Carey 2017). So, individuals who smoke will continue to do so even if they acquire more income, say, and move upwards in the social hierarchy. Smoking as a "habitus-incorporated behaviour" is resistant to change. More proximal explanations of smoking than the position in the social hierarchy include addiction (described by working-class smokers) or aesthetic pleasure (described by middle-class smokers) (Crammond and Carey 2017) [27].

Crammond and Carey (2017) summed up their view: "There are... no fundamental causes of health inequalities, rather there is a complex layer of interrelated and interacting causes... Structure is embodied by the individual, making it futile to construct a hierarchy of influences operating at different distances from the individual. A person's income level is a part of her daily reality and is navigated as such, along with all of her other quotidian concerns" (pp94-95).

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[27] Crammond and Carey (2017) accepted that "Bourdieu's description of habitus does not give due credit to the power of public health interventions to shift habitus and behaviour" (p90).

1.6.4. Reducing Health Inequalities

"Reducing health inequalities involves improving health for the most disadvantaged members of the population to a greater degree than for others... Health strategies have considered resource allocation to be an important mechanism for achieving this differential improvement, if resources that benefit health can be allocated in greater quantities to those population sub-groups who are most in need. Commentators... have argued that simple targeting of the most disadvantaged populations for intervention is problematic. Such an approach fails to recognise the health needs of other sections of the population, some of whom will also be disadvantaged to some degree even if they are not identified as targets for specific interventions" (Egan et al 2016 p42).

"Proportionate universalism" is more resources for all social strata, but "with a scale and intensity that is proportional to the level of disadvantage" (Marmot et al 2010 quoted in Egan et al 2016) (ie: increased benefits with increased needs). Egan et al (2016), however, noted the following problems - "how need or disadvantage is to be defined and measured, the proportion of resource that should be allocated to different need-levels, and the means of ensuring that different allocations of resource reach their intended sub-populations" (p42).

Egan et al (2016) reported a specific example of proportionate universalism in housing in Glasgow begun in 2005 ("GoWell"). Data were collected between 2006 and 2011 from fourteen neighbourhoods at different stages of the housing-led renewal, and these were divided into three groups for analysis (lower, medium, and higher investment).

Modest reductions in area-based inequalities in health were found. In other words, the higher investment group (which included the most deprived areas in 2006) showed a greater improvement in mental health than the other groups by 2011, and less of s decline in self-rated physical health (figure 1.2).

There is the "Glasgow effect", which is "the curious phenomenon whereby inhabitants of Scotland's largest city have substantially higher mortality rates than their counterparts in similar British cities, despite adjustment for factors such as socio-economic status, obesity, smoking, drinking, and drug use" (Shaw 2015 p11). It is an example of exaggerated health inequality with life expectancy differences of up to thirty years between socially disadvantaged and advantaged individuals in the city, while both groups experience worse health outcomes than comparable individuals elsewhere in the UK
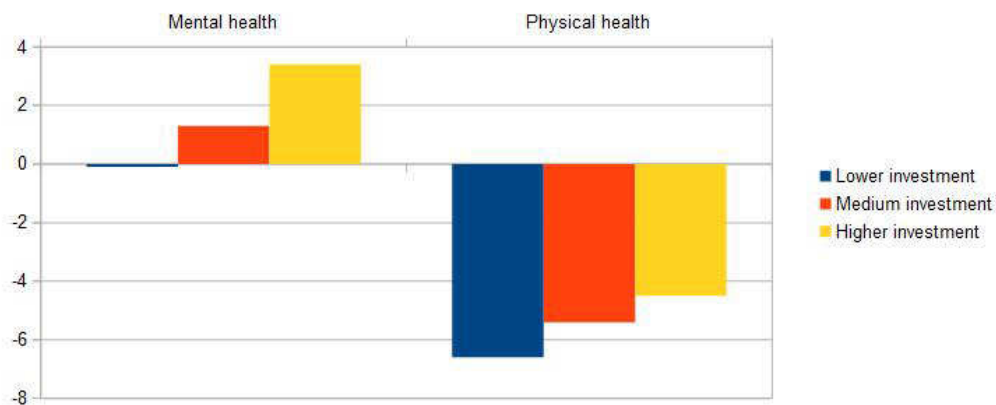
(Based on data from Egan et al 2016 table 3 p45)

Figure 1.2 - Mean changes in self-ratings for mental and physical health between 2006 and 2011 based on housing investment.

(Shaw 2015). In fact, Shaw (2015) argued that there were three "Glasgow effects":

- Health disparities within the city between rich and poor;
- Glasgow poor compared to poor in other cities;
- Glasgow rich compared to rich in other cities.

    Shaw (2015) found "at least seventeen different hypotheses" for the "Glasgow effect", including deprivation, lower "social capital", sectarianism, and poor health behaviours.

    Shaw (2015) explored the ethical aspects of the "Glasgow effect", and specifically whether an individual should move to another city. A number of points were raised:

    a) The "status quo bias" (Bostrum and Ord 2006) "would cause many people living in Glasgow to remain, as many people would be reluctant to leave behind their roots and communities despite any prospective benefit" (Shaw 2015 p12).

    b) The loss of social support networks by moving, and "it is possible that any benefits conferred by avoiding the effect might be outweighed by the disutility of living far from one's (and one's children's) family and friends" (Shaw 2015 p13).

    c) Those who can move will probably be better off,

which will exacerbate the "Glasgow effect" further, "meaning that the worse off in Glasgow are also disadvantaged in terms of being less able to avoid the Glasgow effect" (Shaw 2015 p13).

"Generally, people can take measures to increase their chances of avoiding future disease by living healthy lives. The Glasgow effect is different: we don't know what causes it, so we can't stop it happening, which is unjust" (Shaw 2015 p12).

Health inequalities, then, can be addressed in four ways (Bambra and Gibson 2016):

• "Strengthening individuals" - eg: person-based strategies for health-disadvantaged individuals;

• "Strengthening communities" - ie: improving health-disadvantaged communities;

• Improving the environment for the whole population - eg: reducing health-damaging materials;

• Macro-policy - improving the standard of living of the whole population.

In terms of reducing health inequalities, overviews of systematic reviews had shown the benefits of targeted warmth and energy efficiency interventions in houses, and workplace interventions (particularly for men, lower SES groups, and ethnic minorities), while privatisation and marketisation of health-care systems has no or negative effects (Bambra and Gibson 2016).

Bambra et al (2010) produced a synthesis of systematic reviews on the wider determinants of health (ie: living and working conditions). Focusing on developed countries, they found thirty relevant reviews, which covered seven areas (Bambra and Gibson 2016):

i) Housing and living environment - small improvements in health from work on poor housing (eg: insulation, better heating), and relocation of disadvantaged to better areas.

ii) Work environment - eg: increased control over aspects of the job increased self-reported mental health.

iii) Transport - eg: driver alcohol restrictions, traffic calming, and speed cameras reduced crashes (fatal and non-fatal).

iv) Unemployment and welfare - eg: interventions to promote employment had little impact on health.

v) Access to health services - eg: better SRH with increased access.

vi) Agriculture and food -eg: financial incentives to improve diet led to weight loss and greater fruit and vegetable consumption.

vii) Water and sanitation - eg: no evidence of adverse effects of water fluoridation.

Overall, there was "a lack of evidence about the health impacts of interventions aimed at the wider social determinants of health, which is even greater in relation to health inequalities" (Bambra and Gibson 2016 p356).

1.7. APPENDIX 1D - HIV RISK PERCEPTION

Adolescents' risk perceptions are less accurate than adults (Kim 2016). In relation to the risk of HIV infection, for example, Malawian adolescents overestimated five-fold (Kim 2016).
This type of estimate of risk is influenced by individual factors, like schooling, past sex practices, self-efficacy, and living with chronically ill family members. More widely, the peer group is influential - having peers (social networks partners) with perception of a high risk of HIV leads to the individual having this view (Kim 2016).

But studies often ask individuals about the views of their peers, and there is the possibility of "projection bias". This "occurs when an individual 'projects' his or her own beliefs and behaviours onto others, unconsciously assuming that most people think and behave like him or her. So, individuals may report their own HIV infection expectations twice: once for individual expectations and once for network partners' expectations. This would clearly inflate estimates of the effect that peers' expectations have on individual expectations" (Kim 2016 p62).
Kim (2016), thus, asked the participants themselves about the perceived risk of HIV infection. Probability was presented as a scale from 0 to 100, and the participants pointed to their perceived risk. The participants were 8000 adolescents in Malawi. After statistical analysis, it was calculated that a one-percentage-point increase in expectation of HIV infection among classmates increased the individual's perceived risk by 0.65 percentage points. Male adolescents were more sensitive to others' expectations than females.

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2. THE "WATCHING-EYES" EFFECT AND PRO-SOCIAL BEHAVIOUR

2.1. REDUCING AIR POLLUTION

        Stationary motor traffic with idling engines is "one of the most potent forms of pollution" (eg: particulate matter, carbon monoxide) (Meleady et al 2017). How to encourage drivers to turn off their engines when they will be stationary for more than one minute?
        One possibility is to use the "watching-eyes effect" (or "cues-of-being-watched") (Bateson et al 2006).

        Bateson et al (2006) placed a picture of watching eyes near an honesty box for drinks in a staffroom, and staff paid three times more for their drinks than when a picture of flowers was displayed nearby (table 2.1). Meleady et al (2017) explained: "This is in line with the assumption that humans have evolved to be strongly attuned to cues that their reputation is at stake, because maintaining a reputation as a cooperative person is necessary for survival in a social system... Thus, subtle surveillance cues, such as the watching eyes, can induce co-operative behaviour" (pp2-3) [28].

• Fehr and Schneider (2010) made this criticism: "Subjects often consume coffee jointly and observe whether their colleagues pay for the coffee. In this case the subject's real reputation — and not just its imagined reputation — is at stake. If eye cues draw attention to the moral appropriateness of paying for one's coffee, then this real reputation incentive may be greatly strengthened. Thus, it is possible that the eye cues in the Bateson et al experiment enhanced the already prevailing incentive to maintain one's reputation as an honest coffee consumer" (p1322).

• Carbon and Hesslinger (2011) made the following criticisms:

i) Procedure - Alternating between one week of eyes and one week of flowers over ten weeks did not take account of "contextual and situational specifics", like absenteeism or "idiosyncratic paying

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[28] Powell et al (2012) summarised two explanations for the "watching-eyes" effect:
i) Individuals who break social norms in a group are often punished for such violations, and the presence of eyes is a cue to the possibility of punishment;
ii) A reputation-based partner-choice hypothesis, which argues that "pro-social acts are performed not to avoid punishment but to increase the likelihood of being chosen by others for mutually beneficial transactions in future" (Powell et al 2012 p2).
        Powell et al (2012) admitted that both explanations are plausible together.

behaviour".

ii) Procedure - Only the total amount of money in the honest box was measured, and so it is not clear "who gave how much money how often".

iii) Stimulus material - Participants asked about the "watching-eyes" stimulus reported feeling watched, and also frightened, and in the Carbon and Hesslinger (2011) study [29], both these responses correlated with predicted amount of money put into the honesty box.

iv) Sample - Bateson et al (2006) gave little details, except to say that forty-eight individuals used the coffee facilities. Carbon and Hesslinger (2011) stated: "Consequently, it is not possible to estimate each individual's cash contribution, to investigate participants' behaviour while they were processing the experimental displays, or to test the hypothesis on the degree to which the pictures appear to observe the participant while integrating theories concerning, for instance, typical personality moderators or gender effects. Again, we want to stress that this drawback is commonly encountered in field studies because of the demands of a natural context" (p204).

v) Statistical analysis - Bateson et al (2006) used four statistical tests of difference, and only one of them was significant.

• Carbon and Hesslinger (2011) concluded that the Bateson et al (2006) study "fails to mention important experimental details and control over some essential variables such as the composition of the sample, which makes any kind of replication very difficult from a technical perspective. Taken as a whole, the general idea that eyes can play an important role as social cues is indeed very important, but Bateson et al's (2006) publication does not seem to give the clearest evidence in favour of this idea" (p209).

Table 2.1 - Criticisms of Bateson et al (2006).

Meleady et al (2017) made use of this idea in two field experiments at a busy railway level crossing in a city in southern England. In the first experiment, a black and white picture of a pair of watching eyes was placed near the level crossing, five metres away from the usual local council sign asking drivers to turn off their engines while waiting. Data were collected in one-hour blocks randomly over a six-month period [30]. There was no significant difference in the number of drivers who turned off their engines with the eyes present or not (20 vs 27%).
    This was contrary to expectations, and Meleady et al (2017) tried to explain why: "we conjectured that it may be necessary to provide meaningful direction in addition to the surveillance cues of watching eyes. Typically, watching eyes are presented with an accompanying written

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[29] Carbon and Hesslinger's (2011) own study involved 138 undergraduates at a German university, who read about four different scenarios requiring help (eg: lend class notes to absent student). The reading material included the image of a pair of eyes or flowers. There was no difference in reported willingness to help in the scenarios (on a seven-point scale) based on the image.

[30] This was 216 cars, of which 112 were the control.

instruction. In our case, the sign instructing drivers to turn off their idling engines (placed by the Council) was independent of the image of the eyes, and so, drivers would not necessarily link the two stimuli" (p8).

So, in the second experiment at the same level crossing, the researchers added text beneath the watching eyes - "when the barriers are down switch off your engine" (instructive watching eyes (IWE) condition), and had a condition with text only: "think of yourself: when barriers are down switch off your engine" (private self-focused (PSF) condition) [31].

Data from 325 cars were used - 123 in the IWE condition, 103 in the PSF condition, and 99 in the baseline/control condition (no watching eyes or text). The percentage of drivers who turned off their engines was 30%, 51% and 20% respectively. So, drivers were nearly five times more likely to switch off the engine in the PSF condition as compared to the baseline, and nearly twice as likely in the IWE condition compared to the baseline. "These findings reinforce the importance of engaging the self in behaviour change, but beyond this suggest that when behaviour is not easily publicly observable, it may be most effective to stimulate private rather than public self-focus" (Meleady et al 2017 p12).

The studies also showed that the usual local council sign was not effective as well as a simple picture of watching eyes.

The two field experiments had the following limitations:

i) No measure of whether the drivers paid attention to the signs.

ii) The watching eyes could only be seen by some drivers (based on the length of the queue of traffic).

iii) The outcome measure of engine on or off was measured by a research assistant walking around. This may have influenced the drivers' behaviour.

iv) Being a field experiment the researchers had less control over confounding variables than in a laboratory experiment - eg: presence of pedestrians at the level crossing. "It is not known whether a static image of watching eyes is more or less likely to activate reputational concern than transitory and moving people,

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[31] Self-regulation theory (Carver and Scheier 1982) proposed that individuals will perform habitual behaviour unless "(a) a different behavioural standard is made salient and (b) their attention is directed to an assessment of whether they are complying with that standard" (Meleady et al 2017 p8). The latter can be achieved by relating the behaviour to the self.

some of whom might glance in a driver's direction. It could be argued that, in the presence of real potential observers, the effects of the images of eyes may become either more or less important" (Meleady et al 2017 p13).

v) Watching eyes and the "think of yourself" text were not combined in another condition.

vi) Only car driver's behaviour was measured because, for example, bus drivers were instructed by their companies to turn off the engine.

vii) Data were collected by at least six different university research assistants.

viii) The outcome measure was binary (engine on or off), but there was room for graduated scoring (eg: turn off engine immediately), though this would have been difficult to measure in practice in a long queue of traffic.

ix) The statistical analysis controlled for weather, duration of barrier down, number of people in the car, and time of day. These were relatively easy to observe, but other factors were not recorded (eg: mood of driver; attitudes towards environment and pollution; local knowledge about length of time barrier down).

x) Data were collected only in university term time, and between October 2012 and March 2013, on Mondays to Saturdays, and between 8 am and 6 pm in one-hour blocks.

## 2.2. OTHER FIELD EXPERIMENTS

1. Bicycle theft

Nettle et al (2012) placed signs featuring a black and white image of a pair of male eyes close to three bicycle racks with high rates of theft on the campus of a university in north-east England (figure 2.1).
There were thirty-nine reported thefts in the twelve months before the sign, and 15 in the year with the sign, while the number of reported thefts increased at control sites (from 31 to 51) (figure 2.2). The researchers admitted: "Unfortunately, the reduction was almost exactly offset by an increase in thefts from the rest of the campus, suggesting that the principal effect of the signs was to displace offending from their immediate vicinity" (Nettle et al 2012 p3).

(Source: Nettle et al 2012 figure 1)

Figure 2.1 - The sign used and an example of the place posted.
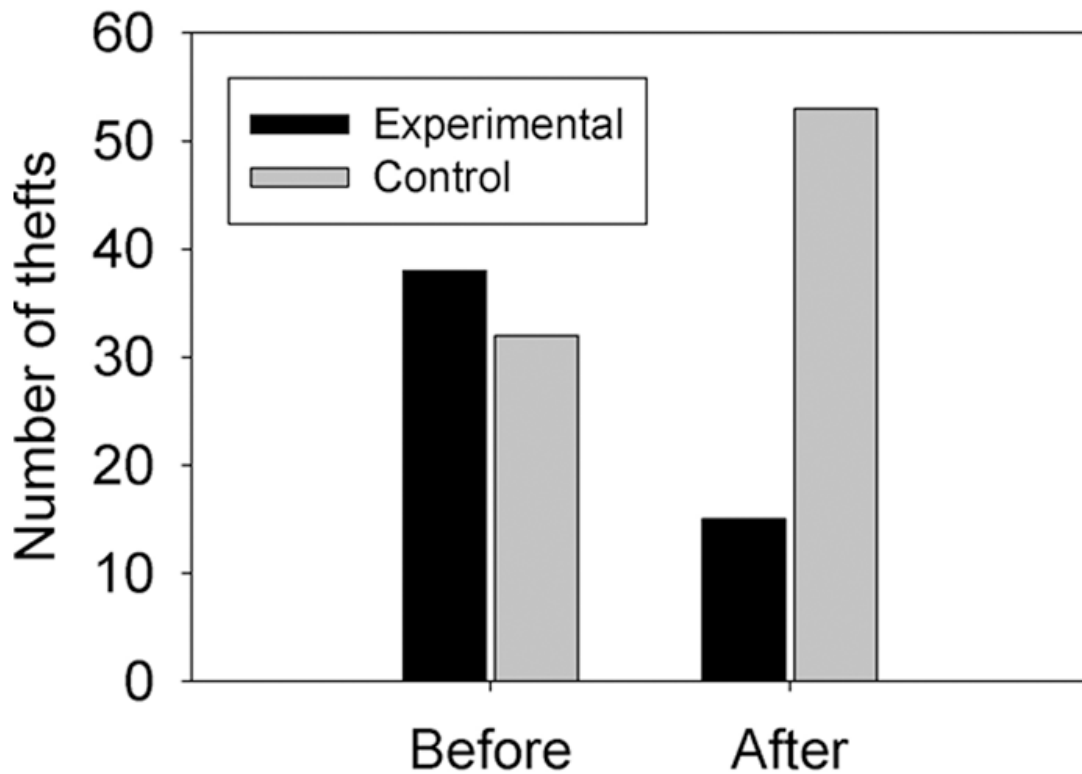
(Source: Nettle et al 2012 figure 2)

Figure 2.2 - Numbers of notified bicycle thefts in the 12 months before and after use of the sign.

    2. Use of litter bins

    Francey and Bergmuller (2012) placed two litter bins at fourteen different bus stops in Geneva (figure 2.3), one for plastic and the other for paper rubbish, and in each case left two empty plastic bottles and a newspaper

on the seats. A sign stating that litter should be thrown
away was attached to a picture of one of five pairs of
eyes or pictures of flowers (figure 2.4).
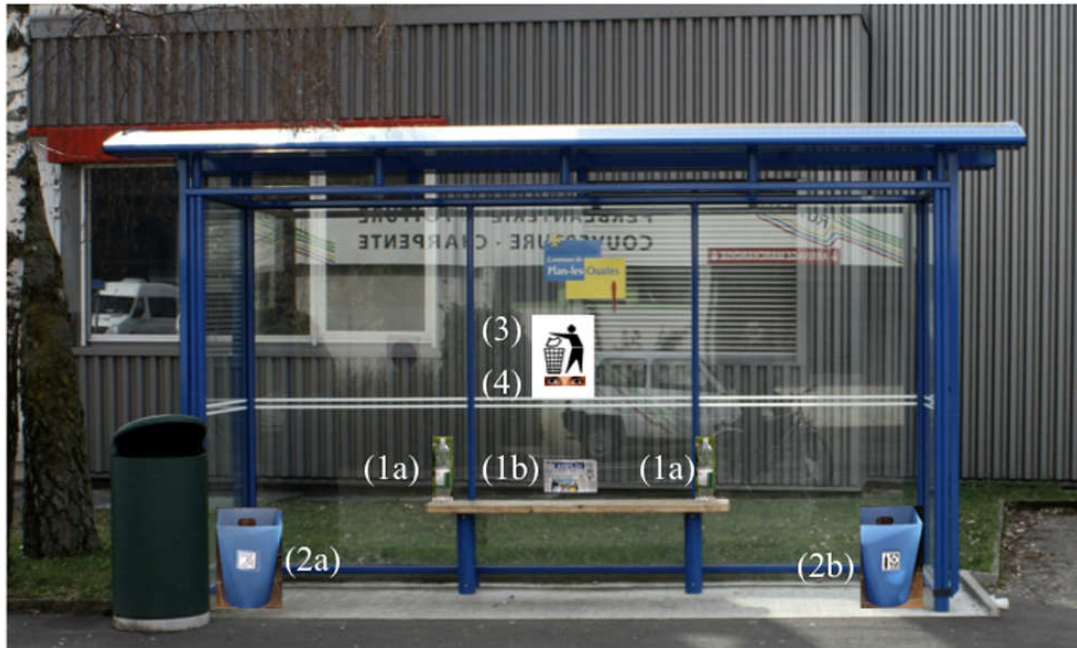
(1a = 2 pvc bottles; 1b = one newspaper; 2a = litter bin for plastic; 2b = litter bin
for paper; 3 = sign to throw litter away; 4 = picture of eyes or flowers)

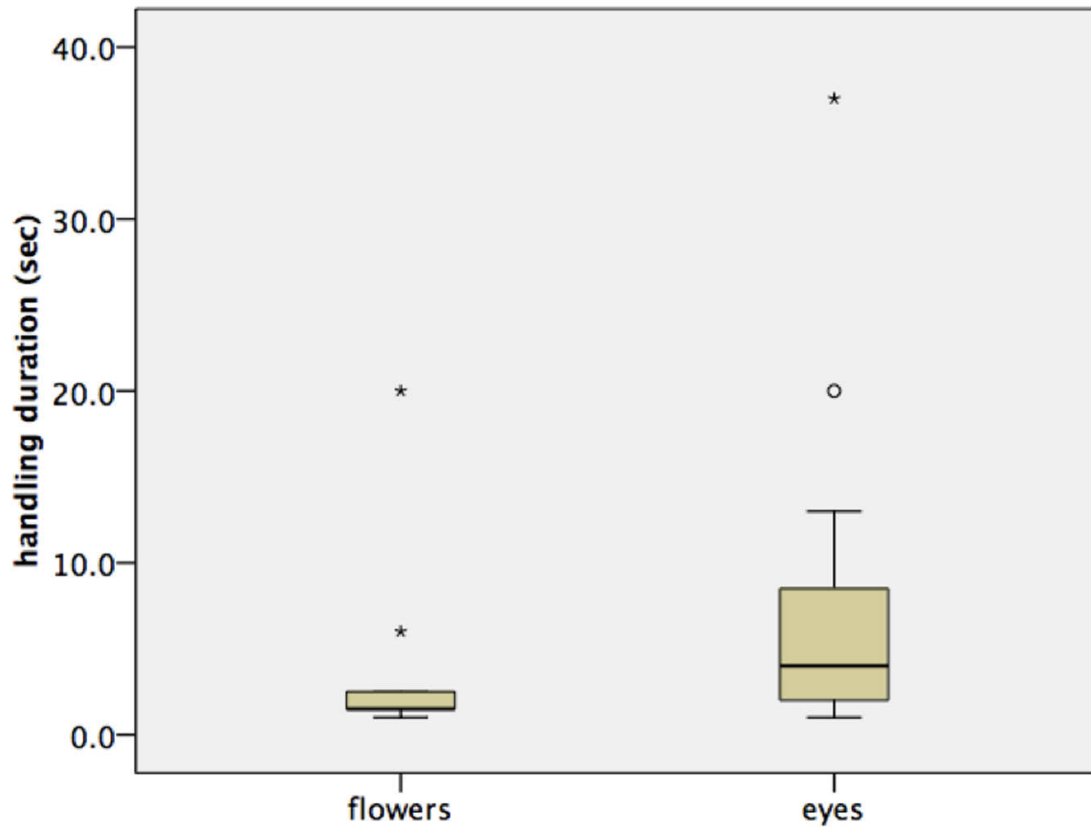(Source: Francey and Bergmuller 2012 figure 1)

Figure 2.3 - Photograph of experimental set-up.

(Source: Francey and Bergmuller 2012 figure 2)

Figure 2.4 - Pictures of eyes and flowers used.

The likelihood of parting the rubbish in the correct bin did not very between conditions, but observed individuals who did handle the litter spent about twice as much time doing so in the presence of the eyes than flowers (figure 2.5).


(Source: Francey and Bergmuller 2012 figure 3)

Figure 2.5 - A boxplot of the mean time spent handling litter by individuals who did handle it.

3. Littering and social norms

Using the same bicycle racks as Nettle et al (2012), Bateson et al (2013) attached safe cycling leaflets to the bicycles (figure 2.6). The researchers manipulated the presence of "watching eyes" and the amount of litter nearby to give four experimental conditions (table 2.2).

|	LITTER	NO LITTER
WATCHING EYES	1	2
NO WATCHING EYES	3	4

Table 2.2 - Four experimental conditions in Bateson et al (2013).

A

B
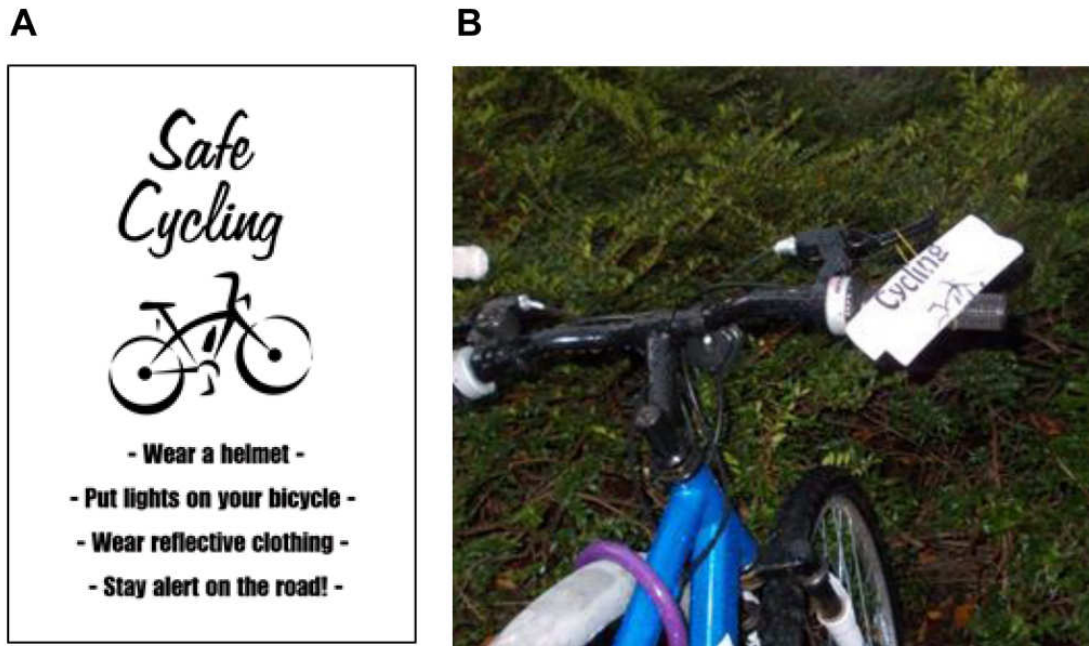
(Source: Bateson et al 2013 figure 2)

Figure 2.6 - Leaflet and attachment to cycle.

A total of 620 individuals were observed. Dropping the leaflets as litter was more common in the presence of litter and no "watching eyes" (figure 2.7). So, "images of watching eyes work by making people behave more normatively as opposed to universally more pro-socially" (Bateson et al 2013 p7).
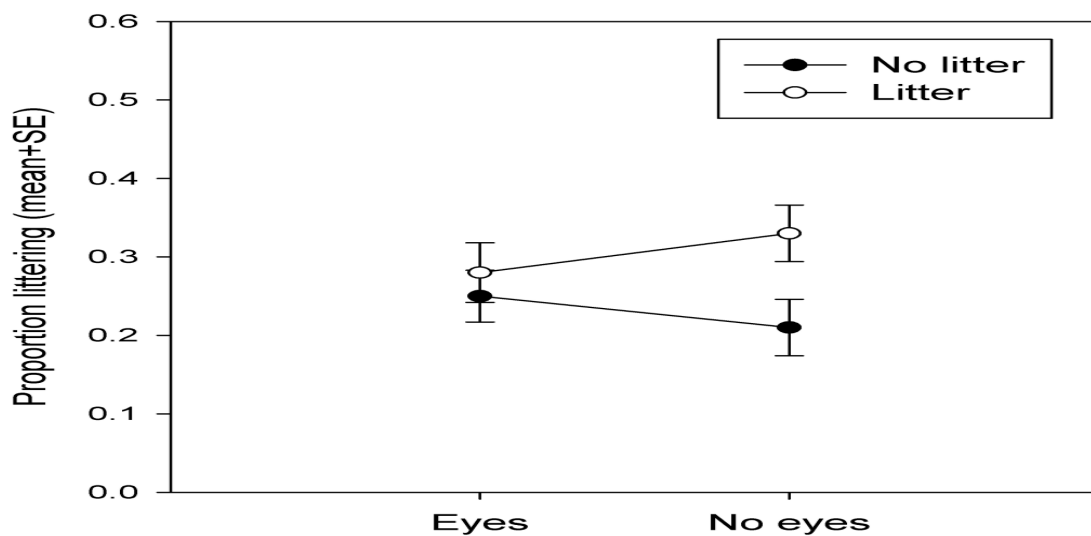
(Source: Bateson et al 2013 figure 3)

Figure 2.7 - Proportion of participants littering in each condition.

4. Pro-social behaviour

Ernest-Jones et al (2011) used the pictures of eyes or flowers (as in other experiments) with messages in a self-clearing cafeteria at a UK university. The message attached to the picture was also varied - "Please place your trays in the racks provided after you have finished your meal" or "Please only consume food and drink purchased on these premises". The outcome measure was the tray or litter left on a table.

Data were collected on thirty-two days in 2008-9, with a total of 562 tables in the analysis. Significantly less litter/trays were left on tables with "watching-eyes" than flowers pictures, and the most effective was the "watching-eyes" and the message to clear tray away.

5. Charity donations

Powell et al (2012) placed charity buckets for donations at checkouts in supermarkets in north-east England for an eleven-week period in 2012. Half the buckets had a pair of cartoon eyes on the top and the other half had three geometric stars.

Nearly 50% more was donated in the buckets with eyes (in total over £180 more). The level of donation also varied with the busyness of the supermarket. "When the supermarket was busy, donations to the control-image buckets were relatively high and the eye-images effect was 28% over the control images. When the supermarket was quiet, donations to the control-image buckets were lower and the eye-images effect was 59%" (Powell et al 2012 p4).

2.3. LABORATORY EXPERIMENTS

1. Sharing

Haley and Fessler (2005) recruited 248 undergraduates at a Californian university to play a sharing game called the "dictator game" (DG) on the computer. In pairs, individuals are randomly assigned to be the allocator ("dictator") or receiver. The allocator is given a sum of money ($10) and has 20 seconds to decide how they wanted to share it with the receiver. The players were in a large computer room, so they did not know directly who they were playing with.

The researchers manipulated two variables (silence and eyespots) to give five conditions:

- Silent/no-eyes - Silence was achieved by playing the DG wearing earmuffs, and no-eyes involved a word displayed at the bottom of the computer screen;

- Non-silent/no-eyes (control condition) - No earmuffs worn;
- Silent/eyespots - Eyespots were displayed at the bottom of the screen;
- Non-silent/eyespots;
- Non-silent/skewed eyespots - The eyespots were "not in the same horizontal plane, creating a less face-like image" (Haley and Fessler 2005).

It was predicted that silence would enhance the focus on the individual and thereby reduce the amount given by the allocator, while "the stylised eyespots were expected to provide cues of the presence of observers, thus leading to increased allocations. Because eyes facing in one's direction are a more direct cue that one is under observation than are noises made by others in one's vicinity, we expected eyespots to have a greater absolute impact on allocations than earmuffs would" (Haley and Fessler 2005 p251).

The mean allocation was highest in the non-silent/eyespots condition ($3.79), and the lowest was $2.32 in the silent/no-eyes condition, with $2.72 in the silent/eyespots condition. In the control condition, $2.45 was the mean and $3.00 in the skewed condition. The findings, thus, confirmed the predictions of the researchers.

Rigdon et al (2009) asked undergraduates at the University of Michigan to play the DG in the presence of three dots that looked like "watching-eyes" ("face" condition) or three dots in a neutral configuration (control condition) (figure 2.8).
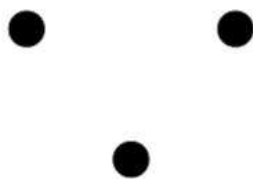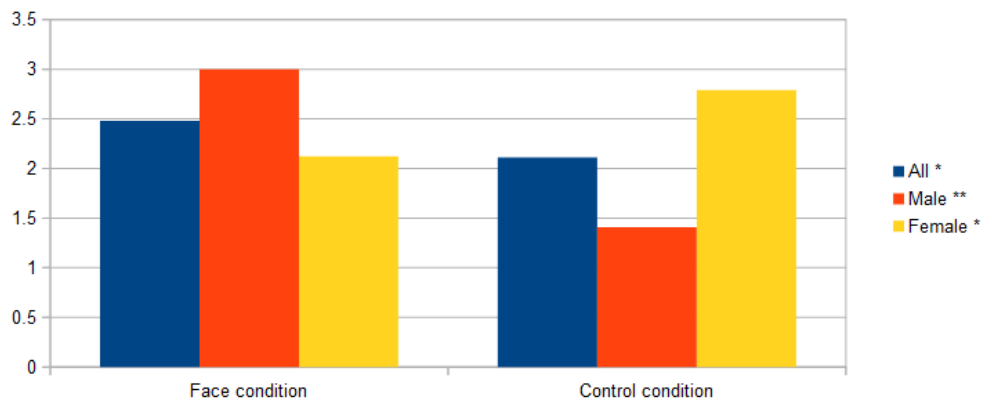

(Based on Rigdon et al 2009 figure 1)

Figure 2.8 - Drawing on dots as in Rigdon et al (2009).

The mean donation by the allocator was higher in the face than control condition, but not significantly so. male participants, but not female ones, gave significantly more in the face condition (figure 2.9). So, a weak social cue of being watched did have some effect on giving.

(* non-significant; ** p = 0.006)

Figure 2.9 - Mean donation by allocator (out of $10).


2. Contradictory evidence

Fehr and Schneider (2010) used the Trust Game (TG) in their experiment. This game involves two players - a trustor and a trustee. The trustor is given a small sum of money, which they can share or not with the trustee. The amount given to the trustee is quadrupled by the experimenter, and the trustee can then give some back to the trustor.

Individuals played alone with a computer screen in three conditions - a neutral screen (control condition), eye-spot-like images on the screen ("implicit reputation cue" condition), and a neutral screen but information about the other player's past decisions ("explicit reputation" condition). The outcome measure was the amount of money returned by the trustee (known as back-transfer).

The average back-transfer was non-significantly less in the implicit reputation cue condition than the control, and the explicit reputation condition was significantly higher than both those conditions (figure 2.10).

Fehr and Schneider (2010) summed up: "The effect of the implicit cues treatment is close to zero, highly insignificant and even has the wrong sign" (p1321). This was the case for participants who were viewed as generous or selfish players.

Fehr and Schneider (2010) made the following points about the difference in findings between their study and those with a positive effect of "watching-eyes":
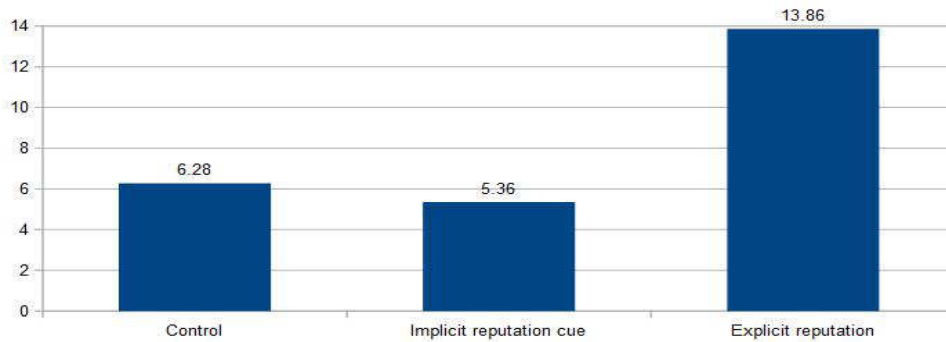
(Data from Fehr and Schneider 2010 table 2 p1319)

Figure 2.10 - Mean back-transfer in Fehr and Schneider (2010).

- In experiments involving giving, "many people are conditional co-operators, and their contributions therefore depend on their beliefs about other people's contributions. Eye cues could generate more optimistic beliefs about other subjects' co-operation behaviour, which then induce higher co-operation rates among subjects with preferences for conditional co-operation" (p1322).

- Fehr and Schneider (2010) argued that the DG is "a less robust situation" than the TG - "Therefore, relatively weak forces can affect behaviour in the dictator game. Perhaps the implicit reputation cue is one of these weak forces" (p1322).

Meta-analyses

Northover et al (2016) found no evidence that artificial surveillance cues ("watching-eyes") increased generosity in their meta-analyses.

The studies for inclusion used visual, artificial cues resembling a watching face or eyes (photograph or drawing), but excluded real human surveillance (eg: one-way mirror, CCTV). Studies had to compare a control (non-surveillance) to an experimental (surveillance) condition, and where there were multiple surveillance or control conditions, the data were pooled.

The researchers distinguished two outcome measures of generosity (ie: "material resources" given):

i) The amount given - 26 relevant experiments were found (with 2732 participants), of which the majority involved the DG. Overall, participants in the surveillance condition were slightly (non-significantly) more generous than in the control condition.

ii) The proportion of those who gave something rather than nothing - Twenty-seven studies covering 19 512 participants were included (mostly using the DG). Participants in the surveillance condition, overall, were 1.17 times more likely to give something than in the control condition. This was not a significant difference.

Northover et al (2016) concluded: "Our meta-analyses are not the final word on surveillance cues and generosity, but they show that scepticism is warranted" (p150).

2.4. REFERENCES

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