

# EDITORIALS

## Breadlines, brains, and behaviour

Targeting executive functioning and environments may loosen the link between demography and destiny

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The first annual report of the Commission on Social Mobility and Child Poverty published last month notes that the number of children starting life in poverty in the United Kingdom is high and increasing.<sup>1</sup> Given the links between poverty, brain development, and behaviour, these children start life with a higher chance than their more fortunate peers of behaving in ways that will harm their health and reduce their life expectancy. An understanding of these links offers some novel targets for intervention.

Evidence is emerging that our capacity to resist environments that tempt us (often without awareness) to overeat, smoke, drink excessively, or be physically inactive is influenced by the strength of our “executive functioning.” This is a theorised control network linked to the prefrontal cortex that regulates behaviour and thought.<sup>2</sup> Its core functions include inhibition of impulsive responses and focused attention. The strength of this behavioural control network is increasingly linked to environments in the early years of development, particularly poverty.<sup>3</sup> This association probably contributes to higher rates of smoking, drinking, poor diet, and physical inactivity in more deprived populations. In turn, the social clustering of these behaviours can explain most of the difference in life expectancy between the least and the most deprived sections of society.<sup>4</sup>

When measured early in childhood, executive functioning predicts a range of important life outcomes, including health and wealth. Some of the strongest evidence comes from the Dunedin study of all children born in this city in one year, who were followed for 32 years. Self control—measured in various ways between the ages of 3 and 11 years—independently predicted smoking at age 15, alcohol use, body mass index, and a range of other health indices measured in adolescence and adulthood.<sup>5</sup> The causal nature of these associations is strengthened by recent experimental laboratory studies.<sup>6</sup> Such findings do not of course preclude bidirectional associations between executive functioning and behaviour. Executive functioning and health related behaviour seem to be linked by positive and negative feedback loops, such that those starting life with the strongest executive functioning are those who are

more likely to engage in the behaviours that most nurture this brain system as well as longer term health.<sup>7</sup>

The development of executive functioning can be facilitated and compromised by the social, physical, and economic environments in which children are raised. This is illustrated in a recent longitudinal study of children in low income families in North Carolina, United States, who were followed from birth.<sup>4</sup> For each of the first four years of life that these children spent living below the poverty threshold, aspects of their executive functioning were correspondingly reduced. The mechanisms by which poverty influences brain development are hypothesised to involve two sets of variables: those relating to the physiological effects of chronic stress caused by low income, and those relating to parents’ ability to invest in goods and services that facilitate child development.<sup>4,8</sup> Exposure to poverty does not affect all children equally, and the effects are predicted in part by genetically based predispositions. For example, in the North Carolina cohort, poverty had the greatest negative impact on executive functioning in those with temperaments characterised by high levels of reactivity.<sup>4</sup>

Executive function continues to develop throughout and beyond childhood, with converging lines of evidence suggesting considerable plasticity in the prefrontal cortex that provides the scientific basis for interventions that target the brain. Two key targets for intervention in childhood and beyond are the brain and the environment.

There is great interest in whether the structure and function of brain circuits can be changed to optimise the operation of the executive control system. There are a few promising leads, outlined below in order of weight of supporting evidence. Firstly, aerobic exercise training can influence the function, output, and even the structure of systems that support executive processes across the lifespan, with some studies documenting predicted improvements in academic performance.<sup>7,9</sup> Secondly, the use of computer based brain training protocols shows promise, with some studies documenting convincing transfer of training to untrained domains of cognitive function.<sup>10</sup> Thirdly, early intervention parenting programmes provide some evidence

of improved cognitive functioning.<sup>11</sup> A less direct route to targeting executive functioning involves supplementing the incomes of the poorest families. This is estimated to improve cognitive function by similar amounts to that achieved by equivalent spending on early intervention programmes, but with additional benefits that accrue from increasing the incomes of the poorest families.<sup>8</sup> The potential for synergy across these interventions awaits evaluation.

A second key target for interventions that could reduce the behavioural and health consequences of suboptimal executive functioning is the environment. Changes made to behavioural cues in the environment can alter behaviour without drawing on executive functioning.<sup>12</sup> Unhelpful cues include the ready availability of fast food and alcohol, which prompt consumption, and helpful ones include the layout of public spaces that prompt walking. The removal of cues for unhealthier behaviours and the addition of ones for healthier behaviours has the potential to shape the behaviour of all those exposed, regardless of their executive functioning. Although plausible, this potential is untested.

Together with interventions that target brains, those that target environments could reduce the double hit faced by those born into poverty: living in environments that contain more cues for unhealthier behaviours, coupled with a reduced capacity to inhibit responses to those cues.

Although the number of children born into poverty in the UK and elsewhere is high and may be rising, a broadening array of findings from brain and behavioural sciences suggest novel targets for intervention to reduce the strength of association between “demography and destiny.”<sup>1</sup>

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