LEARNUS®

Mediated workshop series:
Understanding learning – is it all in the brain?

Report of mediated workshop:

The cognitive neuroscience of socioeconomic status (SES)

19th October 2016
18.00 to 20.30
Robert Runcie Room, Church House, Deans Yard Westminster London, UK.

Introduction and purpose

This workshop formed part of the LEARNUS 2016-17 series of mediated workshops which aim to explore factors that appear to influence the quality of education for young people. Within the context of the overall mission of LEARNUS, the purpose of this event was to bring together a range of stakeholders to share their expertise in order to explore the insights provided by cognitive neuroscience in understanding the influence of socioeconomic status (SES) on learning.

Examining the effects of SES on education and learning is one of the more challenging topics that have been addressed by the mediated workshops to date. The vast scope of the subject material and the potential for controversy in particular makes it something of a minefield to negotiate successfully. As the paper[1] sent out prior to the event points out there is a large research literature on SES but the vast majority refers to behavioural studies with few using neural data to explore underlying mechanisms. Although the latter have increased in recent years, there is still much to learn and understand.

Keynote presentation[2]

Professor Michael Thomas opened his presentation by reminding everyone that understanding learning is a multi-facetted challenge which needs to be addressed from a variety of perspectives. The sheer complexity of the issues often results in, at the very least, mis-understanding or misinterpretation of data. The relationship between SES and learning is certainly no stranger to misleading claims so it is essential to understand what is involved: from a definition of what SES is to the need for explanations of causal factors and neural mechanisms which can begin to explain the observed behavioural effects. In his presentation Professor Thomas endeavoured to tease out some of the issues which are summarised here under the following headings (see www.learnus.co.uk for the full presentation):

[1] Raizada, R. D. S. and Kishiyama, M. M., 2010. Effects of socioeconomic status on brain development, and how cognitive neuroscience may contribute to levelling the playing field. *Frontiers in Human Neuroscience Feb 2010, Vol4 pp1-11.*

[2] A video and .pdf of the presentation slides will be made available on www.learnus.co.uk.

1. What is SES and the problem of confounded factors?
2. What are the relationships between SES, behaviour and the brain?
3. What causal factors can be identified and to what extent do they help develop accounts of the mechanisms involved?
4. What might successful interventions look like?

1. What is SES and the problem of confounded factors?

The problem with SES is that it is 'a number' derived from 'a basket of environmental factors that seem to hang together' (Slide 13) and includes factors such as family income, health, neighbourhood, home environment, characteristics of parents and maternal education. When measures of things such as health, cognition and social behavior are compared against SES there are clear differences, with people having lower SES status doing less well than those in higher SES groups. The gaps between the different groups can be detected at an early age and are resistant to change (Slide 10). These kind of data combined with economic studies (Slide 11) provided the impetus for increasing investment being put into supporting children between birth and 3 years old as this would provide the greatest 'return'. However this needs to be challenged; the first three years of a child's life are very important but so are later years.

Tackling the problems of SES is further complicated by the fact that when various measures that are considered to contribute to the effects of lower SES situations are compared against each other they all tend to correlate with each other (Slide 20) with high levels of statistical significance. The close relationships of these 'confounded factors' make it difficult to identify which ones have the greatest impact on the life chances of children especially at the level of the individual. It is always important to remember that studies are carried out at the level of the population and whilst there are trends and correlations there are also 'outliers' (either individuals or specific groups) that do not fit the overall pattern. Thus interpretation of all data needs to be carried out with caution.

2. What are the relationships between SES, behaviour and the brain?

As indicated earlier, picking out the specific effects of SES is not straight forward but there is evidence from both behavioural and neural studies that is beginning to identify particular features of the impact. For example, there appears to be a differential effect across cognitive domains (Slides 22 and 23) with SES having a stronger impact on language and working memory than on spatial or visual awareness.

Direct impacts of SES on brain structure are also being detected, for example (Slide 27) children in families living below the federal poverty lines in the US can have 7-10% less 'gray matter' in the brain than those living above the line. Another study (Slide 28), using a cohort of 1099 people between the ages of 3 and 20 years old, has indicated that, independent of genetic ancestry, parent education is linearly associated with cortical surface area and suggests that SES accounts for 1-2% of the variability in the brain structure of those in the cohort. Other research (Slide 30) has detected effects on brain structure in infants as young as 1 month old.

3. What causal factors can be identified and to what extent do they help develop accounts of the mechanisms involved?

As previously indicated, teasing out causal factors is extremely difficult and much more work is needed. There is evidence that points to the importance of the family environment; for example at the age of 4 years old children in families on welfare have heard up to 30 million fewer words than children in a professional family (Slide 33). Family based models identify groups of factors – pre-natal, parental, cognitive stimulation, other factors – that contribute to brain development which in turn relate to children's cognition, academic achievement and mental health (Slide 34). The interaction between parents and children appears to be key in development but this specific influence has only been observable when SES starts to improve. Furthermore, the gaps between children from different SES levels that appear early remain once the children start school which suggests that schooling itself has a weaker effect. Home based-factors are more powerful.

When the environment is good there is evidence that genetics may play a greater part in explaining variations. For example (Slide 37) moderately sized 'Gene x SES' effects have been found in the US. This contrasts with findings for Western Europe and Australia, where social policies ensure more uniform access to high-quality education and health care, 'Gene x SES' effects were zero or reversed. Findings such as these emphasise the need for more details as to the mechanisms by which the differences develop. Studies using computational models, as well as behavioural and neural data, support the ideas related to brain development that the number of connections being formed, especially in early years, are influenced by SES. There are benefits of high quality nursery education (Slide 41) but the differences between children from various backgrounds are not entirely the result of nursery education, other factors including the level of maternal education also contribute to the variance.

4. What might successful interventions look like?

'The essence of cognitive neuroscience research on SES is to point towards interventions to reduce the impact of family differences in SES on child development.' (Slide 42). However there are 3 approaches to interventions that could contribute to greater understanding and benefits.

a. The need to recognize that just because SES-related differences are measurable in the brain, it does not mean they cannot be changed – they can. There is evidence for the need to target family not just school and that working on language development and improving executive function can bring about long –term benefits. However, the evidence for some interventions is variable and so needs to be interpreted with caution (Slides 43-45).
b. A mechanistic perspective suggests interventions could be undertaken in a variety of ways including: directly on SES conditions; indirectly on biological processes (e.g. via pre-natal diet) or brain development via specific training programmes for executive functions; or strengthening factors such as resilience by supporting the care-giver-child relationship more directly (Slide 46).
c. The measurement of brain functions could be helpful in distinguishing the underlying causes of what appears to be the same behavior (Slide 47).

Professor Thomas ended his presentation with a list of questions and invited the participants to consider them during their roundtable discussions.

Roundtable discussions and plenary

The groups at each table were invited to consider the questions raised during the keynote presentation and in doing so reflect on:

- the extent to which current practices in teaching and learning of young children from lower SES backgrounds reflect understandings gained from educational neuroscience;
- what evidence we have that particular strategies work;
- ways in which current practices as a teacher / practitioner / researcher might be reviewed / modified in order to take account of new evidence.

While the lively rich discussions that ensued inevitably raised many more questions than answers it is possible to identify several overlapping themes which ran through the discussion and the questions raised during the Q & A plenary.

a. **Impact of the home environment** was considered by all groups raising questions about the role of schools and the pressure placed on them to address underperformance of children from lower SES backgrounds. It was noted that many schools already have programmes in place to increase the involvement of parents in trying to tackle the problem. However, more attention needs to be given to establishing more sustainable programmes which can also be tailored to meet specific needs. As one group pointed out there is a danger of 'generalising SES' and assuming that a 'one-size-fits-all' intervention will work everywhere. Several groups felt that a better understanding was needed as to why some schools with a high proportion of low SES pupils perform above average in terms of overall performance. Identification of the characteristics of such schools could help to reduce the effects of SES in other places.
b. **The variation in the impact of SES on different groups within and between populations / countries** is marked. SES has an impact on children's life chances but not all children are affected in the same way; the question is why not and leads to another question, what might be learnt by investigating outliers? One group considered this question of variation in the context of immigrant populations and refugees coming into a new country, noting the possible effects of SES, cultural views and levels of parental education.
c. **The need for a better understanding of whether it is the absolute measure of SES that is critical or whether it is the SES level relative to others in the population.** This specific issue as well as the wider matter of what SES actually means, seems to be central to understanding how to tackle the effects of SES. Absolute measures of SES to some extent might be easier to address by putting in place schemes to raise the level of SES for everyone. However the sometimes conflicting evidence, e.g. difference between US and Western Europe, suggests that it is the relative differences in SES that are important. If this is so then the question is what are the mechanisms that bring about the differential impacts on communities and individuals? To what extent do factors such as identity, cultural capital, resilience and particular lifestyles contribute to the effects of SES on people.
d. **The types, frequency and timing of interventions** are obviously critical in addressing the challenge of minimising the impact of SES. However the bigger challenge is knowing which interventions are appropriate and when they should be used. As noted above, there is no 'one-size-fits-all' solution, and that the success of interventions appears to

vary depending on context. Two not unrelated challenges keep recurring: first that of sustaining an intervention beyond the research and development phase so that it retains its validity and reliability; and second, that of scalability of an intervention and its use in new contexts.

e. **The implications for funding and policy development** formed part of most of the discussions but as was pointed out during the Q & A governments want proof that something will not only work but that the design is reproducible and scalable whilst maintaining the beneficial impact demonstrated during trials. Ultimately the range of interventions available need to work for all but in order to get to this point, further co-ordinated research is required across the various disciplines including neuroscience.

In summary

The underlying argument put forward by Professor Thomas, i.e. that cognitive neuroscience can contribute to understanding of the effects of SES on the life chances of children, was widely accepted. The need for more reliable and robust scientific evidence especially of the mechanisms driving the effects was also acknowledged. Inevitably there are many caveats, notably that there are still many unanswered questions and, importantly that the findings should not be taken in isolation of other evidence – especially when the research findings are applied to interventions.

The workshop was attended by 38 participants.

Thanks

LEARNUS wishes to thank Professor Michael Thomas for his thought provoking presentation and responses to the questions and to all the workshop participants for their willingness to share their ideas, experience and expertise. Thanks also go to everyone who helped to make this workshop possible, the staff at Church House and the Garfield Weston Foundation for all their support.

Derek Bell
Director of Learnus
8th November 2016

