Supplementary Material for

Evidence, policy, education, and neuroscience – The state of play in the UK

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Section A: Density plots for intervention effect sizes

Section B: A single UK teacher's practical use of educational neuroscience in the classroom

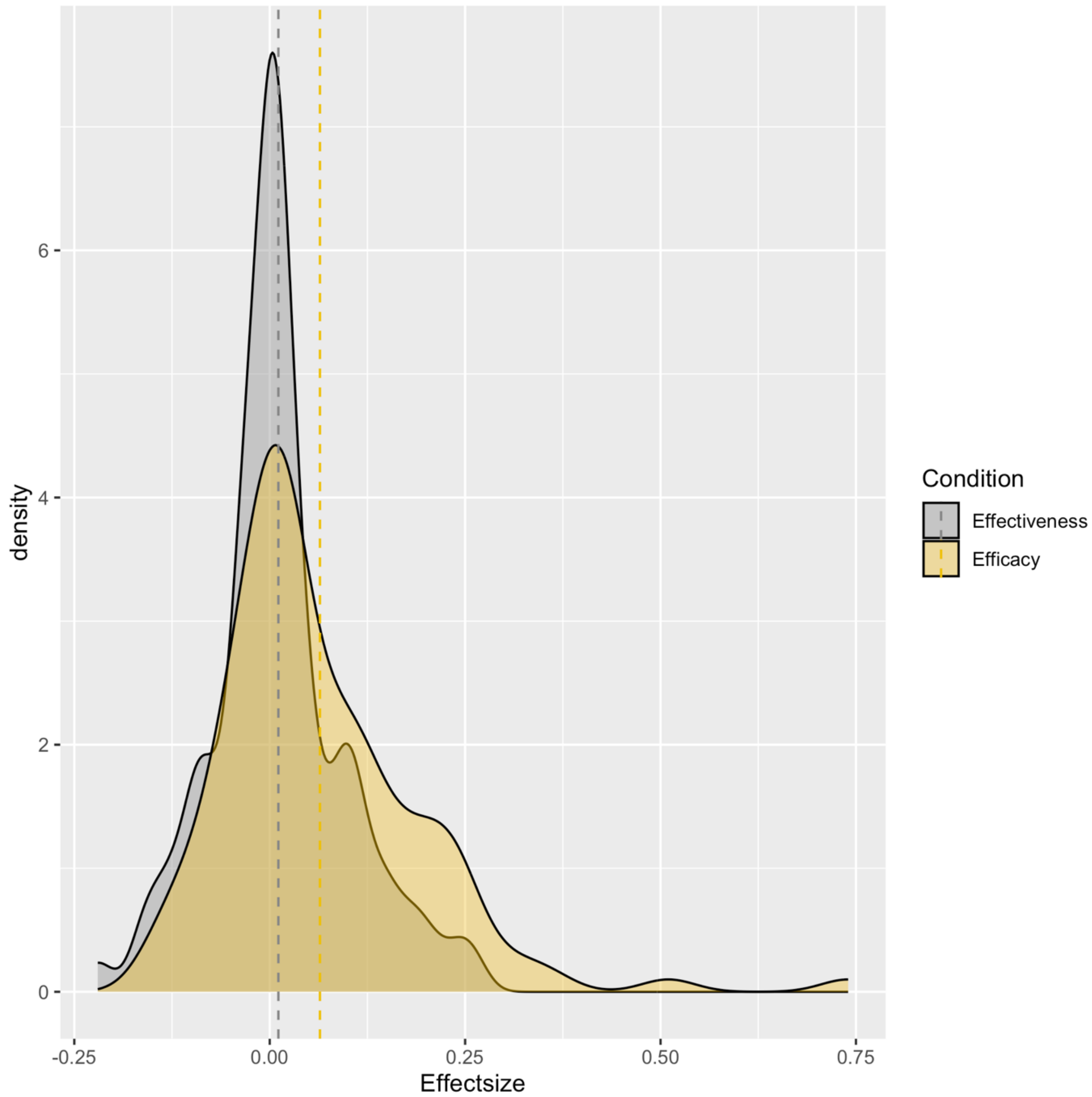
Section A: Density plots for intervention effect sizes

Lortie-Forgues and Inglis (2019) analysed the results of 141 randomised controlled trials of educational interventions commissioned by two organisations, the UK Education Endowment Foundation and the US National Center for Educational Evaluation and Regional Assistance. They found a mean effect size of 0.06 (95% confidence intervals: 0.04, 0.08) with 35% of trials showing zero effect size or lower.

Lortie-Forgues and Inglis (2024) provided a more up-to-date view of trials completed through 2022, focusing just on the UK Education Endowment Foundation. The mean effect size of 117 efficacy trials (where the goal was to assess an intervention under ideal conditions) was 0.06 (standard deviation 0.13), and of 90 completed effectiveness trials (where the goal was to assess the intervention under more real-world conditions) was 0.01 (standard deviation 0.09). Figure S1 shows a density plot depicting the frequency distribution of the effect sizes for the two types of trial.

One interpretation of these distributions is that the RCTs reveal many of the purported methods and approaches don't work (zero effect size), while just a few do work and show large effect sizes. This fits with the distribution for efficacy trials. However, usually effectiveness trials for an intervention are only run when efficacy trials have been successful, predicting that effectiveness trials should have a more positively skewed distribution, even if the mean size of the effect is reduced or diluted by less fidelity in implementation. This is not apparent in the distribution for the effectiveness data.

Figure S1. Density plot of the effect sizes of UK Educational Endowment Foundation randomised controlled trials, split into efficacy and effectiveness trials. The plot was created in R using ggplot.

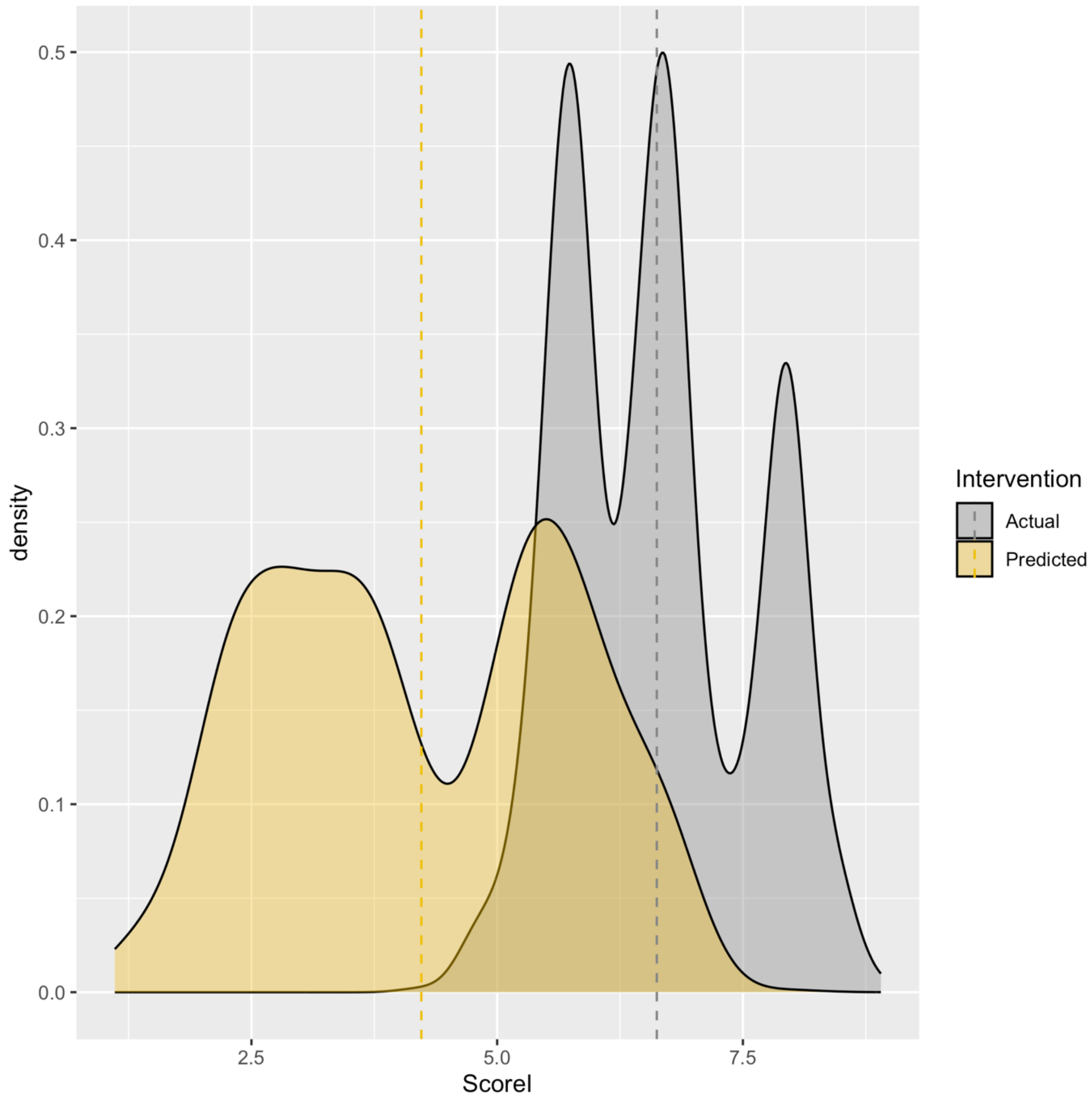


In child-centred or holistic interventions, many approaches are combined and tailored to the child. These sometimes report much larger effect sizes, particularly in low attaining students. Samani (2024) reports one example. A commercial education provider in the UK, Performance Learning (myperformancelearning.com), targets low attaining students in high school. The intervention, lasting between one and three academic terms, provides assessments that help pupils identify strengths and areas for improvement in their meta-cognition, from behaviour to core learning skills. This is followed up with a personalised intervention that focuses on teaching pupils how to learn through the company's online platform and live coaching.

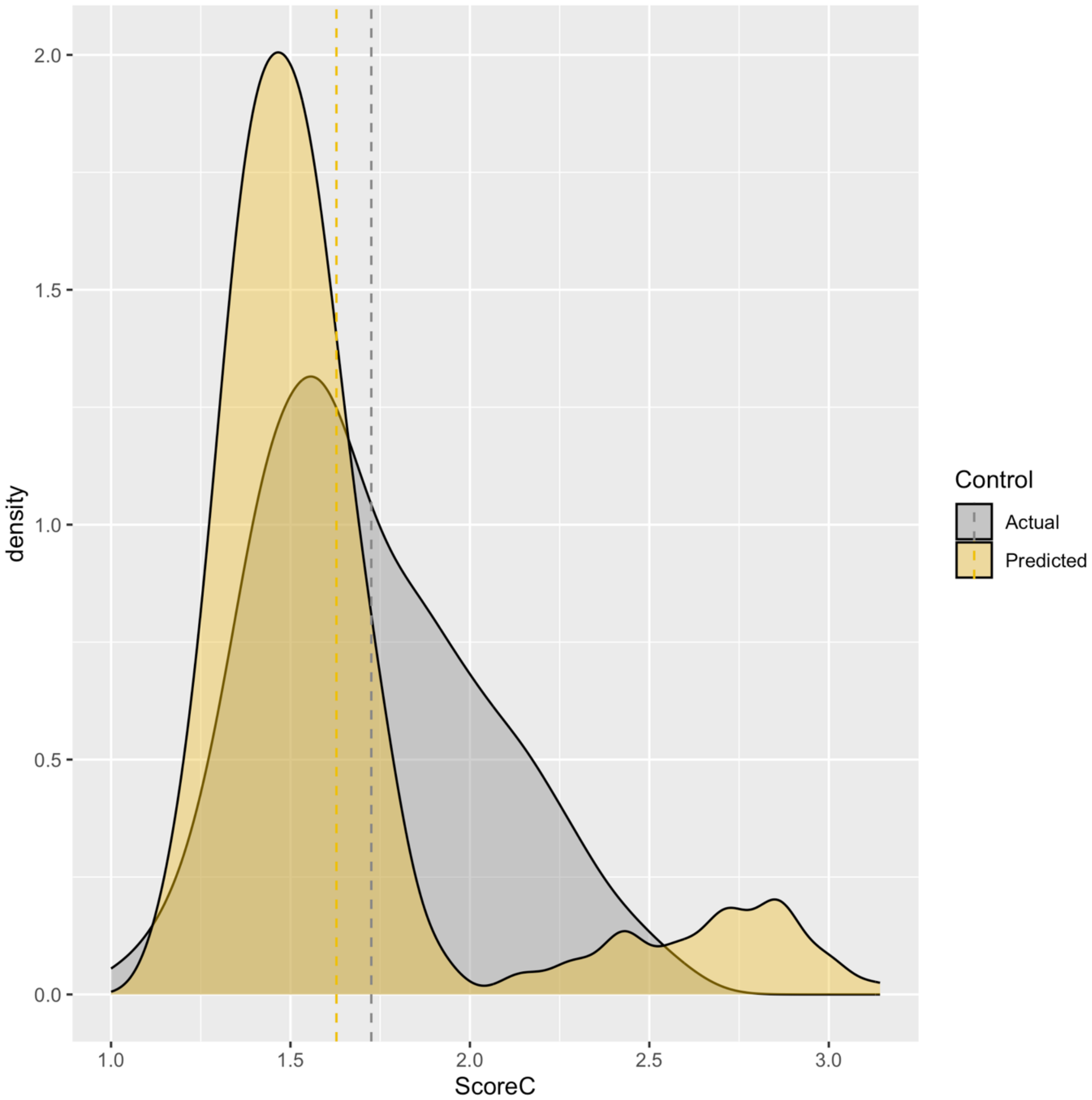
In the UK, secondary schools generate predictions for student grades six months prior to their actual examinations. The data reported in Samani (2024) for the Performance Learning intervention were collected between 2016 and 2018, prior to the pandemic. For the intervention group, actual grades achieved in summer examinations were compared to predicted grades (based on within-school mock examinations in December and January), with the intervention occurring between these two time points. For 940 15-16-year-olds with 'low previous attainment' from schools across the UK, the intervention showed on average a +2.4 grade increase in national examination results (averaged across math, biology, chemistry, physics, history, and geography) compared to the grades originally predicted by the school, an effect size of 1.58 (Samani, 2024). A paired sample t-test confirmed the improvement was highly significant [$t(939)=47.46$, $p<.001$]. For comparison, a contemporaneous control group of N=314 low attaining students in the same schools who were allocated at random not to enter the intervention also showed a small difference between predicted and actual grades of +0.1, an effect size of 0.23 [$t(313)=3.35$, $p=.001$]. Analysis of variance indicated the change between predicted and actual grades was significantly larger in the intervention group [$F(1,1252)=669.37$, $p<.001$, $\eta_p^2=.348$]. Figure S2(a) shows the frequency distribution of predicted versus actual grades for the intervention group, while Figure S2(b) shows the equivalent distribution for the control group.

Figure S2. Distribution of 16-year examination grades from Samani (2024): (a) distribution of school-predicted and actual grades for the intervention group (effect size of difference = 1.58); (b) distribution of school-predicted and actual grades for the control group (effect size of difference = .23). School-predicted grades were based on mock examinations in December and January, while actual grades were based on examination performance in the following May and June.)

(a)



(b)


density
2.0
1.5
1.0
0.5
0.0
1.0
1.5
2.0
2.5
3.0
ScoreC
Control
Actual
Predicted

Section B: A single UK teacher's practical use of educational neuroscience in the classroom

The YouGov survey of UK teachers described in the main paper (YouGov, 2022) provides a snapshot of the penetration of educational neuroscience and current opinions on its utility in the classroom. However, it does not provide the details of how scientific insights might inform practice. We can complement the bird's-eye-view of the survey with an on-the-ground case study of one UK teacher who utilises educational neuroscience in his practice. He also gives talks to students, teachers, and parents on the value of the approach. What educational neuroscience findings are most useful for informing his practice? How do students and teachers respond to his talks? The teacher, Jeremy Dudman-Jones is an experienced secondary school teacher and assistant head in a London school. He has taught for over 34 years, including in three culturally diverse public schools in London, teaching geography, psychology, government and politics, and sociology.

We asked Jeremy three questions: how did he first encounter educational neuroscience, which findings from neuroscience did he feel were most important in his practice, and how did he communicate educational neuroscience to others (and what was their response).

We first asked Jeremy how he had first encountered educational neuroscience: As a young adult training to be a teacher, it was obvious to me that engaging with a young person's brain was going to be an important part of my job and as someone who had studied a biology degree, I had some vague understanding of the importance of chemical neurotransmitters and neurons even back in the early 1980s. The penny dropped in the mid-1990s with the publication of Steven Pinker's "The Language instinct" and Judith Harris' "The nurture assumption". These books gave me the first insights into the fact that the brain was plastic, that it changed and that at certain periods of one's life, it seemed to almost have greater specific skills. The pre and post adolescent brains that I had been interacting with as a professional were different, were changing and were miraculous. In the early 2000s, when I was a tutor at the University of London Institute of Education working with teachers training in social science, I began to tell them about *brain plasticity*, a term that was being increasingly referenced in the literature I was reading. One of the new teachers seemed not to be particularly engaged so I asked what the problem was, and they said, "I don't need to know what goes on under the bonnet, all I need you to tell me is how to drive the car". For me, this became my inspiration and from then on, I resolved to learn more about neuroscience and to translate it, as any good teacher should be able to do, into meaningful and useful information for my teaching colleagues and I have continued this approach for over 20 years.

We asked which findings from neuroscience were most important in his practice: Having read the literature over the past few decades, it seemed to me that as a teacher I should try to focus on four main areas: (1) The idea of brain plasticity, of laying down neural connections and of synaptic pruning. (2) The idea that the brain in a sense matures as people go through adolescence and into adulthood – which parts of the brain appear to mature later and the impact this might have on behaviour and attitudes to learning. (3) Circadian rhythms are also important, given the timing of the school day, the importance of sleep and the apparent lag time the adolescent brain as in producing melatonin compared to the adult brain. (4) The role of neurotransmitters especially dopamine (for reward), serotonin (for mood) and oxytocin (for social bonding).

All of these insights have been useful to me as a teacher, pastoral lead and member of the school's leadership team; I have certainly become more understanding and therefore more sympathetic to the changing attitudes of the secondary school student; I have been able to think more clearly about the need to return to topics to slow down or prevent synaptic pruning, I have been able to incorporate more dopamine events into the curriculum and use the "high five" to form oxytocin bonds; and I have been able to believe in the students much more given the insights that I have into the brilliant concept of plasticity.

Finally, we asked Jeremy how he communicates educational neuroscience to others (and what their response is): Over the years I have developed several presentations that I give to various educational stakeholders. These include presentations to primary school teachers, primary school parents and primary school students; secondary school teachers, parents, and students; senior leadership teams and individuals training to become teachers; and finally, people in industry and business settings. All of my presentations revolve around similar themes. These are: plasticity, synaptic pruning, motivation, circadian rhythms, neurotransmitters, basic cognitive psychology, and memory. Thankfully, all the audiences are fascinated by the insights that I have to offer. The problems, if any, arise from what practically can then be done about the findings. Practical solutions need time to be figured out and applying strategies in an already crowded market where silver bullets are promised by everyone is a real issue. My own presentations suggest that at the moment, there are no silver bullets on offer and that actually what stakeholders need to do is take on board the current academic findings and work with small personal strategies. Or realise that the brain changes and develops – understand this and you will be more understanding and accepting of adolescent behaviour and quirks.

I have also implemented a whole series of Action Research Groups with colleagues in my school. This means that I give a presentation on the "Teenage Brain" for 25 minutes, to a group of staff, including student teachers and then set aside another 25 minutes to allow staff to decide upon an Action research strategy that they can implement in their lessons or other aspects of school life over a 3-month period. They establish success criteria and ways of measuring impact and return after 3 months to feedback on their findings. Over the past few years, feedback has been nothing but positive and it has given staff the opportunity to take a more personal, trusting role in their own application of neuroscience findings.

In my experience, everyone is fascinated by neuroscience: parents are reassured that the changes they witness are the norm, staff understand that making memories requires effort, and students understand that their own brains are changing and that it is not to be feared; senior leaders become more sympathetic to teaching staff and they reconsider expectations including timings of meetings, and of course staff themselves become more aware of the genius and diversity of the students in their care. Finally, even slightly cynical business leaders see value in many elements of cognitive psychology, especially around the idea of team building, motivation and how reward channelled by neurotransmitters can best be utilised. However, I am very much of the view that educational neuroscience is at the early stages of its development, and there is much more to come.

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