The references below present the evidence base for the statements found in the "Tackling common misconceptions" section of the *Gender stereotypes and their effect on young people* booklet.

For further information about our work and to access our library of resources visit iop.org/genderresources

## "Boys and girls are just different"

There is more variance within groups of boys and within groups of girls, than there is between boys and girls. Gender differences are learned, not innate.

There is little evidence to suggest that neurological differences result in boys having different abilities or ways of learning to girls. Teaching boys or girls as though these are discrete groups will fail to meet the needs of many girls and boys.

A majority of these articles point out chemical differences in the brains of females and males but make no concrete evidentiary claims that emotional reaction/capacity in any way affects intellectual capacity - in our case as it pertains to education.


- Bluhm, R., Maibom, H., & Jacobson, A. (2012). *Neurofeminism*. Basingstoke: Palgrave Macmillan.
- Fine, C. (2010). *Delusions of Gender: The Real Science Behind Sex Differences*. London: Icon.
- Fine, C. (2017). *Testosterone rex*: *Unmaking the Myths of Our Gendered Minds* (p. 42). London:Icon.
- Saini, A. (2017). *Inferior: how science got women wrong - and the new research that's rewriting the story*. London: 4th Estate.
- Sonnert, G. (2009). Parents Who Influence Their Children to Become Scientists. *Social Studies Of Science*, 39(6), 927-941. doi: 10.1177/0306312709335843


## "It's unfair to do something just for girls or boys".

One group should not be preferentially treated compared to any other group. However, if one group is being disadvantaged, and then positive action should be taken. For example, if a lunchtime languages club only attracts girls, the organiser could consider ways to encourage boys to participate

People are often, understandably, cautious about planning to treat people differently based on any particular characteristic. Positive action – taking steps to help certain groups of people with different needs – is lawful and can be very helpful in redressing inequalities.

This passage from Citizens Advice Bureau focuses on employers, but is helpful in clarifying the difference between positive action and positive discrimination:

"The **Equality Act 2010** says employers can, in some situations, take steps to help certain disadvantaged groups access employment or training. This is called **positive action**.

"Positive action is when an employer takes steps to help or encourage certain groups of people with different needs, or who are disadvantaged in some way, access work or training.

"Positive action is lawful under the Equality Act. For example, an employer could organise an open day for people from a particular ethnic background if they're under-represented in the employer's workforce. This wouldn't be unlawful discrimination under the Act.

"Generally speaking, it's unlawful discrimination under the Equality Act if an employer treats you differently because of one of the following things: age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, sexual orientation.

"Employers can take positive action to help people with a particular protected characteristic if:

- they're disadvantaged in some way in relation to work,
- their participation in employment or training is particularly low, or
- they have particular needs which are different from other people who don't share their protected characteristic.

"An employer can take your protected characteristic into account when deciding who to appoint to a job, if:

- people with your characteristic are at a disadvantage or under-represented in the employer's workforce, and
- you and the others candidates are equally qualified."

Full document: Discrimination at work - positive action. (2018). Retrieved from https://www.citizensadvice.org.uk/work/discrimination-at-work/what-doesn-t-count-as-discrimination-at-work/discrimination-at-work-positive-action/

## "All pupils know they are free to choose any subjects they want"

Unconscious bias and normalisation of stereotypes means there are often unspoken barriers. Simply informing students they are free to choose, without addressing these barriers, is not sufficient.

- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2013). 'Not girly, not sexy, not glamorous': primary school girls' and parents' constructions of science aspirations. *Pedagogy, Culture & Society*, 21(1), 171-194. doi: 10.1080/14681366.2012.748676

> *"We argue that science aspirations are largely 'unthinkable' for these girls because they do not fit with either their constructions of desirable/intelligible femininity nor with their sense of themselves as learners/students. We argue that an underpinning construction of science careers as 'clever'/'brainy', 'not nurturing' and 'geeky' sits in opposition to the girls' self-identifications as 'normal', 'girly', 'caring' and 'active'."*

- Kessels, U. (2015). Bridging the Gap by Enhancing the Fit: How Stereotypes about STEM Clash with Stereotypes about Girls. *International Journal Of Gender, Science And Technology*, 7(2), 280-296.

- Kilvington, J., & Wood, A. (2016). *Gender, sex and children's play* (pp. 59-83). London: Bloomsbury Academic
- McGeown, S. (2012). Sex or gender identity? Understanding children's reading choices and motivation. *Journal Of Research In Reading*, 38(1), 1 -12. doi: 10.1111/j.1467-9817.2012.01546.x

> *"The extent to which children's reading choices could be predicted by their motivation and gender identity was examined. Differentiating between sex and gender identity may provide a better understanding of variation in children's reading motivation and reading choices…The results of this study suggest that children's book reading choices are not only influenced by their sex, but by the extent to which they identify with masculine and feminine traits."*

- Mendick, H. (2005). A beautiful myth? The gendering of being/doing 'good at maths'. *Gender And Education*, 17(2), 203-219. doi: 10.1080/0954025042000301465

Stereotype threat occurs in situations in which people are or feel themselves to be at risk of conforming to a stereotype about their social group. It has been shown to affect performance in a wide range of tasks, both mental and physical. In education, stereotype threat has been linked to academic performance. For example, girls who are aware of the stereotype that boys are better at mathematics perform worse on tests if they are asked to state their gender prior to the test.

- Steele, C. (2011). *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do* (pp. 177,209,218). New York: Norton.

> *"Identity threat isn't a passing threat that happens just on tests. It's a cloaking threat that can feed on all kinds of daily frustrations & contextual clues & get more disruptive over time."*
> *"we think of ourselves as autonomous individuals. After all, we make choices … make choices within a context, always… stereotype threat is a broad fact of life"*
> *"identities are fluid … their influence on us is activated by their situational relevance"*

## "We can just run an annual girls into science event with lots of female role models".

One-off activities or interventions do not have a lasting impact. They need to be part of a wider strategy. Role models can have a positive impact, but usually only where there is an ongoing relationship.

- Archer, L., Osborne, J., & DeWitt, J. (2012). *Ten science facts & fictions: The case for early education about STEM careers*. London: The Science Council. Retrieved from

https://www.kcl.ac.uk/sspp/departments/education/research/aspires/10FactsandFictionsfinalversion.pdf

- Archer, L., DeWitt, J., & King, H. (2018). *Improving science participation: Five evidence-based messages for policy-makers and funders.* London: UCL Institute of Education. Retrieved from https://www.ucl.ac.uk/ioe/departments-centres/departments/education-practice-and-society/science-capital-research/pdfs/improving-science-participation-policy-overview.pdf

- Buck, G. A., Leslie-Pelecky, D., & Kirby, S. K. (2002). Bringing female scientists into the elementary classroom: Confronting the strength of elementary students' stereotypical images of scientists. *Journal of Elementary Science Education*, 14(2), 1-9. doi:10.1007/bf03173844

- Hazari, Z., Potvin, G., Lock, R. M., Lung, F., Sonnert, G., & Sadler, P. M. (2013). Factors that affect the physical science career interest of female students: Testing five common hypotheses. *Physical Review Special Topics - Physics Education Research*, 9(2). doi:10.1103/physrevstper.9.020115

> *"we test the following five commonly held beliefs regarding what factors might impact females' physical science career interest: (i) having a single-sex physics class, (ii) having a female physics teacher, (iii) having female scientist guest speakers in physics class, (iv) discussing the work of female scientists in physics class, and (v) discussing the underrepresentation of women in physics class. …No significant effects are found for single-sex classes, female teachers, female scientist guest speakers, and discussing the work of female scientists.However, discussions about women's underrepresentation have a significant positive effect."*

- Holman, J., & Finegold, P. (2010). *STEM career review*. Retrieved from Gatsby Foundation website: https://warwick.ac.uk/fac/soc/ier/ngrf/stem/movingon/research/500-stem_careers_review_nov_2010_holman.pdf

- Holmes, S., Redmond, A., Thomas, J., & High, K. (2012). Girls helping girls: Assessing the influence of college student mentors in an afterschool engineering program. *Mentoring & Tutoring: Partnership in Learning*, 20(1), 137-150. doi:10.1080/13611267.2012.645604

- *Girls' career aspirations*. (2011). Retrieved from Ofsted website: http://www.ofsted.gov.uk/resources/girls-career-aspirations

## "We need more women physics teachers"

A teacher's gender does not have a large influence on subject choice. The majority of students respond to good teaching, irrespective of whether the teacher is male or female.

- Carrington, B., Tymms, P., & Merrell, C. (2008). Role models, school improvement and the 'gender gap'—do men bring out the best in boys and women the best in girls?1. *British Educational Research Journal*, *34*(3), 315-327. doi:10.1080/01411920701532202

- Francis, B., Skelton, C., Carrington, B., Hutchings, M., Read, B., & Hall, I. (2008). A perfect match? Pupils' and teachers' views of the impact of matching educators and learners by gender. *Research Papers in Education*, 23(1), 21-36. doi:10.1080/02671520701692510

## “A lesson on the science of make-up will encourage girls to take an interest”

Attempts to make a subject more appealing by reinforcing a stereotype are unlikely to be effective. Makeup, for example, may appeal to some girls, but will make others feel patronised and will deter most boys.


- Murphy, P. and Whitelegg, E. (2006) *Girls in the Physics Classroom: A Review of the Research on the Participation of Girls in Physics*. Institute of Physics, London
- Hollins et al. (2006), *Girls in the Physics Classroom: A teacher’s guide for action.* Institute of Physics, London