

The Importance of Environmental Influence on Learning:

The role that the social sphere plays on learning

This part of the lecture series considers the way that the social sphere plays a part in learning (or not learning). However, in order to do that, I'm going to spend the first half of the lecture considering how the innate, or genetic approach has tried to predominate in psychological thinking particularly on the issue of the connection between intelligence scores and genetics. I could be accused of building up a 'straw man' argument because my aim is to **tear it down** I hope not on the basis of my value system (which I told you was more humanistic) but on the basis of showing how bad science has been applied. I want to do that in order that you are inoculated against this kind of thinking. You may not be aware of it but this kind of theory has had huge consequences in the way that educational practice has occurred particularly at the national level (not just Fiji but worldwide).

Only after this argument is presented (and destroyed) should you have confidence in the role that the social sphere has on education. We'll be considering Vygotsky's *Zone of Proximal Development* and then a more recent follow on from that which is the *Communities of Practice* as presented by two French researchers, Lave & Wenger.

Not that the social sphere's influence on learning is not quite the same as Social Learning Theory. The latter is more concerned with how the the social domain forms the mechanism of learning. The issue we're concerned about in this lecture is the influence that society plays in learning regardless of what the individual learning mechanism is.

Nature vs. Nurture?

Particularly in personality theory, the big debate that was often discussed was the extent to which a person's personality was dictated to by their biological inherited make up (the *nature* of ourselves) vs. the influence that the environment and social side had on us (the side of ourselves that is *nurtured*). One of the ways that this was approached was to consider similarities between people that were brought up in the same environment, compared to those that were not in the same environment but had a similar genetic make up. Specifically looking at identical twins, vs. fraternal twins, vs. siblings all brought up in the same family or in different families. In principle this is a very clever design to try and tease out where the influence would come from. In the table above, I've set out where the differences and similarities would be. Pay particular attention to the cells shaded in yellow. Particularly the ones shaded in the darkest yellow. This requires finding a set of suitable identical twins who have been brought up in completely different

Genetic determinancy taken to it's conclusion

Whilst, in principle I, as a scientist, am guided by the belief that the data should tell us what is going really going on, and therefore I should have no problem with the idea that our intelligence (and other behaviours) are really part of our genetic code – in reality I do have a bit problem with it. Fortunately, as far as I see it, the data does not show me that this genetic determinancy is a fact. However, just so you know what this really means and what the social consequences are for genetic determinancy.

If our intelligence is really 'fixed' in our genes, then this suggests that children with low intelligence, will not benefit from any environmental advantages. Having a nice school, with great resources, well trained and experienced teachers, will not in the end help these children. Their genetic code has fixed them to be 'dumb'. A national policy that is based on this wisdom, should spend it's scant resources wisely. In it's most cynical expression, all the best resources should go to the 'smart' children. The 'dumb' children should be given just enough resources to be content – so as not to cause trouble.

The extreme logical step, would be to provide incentives for the 'smart' people to have children, and to dissuade the 'dumb' children from having children. In this way, so the argument goes, the overall intelligence of a population rises.

So you don't believe that it could happen? Well any programme that promoted eugenics (think Nazism in Germany of the middle of the 20th century) is thinking exactly along these lines. Less extreme, but any programme that 'streams' children into 'intellectual' schools vs. 'vocational' schools on the basis of their potential achievement (think 'IQ' score) rather than what they would like to do – is going down this path too.

environments, normally because the twins have been separated at birth.

Genetic similarity	Grow up together		Grow up apart	
	if nature	if nurture	if nature	if nurture
complete strangers	We're talking here about adoptees. Nature's side would suggest that these people would be very dissimilar.	Although we're talking about at least one of the children being adoptees, there would still be high similarity. Some differences if the ages are different because the environment slightly different	These are effectively complete strangers, very dissimilar, makes no difference between these people and the strangers that are	Very dissimilar because non of the environment would be the same.
siblings	higher than complete strangers, because at least half the genetic component is shared.	high similarity, same as above	only marginal similarity, some genetic components shared, same as when the children are brought up together.	Dissimilar for the same reasons as above.
di-zygotic (non identical) twins	the same as above, the fact that they are in similar environments makes no difference because it's the genetic component that makes the difference not the environment.	very high similarity, because the children being twins will be in very similar environments, eg same school, class, probably clothes or style of clothes etc.	this would be essentially the same as above (siblings) where there would be some similarity, the fact that they are born at the same time, has no influence.	As above – dissimilar.
mono-zygotic (identical) twins	very high similarity, principally because the the genetic component is the same	same as the dizygotic twins, ie high because they are brought up in the same environment.	very high similarity, essentially the genetic component is the same and it would not matter that the children were brought up apart.	As above, ie dissimilar, the genetic component has no influence and since they are brought up apart (that means different environments), hence no similarities.

Table 1: The consequences of children who grow up together, or apart, and who are genetically related by different degrees. The consequences of those brought up together (red column) are shown depending on whether the 'nature' contribution dominates (green sub-column), or the nature contribution dominates (purple sub-column predominates). The same is done for those brought up apart (brown column). The cells that shows the most interest to researchers is shown shaded in yellow. The darker yellow cells are of particular interest because they would show the most difference between the two extremes.

You would think that there must be very few cases where this would happen (which parents would willingly split their twin children up at birth?), but it turns out that this is frequent enough for researchers to actually find significant numbers of twins who fit this criteria and therefore can be compared to other twins that have been brought up together. The result of all of this is a range of components that suggest that the heritability quotient (it's the same as a correlation score in statistics), is anywhere between 0.5 (50%) and 0.8 (80%).

Setting fire to the strawman argument

OK, now I want to show you how this argument is 'destroyed'. To some extent it's not a fair way of doing this as I'm (i) biased against this theory and (ii) it is me that has set up the argument and therefore I'm in the best position to destroy it. Sorry, you'll have to figure out for yourself whether my arguments are strong enough or not.

Primer on Correlation

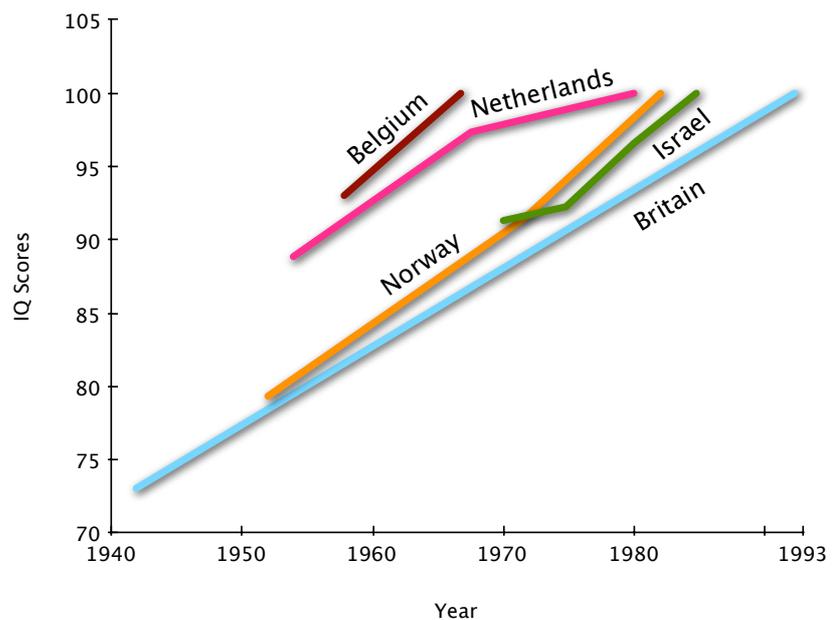
A 'correlation' is actually a precise technical statistical term. It is an index that can range from -1.0 to +1.0. If it is the former then it is a perfect negative correlation; the latter is a perfect positive correlation. Think of correlation as being how well knowing one variable can predict the score of another variable. If the correlation is a perfect '1.0', then knowing one variable will mean that we can perfectly predict the score of the other variable.

Knowing one's shared genetic component that is used in 'intelligence tests (aka IQ score) between yourself and someone else, gives us an ability to predict the intelligence score of the other person.

The heritability quotients of 'intelligence' are actually very high for any studies done in social science. This might lead us to believe that the 'genetic' component is therefore of paramount importance. As usual in this kind of debate, the numbers may indeed be correct, but their interpretation is open to considerable debate.

Firstly, genes need to be expressed in an environment. In the same way that a seed has the genetic code to grow into a plant, but if you throw it on concrete it's not going to get very far. That suggests that even if there is a lot of genetic foundational causes to person's intelligence, it still requires a rich environment to allow itself to be expressed properly. No-one really has an idea to what extent the 'genetic' component of a person's intelligence is fully expressed. This point is sometimes expressed in a slightly different way called 'malleability' is another slightly more subtle point, that knowing how heritable a trait is does not actually tell us how that expression will shown to us. So for instance height in humans appears to have a heritability quotient also of about 0.8 (generally speaking tall parents will have tall children). However, measuring average national heights in Europe for instance has shown a dramatic increase in average height over the past 1000 years. Depending on

how you count a generation but that is only about 40-50 generations ago – NOT enough time for the genes to have been selected through natural (or some unknown artificial) selection. Instead, it's clear that the change in height has been due to the change in the density of calorific nutrition. This is a purely environmental influence even though the heritability of height is very high. Another oft quoted study is called the 'Flynn effect' where it was found that the national averages on IQ scores in affluent Western ethnic cultures, tended to increase over time - approximately 2-3 IQ points per decade; it is hard to know how to explain this effect through purely genetic means.



Adapted from *Scientific American*, January, 1999, p. 38

Secondly, even if the heritability quotient is as high as 0.8 (and I believe this can be debated¹), there's still an environmental factor of 0.2 which, while smaller, is not insignificant.

¹ See for instance: Devlin B, Daniels M, Roeder K. (1997) The Heritability of IQ, *Nature*, 388 (6641), 468-71, who estimate that after corrections the true heritability is between 0.34 or 0.48 depending on which definition of heritability one takes. The former (defined as h²) is the one that most geneticist statisticians would take. That places the validity of the 'nature' predominating very much as a low priority. If nothing else, take away from this that despite the beatings of researchers that state that the evidence has been 'established' and that all psychologists agree that the genetic component is self evident today – that this is simply not true. The interpretation of the data is still very much in doubt.

So the environment (of which the teachers and schools are a part of this), plays a critical role because:

1. The environment is the place where the genetic code is expressed, some environments allow the genetic code to be expressed to its fullest extent, others less so.
2. There is still an acknowledged 20% of a person's intelligence is under the control of the environment.

Thirdly, there is the issue of whether the IQ test scores are really an adequate measure of intelligence. The previous lecture covered some of this in detail as to what the actual theories of intelligence were. There's insufficient evidence to state that IQ is measuring a real entity (called 'g') instead of a mathematical construct².

Finally, I want to go the other way and state that there are studies that seriously undermine the heritability quotient for intelligence which has to do with poor sampling design. For the most part, identical twins reared apart, it can be argued, actually have probably far more in common in their environment than is normally accepted. So for instance, a twin separated at birth and given up for adoption, is likely to be given to adopting parents who come from similar or close to the socio-economic status as their parents, likely to attend the same church, be exposed to similar schooling methods and generally get brought up in the same ethnic cultures. You do not find (say) twins where they are brought up in radically different environments. When you do, the correlation between the twins on their personality tests sink down considerably (the heritability being nearer 6-23%). What this line of research states is that what looks like genetic heritability is in fact a confounding variable that has not actually accurately measured the degree of environmental similarities between dizygotic twins even if they are apparently reared 'apart'.

Either way, you should conclude from this research, is that the social environment plays a critical role in a person's ability to learn to act intelligently (ie to learn) and that this is the one thing that society can actually control – for the moment we have not been able to 'play God' by altering our genetic make up.

I'm sorry that it took me so long to get here, but I think it's important to recognise that the nature/nurture debate is still far from over although in the scientific circles the debate, whilst far from closed, is not 'either/or' but rather a degree of proportion with the acknowledgement that you cannot have one without the other. The place where the debate is still raged is in the political circles who appear to be blinded by the science that supports their political points of view.

So Social Policy is not affected?

The Wall St. Journal in 1994, published an editorial piece, essentially supporting the many claims made by the book 'The Bell Curve'. Here is a quote from their last point made in the letter (#25).

The research findings neither dictate nor preclude any particular social policy, because they can never determine our goals. They can, however, help us estimate the likely success and side-effects of pursuing those goals via different means.

Translation: We think these results do not have to dictate how or what our social policy should be towards children with high or low intelligence. But these results remain to tell us that if we choose to put money, and resources into children (or races, or gender, or take your pick) with low intelligence, then we're essentially wasting those precious resources.

Folks, please don't be persuaded by this kind of rhetoric. Of course this kind of research influences social policy (get real). However, when the science is bad because it's been set up to prove what it wants to show, and then been misinterpreted anyway - well then of course it should be shot down.

² (if you're really keen and a maths whizz go to: <http://www.cscs.umich.edu/~crshalizi/weblog/523.html>)

Zone of Proximal Development

The theory is often cited as an [alternative](#) to Piaget's theory of intellectual development. It tries to explain not so much how a child learns, but when it is able to learn and what role the social sphere plays in aiding (or hindering) the learning process. Specifically teaching and learning is most effective in this zone because it is the place where children are able to understand and solve problems with the assistance of adults, but not independently. When you think about it, you'd never, as a teacher, try to teach something to children that was clearly way beyond their comprehension level. The theory formalises this and has been expanded upon subsequently particularly in the realm of education.

Communities of Practice

[Jean Lave & Etienne Wenger](#), were two social scientists who studied the learning that takes place in traditional apprenticeships. Think of three concentric circles. In the middle are the 'experts', then there are the 'active full members' and on the outside, the 'periphery' so to speak are the new comers to whatever field is being considered. Learning can take place in a 'zone of proximal development' where the zone can be considered both an intellectual zone as well as physical 'space' where peripheral participants and active members of a community actually interact.

ZPD's relevance

Every psychology student and education student has Lev Vygotsky's 'Zone of Proximal Development' explained to them and they all need to understand it in order to become aware of the influence of learning. Personally I must be a bit dumb as I cannot see (i) what is so stunning about the theory, and (ii) how that translates practically into educational practice.

However, I think that it would be irresponsible of me to not present the theory to you, in case someone asks you after you've graduated 'So what is your take on Vygotsky's theory of ZPD?' and you say 'Huh?'

I hasten to add, that the theory is important because it lays a foundation for more relevant theories, such as the Communities of Practice. Do you actually need to know ZPD in order to understand and use CoP? I don't think so, but don't take my word for it. Decide for yourself.

Title	Role
Core group	these are the folks that define any particular field; the ones that state which is acceptable practice and which is exceptional craftsmanship.
Active group member	these are the people that are full members of the community but are not breaking new ground, or cutting new steps. They are the 'followers' of the experts. Some of them will eventually become 'core group' experts.
peripheral participant	These are the apprentices who interact with full members and gradually get to know the language spoken, the codes of conduct and so on that are relevant to the practice. Think of it as a 'lurk'n'learn' strategy.

Although the theory was initially constructed to be a way of understanding traditional apprenticeships such as tailors in Liberia, the issue has just as much to say about children learning in schools where they are 'apprenticed' to the whole school system. Presumably the 'core experts' are the curriculum development people, the active group members are the face to face teachers and the peripheral apprentices are the pupils themselves. The problem with this model is that this panders to the so called '[hidden curriculum](#)', where children are learning more and more about how to get by in the school system rather than actually learning activities that they can genuinely use outside the classroom.

Communities of practice was not designed to be a pedagogical approach to teaching/learning, but rather a way of analysing a teaching situation. That has not stopped educators from considering how to apply the theory in an educational context. Effectively how to deliberately engage pupils as peripheral participants so that they can have easy exposure to active group members and start to learn the practices and norms. One place where I've seen this happen to me on a personal level was visiting rural primary schools in Koro Island in the Lomaiviti group. Most of the primary school teachers that I visited there begged me to come into their classes just to read and speak with the children in English. The explanation was that the teachers themselves felt that they were not that strong in their spoken English and therefore one might argue that they did not feel that they were indeed 'active members' in the community of native speakers of

English. I, on the other hand, was having been born and educated there (and trust me I am definitely no core expert on this). When schools invite other active members, say the police, to come and speak to a class the same thing is happening.

Summary

In the first part of this lecture, I tried to show how a non environmental theory of intelligence – the role of the contribution of one's genetic make up – has played a role in educational practice. Most particularly at the national level, where so called 'streaming' occurs. The belief that one has a fixed amount of intelligence and that this is innate and therefore cannot be altered by any amount of environmental influence. The logical expression of this sentiment is to divide people broadly speaking into 'intelligent' vs. 'dumb' and then to give preferential resources to those that are intelligent, and given enough resources to keep the 'dumb' ones happy. Even if you agree to this philosophy (it could be stated in a far 'nicer' language to not make it sound so harsh as I've just stated it), the scientific underpinnings that support this theory are plain and simple – wrong!

Even if their results were correct at the extreme (correlation of 0.8 genetic component), and the IQ test was a 'real' measure of one's intelligence, the correct interpretation still comes from the idea that **you** the teacher and the rest of the social sphere that the child is in, have the most influence as to how much a child improves or not in their educational achievement. In other words, even if we were to make certain assumptions that favoured the 'nature' side of the nature-nurture equation, the place where there is the most amount of change in a person's educational achievement is in the social sphere. Thus the logic that preferential resources should be given to those who are 'intelligent' is 'dumb'.

Vygotsky's Zone of Proximal Development has had a huge influence on educators all over the world. Perhaps, it's greatest contribution has been the formation of more sophisticated versions of it which have greater relevance to education, such as the Communities of Practice proposed by Lave & Wenger. This is still an emerging theory in education specifically, and the original authors have been keen to point out that they intended their model to **not** be used as a learning theory, but rather as a way of understanding the sociological context in which learning has occurred (the authors describe themselves as 'cognitive anthropologists').

References

Holloway, M. (1999), Profile: Flynn's Effect. *Scientific American*, **January**, 37-38.

References that are 'pro' the nature

The editorial piece in the *Wall Street Journal*, printed as 'Mainstream science on Intelligence', published on 13th December, 1994. It was written by Linda Gottfredson along with 52 other science signatories, including Hans Eysenck, Arthur Jensen, John B. Carroll, Garrett Hardin & Robert Thorndike. All established psychologist luminaries but very much in the 'nature' camp of personality theory.

Glossary

Heritability

Streaming

Zone of Proximal Development

Communities of Practice