PART 4

Documenting and developing children's thinking

31

THE DEVELOPMENT OF LEARNING POWER

A new perspective on child development and early education

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> The goal of early education (and perhaps of all education) should not be seen as simply that of training brains whose basic potential is already determined. Rather, the goal is to provide rich environments in which to grow better brains.
>
> (Clark, 2003)

Introduction

Children's development reflects an entwining of genetic endowment and experience. To understand development – and guide it successfully – we must understand the dispositions and capabilities with which babies come bundled, like the pre-installed software on a new laptop, into the world outside the womb. And we have to understand the way these potentialities are influenced by the world *in which* they find themselves, and the world *for which* their culture and their caretakers are preparing them. This mix of accidental and intentional influences moulds young minds in ways that leave their capacity for intelligent thriving either augmented and differentiated, or alternatively stymied and shrunk.

The story of child development can be told from many perspectives. The 'genetic epistemology' perspective made famous by Jean Piaget identifies a series of stages in the unfolding of a person's ability to handle abstract knowledge and logical reasoning (Piaget, 2001). The sociocultural perspective looks in more detail at the culturally mediated unfolding, and internalisation, of the child's abilities to think, imagine and remember (e.g. Vygotsky, 1978; Daniels *et al.*, 2011). The cognitive perspective uses the models and frameworks of cognitive psychology to chart the developmental trajectories of children's thinking (e.g. Gopnik *et al.*, 2011; Meadows, 2006). Moral perspectives, such as those of Kohlberg (Colby and Kohlberg, 2011) or Haidt (2012) look at the child's progressively more sophisticated understanding of 'right and wrong'. More recently, social and affective perspectives focus on the development of children's interpersonal skill and the range of emotional expressions which their culture sanctions or prohibits (Schore, 1999; Siegel 2012).

In this chapter I want to offer a different perspective, that of the child's developing 'learning power', which draws on, and cuts across, many of the more familiar perspectives I have just mentioned. The need for this new perspective derives from the growing confluence of several streams of contemporary thinking: sociological, educational and psychological. One stream points to the increasing demands which the modern world places on people's psychological resources, especially on their ability to engage with complexity, uncertainty and change. Kegan (1995), for example, in a book tellingly entitled *In Over Our Heads: The Mental Demands of Modern Life*, points to the speed with which, for many children and their families, an 'automatic' is being replaced by a 'stick-shift' world. In an automatic car, as in a traditional culture, many decisions – like when to change gear, or what it means to be 'a girl' – are embodied in the functioning of the 'vehicle' (the car or the culture) and are not readily under the direct control of the 'driver'. In a stick-shift culture, deciding when to change gear, or what religion to follow, is the responsibility of the individual, and this is demanding and potentially stressful. That you *can* make so many decision for yourself is liberating, but to the extent that you feel you *have to*, the responsibility can feel burdensome or even overwhelming (Gergen, 1991). For example, a survey of 3,500 young people's views on education as a preparation for their future commissioned by the Industrial Society (now the Work Foundation) concluded:

> Most young people fear that their world will generally become more challenging… [For many] their lives are riddled with insecurity; insecurity becomes an integral part of growing … Schools are seen as failing to equip young people with the ability to learn for life rather than exams.
>
> *(Industrial Society 1997)*

Hence there is much current concern in the parenting literature about how best to help children prepare to flourish rather than flounder in such a world (e.g. Furedi, 2008; Palmer, 2007), and this is paralleled in educational research by a recognition of the importance of developing 'learning how to learn' (James *et al.*, 2007) or related 'twenty-first-century skills' (Istance *et al.*, 2002).

Another stream of thought concerns the academic conceptualisation of 'intelligence'. Instead of the traditional focus on intelligence as the discrete, unitary and relatively unchanging source of disembodied and disembedded rationality, recent work emphasises the extent to which intelligent behaviour, amid the complexities of real life, reflects a shifting and changeable composite of many resources and characteristics that include emotional and personality traits such as 'resilience' 'open-mindedness' or 'tolerance for uncertainty' (Lucas and Claxton, 2010). An early book in the field by co-founder of Harvard's influential Project Zero, David Perkins (1995), for example, was entitled *Outsmarting IQ: The Emerging Science of Learnable Intelligence*. Resnick (1999), another leader in the field, has defined intelligence as 'the sum total of one's habits of mind', thus emphasising both the composite and the malleable character of intelligence. And Piaget himself is often reported to have remarked that the essence of 'real-world intelligence' is 'knowing what to do when you don't know what to do'.[1] Some have even suggested that intelligence inherently involves processes that 'loop out' beyond the individual body to capitalise on material and social resources (Clark, 1997; Salomon, 1993). Thus social concern about young people's robustness in the face of difficulty is complemented by a renewed research focus on the psychological elements that underpin that robustness, and on the ways they can be developed.

The concept of 'learning power'(Claxton, 2002; Claxton *et al.*, 2011; Deakin-Crick, 2006) has emerged at the confluence of these streams of thought, and has excited educationalists' interest in the possibility of teaching children in a way that systematically prepares them for the rigours and responsibilities of lifelong learning.[2] However, learning power has so far lacked a developmental narrative that suggests how the genetic predisposition for learning, with which infants are so obviously endowed, unfolds through maturation in the early years; and how that maturational potential is cumulatively strengthened (or undermined) by cultural messages from the home and peers, as well as from the school. If we imagine that babies are biologically endowed with an entry-level Learning Operating System, let us call it LOS 1.0, we can ask how the power, the reach and the sophistication of that core psychological capability unfolds over the early years of life, and what kinds of experiences contribute to its development and differentiation.

What follows is an illustration of what such a narrative might look like. It is, in its current state, highly sketchy and schematic. Much of the detail, such as the exact progression or sequencing of developmental steps, and the ages at which they might normatively be expected to develop, is lacking. Nevertheless, it demonstrates, I hope, the value and validity of such a perspective. In brief, what I will suggest is that babies come bundled with a brain that is predisposed to learn, and also a built-in range of learning amplifiers that kick in during the early stages of development (provided all goes well biologically). Some of these on-board amplifiers set us to learn especially well from other people, and from the cultural products (language, digital media) with which they furnish the growing child's surroundings. Many of these culturally mediated tools are themselves powerful learning amplifiers. Thus one of the ways in which biology moulds cultural learning is (or can be) towards ever more sophisticated ways of approaching novelty, complexity and uncertainty both in school and beyond.

LOS 1.0: Natural born learners

Among the animal kingdom, human infants possess supremely malleable brains. Even before they are born, they are registering recurrent connections between aspects of their experience (Lyman, 2009). A tune 'heard' repeatedly *in utero* is preferred, by a newborn baby, to a novel tune, for example (Partenen *et al.*, 2013). In the first year, babies' brains experience a massive overproduction of dendrites which are 'whittled down' by experienced statistical regularities into well-worn circuitry. These 'cell assemblies' (Hebb, 1949; Pulvermuller, 2013) distil out of experience 'what precedes what', 'what goes with what' and 'what follows what', and, critically, 'how what I do alters the flow of events'. These regularities enable the child to stitch together connections between different states of the world, different interventions they can make, and the fluctuating array of needs which they have, and thus to begin to anticipate and exert some control over the flow of events. 'If I smile, that might elicit a cuddle – but only if my mother's pupils are relatively dilated': that kind of thing. The inherent plasticity of the nervous system enables the child to gain an ever more sophisticated and reliable (though always open to surprise and correction) handle on the world. Exactly the same neural tune-ability underpins the adult's ability to learn to jive, play spin bowling or find their way around a new work-place. This basic sensorimotor learning capability has no developmental sell-by date. And the only fuel it needs to run on is an open sensibility to experience (Spitzer, 1999).

LOS 1.1: Attentional control

LOS 1.0 is exquisite, but it is passive, holistic, cumulative and slow (Clark, 2003). It can only track the patterns that come its way. It cannot take what it has learned to bits and improve just one part of it. But LOS 1.1 can, because it adds the abilities for top-down processing and attentional control. The ability to predict what might be coming up next, on the basis of cell assemblies that link what has just happened, or is happening, to what has ensued previously, can be used to speed up and refine the process of perception itself. Crudely, if I have just seen a cat's face heading to the left, through a slit in the fence, LOS 1.1 can quickly set itself to look for an up-coming cat's tail. We are able not just to *look at*, but *look for* things (see Clark, 2013). We can specifically attend to and adjust just those aspects of experience that *don't* match the prediction – the cat turns out to be Manx – and thus our learning capacity is sharpened and amplified.

So the ability to predict enables the child to begin to focus her attention. But to do this, she has to be able to inhibit other things she could be noticing, and other things she could be doing. And it is one of the main jobs of the rapidly maturing frontal lobes of her brain to do just that. Selective attention is the beginning of a much wider power: the capacity for self-control or self-regulation. As children develop this so-called 'executive function', they become able to prioritise and plan their activities and therefore their learning. The kind of learning that Anders Ericsson (e.g. 1996) calls 'deliberate practice' – picking out the hard parts of a developing skill and working on them selectively and intensively – would be impossible without the brain's ability to keep reminding itself why it wants to excel so badly (or rather so well) that it can resist any kind of alluring distraction (Perkins, 2009).

The ability to control and focus attention also illustrates how the maturation of the brain enables the child to benefit from the social world of learning – how 'nature' and 'nurture' lock together to boost learning power. Towards the end of their first year, children master the tricky ability to know what someone else is looking at – and possibly talking about. By looking at the angles of their mother's head and eyes (helped, to begin with, often by a pointing finger), they can figure out the direction of her gaze, and – in their own mind's eye – look along this invisible line and find what she is attending to (Moore and Dunham, 1995). This is a hugely important learning amplifier: without it, it would be almost impossible to learn language. Once children have mastered the trick of joint attention, other people can begin to teach them their culture's ways of looking at and carving up the world. They can be taught (through what is called in the literature 'social referencing') what to notice for example, and also what to ignore – what to treat as trivial, disgusting or invisible (Dickstein *et al.*, 1984).

LOS 1.2: Exploration and prodding

Another way of enriching and focusing attention, and thus of amplifying learning, which also seems to be built in, is exploration. Babies do not just look at things; they soon learn to pick them up, stroke them, suck them, rattle them, drop them or throw them (to find out what kind of sound they make when they land – and what kind of sound *you* make when they break!). As soon as they can crawl they go looking for trouble, and they develop a useful set of basic tests that encourage new objects – a visitor, next door's dog – to reveal their properties. What does it tell me about itself if I smile at it, babble or pull its tail? As they grow up, the repertoire of such information-revealing, learning-enriching strategies will become more targeted and sophisticated. You don't just smile, you say, 'Hi, I don't think I've seen you here before …' Or, in a chemistry class, you will learn a specialised set of basic tests for getting an unknown compound to reveal something of itself. Does it dissolve in water? How hard is it? What happens if we put some dilute hydrochloric acid on it? And then you google the results.

Parents, caregivers and teachers of young children will spend time training and refining these world-revealing explorations and experiments, so they are informative but not life-threatening. But here we also have to introduce a new theme into the developmental story of learning power. Adults can inhibit learning as well as amplifying it. Bonawitz *et al.* (2011) demonstrated in young children what we all know: if someone tries to direct your learning too tightly, your curiosity can easily get turned off. Pre-schoolers who have the main function of a toy demonstrated to them subsequently played with it, and explored other things it could do, less than other children who were left to figure it out for themselves. The learning strategies of exploring and prodding can themselves be muted by the wrong kind of guidance and support.

LOS 2.0: Good guesses

Learning, to echo Piaget, is what you do when you don't know what to do. You find yourself in a situation that requires some kind of response – but you don't yet know what would fit the bill. When babies don't know what to do, they are designed to squirm and cry. From an evolutionary point of view, this is not a bad starter kit. We all still wriggle at night if uncomfortable, or to throw off a cover when hot; and we all ask for help when we are stuck (if not as loudly or urgently as the baby). But humans' success as a species depends on being able to invent and trial ever more targeted responses. (Just wriggling and yelling in the examination hall won't get you very far.) We need to be able to generate good guesses for what might work, and try them out. As children grow, they assemble a larger and more effective repertoire of ways of coming up with things to try. Their learning becomes more resourceful and creative.

LOS 2.1: Imitation

Babies are built to imitate (as are we all). There is little doubt now that the human (and primate) brain contains important circuits of 'mirror neurons' that predispose us towards interpersonal resonance and mimicry. When a person observes a significant other performing a meaningful action, their brain automatically primes them to execute the same (or a reciprocal) action (Glenberg and Gallese, 2012). This mimetic resonance with others is the foundation of empathy (Iacoboni, 2009), but it is also a powerful amplifier of learning. A learner who is stuck (on their maths or their painting, say) and stuck for an idea as to how to get unstuck, can look and see if there is anyone about who is making better progress, and try to copy what they are doing. Harris and Want (2005) have shown that young children are such inveterate copiers that they will faithfully mimic an adult's demonstration of how to solve a problem, even if it contains all kinds of superfluous gesturing (whereas chimpanzees seem to see through the irrelevancies and cut to the chase).

Imitation is one of the most important hinges that links biology and culture together. It is a built-in disposition that vastly accelerates the process of cultural learning in all its forms (Tomasello, 1999). Watching and copying others begins in early childhood, and remains a valuable learning strategy throughout life (whether the skill in question be high-jumping, violin-playing or telling jokes). Of course, there is no guarantee that what worked for them will work for you: there are all kinds of reasons why their 'solution' may not transfer lock, stock and barrel to you and your situation. But the attempt to imitate may get your own process of trial and error going again. And it is a learning tool that, like all the others, is capable of itself being sharpened through experience. Young children, for example, have already picked up that not all role models are equally reliable, and they pay greater attention to those whose modelling has proved the most helpful in the past (Harris *et al.*, 2013).

LOS 2.2: Imagination

Trial and error is a vital learning strategy, but when it is overt, out in the 'real world', it carries risks. Expensive materials might be ruined. Competitors might be engaging in a bit of 'industrial espionage'. So being able to run experiments in your own head is a great asset. Luckily, the human prefrontal cortex, through its ability to inhibit other areas of activity in the brain, confers just that advantage. Not only, as we have already seen, can inhibition keep us concentrated and on track; it also allows us to partially activate both developing skills and possible scenarios. It becomes possible to internalise 'pretend play', and thus inhabit a private laboratory for trying out fantasies and possibilities. Again, as children grow up, it is possible for imagination to become more targeted and sophisticated. We know that 'mental rehearsal', using the mind's eye to practise new levels of skill, is a powerful adjunct to actual physical practice (Beilock and Lyons, 2009). And when imitation and imagination work together, children become able to construct dynamic mental models of other people, and run simulations to explore 'what would Sophie do?' in a currently problematic situation, and thus generate 'good guesses' about possible courses of action for themselves.

LOS 2.3: Reverie

Putting yourself in someone else's shoes (to generate learning possibilities for oneself) or imagining oneself performing a skill to a higher level than one actually can, are learning amplifiers that require a high degree of cognitive control. They are quite deliberate, and children may need time and some informal coaching to master them. But ideas for action also occur to us when we are in more relaxed, less purposive frames of mind. The literature on creativity repeatedly attests to the value of interpolating periods of 'incubation' in between more focused and purposeful kinds of thought (e.g. Dijksterhuis, 2004). Children are natural day-dreamers, and need coaching if they are to develop the more disciplined kinds of thought. But in the process of developing the skills of deliberate, explicit rationality it is important that the learning potential of reverie is not neglected – indeed, is also cultivated. Highly creative learners, such as Nobel Science Laureates, know the value of being able to toggle between controlled and receptive modes of thought (Fensham and Marton, 1992), and there is no reason to deprive children of the same insight. The disciplined use of reverie can be learned, just as well as logic can (Claxton, 2006).

LOS 3.0: Language

With the advent of language, the Learning Operating System obviously receives a massive and highly intricate upgrade. There is no room here to do this proper justice: a few comments will have to suffice. Language enables parents and teachers to 'point' at interesting aspects of experience, and thus tune children's learning, much more accurately than they can through joint non-verbal attention by itself. Language can articulate experience not only in the sense of naming it, but also by being able to joint or segment ('articulate' as in 'articulated lorry') it more finely, and thus allow much more fine-grain learning. Language enables children to ask questions, ask for help, and communicate their learning difficulties. It will enable them to learn through all kinds of conversation, and in due time through reading and the mastery of a range of symbolic literacies (including mathematics).

Language enables children to 'fault-find' more precisely, and to generate (or apply) explanatory frameworks for puzzling or complicated phenomena that will, in their turn, generate fruitful ideas for action and experimentation. If you can give yourself an answer to the question 'Why?' – how come things behaved as they did – you are halfway to a new thought about what you might do to improve them. And language, of course, enables analysis and logical deduction, and thus boosts further the ability to come up with plausible, if not water-tight, lines of exploration and inquiry. (From the learning perspective, it is the capacity of language to support ever more intricate and interesting discovery that is key; not its ability to mount arguments, knock out small essays, or 'show your working' *per se*.)

Conclusion

Children grow with age in a variety of ways. They can become more logical, more sociable, more self-aware and more articulate, as well as stronger and taller. They can also become better at learning: more able to tolerate uncertainty and persist (sometimes for years) with really difficult problems; better at asking for help and learning with others; better at adopting different perspectives and deriving candidate solutions from well-informed explanations. As they grow, their capacity to learn itself grows. Or it could. But sometimes opportunities to strengthen children's learning power are missed. Adults do too much of the learning work for them, or imply that imaginative playfulness is merely an immature precursor to disciplined pages of writing or sums. In the worst cases, learning power is even undermined, as when parents or teachers inadvertently make children afraid of error or failure; or teach them (implicitly) that struggling with difficulty is a sign of lack of 'intelligence' (Dweck, 2000).

But intelligence is not a universal constant. What it takes to be smart depends on the world in which you find yourself. 'Intelligence' is a label that honours the constellation of habits of mind that a culture takes to be valuable. In a stable, traditional culture, it makes perfect sense to treat as 'intelligent' the ability to retell the myths of your tribe with accuracy and flair (Curran, 1988). In a turbulent, digital, globalised world, it makes more sense to honour the ability to engage confidently, calmly and capably with situations that are complex and fast-changing. In the world in which most of us live, it is smart to be a powerful learner. We need a perspective on child development that foregrounds the natural endowments, and the matured dispositions, that underpin this capacity for calm, intelligent presence of mind. We need to be able to chart the developmental trajectory along which children can travel, as their genetic potential guides the distillation of learning experiences into knowledge and skill, and also, crucially, into an ever-expanding competence in the face of uncertainty.

Notes

1 Though no one, to my knowledge, has yet come up with chapter and verse for this.
2 There is no claim that 'learning power' represents a unitary psychological capability. The term is merely a useful place-holder for a to-be-discovered constellation of strategies, skills, beliefs, dispositions, interests and values that have general utility in the face of difficulty or challenge.

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