

# Undergraduates' stories about why they are studying physics: implications for policy

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*Abstract: The research on which this report is based was commissioned because of concerns about perceived shortages of willing and able young people choosing to study physics at university. This paper reports on first year physics undergraduates' stories of why they are studying physics. Narrative-style interviewing with a purposive sample of first year undergraduates enabled data that revealed complexities around decision making, including choice of university course. Analysis of the texts was informed by psychoanalytic notions rooted in the work of Sigmund Freud. These psychoanalytic notions were used both in generating the interview data - the undergraduate volunteer interviewees were conceptualised as 'defended subjects' - and in analysing these interviews in order to conjecture how unconscious forces might figure in young peoples' 'decision making'. After analysing the interviews with physics undergraduates, with respect to the question 'why are they reading physics?' the claim is that identification with key elders is an important positioning for participation. We discerned no evidence that experience of a strategic innovation designed to increase physics uptake - for example a 'fun project' or a competition - had been transformative with respect to a desire to read physics.*

## 1 Introduction: 'participating' in studying physics

First, the instinct of *mimesis* (imitation/representation) is implanted in man from childhood, one difference between him and other animals being that he is the most imitative of living creatures, and through mimesis learns his earliest lessons; and no less universal is the pleasure felt in things imitated.

Aristotle *Poetics* Part IV trans S H Butcher <http://classics.mit.edu/Aristotle/poetics.mb.txt>

I don't know if it's relevant cos it's not to do with education as such but my Grandpa, he helped a lot because when I went to visit him in Spain we went for a walk and he was telling me about the stars and about the earth rotating and it's all these new things, it was like, wow. ...I didn't see him often because he's lived in Spain since I was about that age [10 years old]. It was just a couple of one offs put together. ...he is a very practical man, very logical and I don't know what he did before he retired, but he obviously has an interest in it [physics]. I don't know if it's as big as mine now, but he definitely enjoyed teaching it to me for no reason whatsoever, he just decided to teach me.

Benjamin, University A, physics with theoretical physics

Initially emerging from the ego's dedication to a refinding in the mind earlier objects of satisfaction experienced in the world, Freud presents thinking as an emotional achievement, a libidinal tie, and a relational event.

Deborah Britzman *Freud and Education* 2011: 126

The research project reported on in this paper was funded by the ESRC and other providers as part of their 2007 science and mathematics education call (ESRC, 2006). The funders' intention was to commission research that could provide evidence for policy proposals that would encourage a technically proficient new generation given that post-16 participation rates in mathematics and

physics are generally not considered sufficient from an economic-modelling perspective (HM Treasury, 2004) to sustain desired economic growth.

### **1.1 Participation rates and current participation strategies**

There has long been concern about the number of students taking physics at advanced level. In 2011 this figure in the UK was 32,860, equal to 3.8% of the total number of A levels sat (JCQ, 2011). Although this figure has risen in recent years from a low point of 27,368 in 2006 (equal to 3.4% of the total number of A levels sat (JCQ, 2006)), it remains well below the peak in the 1980s when numbers often exceeded 50,000 (Sainsbury of Turville, 2007). Equally, HEFCE continues to recognise physics as a strategically important and vulnerable subject (HEFCE, 2011).

There are many initiatives designed to increase the numbers of post-16 students of physics. Furthermore, evaluations to date have tended to be small and too often look at whether students and teachers say they enjoyed the initiative rather than seeing what, if any, consequences such initiatives have on attainment or subsequent uptake of physics (Johnson, Riazi-Farзад & Reiss, 2009).

#### **1.1.1 School-based strategies**

In schools, there have been a number of initiatives to increase the supply of specialist physics teachers (e.g. the current Subject Knowledge Enhancement courses that non-physics graduates can take before training to be specialist physics teachers), to produce more engaging curricula both at GCSE (e.g. 21<sup>st</sup> Century Science) and at advanced level (notably Advancing Physics and Salters Horners Advanced Physics) and to increase the number of good quality school laboratories. However, there is little solid evidence to suggest that any of these approaches is working. Furthermore, almost every year the number of teachers in England training to be teachers of physics falls well short of the government's official (TDA – Training Development Agency for Schools) target. As a result, approximately one in four 11-16 state schools in England has no specialist physics teacher (Moor *et al*, 2006).

#### **1.1.2 Out of school strategies**

There are a large number of out-of-school initiatives attempting to increase post-16 participation in physics. Visits by students to places where physics is used are quite frequent (Parvin & Stephenson, 2004; Swinbank & Lunn, 2004) as are competitions (e.g. The British Physics Olympiad, F1 in Schools and many others). Visits and competitions are approaches used by a large number of educational charities in physics and engineering; again, evaluations of these approaches generally rely on participant responses to simple surveys rather than on long-term follow up of participants.

### **1.2 The (relative) failure of current policies**

Given data from 1.1, despite initiatives described in 1.2, it is widely held by government, CBI and others that there are not enough able and willing participants in physics courses. As only 21% of A level physics entries are by young women, one proposed solution to the perceived shortage of the number of students taking physics post-16 is to make the subject more attractive to girls. A thorough review of all the literature on attempts to make physics more engaging to girls was undertaken by Murphy & Whitelegg (2006) who emphasise how much there is to learn; they concluded that at present there are no 'quick fixes' that they can recommend.

The government achievements of the last five years (notably the reverse in the decline in the number of students taking advanced level physics) have come about principally by raising the

political importance of physics education. In particular, under the last Labour government, substantial amounts of money were used to improve STEM (Science, Technology, Engineering, Mathematics) education. A government Chief Advisor for STEM education, Professor John Holman, co-ordinated this and this helped increase the numbers taking STEM advanced level subjects (cf. NFER, 2011). In the absence of hard evidence as to what worked, something of a scattergun approach was used. There are now arguments, including economic ones, for favouring a more evidence-based approach. Hence we asked: how should we investigate how or why options are made to participate/not participate in physics study so that interventions can be devised to promote participation?

## 2 Methodology, analysis and results

The UPMAP project consists of three strands: (1) questionnaires with approximately 30,000 students in 140 schools; (2) interviews with 72 school students, each on three occasions over three school years from 12 schools; (3) interviews with 51 first year undergraduates, who had come straight from school or a 'gap year' experience, all of whom had mathematics or physics A level (or equivalent), that yielded retrospective narratives about their choice of course. This paper is centred on physics undergraduates interviewed as a part of Strand 3. Out of the 51 interviews, there were seven undergraduates reading physics, three male and four female, distributed over three of the four participating universities.

As reported in the introductory section, there have been a myriad of initiatives and schemes to encourage young people to choose science, particularly physics. The lack of sufficient success of these investments is puzzling. And this is why Strand 3 of the project wanted to 'get beneath' standard student 'reasons' for choices like: "I'm good at it [subject of study]", "I enjoy it", "it will help me get a good job" and to do that we drew on Sigmund Freud's central discovery that "psychic processes are in themselves unconscious" (Freud, 1911/2005: 54). Hence we worked with the notion that there exist unconscious forces, which are psychic processes that operate beneath conscious awareness. This working principle played out both in our conceptualisation of the data generated in interview – our interviewee was conceptualised as a 'defended subject' (see below) – and also as a lens for analysis of the undergraduates' narratives. As Britzman remarks "The unconscious is attraction. Its qualities, pressures, aims and objects, associated with gratification at all costs, inevitably exchange the problem of judgement for the interdictions of its own authority" (Britzman, 2011:127-8). We proceeded adopting this hypothesis that attraction is deeper than reason.

### 2.1 Methodology

In Strand 3 of the UPMAP project we interviewed individuals on a single occasion in order to get a relatively spontaneous take on how they got to be studying their subject at university. The approach to interviewing was designed so as to produce a comfortable environment for talking while theorising the interviewee as a 'defended subject' who:

- May hear a prompt or question in a way not intended by the interviewer,
- Protect themselves by 'investing' in ways of talking,
- May not understand why they feel things they do,
- Unconsciously disguise some feelings (adapted from Hollway and Jefferson (2000: 26)).

The freshness of the encounter within a safe space (a private and comfortable room, conveniently located at their university) and the lack of on-going responsibility for the relationship was set up to

facilitate a narrative that allowed feelings – not just ‘rational reasons for choices’ – to be voiced. The aim of this method is to ‘encourage’ unconscious forces to leave their trace in language. In Freud’s words “How are we to acquire knowledge about the unconscious? We know it of course only after it has been transformed or translated into something conscious” (1911/2005: 49). Transformation into language was Freud’s well-known gambit for detecting unconscious forces. In a psychoanalytic encounter the role of the analyst is of course quite different from that of a research project interviewer. In a clinical setting, the analyst is responsible for the on-going relationship s/he has with the client, as well as the interpretation of the material the client offers that is intended to facilitate the client’s progress. In the research-based setting reported on here, the relationship between the undergraduate and interviewer was temporary and the interviewer facilitated a very open-ended interview, maintaining a positive atmosphere of interest in the interviewee and asking questions that encouraged the interviewee to say more about areas to do with subject choice and their relationship with subjects. The data generated from this encounter were an audio file, (later transcribed as) a text file, and brief field notes about the undergraduate’s self-presentation, demeanour and style of dress.

## 2.2 On analysis of the interviews

Unlike in a clinical setting, the data were analysed by a team (the three of us and a graduate student). We studied the transcripts, initially individually and later in group discussion. Our analysis of these texts used different lenses (Black, et. al. 2009). Indeed, there are many aspects of psychoanalytic theory and in other reports from Strand 3 of the UPMAP project (Reiss et al. 2011) we have used different view points: for example, defence mechanisms, states of mind, phantasy, (Rodd et al. 2010, Rodd, 2011a, Rodd 2011b). How we came to work with a specific theoretical psychoanalytical viewpoint depended both on the specific research question (e.g. ‘why did these students take a minor subject with mathematics?’ or, as in this paper, ‘why did this undergraduate opt for physics?’) and the informed reading of the texts while keeping in mind a range of psychoanalytic concepts. In this paper, we addressed the question ‘why did these undergraduates opt for physics?’ and our readings of the interviews drew us to the importance of *relationships with significant adults associated with physics*. This was not only because of what the interviewees said – although each referred to physics being personified in some sense (discussed below) – but also because of what they did not say: none of the undergraduates mentioned interventions despite the many interventions available designed to encourage young people to opt for physics.

## 2.3 The centrality of relationships with people associated with choosing physics: a worked example

Zac says “Physics started to interest me because it made sense, we had a good teacher that would tell us about, he’d tell us that he wasn’t telling us the full truth. And then he’d go into it after class sometimes and he got me interested in physics”. So while Zac gives a reason for doing physics from educational discourse “it made sense”, our reading with a psychoanalytic lens allows a focus on the relationship with the adult, the teacher, who transgresses (“after class”, not “the full truth”) and allows the hypothesis that the cognitively ascribed “sense” is a projection of the mind of the teacher with whom Zac is identifying / bonding / thinking like. This is an example of an observation that led to the conjecture that *a young person’s attachment to an elder who represents the potential field of study for them is key to their participation*. An important consideration is that this attachment does not actually have to be a recognised actual relationship (like father, teacher or big sister) but can be one of the imagination. For example, television science presenters, just like film stars or popular

musicians, can excite adolescent fantasies resulting in emotional attachment. On the other hand, the elder with whom the young person has a relationship need not be a practicing physicist but represents, in the young person's imagination, the potential for this role; thus through their emotionally close attachment, the young person can her/himself project this as a possibility.

Psychoanalytic approaches, developed from Freud's clinical practice and central to the process of the 'talking cure', facilitate the delivery of material hitherto held unconsciously into the space of language. Once voiced, such material is available for reflection, (by both interviewee, interviewer and, after the event, analysers of the resulting text). For example, when Zac says "It's just because he's your Dad isn't it. You kind of want to do what he did. Never thought about it properly" he indicates how the narrative style of interviewing can reveal such hitherto unconscious feelings. For the researcher, engaging with the whole of Zac's interview, hearing that his father, who Zac associated with physics, was mostly absent in Zac's adolescence while the physics teacher who took Zac under his wing was playful and intellectually stimulating, the hypothesis of the centrality of relationships emerges strongly.

### 2.3.1 Examples of relationships' importance even when interventions are mentioned

Although physics-based interventions were not raised by the physics undergraduates as transformative to their decision to study physics, various interventions were cited by a few of the 51 interviewees overall: for instance, Geraldine (University A, electrical engineering) mentioned SENTINUS, Robin (University A, history with economics), talked about the Engineering Education Scheme and Joe (University B, mechanical engineering) described his experiences with the Smallpiece Trust. But even with these examples, the role of adults, as 'elders', is evident: Geraldine while acknowledging the "push to get girls into engineering" comes from a family that includes engineers (father and older brother). Joe also comes from an engineering background and was introduced to the Smallpiece Trust's courses by a family member. Robin got involved in the Education Engineering Scheme through his history teacher at school and while he initially did go to university to read engineering, he dropped that course and enrolled on a history with economics degree.

## 2.4 Example of analysis positing unconscious forces

Location of evidence of unconscious forces in texts is a methodological issue. If one analyser points to a selection of text that s/he reads as evidence of unconscious forces leaving their trace in language, it does not follow that the next analyser or another reader will agree. The process of seeing in text the remnant of another's psychic processes cannot be entirely objective; it is interpretive, so interpretations are results' intermediaries. These two extracts from the interview with Gita, who was in her second term of studying physics at University D, exemplify how small the language traces can be that a team of three, both individually and collectively in this case, interpreted as evidence of unconscious forces:

I wanted to do something that, I wanted a degree that, if later on in the, if when I'm older and stuff and something was to go wrong, I've got a good degree to fall back on if anything was to happen. I thought physics, em, I went to my careers advisor and I read a lot on the internet and it said that physics, it opens a lot of, it opens a lot of em, opportunities and stuff.

These reasons (the esteem-value of a physics degree and the opportunities a physics degree provides), though rather uncomfortably voiced, are both rational and standard. However, later on in her interview, Gita repeats the little phrase “back on” (‘...’ indicates text has been cut):

my Mum got married when she was 19, ... my Mum was like, now she does regret that she didn't do anything cos she thought to herself, you know, I'm not that stupid I could have done something so then she wanted to part, she wanted us [Gita and her brother, one year older than her] to do something for our future cos when we were young, when my parents came here [from India as newlyweds, Gita was born in the UK] and we were really poor and we didn't have much, so Mum's like, I don't want you to be the same when you're older, I want you to have some sort of foundation that you can go back on if you've got an education you've got everything in this world. Well, not everything but.

The phrase “fall/go back on” belongs to Gita's mother and Gita uses it as her own. The interpretation is that Gita's mother's projection into her daughter is carried unconsciously by Gita and when prompted to talk about coming to read physics at university, Gita speaks out her mother's desires for her (only) daughter. This is an example of an interpretative claim for the power of unconscious forces on young people's choices. And is part of the evidence that firms up the conjecture that, for this young woman, relationships with significant adults were central to why she is reading physics. The reader may resist this being evidence or resist the conjecture that relationships with elders is key, but resistance to an analytical interpretation can be seen as an aspect of the reader's thinking mind's engagement with the material that is offered from the narratives that we present as data. Movement forward to understanding the subtle but effecting ways that the waters of the unconscious wash through the mind involves locations of repetitions as well as indicators of defences and fantasies. In a recent book that examines Sigmund Freud's ideas concerning education, Deborah Britzman (2011) says:

The unconscious and sexuality are the most difficult, contentious concepts in his work and do transform what education and psychoanalysis may mean. They are the most ignored and repressed forces in any education and serve as a magnet for both objections and imagination. (*ibid.*: 20)

In this paper, we focus on the concept of the unconscious. For while we discern traces of sexuality or its latency, our central claim is that the young person takes in their career direction from an elder adult while voicing reasons for their choice such as “I'm good at it”, “I enjoy it”, “it will help me get a good job”.

#### 2.4.1 Illustrative case study of Eleanor

Eleanor is the older of two sisters and was brought up in Southern England. Her father was originally from Scotland and had been in the army before working in a bank; her mother had worked in a bank and was now in public relations. Eleanor went to a maintained selective school after having moved primary schools in order to better her chances of success at the 11+ selection. Eleanor took physics, mathematics and English at A level, all A grade A, and German AS. She studied mathematics A level in a ‘further maths’ class, though did not take further maths. At the time of her interview she had completed her first two terms of studying for a four year Masters level degree in physics at University C.

The following extracts from the transcript of Eleanor's interview constitutes about a fifth of the text, narrated chronologically. These sections have been chosen because they illustrate aspects of relationships with her father, her GCSE physics teacher and her A level physics teacher as well as indicating the high achievement and wide choice culture in which she was raised. The rest of the

interview includes more biographical information that did not strike us as particularly significant with respect to her subject choice.

E: I [went to] a grammar school so I have always had to do sciences and languages. I chose to do history, art and German as well as French at GCSE on top of the ones we had to do. ... I was going to do English literature, German, history and physics [A level] but then I always thought I was going to do English literature at university.

E: I always found [physics] fascinating from an early stage, space and particle physics and I read books about it for a long time because my dad was interested in it so there was books around the house and that helped me to develop my interest.

I: Is your dad doing anything with physics?

E: No he isn't, I mean he left school at eighteen, never went to university, worked at a bank but he has always had a casual interest in it. He has got all the Stephen Hawking books and it was always a well respected thing in the house, so I took that purely out of interest and then my parents persuaded me if I am going to do physics you may as well do maths and you have got the option of taking it somewhere because if I didn't have maths A-level I couldn't do anything with it but doing maths and physics and also having German and English would give me the choice to go either way and so I did that. I am not that interested in maths but it was doable and then as I went through the AS levels I started thinking about my university choices and then I started to move away from the English idea and partly because of job prospects, it was always going to be easier to find a job with a physics degree than a degree in English literature so that was a factor and I thought it would be more interesting a girl taking physics than a girl taking English literature because so many people do it and I thought it would be more interesting so in the end I dropped German and kept maths and physics and did English out of interest so I kind of switched over.

In this extract, Eleanor weaves the 'rational choices' discourse in with her unselfconscious communication of the centrality of her father to her. His interest becomes her subject. His lack of physics education is repaired by her choice of university course. She permits herself to be positioned through her choices (maths rather than history A level) to both be him and to surpass him. In discourses available to young women like Eleanor not only is 'job prospects' available but also that of the 'specialness of being female'. Nevertheless, Eleanor 'knows' that the appropriate reason for 'choice' in her society is 'interest': so, while English remains "of interest", physics – or, perhaps with unconscious conflation, her being a "girl" in physics – is positioned as "more interesting", thus 'sensible/rational' to choose:

I: So what do you think of your future now?

E: I am not too sure to be honest, I still like writing and that sort of thing so there was always a possibility at the back of my mind about writing about science ... I feel like I have a lot of options with it. I don't see myself going further into research. I am doing a masters course for the fourth year in physics and I can't see myself taking it any further.

That Eleanor "can't see" continuing with physics beyond her degree is an important issue with respect to the education of future scientists. In particular, given the recent increases in A level physics participation outlined above, it behoves policy makers to attend to the stories of young women like Eleanor who, while studying physics at university, do not anticipate taking it as a career. In the next extract, we read of Eleanor's GCSE physics teacher who, together with her father, facilitated her studying undergraduate physics. This raises the hypothesis about the imagination of future identities: father and school teacher, representing home and school, were sufficient to get to undergraduate level, but, at time of interview, Eleanor had not found a relationship with someone

who was the personification of professional physics practice and it seemed to her that that mattered:

I: Going back, you said you had a very good teacher at GCSE, what was good about him or her?

E: She was very good at making it interesting, she made the lessons fun and I suppose I got on with her on a personal level so that helped and she was very encouraging, she wouldn't tell you stuff directly, she would hint until you managed to work it out yourself, which I found I enjoyed learning like that and I found it worked well for me and she was fairly strict but fair, she encouraged people a lot and made it very interesting. I suppose she did encourage me to take it further, she was always quite supportive.

... but she wasn't my A-level teacher but I saw her a lot during my A-levels because my A-level teacher was pretty bad

I: Why was he or she bad?

E: He was bad because he didn't know my name for maybe nine months and he didn't pay any attention. ... it got to a point where I wouldn't go to the lessons sometimes and would teach myself from the books, to some extent I taught myself ... I got my old teacher to write my references, he was just useless but I was able to keep up an interest regardless.

I: So personal contact is important for you isn't it?

E: Yes I think so, I suppose to some degree I am motivated if I want to impress someone so if there is someone around who cares how well you do then yes it means a lot.

... Its one of the things which I find about university difficult is that no one really cares and I really have to motivate myself but I had to do that A-level anyway, yes I did find that very helpful and she expected me to do very well so tried my best to do very well.

I: What about your family

E: ... When I was going to do English they were happy with that and willing to support me, I think my dad is very pleased I have changed my mind because he has always loved science and he is very interested in what I am doing now and he finds it all fascinating which is nice because when I come back I tell him I am doing this, this and this and he would say 'Amazing' because he never really got the chance to study it as he came from a very deprived background and left school at eighteen and joined the army so he never really had the chance to pursue it further and he said if he could go back he would and he is very happy with what I have done and at the same time if I had done something else that would be fine.

In this part, which starts off with discussion of school and teachers returns to the father, what is notable is her story of the A level teacher who never becomes a significant figure for her. It seems that the GCSE teacher who is both role model and friend, as well as instructor, is sufficient for Eleanor to sustain her imagination for a physics degree, though not a career.

In every case of an undergraduate reading physics, their narrative tells that an adult has been significant in their becoming a physics undergraduate. Not peers, not enrichments, interventions or events, but some adult person or people – usually teachers or family members. The undergraduates' imaginations (conceptions) as to the nature of physics is internalised from these elders. And these relationships can be varied and interconnected: as we have indicated, Zac, Gita and Eleanor each had important relationships vis-à-vis physics with a teacher and with a family member.

### 3 Discussion

The principle finding that emerges in our analysis of these narratives is that a young person comes to be reading physics because of his/her relationships with key people. Is this different from those reading humanities subjects, say English or history? A conjecture is that there may indeed be a



difference: in humanities, like English or history, a deep involvement in the subject is likely to include favourite characters from literature or the past. A relationship is made with these characters. They become someone to think through within the imagination; the mind of the Other is taken in and used as part of mental, even spiritual, growth. This process of taking in another's mind may relate to social aspects of learning in situations where there is a group attraction to characters – whether particular teachers at school or media celebrities; the group reinforces and helps construct the process.

In what sense can this character-creation happen in sciences? When does Fermat's Last Theorem or black holes become character-like? The strength of Andrew Wiles's emotional connection to Fermat's Last Theorem is evident in the Horizon documentary (Horizon, 1996) that followed his relationship with the Theorem; this exquisitely personal relationship with a theorem is unusual. More unusual than, say, personifying Heathcliff or Elizabeth I and taking these literary or historical characters into oneself as people to think through, meaning that in some sense their minds are introjected in imagination and through *their* feelings being felt, something of their approach to the world is taken on; in Britzman's words, "Identifications are the earliest form of emotional ties. It is how the world is taken inside" (2011: 110). Our claim is that the 'physics world' – as a place to journey – is typically taken inside through such identifications with people. This claim is quite compatible with Freud's view that love is the leader and stimulator of mimesis:

*Education* can without question be described as an impetus to overcoming the pleasure principle and replacing it with the reality principle; thus it assists the process of development undergone by the ego. For this purpose, it uses the educator's love as a form of reward, and therefore goes awry when a spoilt child believes it possesses this love anyway and cannot lose it under any circumstances. Freud (1911/2005: 7)

In this short explanation of his view on education, Freud positions love as central. And he also points to the importance of hunger within a relationship if an educating (a leading) experience is to occur.

### 3.1 Questionnaire data from school students

As part of Strand 1 of the UPMAP project, nearly 5000 school students studying physics in Y10 (or equivalent) throughout the UK were surveyed to find out about their intention to participate in physics study post-16. The questionnaire items 'home support for achievement in physics' and 'advice/pressure from others to study physics' were more significant in terms of intention to study physics than a student's current conceptual ability, prior attainment, gender and extrinsic motivation. Other questionnaire items on the survey addressed students' perceptions of their physics' teachers. We found that 'physics teachers believing in an individual student's capacity to continue with physics post-16' was the most strongly associated item, of ten items, with intended physics participation. The other item within the 'perceptions of teachers' items that was associated with intended participation was 'teachers taking interest in students as people'. These questionnaire responses, taken from younger students who were still at the pre-choice threshold, resonate with the narratives of the older, post-choice, undergraduates; as Eleanor said "if there is someone around who cares how well you do then yes it means a lot".

### 3.2 Policy issues

Projects and other interventions that promote engagement in physics are important in getting young people over the threshold into a physics degree course and helping them to have confidence in their abilities. However, unless a human-style relationship can be established, it is not surprising when the

enthusiasm generated by the fun of the project (our examples include: flying with the RAF, contributing to product design in industry, going to the Olympic site) withers.

A real difficulty in designing policy is that how people build and sustain relationships with imaginaries in adolescence will depend on their early relationships and intrinsic aspects of their self (e.g. if they are sense-impaired) as well as on their environment. While sustained mentoring is an obvious suggestion, such institutional pairing cannot presume to evoke the internal attachment that our research suggests is key to sustained involvement. While a teacher is an “emotional figure; she or he stands in for the parental and cultural authority, serves as ego ideal and superego, and stirs Oedipal conflicts and the identifications of group psychology” (Britzman, 2011: 127), this teacherliness is not achieved by every instructor a young person faces. Britzman’s use of ‘teacher’ does suggest the Ideal exemplified by Eleanor’s GCSE physics teacher but not her A level one.

Fostering a yearning for knowledge and for the experience of being taught is not currently the emphasis for educational policies. Rather, the current emphasis is for mastery of content and the attainment of grades and satisfaction. This mirrors Carol Dweck’s well known (e.g. Dweck, 1999) dichotomy between mastery and performance learning. The notion that examinations detect a competence in a subject that would be the same competence even if the exam did not exist, is a present-day myth. And with the demands of policy that schools should improve levels of results year on year, the increasing focus for school students is on results as measured by examination success rather than the experience of forging a relationship with a subject, which, as we have claimed here, is strongly tied with relationships with adults from whom something of thinking-that-subject is introjected.

Many, perhaps nearly all, young people in UK schools are positioned to choose and thereby consume educational products. This contrasts with practices in cultures where children are specifically inducted early in life into their role. In such cultures, choices are few. For example, in Mali, musical families have been producing musicians for many generations. In contrast, while in the UK and other modern societies (Schreiner, 2006), musical families do produce musical offspring, opportunities for a career rarely depend on music alone; music is a cultural artefact and only a very few – deemed quite exceptionally talented (and needing to be particularly dedicated) – earn their living through music. In terms of livelihoods within UK contexts, farming still has something of a traditional family connection. However, where once a modest farm would have supported an extended family in work, within the last 50 years, family farms support only one farmer with other adult members needing to work elsewhere. This can cause tension for those for whom farming ‘is in their heaf’<sup>1</sup>: there may be family responsibility or commitment to having an adult role on the family farm but many children of farmers are uprooted whether they choose or not.

#### **4 Conclusion**

Projects like UPMAP are part of society’s defence against the loss of old relationships with the arts, with crafts or with the land. Current discourse assumes that human beings’ adaptability can be exploited so that people do not ever experience a connection with music or land over generations,

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<sup>1</sup> Heaf/ n. A portion of fell which by custom it always grazes. [www.lakelanddialectsociety.org/dialect\\_glossary.htm](http://www.lakelanddialectsociety.org/dialect_glossary.htm)

but that from early childhood choices are presented. Flexibility is a virtue; multi-tasking is a skill. How can young people be turned into physicists, mathematicians or engineers when there is no emotional or cultural embedding? Given the discourse of life-designing in economic-driven societies, can we reckon on children following in their parents' footsteps? Even the nature of the work of scientifically technical people is such that it is done away from a child's eyes. So science is double damned: (i) more scientists are 'needed', so the defence goes, yet (ii) the children of scientists are not generally drawn into practices through "legitimate peripheral participation" (Lave and Wenger, 1991). The new generation of participants have to be taken from elsewhere. Facilitating traditions is not a significant part of UK education policies, though – because many professional parents do position their offspring for professions like law or medicine – policy discourse does address widening participation in these fields. The issue of the design and implementation of a curriculum that is flexible enough to support traditional livelihoods, while not unduly privileging insiders and while retaining a young person's entitlement to compete in an international field, is a challenge to be addressed. However, there is a paradox at the heart of current discussion around choice and participation: as a young person, one 'should choose' what is one's 'interest', given at least a modest skill, but as policy, those who are scientifically capable 'should choose' STEM, if national or collective interests are to be met. So while scientifically capable young people should choose STEM because it is in the collective good, at the point of choice – as current discourse and policy do not include collective responsibility – they must believe it is in their individual advantage.

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