‘Oh yeah, yeah you get a lot of love hearts. The Year 9s are notorious for love hearts. Everything is love hearts.’ Fixation in Pupils’ Design and Technology Work (11-16 years)

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Abstract
This paper focuses on the design ideas generated by young people aged 11-16 years when solving design and technology problems. A number of methods including focus interviews with pupils and teachers, lesson observations and analysis of documents and pupils portfolios are used to help explain how pupils aged 11-16 years generate their design and technology ideas. The findings indicate that a significant number of pupils produced stereotypical design ideas such as love hearts and sports logos. This was the case regardless of their age and gender and happens at various stages when designing. A review of the creative cognition literature suggests that this occurs as a result of a normal way of thinking and is referred to as fixation. Fixation, that is, what it looks like and how it manifests itself in the D&T classroom is discussed in detail. Fixation was also found to manifest itself in other ways such as a strong desire to do the first idea that comes into your head. It is argued that an understanding of fixation gives insight into why pupils find it difficult to generate creative design ideas. As fixation can be overridden, we believe that the role of the teacher in this process is important. Aspects of current practice that might be problematic are begun to be considered.

Key words
creativity, fixation, generating ideas, creative cognition, 11-16 years

1. The context

In the UK debates about the importance of creativity have once again gained prominence. The Cox Report stated the importance of maintaining, 'our [UK] world leading creative capabilities' (2005: 1), and suggested that various sectors in the UK, including the education sector, could more constructively 'harness the world-class creative talents that the UK possesses' (2005: 1). Sternberg et al (2005) remind us that creativity is not only essential for generating economic wealth but also for everyday lifeskills. In education, the Robinson Report (1999) highlighted the importance of the creative and cultural development of young people and in the UK Creative Partnerships (Department for Culture Media and Sport, 2002) and the central government’s Office for Standards in Education Survey (2003) both sought to develop good creative practice in schools.

The creativity agenda has become influential within Design & Technology (D&T) education. Both Kimbell and Barlex referred to creativity as being in 'crisis' (Barlex, 2003; Kimbell, 2000a, 2000b) and government inspection reports in the UK have continually referred to the lack of design opportunities, particularly for pupils aged between 11-14 years (Office for Standards in Education, 2001/2).

Few would argue against creativity being important, but making it happen in the D&T classroom seems to be problematic. One of the issues may be competing and confusing definitions and conceptualisations of creativity. Sternberg and Lubart define creativity as, 'the ability to produce something novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints)' (1999: 3). This would seem to be a good working definition as it is complementary to the creative cognition approach (discussed in more detail below), and is widely accepted in education (e.g. see Robinson, 1999). There are other interpretations and emphases including the psychodynamic (Weisberg, 1993), the psychometric (Torrance, 1974), the socio cultural (Amabile, 1983, 1996), the confluence approaches (Collins and Amabile, 1999; Csikszentmihalyi, 1988, 1999), and the pragmatic approaches (de Bono, 1994; Osborn, 1979). For a general overview see Sternberg et al (2005), Sternberg (1999) or Cropley (2001). Many of these approaches have informed this research but the focus here is on the cognitive dimensions to creativity and in particular, the creative cognition approach developed by Finke, Ward and Smith (1992). This work focuses on the processes involved in the generation of ideas, processes Finke et al suggest are normative and can lead to both big C creativity (arguably Jonathon Ive's groundbreaking conception of the iPod) and small C creativity, the creative thinking possible by all of us in a smaller, less groundbreaking way, in our everyday lives (Gardner,

1993). It is these normative, cognitive processes that Finke, Ward and Smith believe to be crucial in the development of creative ideas, which in turn, might lead to creative products. In other words, if you have not got a creative idea to begin with, that is, novel and purposeful, albeit in the small C sense, then it is unlikely to lead to a creative product. Thus, to focus only on the end product - the unusual piece of furniture, the innovative personal alarm, the smart textile waistcoat or novel food product - would deny the opportunity to understand the processes involved in the design and development phase - and such an understanding we believe, is important in education and the teaching and learning of creativity.

Nicholl (2002, 2004) showed how pupils tended to generate 'stereotypical' design ideas when solving a design problem. His studies suggested that many pupils in D&T found the process of generating ideas difficult, and often based their design ideas on images in popular culture. Girls often settled for ideas based on love hearts and Disney characters and boys for sports images such as football logos or Nike ticks. As one pupil said, " You really wanted to try and come out with something new and original but this can be quite difficult," (Nicholl, 2004). This situation seemed worthy of more research. In this paper, it is argued that this relates to a state known as fixation. The nature of fixation is explored in relation to the creative cognition literature and how it manifests itself in the D&T classroom is examined.

2. Generating ideas

Most areas of design (e.g. product-engineering design) involve generating ideas at an early stage when designing and this has been emphasised not only by academic researchers (Jansson and Smith, 1991), but also by practicing designers (see for instance Powell, 2006). Dick Powell, an eminent UK designer who was interviewed as part of this ongoing research, states the central importance of the idea in 'the design process' in the following extract from the interview transcript:

> *'having an idea, putting belief behind it [prototyping it] and embodying it [getting business on board]. That actually is the design process.'*
>
> (Dick Powell, December 2005)

Indeed, in England and Wales the D&T National Curriculum Programmes of Study (the curriculum stipulated by central government) states that pupils should be able to 'generate design proposals' (DfEE and QCA, 1999: 20); furthermore, 'generating ideas' is one of the 'six subskills of designing and making' identified in The Design & Technology Key Stage 3, a government reform programme to raise standards (KS3 National Strategy, 2004). It would seem therefore, that the ability to think creatively, that is, to generate novel, purposeful ideas, is an important and necessary part of solving design problems. The generation of ideas is discussed in the context of the literature on creative cognition.

Ward suggests that generative activities that lead to creative ideas have one thing in common; they are all instances of conceptual expansion (Ward et al., 2002; Ward et al., 1997). This is where people 'extend the boundaries of a conceptual domain by mentally crafting novel instances of the concept (Ward et al., 2002: 199). The phrases, 'extending the boundaries,' and 'novel instances' highlight the expectations of creative thinking that goes beyond what is easily predictable (or ideas that are different from other people solving the same problem). This, we argue, should be the basis for judging creativity, albeit at the everyday small C level (Gardner, 1993), and is the level pupils could reasonably be expected to be working at when doing design work in D&T. Interestingly, a number of studies have shown that when participants have sought to generate novel responses their ideas are often similar to existing ideas. For example, Karmiloff-Smith's (1990) studies showed how the younger pupils in her sample (aged 4-11 years) produced similar drawings given the instructions to draw a house and then to draw a house that did not exist. Jansson and Smith (1991) showed how both student and professional design engineers, possibly unconsciously, used features in products they had recently viewed and projected them onto their own design ideas when solving similar problems. Furthermore, they did this even when they were asked not to and had also been told that some of the features were bad design features. Jansson & Smith refer to this as a fixated state, or fixation, which 'refers to a blind, and sometimes counterproductive, adherence to a limited set of ideas in the design process' (1991: 4). Further studies by Condoor et al (1993) and Smith et al (1993) arrived at similar conclusions.

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The idea that thinking might be constrained by certain aspects or features of the situation has a long history, dating back to the earliest work on problem solving and thinking by psychologists from the Gestalt School in Germany. They describe, for instance, ‘functional fixedness’, which is the assumption that objects can only have a limited number of uses based on past experience. This can result in the failure to solve a given problem because of an inability to ascribe a new function to an object, for instance the use of a box of nails to form the stand for a candle (Duncker, 1945). Fixation, therefore, appears a potentially useful construct to explain why previous research (Nicholl, 2002, 2004) has found that pupils’ D&T design ideas lack creativity. It is possible that the stereotypical designs pupils generated resulted from thinking being constrained to a limited set of ideas. The obvious question that arises is, given that fixation is the result of everyday thinking being constrained by a limited set of ideas, what is the nature of this ‘limited set of ideas’?

Many studies have focussed on how existing knowledge can influence the generation of new ideas – a process that Ward refers to as ‘structured imagination’ (see Ward, 1994; Ward et al., 1995; Ward and Sifonis, 1997; Ward et al., 1997; Weisberg, 1986, 1993).

Structured imagination refers to the fact that when people use their imagination to develop new ideas, those ideas are heavily structured in predictable ways by the properties of existing categories and concepts. (Ward, 1995: 157)

Ward offers further insights by predicting which aspects of existing knowledge people are likely to 'retrieve' and therefore use in the generation of new ideas (Ward, 1995; Ward et al., 2002). He refers to this as the 'path-of least resistance' model (Ward, 1994, 1995). For example, when asked to generate novel ideas for tools, two thirds of participants would retrieve the most 'representative' category (for example in one experiment, a hammer) to help generate new ideas. In other words, 'items that come to mind more quickly and to more people are the ones most likely to be used as sources of information for the development of new ideas' (Ward et al., 2002: 203). Thus, returning to the question above, it would appear that fixation is caused when people draw on a limited range of previous knowledge, which is knowledge that readily comes to mind. If this is the case, pupils would be expected to draw on knowledge that is the most readily available to them when they think up design ideas.

Smith (1995), making the analogy to a road map, suggests that thinking in the way described above to solve a problem is a normative cognitive process whereby an individual plans a route (formulates a cognitive plan) in order to get to their destination (or goal), in this case to generate ideas in D&T. This route is pursued until an obstacle is reached (i.e. not knowing a particular process or technique) which ultimately leads to the individual becoming fixated.

3. Summary

Generating ideas is an important part of designing. Ideas are often based on previous knowledge and this can constrain creative thinking and results in fixation or stereotypical design ideas. Furthermore, the processes that help generate ideas are predictable. The creative cognition approach suggests that these are perfectly normal processes. How this manifests in D&T will be explored further below.

4. The Study

4.1 Purpose, participants and approach

The purpose of this paper is to examine how the concept of fixation applies to the idea generation process when pupils are solving D&T problems. It should be noted at this point that pupils design work is likely to be influenced by factors such as attitude towards D&T, motivation and self-efficacy towards specific design tasks and ability; however, of interest here, is the actual cognitive processes involved in the idea generation process. Hence the scope of this paper is restricted to that focus.

Research Question:
What does fixation look like in Design and Technology (11-16 age range)?

The data that is drawn on were collected as part of an ongoing research and intervention project ‘Subject Leadership in Creativity in Design and Technology’ funded by the Gatsby Foundation. The discussion relates to data gathered during the preliminary phase of the research which spanned the first nine months of the project (January to September 2005). The aim

of this phase of the research was to understand how current practice in secondary Design & Technology teaching (11-16 age range) influences pupil creativity, however in this paper the focus is specifically on the design ideas generated by pupils, without discussing in detail how this is influenced by current practice (which will be discussed in a further paper). The approach taken was influenced by the researchers' philosophical stance and the purpose of the research (Tesch, 1990). We believe that there are regularities in human experience (Searle, 1995) which can be identified through gaining access to the perspectives of those involved. This means eliciting the views of relevant players, both teachers and pupils (Rudduck and Flutter, 2004). For this reason the primary method of data collection adopted was interviewing.

Data were gathered in six secondary schools (pupils aged 11 to 16 years) in the UK. Five were schools that the researchers already knew well as they are part of the Faculty of Education's Partnership Programme for professional placements for initial teaching training and are located within East Anglia. Although this could be regarded as a convenience sample (Cohen and Manion, 1994), selection from among the many partnership programme schools deliberately included those serving a variety of communities in terms of socio-economic background, ethnicity and GCSE results (public examinations taken at the end of compulsory schooling in the UK, when pupils are 16 years old). This was done because the researchers were interested in investigating differing experiences in different contexts. These five schools were judged to represent a range of practice in secondary D&T teaching. The final school was selected on the grounds that it had been identified by several sources (including government inspectors) as exemplifying good practice in D&T in terms of fostering creativity. It would have been desirable to include more than one school of this type but the advisors approached struggled to make further recommendations. This school was located in the South West of England.

Interviews were conducted with D&T teachers and pupils; these were taped and transcribed. Informal conversations were recorded in fieldnotes. Observations of D&T lessons were conducted in follow-up visits to some of the schools and observation notes were typed up. In addition various documents were gathered (worksheets and project booklets used by pupils, schemes of work relating to activities which were the focus of interviews or observations, central government (Office for Standards in Education) inspection reports, and school prospectuses). Samples of pupil work were also collected.

A semi-structured format was chosen for interviews with both pupils and teachers which enabled areas of interest to be probed but also allowed responsiveness to participants' stories. There were two main areas of interest:

- Research undertaken by pupils for projects (what / when / who decides)
- Idea generation (how / when / how many are expected / contribution of research).

The researchers were also interested in understanding the roles of the teacher and pupil during these two activities. For instance, teachers were invited to talk about the place of creativity in D&T; their role in creativity (particularly in relation to research and idea generation); the extent to which creativity is valued in the department, and their perception of the barriers to creativity.

At least two D&T teachers were interviewed, individually, in each school. One was the Head of Department. A second teacher was interviewed whose specialism was different from that of the Head of Department. In some cases a third teacher was interviewed if they had responsibility for a particular area of D&T that the researchers wanted to know more about in relation to its potential for creativity. Many of the interviewees were known to at least one of the researchers so it was necessary to be mindful of the agendas they might bring to the situation (Cohen and Manion, 1994). Interviews generally lasted for 60 minutes and in some cases arrangements were made for follow-up interviews to complete conversations.

Schools were asked to identify three girls and three boys in each year cohort that would give a reasonably representative sample of the school's intake (in terms of ability, ethnicity etc.) and who would be willing to speak to the researchers. These pupils were interviewed in same sex, same-cohort groups. Group dynamics and power hierarchies can affect

what pupils feel able to say when with peers (Cohen and Manion, 1994) but the researchers felt this arrangement should minimise these effects, especially as they were not being asked to discuss a particularly controversial or personal topic (Madriz, 2000). Indeed pupils were generally very forthcoming. Across the schools, 126 pupils were interviewed (68 girls and 58 boys), each interview lasting about 30 minutes.

In addition to these interviews, 10 Key Stage 3 lessons (pupils in the first three years of secondary schooling) were observed, where pupils aged 11 to 14 years were mainly generating and developing ideas. One researcher constructed a narrative of the lesson (Ely et al., 1991), which included a description of events and some commentary. The other researcher focused on teacher-pupil interaction as this was a key area of interest. These notes were written up and discussed so that the approach could be refined in later observations. The dialogue in the lessons was also tape-recorded and key (audible) moments were transcribed.

Interview transcripts, observation narratives, fieldnotes and memos were transferred to the QSR NVivo programme (Fraser, 2000). An initial set of descriptive codes (Miles and Huberman, 1994) was developed, which related to the questions asked during the interviews and additional ones were added that reflected important strands in the responses. For instance, pupils frequently commented on how difficult it was to generate ideas and so a code was generated to cover this response. Coded segments were examined to see whether there was evidence of 'fixation'. From this a number of themes emerged which are discussed below.

5. Results

5.1 The analysis: evidence of 'fixation' in D&T

Pupils in interview were asked a series of questions in relation to both their current project and previous projects. These included: where they got their ideas from; how many ideas they were expected to come up with; what happened typically in lessons when they had to come up with ideas; whether they felt their ideas were similar to those of other pupils or different; and whether they wanted them to be the same or different. The interviews suggested that pupils found idea generation difficult and this was probed specifically by asking them what they did when they got stuck. Each pupil was also asked whether they felt they were creative and to justify their response. Then, what teachers had said about pupils' design ideas, and the observational data on ideas generation in lessons, were examined. A sample of pupils work was also analysed. Evidence of fixation was rife across the 11-16 age range, but it appeared in a number of guises.

5.2 Stereotypical design ideas

Overwhelmingly pupils' design ideas reflected popular teenage culture, and, perhaps not surprisingly, stereotypical ideas reflected gender patterns. The following quotations are typical of pupil responses.

Y9G *'I made a cushion last year which was purple with hearts on it.'*

Y11G *'I printed off loads of cartoon characters, like Winnie the Pooh and stuff, which I used for my design.'*

Y10B *'There is a lot of flowery boxes from the girls.'*

Y7B *'I did a football boot. That's what I did on my photo frame.'*

Y8B *'Mine's a car.'*

Stereotypical design ideas were also highly evident in the observational data and samples of pupil work. Figures 1 to 5 provide some illustrations.

Boys' designs tended to be based on sport, particularly football. Hence football logos were common decorations and the shape of a football figured regularly in the shapes of products. Girls were more likely to use hearts, flowers, animals and Disney cartoons in their designs, although the Playboy Bunny also appeared. The ideas clearly reflect the hobbies and interests of pupils of this age and were similar to findings reported by Nicholl (2002, 2004). Some design ideas were, however, used by both boys and girls. Initials (either for the shape or as a decorative feature) was one theme that was common. Overall the design ideas mentioned by the vast majority of pupils interviewed could be classified as stereotypical.

Such designs irritated D&T teachers: 'Oh yeah, yeah you get a lot of love hearts. The year 9s are notorious for love hearts. Everything is love hearts.' But teachers seemingly did not know how to intervene to prompt less predictable design ideas. An additional source of irritation was that pupils thought these ideas were creative and original:

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Figures 1-4 are examples of students design ideas generated for a card they were going to send to their friends. Observed June 2005.

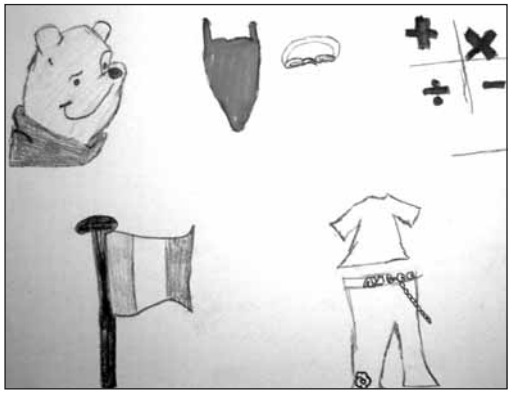

Figure 1. Yr 7 female

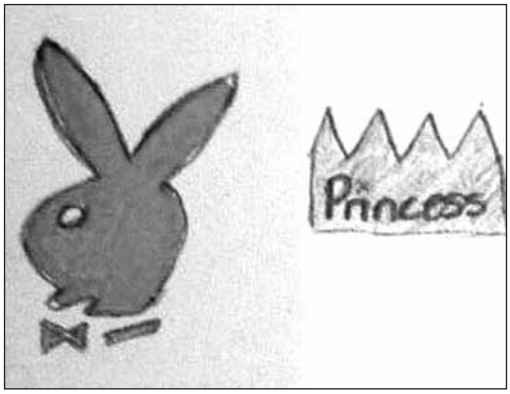

Figure 3. Yr 7 female

Figure 2. Yr 7 male

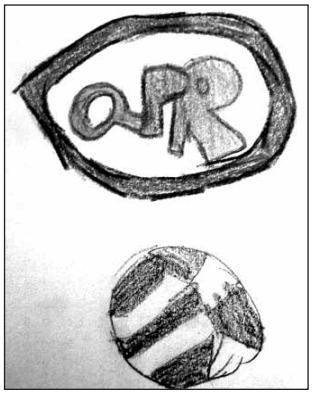

Figure 4. Yr 7 female

Y10G
‘Well my friend. She had a skirt with loads of kisses all over it so…, so I’d say that’s wacky.’

Y11G
‘I think they (my ideas) are quite different… One of my ideas was to have a flower, a purply flowery print with a purple lining.’

Whilst some might suggest that these designs are creative for the pupil concerned as they had not made such designs before, they are not creative in the sense of being instances of conceptual expansion as described by Ward and colleagues (2002), which we argue should be taken as the basis for judgements of

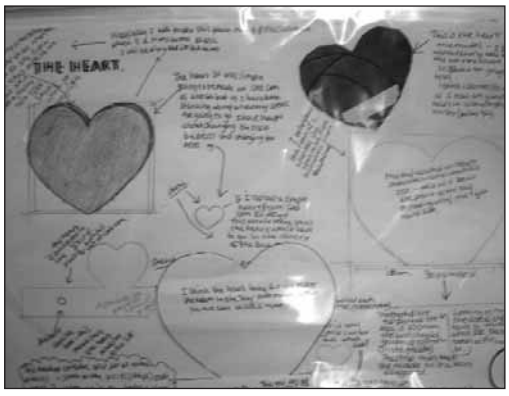

Figure 5. Yr 11 female.
Ideas for a night light project. Interview June 2005

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creativity. The pupils' comments above may seem unsatisfactory in relation to a valuing of originality in design, when considered in the light of the creative cognition literature, it is far from surprising. Pupils will draw on existing knowledge that is most accessible to them (Ward et al., 2002), which, arguably for teenagers, is the culture they are, and want to be, part of. The path-of-least-resistance models suggests that 'the predominant tendency is to retrieve fairly specific, basic level exemplars' from their cultural domain, select one or more of those retrieved instances as a starting point, and project many of the stored properties of the instances onto the novel ideas being developed' (Ward et al., 2004: 2). Hence pupils will use the common shapes and images they are familiar with, such as hearts or footballs, rather than attempt to think of something more original and more complicated.

We believe that pupils are not necessarily being lazy when they draw on images from popular culture; rather it is the result of 'normal' thinking processes operating. Work by Ward and his colleagues has shown that even when adults are asked to be creative and are apparently highly engaged in creative tasks, outcomes tend to be stereotypical because imagination is structured and constrained by the processes outlined above. Furthermore, this process is subconscious. It was not surprising then, that many pupils found it hard to articulate where their design ideas came from. A common response from younger pupils interviewed was 'dunno', whilst others didn't even attempt a reply or tended to agree that ideas just appeared in their heads. Older pupils, such as this Y11 pupil, sometimes attempted an explanation but were often vague: 'it might just pop into my mind from somewhere, maybe from the research'.

It is therefore argued that the overall effect of these subconscious, automatic and normative cognitive processes, in the case of pupils working on D&T projects, is often the literal reproduction of popular culture images in design ideas a dominant approach explained by Ward's path-of-least resistance model.

5.3 Design Ideas that are similar in style

Stereotypical ideas were more evident in some projects than others. For instance, if pupils had to decorate or embellish a product (for instance, the lid of a pencil box or the design on a cushion), stereotypical ideas were particularly common. If, however, pupils' design work was more concerned with the function of the product then stereotypical ideas were less common. For example, a Year 7 (pupils aged 11 to 12 years) materials project seen at our 'exemplary practice' school, where pupils had to design a toothbrush holder from a piece of wood to use in their own home, successfully avoided stereotypical designs. However some degree of fixation was still evident: many pupils – like this one - commented on how similar their design ideas were:

Y7G
'I think some people do come up with the same ideas, but slightly different. They would be each unique but some of them might be similar and have the same feet positioning.'

So although the designs in this case were not stereotypical, as the project did not lend itself to this, there was little evidence of original, creative thought. Pupils in other schools also commented on the similarity of design ideas across a class (which may also be stereotypical in type), as these quotations demonstrate:

Y10B
'We all have to do the same project…some of the final designs look a bit similar I mean…you can see like…the similarities between each and every one.'

Y8B
'Sort of like similar sort of type (themes for board games)… like war games and then football games.'

The important point to note here is that pupils were accessing the same sources to generate ideas, and because cognitive processes operate along the path-of-least-resistance, similar end points were being reached, i.e. the resulting products were almost identical. This lack of creativity would seem to reflect the operation of fixation.

5.4 Acceptance of the first design that is thought of

Another form of fixation can be seen in pupils' desire to stay with the first design they think of:

Y7B
'As soon as they said come up with an idea for a pencil box (decorative lid design) I already knew that

I was gonna do either a Man United player or just the team.'

Y11G
'I just thought I wanted to do something [for GCSE coursework project] with a dinosaur that would suit both boys and girls. I just wanted a dinosaur.'

Pupils often reported that they felt annoyed that they had to sit and think of a number of ideas, when they knew straight away what they wanted to do – and what they wanted to do was, as the examples above illustrate, often stereotypical. Teachers across the schools also found this problematic, as these extracts show:

'The other thing that pupils find totally alien to them is the idea of acceptance and rejection of ideas. They can't accept if you are producing a range of ideas to a problem, three or four different ideas, let's say, that only one of them is going to be developed and they think along the lines, 'Well, okay, I'll just draw the one that I want to make. They've very clearly worked out how they want to proceed and they're difficult to budge from that particular root of thought.'

'They get a fixed image, that's what I want to make. It's very hard to make them see that you can change it and modify this. They're fixed, they think now that's what I want and that's what I'll do.'

The speed with which pupils come up with their first idea is illustrative of Smith's (1995) road map analogy; they generate a quick simplistic (cognitive) plan to reach their goal of coming up with a design idea, rather than exploring possible alternatives. Hence the combination of this process (devising a plan), plus the fact that accessible knowledge is activated, means that the road map leads them along the path-of-least-resistance, resulting in pupils becoming fixated on their first, often stereotypical, idea.

5.5 Inability to generate Ideas

The active cognitive plan can come to a dead-end when information necessary to achieve the design goal has failed to be retrieved from memory. This is experienced as 'being stuck' and is something that pupils complain about quite often, as the following quotations reveal:

Y10G
'Sometimes…like um…sometimes you just think of like a plain skirt and you wanna do something else just to make it really nice…sometimes you have tough time just thinking what to do.'

Y8G
'Yeah… it is quite a common thing [difficulty with generating ideas].'

This Y11 pupils talks about her difficulty in producing any ideas at all:

'When I'm designing…I'll put my pen to my paper like…I gotta design something…but nothing really springs because there's nothing there to spring from.'

Pupils were particularly likely to complain when asked to come up with more ideas once they had generated one or two already – as these pupils explained:

Y9G
'Sometimes, like, 'cos if you think of an idea then usually that's the one you want to do and like if you think of other ideas, then you really usually go through with your first one, so it's like hard to come up with others.'

Y7B
'I think you could run out of ideas.'

The inability to generate ideas in this instance seems to be due to the fact that the dominant cognitive plan relates to a previous idea that has already been generated; the pupil keeps thinking about her first idea and is unable to launch a new plan to generate a different idea. This is an instance of what Smith (2003) calls 'retrieval bias' and in this case can mean that once an idea has been generated, often using obvious, predictable information which can lead to fixation, it acts as a blocker, constraining the opportunities to retrieve other information from memory, that perhaps could lead to more novel and appropriate ideas.

5.6 Discussion

When discussing these findings, it is not suggested that young people's culture is not important, or that popular cultural images cannot be used to generate creative ideas and eventually products. What is being

suggested is that, left on their own, many young people find it difficult to generate novel ideas that extend the boundaries of a domain. They copy images, usually the first that come to mind, from their popular culture and use these exact copies as their 'ideas'. These copies, we argue, have not extended the boundaries of possibility, nor are they novel, even with respect to the little C or everyday definition of creativity, as they are similar to those generated by their peers. This state of affairs is not surprising given what the creative cognition literature has revealed about how cognitive processes function. Fixation is entirely predictable. However, just because fixation is predictable, does not mean that it cannot be overcome. According to Ward (1995) it is possible to change the dominant processes of structured imagination.

Note that structured imagination predictions are about the natural or default tendencies that people will follow due to the nature of category structures and processes. These default tendencies determine paths along which imaginative ideas are most likely to be guided. They do not represent absolute constraints that can never be overridden. (Ward, 1995: 162, italics added)

This, we believe, shows that the teacher has a crucial role to play in helping young people overcome fixation. Teachers need to adopt pedagogical approaches that can help young people extend the boundaries and produce novel and appropriate ideas and eventually products. The ongoing research in this project, which will be elaborated in future papers, indicates that current practice is contributing to fixation rather than overcoming it. For instance, numerous pupils said that they do their research on their own "at home" and the predominant response to the question, where did you get your research was, "I got it off Google images." Without the support to go down different paths to guide imaginative ideas, it is not surprising that pupils first gather, then use similar images to inform the generation of their ideas. This, the creative cognition literature and our studies suggests, can lead to stereotypical design ideas. Nicholl (2004) reported the main source of design 'ideas' was the Argos catalogue and it appears that the modern default research strategy is now Google images. Nicholl banned the Argos catalogue in his school but acknowledged that removing the main source of fixation was not going to overcome this problem. Teachers first of all need to be made aware that they have pivotal role to play, if young people are to get beyond love hearts as designs in D&T, and then to start to examine aspects of their practice that might be contributing to this situation, such as the research they ask pupils to do. Finally, alternative strategies teachers could use to help pupils overcome fixation should be developed and evaluated. This is the longer term aim of the ongoing research project.

6. Conclusion

Whilst acknowledging other approaches to creativity, the focus of this paper is creative cognition, specifically how pupils generate their design ideas. Fixation, as has been discussed, is widespread amongst pupils' work in D&T. It can appear at different stages of design and can take different forms; however the outcome is the same – we believe pupils will continue to struggle to come up with creative design ideas unless there is targeted intervention from their teachers. It is now clear, and different accounts of the design process in the classroom confirms it, that this way of thinking is dominant and even predictable. At the same time however, we are concerned to promote creativity, particularly in producing ideas that 'extend the boundaries' and which are novel and purposeful. This would appear to be an essential part of design and technology. This tension can only be resolved if what fixation is and how it operates is understood. We believe we are now in a better position to understand the likely causes of fixation in D&T. For instance aspects of current teacher practice, such as how students are asked to conduct research, seem to contribute to fixation in the D&T classroom. This will be focused on in more detail in a further paper. Once teachers know the nature of the habit (i.e. the tendency to fixation) and what holds it in place, they will be in a good position to develop approaches to teaching and learning that will overcome this dominant mode of thinking, and enable both teachers and pupils to contribute towards the harnessing of world class creative talents and equally importantly, develop essential creative lifeskills.

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