

## **Identity and affect in design cognition**

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## Identity and affect in design cognition

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### Abstract

Much Design Research effort has been afforded to investigating how designers think and what they do; often in the form of protocol analysis. These investigations have mainly focused on how designers influence material culture however, little attention has been paid to another line of enquiry; that is how the act of designing affects the individual undertaking the work and the role of social psychological phenomena e.g. attitudes, evaluations, emotions, impressions, motivations and social behaviour - on design activity.

This interplay of affect between design activity and a designer's social psychological behaviour is a complex two way process that warrants further investigation. Our research agenda focuses on the individual undertaking design activity and asks how does designing affect the designer and their behaviour?

In this paper two issues are addressed:

1. The immediate effects of design activity on the designer
2. The role of self-concept in design cognition

These two issues are investigated through a series of experiments carried out under semi-controlled conditions using several forms of observation and novel self-concept inventories.

This paper draws attention to the need to consider self-concept and affect in design cognition and introduces the idea of *design identity*, which is uniquely different to the concept of design experience often quoted in the literature. This is an area of the ongoing research agenda within the Department of Design and Technology, Loughborough University, UK.

### Keywords

Design Activity; Design Behaviour; Psychology of Design; Self-Concept; Immediate Effects

The activity of comparing several different options before arriving at a satisfactory solution has been labelled 'evaluation' and is considered a fundamental component of designing (Gregory, 1982). Evaluation forms an integral part of the positivist design paradigm typified by the widespread analysis, synthesis, evaluation (ASE) model of a design process (Gregory, 1982; Jones, 1970; Seider et al., 2003). Under such a model solutions are evaluated against a specification. The term specification can have several meanings but in design research it usually describes the characteristics a design must possess in order to provide an appropriate solution. The ASE model assumes that

designing can be equated to a rational problem solving activity and can therefore be described in terms of patterns of information (Chandrasekaran, 1990; Coyne et al., 1990; Visser, 1996). However, this view has been challenged by several researchers who argue that designing is much more than just a problem solving or information processing exercise because what sets Design (Archer, 1979) apart from other fields of study is the judgement of the human designer (Coyne & Snodgrass, 1993; Dilnot, 1982; Franz, 1994). Hence, theories within design research should account for human values and the personal idiosyncrasies of the designer (Love, 1998).

Until now investigations have mainly focused on how designers influence material culture however, little attention has been paid to another line of enquiry; that is how the act of designing affects the individual undertaking the work and the role of social psychological phenomena e.g. attitudes, evaluations, emotions, impressions, motivations and social behaviour - on design activity, see Figure 1.

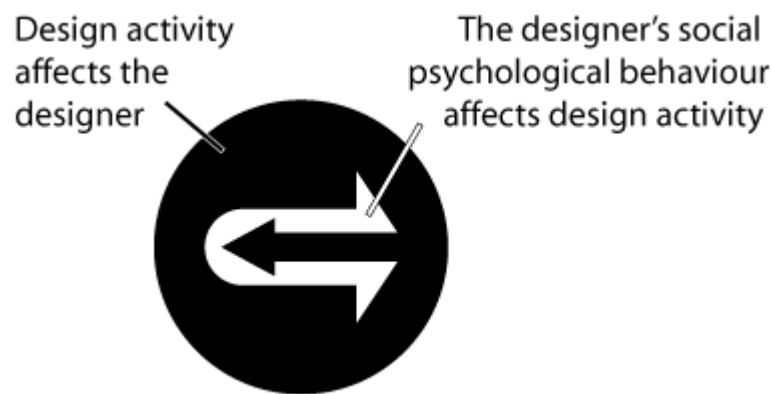


Figure 1 The interplay of affect between the designers social psychological behaviour and design activity

In this article, this two way process is investigated by observing how subjects evaluate their own work immediately following a basic design related task. The experiments were undertaken to identify if engaging in the act of designing might change the reflective evaluation process that proceeds it and also if the response is linked to a subject's view of themselves as a designer.

## Introducing Design Identity

The term 'self-concept' is used to refer to the sum total of the knowledge and understanding a being has of his or her self and includes feelings of self-confidence, self-worth, self-acceptance, competence, and ability (Marsh, 2007). Self-concepts are multi dimensional in that human beings may have very differing opinions about themselves with respect to physical, psychological and social factors. Within the global construct of self-concept, self-identity can be defined as, 'a combination of self-referent cognitions, emotions, and attitudes expressed within various aspects of life' (Li, 2006). Since self-concept and hence self-identity are multidimensional, individuals can switch between multiple identities under varying situations.

Within sports psychology the term athletic identity (AI) refers to the degree to which individuals identify with the athlete role (Brewer et al., 1993). AI is a well established, peer reviewed psychological concept and its impact upon behaviour has been studied relative to a number of sport related scenarios (Brewer et al., 1993; Green & Weinberg, 2001; Grove et al., 1997; Hale et al., 1999; Horton & Mack, 2000; Phoenix *et al.*, 2005; Ryska, 2002; Sparkes, 1998).

AI is both a 'cognitive structure' and a 'social role'. A cognitive structure, or 'self-schema', is a way of looking at the world that affects the processing, organisation and interpretation of information and the term 'social role' refers to the behaviour society expects from an individual based on social status and social position (Larsen & Buss, 2006). As a cognitive structure AI provides a framework to interpret information and to influence behaviour in a sporting context, while as a social role it is influenced by the perceptions of significant others (Horton & Mack, 2000). Therefore, Tasiemkis et al (2004) suggest that although AI is likely to be built over time; it should not be solely inferred from the current levels of participation, time spent, or achievements in sport. In a Design context this would mean that a person's self-concept of being a designer may not directly correspond to their level of design education or experience in the field.

In mainstream psychology several researchers (Harter, 1990; James, 1984; Rosenberg, 1979) have described how the importance attributed to a given self-construct domain determines the extent to which perceived competence in that domain influences motivation, affect, and self-esteem. Perceived incompetence in a domain of high perceived importance can profoundly affect one's feelings of self-worth, while incompetence in a domain of low perceived importance is unlikely to have an impact. In addition, Brewer et al (1993) propose that people with strong domain specific identities place great importance in participating in activities, and are especially attuned to self-perceptions, in that domain.

Both sports science and design research share a common goal in that they aim to understand human performance. We therefore considered that a self-concept construct similar to AI exists for designers and can influence performance in the act of designing. This construct, 'designerly identity' (DI) refers to the degree to which individuals identify with the designer role. Since DI is a new concept to design research, much of the theoretical basis for this paper has been taken from work in sports psychology. Nevertheless we will assume for now that DI should be considered somewhat different to design expertise or level of experience and while it is likely to develop over time it should not be inferred from an individual's current level of participation in design activity, time spent designing or achievements as a designer.

So in the context of designing, we could expect persons with a high DI to place great importance in design activity and be sensitive to their own perceived competence as designers. For instance, when evaluating ones own emerging designs, one may express contentment with a proposal or ask, 'is this design representative of my designerly ability?' Therefore, we hypothesise that DI contributes to design cognition because it changes the importance placed on perceived self-competence during evaluation of one's own design work.

### ***Design Identity Measurement Scale***

To gauge the level of DI attributed to a subject The Design Identity Measurement Scale (DIMS) was created. DIMS contained ten statements and subjects were asked to indicate their agreement or disagreement with each statement using a seven point Likert scale, see Table 1.

- 
1. I consider myself a designer.
  2. I have many goals related to being a designer.
  3. Most of my friends are designers.
  4. Designing is the most important part of my life
  5. I spend more time thinking about designs and designing than anything else.
  6. I need to undertake design orientated projects to feel good about myself.
  7. Other people see me mainly as a designer.
  8. I feel bad about myself when I am unable to create good designs.
  9. Design is the only important thing in my life.
  10. I would be very depressed if my circumstances changed and I were unable to take part in designerly activity.
- 

Table 1 Design Identity Measurement Scale (DIMS) adapted from (Brewer et al., 1993, p.243)

The questions were based on those presented in a standard inventory, known as the Athlete Identity Measurement Scale (AIMS), used to assess the level of athletic identity within sports psychology. The AIMS was developed by Brewer, Van Raalte, and Linder (1993) to measure the strength and exclusivity of identification within the athletic role and has since been validated by a number of different researchers (Brewer & Cornelius, 2001; Hale et al., 1999; Li, 2006; Martin et al., 1997).

### ***The Immediate Effects of Designing***

In human physiology the effects of a stimulus upon the organism, that is the changes that occur as a result of exposure to the stimulus, can be classified under several headings such as acute, immediate and cumulative (Zatsiorsky, 1995, p.18).

In this article the immediate effects of design activity are investigated. Immediate effects being those that occur as a result of a single period of designing, which are manifested soon after the activity has ended. This is achieved by examining the way subjects' evaluate their own work immediately following a basic design related task compared to subsequent re-evaluation.

### **Method**

To study the immediate effects of design activity upon the designer and the role DI plays as an input to designing 14 subjects participated in a series of experiments under controlled conditions.

The research was split into four parts:

- I. Subjects completed the Design Identity Measurement Scale (DIMS).

- II. The subjects completed a basic design related task under video observation. This was immediately followed by a debriefing session, during which subjects evaluated their own work, where interviews were used to elicit information regarding their decision making process.
- III. After a two week interval each subject re-evaluated their work in a second debriefing session.
- IV. A peer review group (35 male 35 female) evaluated each subjects work in relation to the aesthetic properties of the images.

The order of events is illustrated in Figure 2 below.

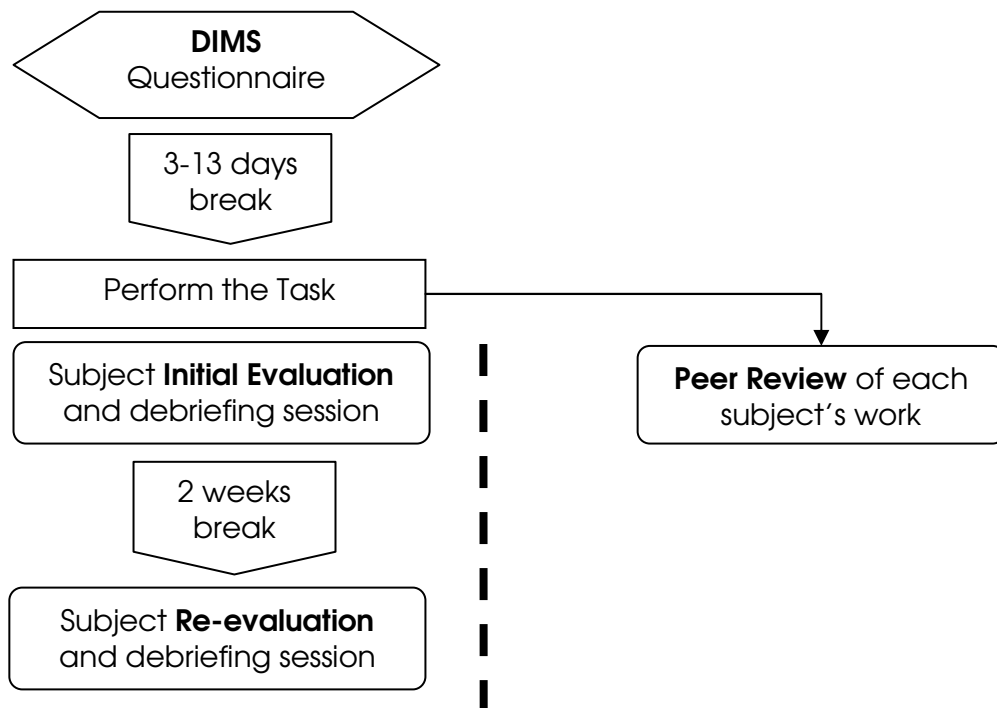


Figure 2 Order of events during the research

### Participants

14 subjects, 5 female and 9 male, agreed to participate in the study. Subjects were aged between 18 and 50 and had varying levels of academic and professional experience as designers. Information regarding their age, academic and professional experience was collected in a short questionnaire when the subjects were first recruited to the study, see Table 2.

Subject	Age	Gender	Years Designing	Design Education	Professional Experience
A	23	M	4	Undergraduate	2
B	21	F	2	A-Level	1
C	26	M	7	Postgraduate	3
D	49	M	30	Undergraduate	28

E	26	M	6	Postgraduate	2
F	25	M	6	Postgraduate	1
G	24	M	4	Postgraduate	1
H	24	M	6	Postgraduate	1
J	30	F	10	Postgraduate	8
K	26	M	8	Postgraduate	3
L	47	M	28	Postgraduate	6
M	29	F	10	Undergraduate	8
N	22	F	3	Undergraduate	1
P	34	F	13	A-Level	9

Table 2 Summary of participant information

### ***The design related task & evaluation***

The subjects undertook a series of predefined basic design related tasks, or enterprises (Archer, 2004) in which four colours were applied to a square area in accordance with a number of constraints. The colours offered were chosen because they do not provoke any immediate relationship with a tangible object or scene. For instance the primary colours of green, blue and yellow were not chosen because it was felt that their relationship with grass, sky and the sun was too strong. The task was used because it is open ended, subjective and has infinite potential solutions. Since the objective criteria for completing the task are very simple and can be easily fulfilled, the emphasis regarding what signified a satisfactory attempt was left purely to the subject.

To facilitate data capture the task was carried out on a computer using a customised raster graphics package that limited the colour choices to the four needed for the task. The subjects were allowed to choose between using a mouse or a tablet to create their solutions. This was done to cater for personal preference and ensure the choice of input device did not limit the subjects' performance.

### ***Instructions***

- You have four colours: white, light red, dark red and orange that can be applied to a square area.
- White must share a border with light red, light red must share a border with dark red and dark red must share a border with orange.
- You must work within the confines of the square only and the entire area must be utilised.

Each subject was given three opportunities to create a solution and there was no time limit for completing each attempt. Three attempts were used because this permitted each subject to address the task from a number of directions but removed the need for paired comparisons during the evaluation process. Once an attempt was complete, it was 'locked' and could not be adjusted further.

All movement on the screen was captured using time stamped screen capture software and time stamped video footage of the designer working was also recorded. The time taken to complete each design solution was recorded from when the subject was instructed to start work to the point where they signalled they were finished.

Having completed all three attempts the subjects were immediately asked to:

*Please rank your work from three to one with respect to which attempt you are most satisfied with? Your most highly rated attempt is ranked three and your least rated attempt is ranked one.*

Next, the subjects were immediately interviewed about their work to try and elicit information regarding the following three areas of interest:

1. Why they were most satisfied with their highest ranked attempt.
2. How they knew they were most satisfied with that attempt more than the others – was it a visual preference or a gut feeling?
3. If there was anything they were unhappy with about their work.

The second question was asked, as a follow up to the first, to try to elicit if the subjects were aware of where the information for the decision was coming from as most of the answers were expected to be intuitive in nature. The third question was included to identify ways to improve the procedure in the future.

### **Re-evaluation**

Having initially created their three attempts an arbitrary period of two weeks was allowed to pass before the subjects were asked to re-evaluate their work. This was done to see if the subjects' preferences would change upon a second viewing and under circumstances where no work had taken place immediately prior to evaluation.

Each subject's three solutions were compiled into a single image file so that all three could be compared side by side. However, the arrangement was randomised, so that attempts were presented in a different order to when they were first evaluated, to encourage the subjects to look again at their work and minimise the effect presentation arrangement may have had on their decision making process. For example, people may naturally be drawn to a centrally located solution. The subjects were asked to re-rank their work and once again a retrospective interview was conducted as described previously.

### **Peer Review**

A peer review group (35 male, 35 female) were shown the fourteen sets of designs created by the subjects and asked to rank the work with respect to which solutions they found most 'aesthetically pleasing', to assess if certain options were generally considered aesthetically superior to others.



## Results

### *Design Identity Measurement Scale*

The results collected from the DIMS showed a large variation in responses between subjects, with the highest total score being 41 and the lowest being 14.

Table 3 ranks the subjects in relation to their response to the DIMS questionnaire, where fourteen is the highest scoring subject (H) and one is the lowest (B). While normative values have not yet been established, this ranking implies that subjects H, D and N identified more with the designer role than subjects B and M.

DIMS rank	Overall score	Subject	
14	41	H	Highest
13	40	D	
12	40	N	
11	35	K	
10	34	C	
9	33	E	
8	33	F	
6	31	A	
6	26	G	
5	25	P	
4	23	L	
3	22	J	
2	15	M	
1	14	B	Lowest

Table 3 Subjects ranking according to DIMS test score

### *Initial Evaluation*

Examples of the work produced in the study are shown in Figure 3 and Figure 4.

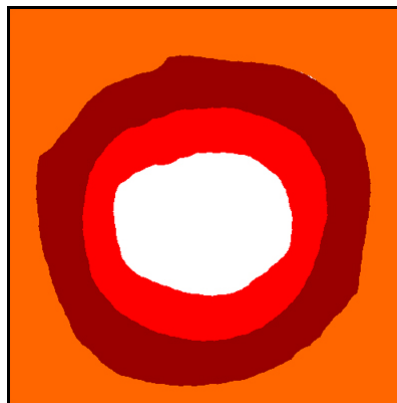


Figure 3 Solution produced by subject A



Figure 4 Solution produced by subject F

Analysis of the subjects' performance during the task combined with their self-evaluation revealed that,

- Individually, some subjects spent considerably more time completing the task than others. Table 4 ranks the subjects in order of total time spent completing the task.

Cumulative time rank	Subject	
14	H	Highest
13	N	
12	D	
11	F	
10	C	
9	E	
8	P	
7	K	
6	J	
5	G	
4	A	
3	M	
2	L	
1	B	Lowest

Table 4 Ranking of subjects by cumulative time spent on task

The interviews immediately following completion of the task were analysed and the responses categorised for each area of interest. Based on the report frequency under these category headings the overall results suggest that:

- Subjects were focused on issues related to their perceived self-competence and paid particular attention to the visual aspects of their designs.
- Subjects used their visual and kinaesthetic representational systems to intuitively assess if they were satisfied with their own work. They also commented on how their work affected them on a personal level.
- Subjects believed that greater precision and concentration could improve their work.

### **Re-evaluation**

When the subjects re-evaluated their work two weeks later,

- Nine changed their mind with respect to the ranking of their work.

During the retrospective interview,

- Subjects now focused on the visual aspects of their designs.
- The visual system was now the dominant representational system used to assess the preference towards their work.

### **Peer Review Evaluation**

Results from a peer review group, who assessed the subjects' work in relation to aesthetic preference, showed that,

- Only two subjects' work could be fully differentiated in a specific aesthetic preferential order, while for three subjects each attempt was rated almost equally.
- For the remaining subjects one of the three attempts was statistically favoured over the other two, which were more evenly matched.

### **Discussion**

The pronounced change in several subjects' evaluation of their own work over the two-week period raises questions regarding the mechanisms responsible for the adjustment in preferences. A shift in perception after repeated exposure to design concepts has previously been reported by Coughlan and Mashman (1999). They suggested that appreciation for novel designs can change over time with repeated exposure. However, their work dealt with evaluation of design concepts by users rather than by the designers responsible for the creations themselves.

Clues regarding the mechanisms responsible for the subjects' change in attitude towards their work can be found in the retrospective interviews conducted after each ranking scenario. Following completion of the task a large proportion of the reasons why the subjects were most satisfied with their number one ranked attempts were related to how the work expressed their perceived self-competence. This implies that these subjects were evaluating their work in relation to their perception of their own ability.

When the fourteen subjects were asked to re-evaluate their work two weeks after its completion, the retrospective interviews indicated that the frequency with which the subjects referred to perceived self-competence as a designer decreased and instead the focus switched to the aesthetic properties of the images.

This new emphasis on the aesthetic properties of the image prompted the authors to attempt to peer review each subject's work to ascertain if certain images were in some way aesthetically more pleasing than others.

When the results of each subject's re-evaluation were compared to the peer review rankings, where the results collected were in relation to aesthetic

preference, it was observed that in seven of the nine cases where the subjects changed their minds the new ranking now mirrored that chosen by the peer review group. In one of the remaining two subjects, the new highest ranked attempt now matched that favoured over all other options during peer review.

Under re-evaluation conditions there was almost total agreement with the peer review group. This is what would logically be expected in circumstances where the subjects' evaluation of their work is being guided by aesthetics. However, under the initial ranking conditions the retrospective interviews show that something about that context encouraged many of the subjects to focus their attention inwards to the self when evaluating their work.

### ***The immediate effects of undertaking the task***

One factor absent during re-evaluation, in comparison to the conditions under which the work was originally evaluated, was the change in emotional state that is hypothesised to occur as a result of undertaking the task.

Although it seems logical that participating in design activity will influence a designer's emotional state, just as participating in a sporting event or musical performance causes physiological and emotional changes, there is currently little research on this topic.

The fact that the initial evaluation rankings agreed less with the peer review group combined with the numerous references to perceived self-competence during retrospective interviews leads to the hypothesis that undertaking design related work brings about an affective change in the designer, which in turn affects the way that they evaluate what they have produced. While the conscious aim of design activity is often to produce a solution that satisfies the needs of others, we believe there is a need to simultaneously fulfil the emotional needs of the creator.

From our results, it appears that following a period of designing there is a need for designers to believe a design embodies their skill as a designer in order for them to develop what could be described as an affectional attachment to it. Simply put the immediate effect of designing is an increased emphasis on the self.

### ***The role of self-concept in design cognition***

A second observation gleaned from this research concerns the data collected from the DIMS. When the fourteen subjects were ranked in order of their DIMS score and this list compared against the ranking of cumulative time taken to complete the task the top two and lowest ranked subjects matched and there was a tendency for time spent on the task to decrease with DIMS rank, see Figure 5.

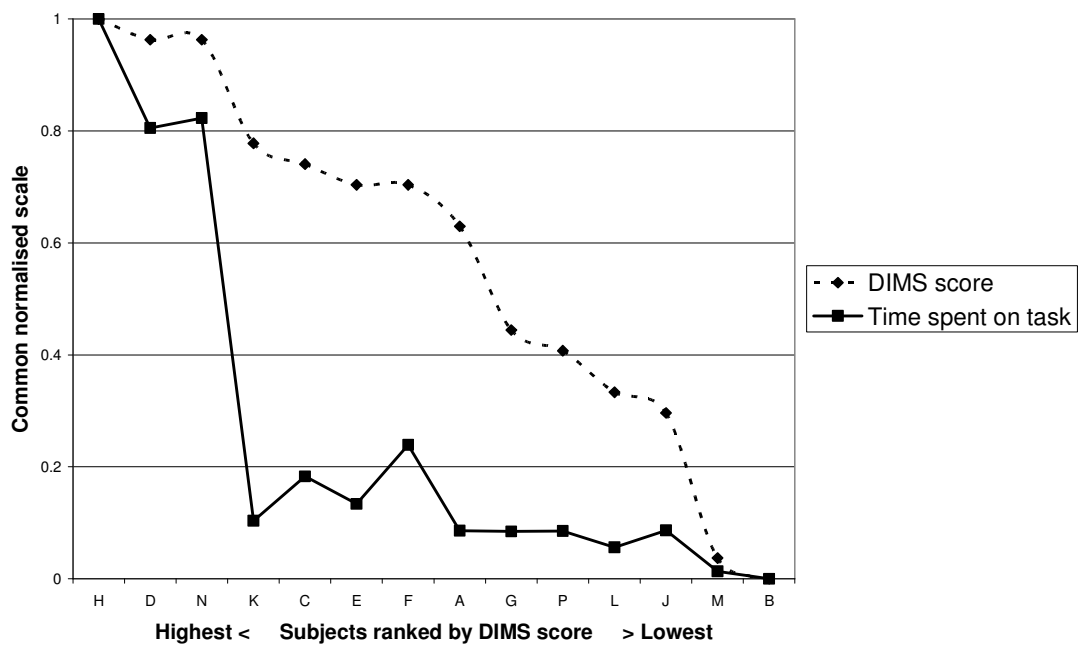


Figure 5 Comparison of normalised DIMS score and time spent completing the task

When information from the retrospective interviews regarding whether or not the subjects made statements related to how well their work expressed their perceived self-competence was assessed relative to DIMS ranking the subjects that did not report this facility tended to also score lower on the DIMS scale, see Table 5.

Subject		DIMS Score	Cumulative Time Rank	Report perceived self-competence
H	Highest	41	14	✓
D		40	12	✓
N		40	13	✓
K		35	8	✓
C		34	10	✓
E		33	9	✗
F		33	11	✓
A		31	6	✓
G		26	4	✗
P		25	5	✗
L		23	3	✗
J		22	7	✓
M		15	2	✗
B	Lowest	14	1	✗

Table 5 Comparison of subjects' ranking according to DIMS test score with cumulative time rank and reporting of perceived self-competence during initial retrospective interviews

This trend was clearer when the results were separated into four groups using a change of at least five points on the DIMS scale as the dividing factor and the values normalised so a standard scale could be used. Under these circumstances, there was a distinct difference between groups with respect

to the average cumulative time spent on the task and the ratio of subjects who reported perceived self-competence as a factor to those who did not, see Figure 6.

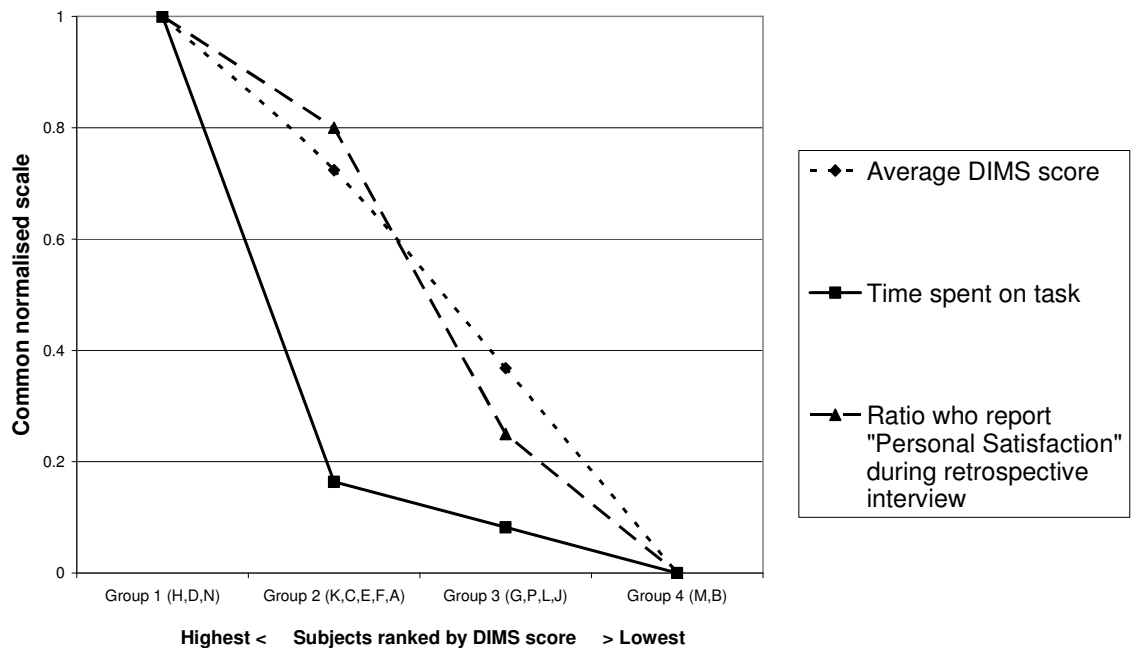


Figure 6 Comparison of DIMS score, time spent completing the task and ratio of subjects who reported perceived self-competence

These results show that on average subjects with higher DIMS scores spend more time completing the task and cite perceived self-competence as a factor in choosing their favourite attempt during the retrospective interviews immediately following the initial task. Since DIMS is a self-concept based inventory designed to measure DI and perceived self-competence is also related to self-concept it would be logical, based on current self-concept research, for some correlation to exist.

In summary, we propose that:

- The immediate effect of designing is an affective change in the designer, which in turn influences the way they evaluate their own work.
- Self concept plays a role in design cognition because individuals who identify strongly with the designerly role will place greater emphasis on how a solution reflects their self-competence as a designer when evaluating their own work.

These two hypotheses are linked in that we expect individuals with a high degree of designerly identity to be more sensitive to their own perceived competence as designers and, therefore, experience greater affective change during designing.

## Further Investigation

To expand upon the ideas presented in this paper research is underway to further examine the immediate effects of designing upon the designer and

the role of self-concept in design cognition. These new investigations also attempt to look at the acute effects of designing upon the designer through the collection of psycho physiological data including galvanic skin response and skin temperature, see Figure 7.



Figure 7: Wireless psychophysiological monitoring setup incorporating GSR, Skin Conductance and Eye Tracking facilities

Data on eye movement and pupil size has also been collected using eye tracking facilities through preliminary data analysis suggests this data is unreliable in such an applied context.

Further work is also needed to validate the DIMS and refine it within a design population. This research is currently also being conducted.

## Conclusions

A design process may include numerous instances of a designer's evaluation of their own work, however, little formal research has been conducted into this phenomenon. This research attempted to explore this area using a basic design related task and discovered that:

- The immediate effect of completing the task upon a subject's evaluation of their work was the degree to which they perceived an emerging attempt to positively reflect their self-competence.
- When subjects were asked to re-evaluate their work after a two week break period the preferences of over 60% of the subjects had changed and now aesthetic criteria were highlighted as the major factor influencing the subjects' evaluation. The new preferential order now

closely reflected that of a peer review group who evaluated the subjects' attempts in relation to aesthetic preference alone.

We propose that the variation in preference between the two contexts was due to affective state changes that occurred as a result of undertaking the task. Further research is needed to explore this hypothesis because it is unclear if these affective changes have a positive or negative impact on designers' ability to evaluate their own work and this has important implications for design practice.

Sports psychologists investigating the affect of personality and self-concept on sports performance have found that the degree to which an athlete identifies with the athlete role can affect their behaviour and motivation. In a similar fashion, we proposed that self-concept may also influence designing and developed a 'Design Identity Measurement Scale' (DIMS) to measure the degree to which individuals associate with the designer role or their 'designerly identity' (DI). The results to date of our research suggest there is some evidence to support this idea because subjects who scored higher on the DIMS spent longer completing our task and were more likely to report the need for their work to reflect their perceived self-competence in order for them to develop an affectional attachment to it.

The observation that subjects with a high DI tend to focus on perceived self-competence during evaluation of their own work is congruent with current psychological thoughts on self-concept as found in the literature.

This research draws attention to the need to consider the potential effects of self-concept and affect on several areas of design research. In relation to design cognition, decisions about ones own emerging ideas may be fundamentally different to decisions about other 'external' issues and may belong to an entirely different class of decision making.

To this end, further research is needed to explain the concept of 'design identity' and to establish its role in design cognition. This is an area of the ongoing research agenda within the Department of Design and Technology at Loughborough University.

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