

Designing Teenage Emotions with a Life of Their Own

Neil Winterburn
School of Computing
Engineering & Physical Science
University of Central Lancashire
Preston, PR1 2HE,
njwinterburn@uclan.ac.uk

Peggy Gregory
School of Computing
Engineering & Physical Science
University of Central Lancashire
Preston, PR1 2HE,
ajgregory@uclan.ac.uk

Dan Fitton
School of Computing
Engineering & Physical Science
University of Central Lancashire
Preston, PR1 2HE,
dbfitton@uclan.ac.uk

In this paper two participatory design activities are described in which teenagers create lo-fi designs describing emotions and explain the rationale for their design choices. Designs annotating and describing emotions are categorised as anthropomorphic, abstract, object based, or biomorphic. The paper concludes that teenagers use a variety of visual metaphors to describe emotions, that teenagers use anthropomorphic visual metaphors the most to describe emotions and that teenagers make more use of abstract and biomorphic visual metaphors to describe 'negative' emotions. The effect of materials on designs is analysed, suggesting that teenagers are more likely to create designs describing emotions featuring anthropomorphic visual metaphors when using malleable three-dimensional materials. Suggestions are made for the use of externalisation and personification as part of interactive emotion displays within affective systems. This research will be of value to interaction designers and Child Computer Interaction researchers seeking to understand how teenagers use different visual metaphors to describe different emotions. The contribution of this work is a categorisation of the visual metaphors teenagers use to express different emotions.

Affective Computing, Child Computer Interaction, Teenagers

1. INTRODUCTION

In this paper we describe an empirical study designed to capture teenagers' lo-fi designs describing emotions. The goal of this work is to explore how teenagers represent and reason about emotion, in order to design applications allowing teenagers to externalise and personify their emotions. This work grew out of creative workshops with young people as part of digital art projects, exploring approaches to visualising thoughts and feelings. It will be of value to interaction designers and Child Computer Interaction researchers seeking to understand how teenagers use different visual metaphors to describe different emotions.

The participatory design of affective systems for teenagers is a new area of research that covers many domains. It combines the multidisciplinary field of Child Computer Interaction (CCI), which incorporates 'psychology, and especially

developmental psychology, learning sciences, product and interaction design, computer science, media studies, and game design' (Read & Markopoulos 2013). It also incorporates the multidisciplinary field of Affective Computing, which incorporates computer science in particular artificial intelligence, cognitive science in particular emotion theory, art and entertainment, health and wellbeing.

In line with Bang et al's (1993) taxonomy of motivations for constructive design research, the motivational context for this study is a mixture of artistic/practice-based and empirical. The practice-based motivation for this research was to further explore observations made about the design contributions shared by teenagers participating (Bishop 2005) in a previous art project known as Flunstellas (Froggett 2011), which aimed to engage teenagers in the creative visualisation of cognition and affect.

During adolescence teenagers are challenged to develop a distinct identity whilst undergoing intense neurological changes. Fonagy et al (2002) state that these changes provide them with 'a far more complicated set of thoughts about his own and others' feelings and motivations.' These 'new ways thinking and feeling about people's feelings and behavior, as well as about his own feelings and needs to absorb the implications' (Fonagy et al. 2002). In response to these challenges faced by teenagers, the applied context for this work was the development of a novel mobile app. The app was designed to support teenagers to describe and interpret complicated and mixed emotions by externalising and personifying them as virtual autonomous agents (Reynolds 1999). Users interact with these emotions as they move around an environment, competing and interacting with one another. The mobile app has two purposes, the first is to support teenagers to better describe and understand how they and other people experience mixed emotional states and the second is to share these descriptions with others. Resnick's motivation to develop StarLogo (1997) was to enable children to explore decentralised systems found in the natural world by building their own simulations. Similarly the empirical motivation for this work was to develop new empirically-grounded, conceptual and computational tools that support teenagers to explore decentralised models of cognition and affect (Velásquez 1997). The complex and abstracted nature of decentralised models of emotion raises complex and new design challenges. Specifically, which kind of visualisation methods can be used to display emotions as autonomous agents in a way that is accessible and meaningful to teenagers? To address this design problem it is important to understand both the kinds of visual metaphors that teenagers use to describe emotions and the most effective methods for discovering them. The two studies described in this paper were designed to explore the following research questions:

RQ1. Which kinds of visual metaphors do teenagers use to describe emotions?

RQ2. How does the use of different materials affect teenage designs of affective displays?

2. RELATED WORK

This section gives an overview of affective computing and the involvement of teenagers as design partners in the field of CCI. It goes on to review emotion theory, the development of teenage theories of mind and techniques to externalise and personify emotions from family therapy.

2.1. Affective Computing

Affective computing is the study of computing systems that recognise, interpret and simulate

human emotions. Picard (1995) defines the research of emotion in Computer Science as 'computing that relates to, arises from, or influences emotions.' Highly influenced by Sentics (Clynes 1977), Picard focused particularly on the use of computers to sense, reproduce and transmit emotions. She cites a range of applications for emotionally intelligent, wearable and ambient systems to be used in education, entertainment and the workplace. Boehner et al (2007) challenged the dominant model of affective computing in which emotion is considered to be a discrete form of objective data. Instead they emphasise the socially constructed discourse within which emotion is produced. They suggest that instead of being designed only to measure and transmit our emotions, affective systems should also be designed to support the negotiation of subjective interpretations of emotion. The success of such a system would be measured by 'whether users find the system's responses useful for interpreting, reflecting on, and experiencing their emotion' (Boehner et al. 2007). As this research aims to develop tools to support teenagers describe emotions and negotiate their meaning, it operates within with the Boehner's emotions as interaction paradigm.

2.2. Child Computer Interaction and Participatory Design

One of the dominant themes in CCI literature is research seeking to better understand children's involvement in the design of technology (Mazzone et al. 2008). In their discussion about the distinction between CCI and Human Computer Interaction (HCI), Read & Bekker (2011) note the lack of control that children often have when they engage with technologies and their discretionary use of technologies. Furthermore, Read and Markopoulos (2013) identify research into the participation of children in the design of new technologies as an important challenge for the future.

Druin (1999b) argued that as technology is becoming an increasing part of children's lives, then children should be actively involved in its design. It has also been argued that participation also benefits designers (Guha et al. 2005). In response to her frustrations with levels of control and authorship offered to children in participatory design studies, Druin (1999a) pioneered the cooperative design method. By emphasizing small numbers of children having high levels of participation over long periods of time, this method places children alongside other specialists in a multidisciplinary team.

Given the practical and time-based constraints of many CCI projects and the desire to engage with large groups of children, Read et al (2006) developed the MESS day format. At MESS days groups of around 5 children rotate around a carousel

of design and evaluation activities, participating in a wide range of activities in a short space of time. In the literature a variety of processes have been proposed for analysing children's designs of interactive systems after participatory design sessions. Xu et al (2009) describe a method for analysing the component parts of children's drawings of their experience of tangible media. Aspects of drawings were categorised according to user experience metrics and statistical analysis was then applied, to ensure that meaningful results were achieved. Read et al (2013) conducted a design study to test the effect that materials had on children's design contributions for organic interfaces. Designs were categorised as being driven either by the affordance of the materials, or by a particular design idea. The study found that materials had an effect on designs created for organic interfaces, with over half of the designs categorised as being driven by the materials. This paper describes new techniques to analyse teenage designs of affective displays that are informed by the methods of Xu and Read et al. Affective learning (Picard et al. 2004) sets out a framework for children's engagement with affective technologies within constructionist pedagogy (Papert & Harel 1991). This framework focuses on children's right to participate in the building of emotions sensing systems, rather than how emotions might be used, displayed and interpreted. Our paper not only extends Papert & Harel's work by including teens in the design process, but also stands in contrast to it because we focus on the ways in which they describe and relate to emotions using psychological techniques.

2.3. Teenagers as Design Partners

Teenagers are generally defined as young people between the ages of 13 and 19. For the purposes of understanding teenagers as participants in Interaction Design, Fitton et al (2013) identified the following key traits including.

- Desire for independence and autonomy.
- Desire to develop/maintain individual identity.
- Desire for association with peers.
- High susceptibility to peer influence.
- Willingness to take risks.
- Increasing dissociation with parents/guardians.

Teenagers have been identified as being of particular interest as participants in design and evaluation studies. Read et al (2013) stated that their child like tendencies and their ability to communicate honestly can mean that 'In many situations, and given the right tools, teenagers may

be the best evaluators of technologies, and with their imaginative risk taking minds, the best designers of products.' CCI researchers designing with teenagers have used a variety of different methods and techniques. Horton et al (2012) describe the use of teen personas to facilitate their work with a group of teenagers on the meaning of 'cool'. Amin et al. (2005) worked with a group of teenagers to design an interface to give affective context to SMS texting. Findings suggested that teenagers would value the use of facial expressions, avatars, decorative text and location awareness to contextualise SMS texts. The COOL project (Mazzone 2012) worked with teenagers from a Pupil Referral Unit to design a computer game that supports the development of emotional intelligence (Mayer et al. 2001). Design activities included devising a scoring system for different emotions and matching emotional terms to simplified facial expressions. The game produced made use of facial expressions to support players to learn how to recognise distinct emotional states in others. This research builds on the methods developed for the COOL project but differs due to its focus on the description and interpretation of complicated and mixed emotions.

2.4. Emotion research

Since Picard defined the field, affective computing has taken its theoretical grounding from emotion theory within cognitive science. Prinz (2012a) gives an overview of emotion theories movement away from a purely cognitivist understanding of emotion, to one that also investigates non-cognitive emotion processing, socio-cognitive appraisals and diverse cultural practices. Hoffman (1986) belonged to a group of researchers who began to limit the processes that could be described as cognitive, by positioning non-cognitive and embodied modes of information processing as fundamental to our understanding emotion. Lutz's anthropological study of emotions as a part of everyday life on a south Pacific atoll, suggest a that emotion is meaningful only within a particular social construct. 'To experience a feeling as, say, anger, love, happiness, lust, or frustration, one must be grounded in a cultural context that makes anger, love, happiness, lust, or frustration meaningful' (Lutz 1988). This study has developed a scheme to categorise teenage designs informed by theoretical debates between cognitivist, embodied and cultural understandings of emotion.

2.5. Teenage Development and Emotion

Theory of Mind (TOM) is a term used to describe our ability to understand our own thoughts and feelings and those of other people. The ability to apply TOM to describe and find meaning in emotions is of vital importance to teenage development and mental health (Fonagy et al. 2002). Modern developmental

psychology suggests that our ability to access our own mental states and to infer those of others is constructed slowly over time. Astington, Harris, & Olson (1990), describe children's initial development of a theory of mind, between the age of two and four, as a new developmental phase. By understanding themselves and others as 'things that think' children are able to make distinctions for the first time between objects in the world and mental representations of these objects. Chandler et al (1988) argue that a mature understanding of theory of mind, does not occur until adolescence. At this time the relativist implications of earlier developmental stages of theory of mind are applied to everyday social situations. Fonagy et al state that the key task of adolescence is the development of the psychological self, as a distinct entity from the main parents or carers. Due to neurological changes taking place, many adolescents risk being overwhelmed by greater access to information about their own and other people's mental and emotional states. 'Thus we believe that one thing that drives - but can also derail - the achievement of separateness is freshly enhanced cognitive complexity, which means that the adolescent is faced with the task of integrating a far more complicated set of thoughts about his own and others' feelings and motivations' (Fonagy et al. 2002). Fonagy et al use the term mentalisation to describe the application of TOM. The ability to mentalise is key to teenage affect regulation, which itself is vital to the development of a sense of agency and self. 'The concept of mentalized affectivity marks a mature capacity of the regulation of affect and denotes the capacity to discover subjective meaning in one's own affective states' (Fonagy et al. 2002). This research seeks to develop interactive digital tools to support teenagers to engage in both mentalisation and mentalised affectivity.

2.6. Externalisation and Personification

Externalising is a narrative therapy practice, first introduced to family therapy by Michael White in the early 80's (White 2006). Carey & Russell (2002), explain the ethos of externalisation as an understanding that 'the person is not the problem, the problem is the problem.' When working with children, this can be combined with personification, the practice of attributing non-living things with personhood. Klein (1929) notes that personification is a common feature of young and older children's play. It is used as a mechanism to externalise psychodynamic conflict and make sense of family issues by transferring them into the behaviour of fantasy characters. Butler et al (2009) used puppetry within narrative therapy to support children to personify their problems and construct stories about problems in their lives. They concluded that the use of the puppet supported the children to objectify their problem and create a critical distance between

themselves and it. The studies we discuss in this paper, draw on these ideas and make use of lo-fi design activities to explore what teenagers' emotions may look like if they were to be visualised using digital technologies. This research aims to combine the use of externalisation and personification, with technological features known to appeal to teenagers, such as interaction, gameplay and networked collaboration, to describe and make sense of their emotions. The categorisation scheme developed in this study is drawn from externalisation and personification theories and techniques in the research cited.

3. STUDY ONE

The first study was an exploratory participatory design activity. The EGG (Marti & Rizzo 2003) model is a framework that can be used by designers to decide what sorts of techniques they can use, based on the design stage they are going through e.g. early phase exploration, prototyping, test/evaluation. This activity was situated in the Emergent phase of the EGG model, which is typically conducted during the brainstorming or early design phases of a project. To support innovative design thinking the activity was framed using a fantasy narrative in which emotions are externalised as things with a life of their own, visible to other people. To ground this narrative in a real world use context, two other techniques were used, a set of teen personas and a scenario featuring a classic teen dilemma, 'What to do with an empty house?'

3.1 Design Objectives

The design activity had two main design objectives:

- **Gain insight into existing practice.** Can teenagers create visual, verbal and kinaesthetic metaphors to describe emotions?
- **Concept generation.** Elicit emergent interaction design ideas for the display of emotions as autonomous agents.

3.2. Method

The design study was run at a MESS day (Read et al. 2006) at UCLAN and carried out by a convenience sample of 10 mixed groups of 55 young people from Years 8 and 9 (aged 12 to 14), from 2 Secondary Schools in Lancaster and Accrington. Each group spent 25 minutes on the activity. It was noted that the abstract nature of the activity could prove challenging to some participants, depending on their theory of mind, emotional intelligence and visual design skills. Given time constraints and the variation in theory of mind found within this age group, teen personas, a scenario and a fantasy narrative (Iversen & Dindler 2008), were used to

scaffold the activity. To encourage fun, playful materials were used with an open design task that involved aspects of imaginative play.

3.3. Design Activity

The ten groups of 4 – 7 young people each carried out the same design activity with the same materials and structure. The group was introduced to the idea that in the future we may have technology that allows us to see each other's thoughts and feelings. They were told that the activity aimed to explore what this kind of technology might look like. Next they were introduced to a set of teen personas (Horton et al. 2012) and asked to choose one to be used by the whole group. Teen personas were used to support participants to talk about emotions without worrying about divulging personal information that could leave them vulnerable. Each group was introduced to the same scenario in which their persona faced a choice. This was between either babysitting for their younger brother or opening their house up for a wild party. Participants were told that their teen persona was confused about the situation and was experiencing mixed emotions. Finally the narrative took a turn towards fantasy. The group was told that due to an unexplained phenomenon it was possible for other people to see the teen personas emotions floating around them. They were told that the personas emotions took on different shapes and colours and that they moved as if they had a life of their own. The group was introduced to a set of 6 plastic tokens featuring textual statements from the perspective of the persona. Each token featured an appraisal of an emotion. To describe a range of emotions, the statements were informed by the big 5 personality types identified within personality psychology, (Eysenck 1991) (table 1). Prepared statements were used to lower the number of variables within the study.

Table 1: Table of affective appraisal statements

Personality Type	Statement
Openness to experience	'I feel excited thinking about a party at my house.'
Conscientiousness	'My Mum looks sad when I disappoint her.'
Extraversion	'I feel relaxed with my mates around.'
Agreeableness	'I feel happy when my mates make me laugh.'
Neuroticism	'I feel tense when my mates moan about me.'

Taking a token each, the young people were instructed to imagine what the personas emotion might look like if it were visible and to build a Play-Doh model around the token. Each young person was provided with an individual workspace, a box of multi-coloured Play-Doh and a time limit of 7 minutes

to sculpt a model. The duration of the design activity was defined by time restrictions imposed by the MESS day format and an understanding of teenage attention spans. After this time, the Play-Doh shapes were brought together and each participant was asked to describe their design and explain the rationale behind it. Data was collected by taking photos of the designs and by making audio recordings of the participants describing their designs.

3.4. Results

The designs were reviewed and the participants' verbal descriptions were annotated. Then the designs were coded into four categories by the first author according to the participants' verbal descriptions. Despite instructions to create shapes to represent emotions, the vast majority of designs were representational. Because of this the following categories were based on the subject matter of designs, using terms drawn from art and design theory (Botar & Wünsche 2011).

- **Anthropomorphic;** Designs using embodied visual metaphor.
- **Biomorphic;** Designs that personify emotions as living things.
- **Abstract;** Designs that externalise emotions in nonrepresentational forms.
- **Object;** Designs that externalise emotions as non-living things.

Of the 56 designs made by the children 25 (44.6 per cent) featured visual representations of the body, 15 (26.8 per cent) featured objects, 8 (14.3 per cent) featured living things and 8 (14.3 per cent) were abstract, (figure 1).

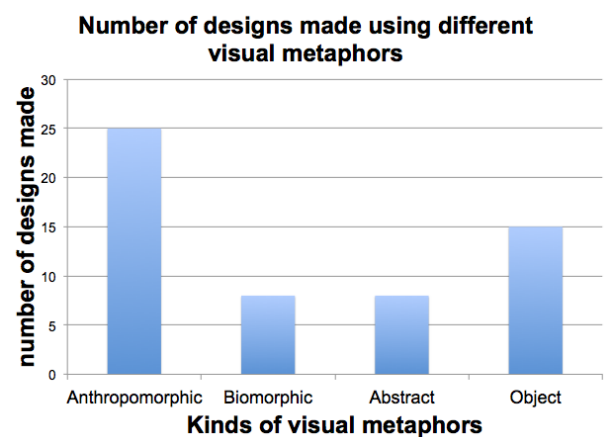


Figure 1: Number of models made using each visual metaphor style.

Participants were able to justify design decisions made for 54 of the 56 designs made. They were able to invent, describe and justify movements for 66.6 per cent of the designs that were created.



Figure 2: An Anthropomorphic design of an excited emotion

Participant 1: 'They are all bright colours, I was going to finish it with it being a person and they're (the coloured balls) all in the stomach, all the excited feelings.'



Figure 3: An Object-based design of a happy emotion

Participant 2: 'When I think of these things I think mostly of blobby spaceships.'



Figure 4: A Biomorph design of a relaxed emotion

Participant 3: 'It's just different coloured wavy lines because that's how you feel when you're relaxed...it moves like a squid.'



Figure 5: An Abstract design of a tense emotion.

Participant 4: 'Triangles are the strongest structure.'

3.5. Analysis

Analysis of the results of this study suggests that teenagers use a variety of visual metaphors to describe emotions. Although the most popular choice of visual metaphor was anthropomorphic, which accounted for 44.6 per cent of the designs made, the other three categories were also well used, with object metaphors at 26.8 per cent, biomorphic accounting for 14.3 per cent and abstract for 14.3 per cent (figure 6). In response to research question one, 47 per cent of the shapes designed represented the body in some way. The high use of anthropomorphic metaphors is in line with much contemporary research on emotion that places non-cognitive physiological responses, sensations and physical behaviours as being a key part of emotion (Prinz 2012). 28.8 per cent of the designs made use of objects as a visual metaphor. Amongst these there was a wide variation, from skateboards, to rockets, to chairs. Although fewer young people used biomorphic forms, those who did were able to explain why they had chosen certain colours, shapes and visual metaphors. The anthropomorphised designs were codified further, into representations of facial features, bodily action, embodied sensation and human figures. This coding revealed that a large number of designs made use of facial expressions to convey emotion. 16 out of 28 designs related to the body making use of facial features, 2 representing embodied action such as flexing of muscles, 3 representing bodily sensation such as a bubbling stomach and 7 representing human figures. That 66.6 per cent of participants were able to invent movements and behaviours for their designs suggests that personification may be a useful visualisation technique for the display of teenage emotions.

4. SECOND STUDY

The second study was designed to expand on the findings of the first study that teenagers use a variety of visual metaphors to describe emotions.

4.1. Design Objectives

The design objectives of the second study were:

1. **Expand on the findings of the first study.** Check that teenagers can create visual metaphors to describe emotions.
2. **Explore the effects of materials.** Discover if using 2D or 3D materials affects the visual metaphors that teenagers use to describe emotions.

4.2. Method

This study took place in a classroom at a Secondary School in Lancaster. Participants were a convenience sample of 38 teenaged pupils selected by a teacher to represent a cross section of ages and abilities. The participants were aged between 12 and 15, studying in years 7, 8 and 9. Of the sample 26 were girls and 12 were boys. The young people in Year 7 were taken from lower ability groups, the young people from Year 8 taken from mixed ability groups, the young people from Year 9 were from high ability groups.

4.3. Design Activity

The study was a between subjects design, with two sets of independent variables, the use of 2D or 3D materials and the use of two different sets of emotional terms as stimuli. The dependent variables were the designs created by the participants and the terms they wrote to describe them. A list of terms for emotions, devised for the COOL project (Mazzone 2012) were reused in this study, because they had been shown to be accessible and useful to teenagers to describe and interpret emotions. The study was split into 4 blocks, A, B, C & D with each block offering a different combination of the two sets of dependent variables. As part of a MESS day event (Read et al. 2006), the time limit for the activity was defined as 25 minutes. This duration has been set to balance pupil attention spans with conventional lesson times. For each activity, the participants were split into 2 groups, either A & B or C & D. During each activity, the participants were split into 2 groups, with one group being equipped with Play-Doh and sculpting tools, the other group using coloured card and scissors. Both groups were given a design worksheet. The worksheet featured 4 rectangular frames. Each frame was titled with one of the 4 emotion terms. Groups A and B used the terms, love, pride, nervous and angry. Groups C and D used the terms sad, guilty, happy and scared. Participants were asked to use the materials to create a shape to describe each of the 4 emotions

and place each shape on the relevant frame. The participants were also instructed to write a textual description of what they had made in their own words, in a text box provided below their model. They were provided a space to work by themselves and given a 7 minute time limit to complete the task. The data was captured by photographing the completed worksheets at the end of the study.

4.4. Results

The first author analysed the text data generated by the participants to describe their own designs and categorised the designs. From a total of 160 designs created, 65 (40.6 per cent) featured anthropomorphic visual metaphors, 15 (9.4 per cent) were categorised as biomorphic, 43 (26.9 per cent) were categorised as abstract and 37 (23.1 per cent) were categorised as object metaphors, (table 2). 30 anthropomorphic designs were created using 2D materials compared to 35 using 3D (table 3). There were 8 biomorphic designs created using 2D materials compared to 7 using 3D. 29 abstract designs were created using 2D materials compared to 14 using 3D and 27 object designs were created using 2D materials compared to 10 from 3D materials.

Table 2: Kinds of visual metaphors used by teenagers to describe emotions

	Anthropomorphic	Biomorphic	Abstract	Object
Happy	7	4	2	9
Sad	12	2	6	2
Scared	6	4	6	5
Angry	6	0	9	4
Nervous	3	1	10	3
Guilty	3	4	7	7
Love	21	0	0	1
Pride	7	0	3	6
Total	65	15	43	37

Table 3: Kinds of visual metaphors used by teenagers to describe different emotions using 2D and 3D materials

	Anthropomorphic	Biomorphic	Abstract	Object
2D	30	8	29	27
3D	35	7	14	10

4.5. Analysis

The percentages of designs that were categorised as either anthropomorphic or object based are largely consistent with the results of the first study (figure 6). There was a slight reduction in the percentage of anthropomorphic designs created from 44.6 per cent to 40.6 per cent. Similarly there was a slight reduction in object-based designs, from

26.8 per cent in the first study to 23.1 per cent in the second.

Biomorphic design creation decreased from 23.8 per cent in study 1 to 9.4 per cent in the second study, with a 14.6 per cent increase in abstract designs from 14.3 per cent in study one to 26.9 percent in study two.

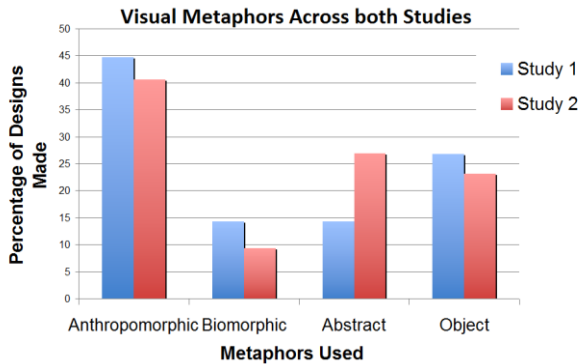


Figure 6: Percentage of models made using different visual metaphor styles during studies 1 and 2

The emotional terms in this study can be categorised as positive or negative. In this basic scheme, sad, scared, angry, nervous and guilty are categorised as negative and happy, love and pride are categorised as positive. The images created to describe negative emotions featured more abstract and biomorphic visual metaphors than those created to describe emotions categorised as positive (table 2).

An analysis of the designs produced by participants using 2D or 3D materials revealed that participants using the 3D material (Play-Doh), created more designs using anthropomorphic visual metaphors than those using coloured card, see Figure 7.

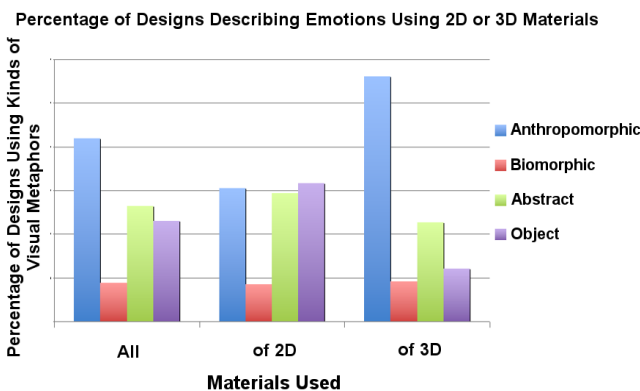


Figure 7: Percentage of designs describing emotions using 2D or 3D materials, featuring different visual metaphor styles.

5. DISCUSSION

Much of the CCI research exploring the design of emotion displays has worked within the emotion as information paradigm. Both the COOL (Mazzone

2012) project and the SenseMS (Amin et al. 2005) project, found that teenagers preferred to use designs featuring facial expressions when asked to describe emotions accurately. Both these projects designed systems that aimed to communicate emotional information as unambiguously as possible using one display method to describe a range of emotions. This study also found that teenagers use anthropomorphic visual metaphors the most to describe emotions. This emphasis on non-cognitive (Hoffman 1986) and embodied (Prinz 2012) interpretations of emotion fits well with contemporary theories of emotion. This study also finds that underlying this initial finding, teenagers have a more complex approach to the design of emotion displays than has been previously thought. A fine-grained approach was taken to understand the different ways that teenagers use visual metaphor to describe different emotions. Although teenagers taking part in this study created anthropomorphised designs the most, they used a range of visual metaphor styles to describe emotions. This suggests that while anthropomorphised visual metaphors remain central to teenager's representation of emotion, a variety of visual metaphor styles should be considered when designing affective systems for and with this group. This would both echo existing practice amongst teenagers as captured in this study and encourage the collaborative interpretation of the meaning of emotions amongst peers as encouraged by Boehner et al. (2007). Interaction designers developing affective systems to support the teenage development of mentalised affectivity (Fonagy et al. 2002), should offer the affordance of 'many paths, many styles' (Resnick & Silverman 2005) for the display of emotions. As Fonagy et al (2002) have stated, the ability to describe and find meaning in emotions is of vital importance to teenage development and mental health. Teenagers participating in this study made more use of abstract and biomorphic designs to describe 'negative' emotions such as scared, angry, nervous and guilty. That teenagers use different visual metaphors to describe negative emotions is a new finding and has implications for interaction design with children. Abstraction and biomorphism are already used as techniques within art and narrative therapy to externalise and personify negative emotions. It seems likely that their ambiguity and their lack of relation to the body make these kinds of designs useful to teenagers to separate themselves from the problematic emotions and think critically about them. That teenagers have used these visual metaphors and techniques whilst designing an interactive system, suggests that they are transferrable from therapy settings to the design of affective displays.

Read et al (2013) categorised teenage design contributions for tangible interfaces as being driven either by design ideas or by materials used.

Participants of this study created more designs describing emotions featuring anthropomorphic visual metaphors when they were using Play-Doh. This suggests that choice of materials has an effect on teenage design contributions for affective displays. The results of this study do not identify whether the key factor here is the difference between 2D and 3D materials or hard and soft materials. These findings are limited by the inconsistency of design stimulus used in the two studies. The change from the use of narrative as design stimulus to descriptive terms, may also have affected results. Further work would need to be conducted to explore these affects in more depth.

5.1 Future Work

While this paper contributes a range of valuable insights and understandings around the visual metaphors that teenagers use to describe different emotions, there is still much to explore within this space. For example, more work needs to be done to explore whether the model developed by Read et al (2013), can be applied to understand exactly how the affordances of materials effect teenagers designs of affective displays. Informed by the findings this research, work has begun on a prototype app. Transferring ideas explored in this study into the digital realm will allow for the integration of knowledge gained here, with new explorations of the use of movement and interactive behaviours to describe emotions. The app will allow users to select and interact with externalised and personified emotions, visualised as autonomous agents.

6. CONCLUSIONS

This research has shown that teenagers use a variety of visual metaphors to describe emotions.

In response to research RQ1, this study has found three conclusions.

C1. Teenagers use anthropomorphic visual metaphors the most to describe emotions.

C2. Teenagers use a variety of visual metaphors to describe emotions.

C3. Teenagers make more use of abstract and biomorphic designs to describe 'negative' emotions such as scared, angry, nervous and guilty.

In response to RQ2, This study found.

C4. Teenagers are more likely to create designs describing emotions featuring anthropomorphic visual metaphors if they are using soft malleable and three dimensional materials.

The contribution of this work to the field of Child Computer Interaction is a categorisation of the visual metaphors teenagers use to describe different

emotions. It is hoped that this will be useful to interaction designers and researchers looking to develop affective systems for and with teenagers.

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