



Exploring Elastic Movement as a Medium for Complex Emotional Expression in Silver Design

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This research explores how elastic movement can be used as a medium for expressing emotion in silver design, using Argentium® Sterling silver and laser welding. The rationale was for technical reasons, traditionally, silver tends to be rigid and therefore uses semiotic language to create emotional expression rather than movement, which is explored in this investigation. The investigation is situated in the context of traditional silversmithing design and practice, and has the aim of expanding its conceptual and creative possibilities. Using conceptual analysis and development combined with creative exploration, the research develops a soma-semiotic framework to serve both as a design tool and as an aid for the interpretation of artefacts. The conceptual development builds on a review of silver design, on selected approaches of emotional design, and on theories from emotional psychology and soma-aesthetics to develop the framework. The creative exploration was used in parallel to understand better the complexities of embodying emotion through designing and of reading and interpreting artefacts, thus serving to refine the framework within an iterative process. The outcome and contribution of this study are firstly an enhanced understanding of the conceptual and creative possibilities of using elastic movement to create emotional expression in silver design. Secondly, the study provides a soma-semiotic framework as an aid for creating and interpreting complex emotions in design. The study highlights the complexity of emotions, stressing the need for future research to develop a broader spectrum and vocabulary of complex emotional expression.

Keywords – Elastic Movement, Complex Emotion, Expression, Silver, Design, Practice-based Research.

Relevance to Design Practice – This research introduces the idea of emotional expression through elastic movement into silver design, and offers a soma-semiotic framework as a tool for designing and interpreting complex emotions in design.

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Introduction: *Elasticity in Silver Design*

In the context of traditional and contemporary silversmithing design (Clifford, 1993; Glanville, 2006, Goldschneider & Zapletalová, 1998, Hill & Margetts, 2003; Hund, 1995; Schadt, 1996; Valcke, Weber-Stöber, Schwarzingler, Laet, & Janssen, 1993; Weber-Stöber, 1992, 1995, 2001), elastic movement has rarely been used in relation to emotional expression, and never been theorised. Indeed, silver is not usually associated with elasticity because it is perceived as a soft metal. For example, Sterling silver is softer than most standard gold alloys (e.g., 14 or 18ct standard yellow gold alloys) or similar platinum or white gold alloys (Wolters, 1996, pp. 44, 62). Silver becomes soft through heating and it becomes hard and elastic through being worked cold. Soldering, which is the foremost technique of joining silver, requires heating the whole piece during the work process, which softens the silver. Any design using soldering processes therefore has to use material of sufficient thickness to avoid easy indentation, which not only makes silverware expensive but also structurally rigid.

A previous project, ‘Exploring the Creative Possibilities of Argentium® Sterling Silver’, demonstrated that a new Sterling silver alloy called Argentium® Sterling silver could be used successfully with laser welding (Niedderer, Harrison, & Johns, 2006; Stern-Leach, 2007). Argentium was developed originally to combat an oxidation process called ‘fire scale’, which occurs

when standard Sterling silver is heated during the fabrication process and appears as bluish-grey stains in the surface of silver, and which is difficult to remove (Davis & Johns, 2007). In addition to being firescale-free, Argentium also has been recognised for a number of other advantages, including lower heat conductivity: compared to fine silver, the heat conductivity of Sterling silver is 96% while it is only 68% for Argentium (Davis & Johns, 2007). This benefits the use of laser welding with Argentium, requiring less than half the energy to achieve the same results compared with standard Sterling silver (Niedderer et al., 2006, p. 18). The benefit of laser welding is in minimal heat application, which allows the joining of thin, work hardened silver parts without losing their elasticity. This opens the design of silverware to the use of elastic movement. The research presented in this article has explored the use of elastic movement for creating emotional expression as an alternative way to semiotic language.

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Elasticity refers to the springiness of silver. More specifically, as the quality of being elastic, elasticity refers to a material substance “that spontaneously resumes [...] its normal bulk or shape after having been contracted, dilated, or distorted by external force” (elastic, n.d.). This is not to be confused with the plasticity of silver, which is “the quality of being plastic; spec. the ability to be easily moulded or to undergo a permanent change in shape” (plasticity, n.d.) and which is normally used in the form-giving of silver. Elasticity can enable movement as exemplified by the well-loved slinky toy: a simple metal or plastic spiral which can be made to ‘walk down’ stairs due to the interplay of elasticity, material weight and gravity (Poof-Slinky, 2012; Figure 1), which is beautifully documented in the Slinky Vintage Commercial (<http://www.youtube.com/watch?v=EZL6RGkPjws>). Elasticity thus offers the potential to design movement into otherwise static structures.



Figure 1. Slinky Toy (see <http://www.poof-slinky.com/>) [original design by Richard James, USA, 1943]. Example owned and photographed by the author.

Building on the insights of a previous project (Niedderer et al., 2006), the research presented in this article explores how elastic movement can be utilised to achieve emotional expression in silver design, focusing on the subject of the (fruit) bowl. Bowls are a common subject in silver design, and there are many examples (e.g., in Goldschneider & Zapletalová, 1998; Hund, 1995). Normally, silver bowls are rigid rather than flexible. More recently, some silversmiths have experimented with elasticity to achieve new forms of expression. For example, Ane Christensen has produced bowls from hard-spun domes. By sawing into them, she has expanded and changed the shape of the domes, inducing elasticity and making them ‘quiver’ (Figure 2). Christensen’s

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bowls are aptly named “Nervous Bowls” (Christensen, 2011; Crafts Council, 2005) to express their emotional appeal. They are a good example of how emotional expression can be achieved through elasticity. However, not being able to use soldering restricts the maker to working from a single sheet of metal without the ability of joining different parts. Although riveting is one alternative for joining metal parts cold, it also has restrictions including structural tension, access to parts to be riveted, and the amount of labour required, which make riveting problematic.



Figure 2. Nervous Bowl (Christensen, 2011). Photograph: Anders Kjaersgaard/Dominic Sweeney. © Ane Christensen, Reprinted with permission.

Using the combination of work-hardened Argentium and laser welding to overcome these restrictions, this research explores the new conceptual and creative opportunities that arise for integrating emotional expression into the design of functional and non-functional bowls through elastic movement. A soma-semiotic framework is developed drawing on studies from design and emotional psychology (Desmet & Hekkert, 2007; Kälviäinen, 2005; Shusterman, 2011; Weerdesteijn, Desmet, & Gielen, 2005) that can be used both as a guide within the design process and as an interpretive tool for analysing design artefacts with regard to complex emotions. The theoretical development of the framework is complemented by creative exploration, a method described by Durling and Niedderer (2007). This method integrates the real life scenario of design practice into the research process, drawing on both the experiential knowledge of the designer and scientific data as appropriate (van Manen, 1990, pp. 8, 74). The creative exploration was used, firstly, to investigate the formal opportunities of creating elastic movement in relation to the bowl form, based on the combination of the selected material, technique and the object function; secondly, it explored the conceptual opportunities of creating emotional expression (e.g., fear, nervousness, sensitivity, humour) through elastic movement guided by the soma-semiotic framework and in turn refining it.

In the following, the paper describes the theoretical framework, the creative exploration and how the creative exploration has helped develop the theoretical framework. The conclusion summarises the outcomes of the study, its benefits and limits, and opportunities for further research.

The Context: *Silver Design, Emotion, and Movement*

This section presents the context of the inquiry and develops the theoretical framework. It brings together three areas of study: contemporary silver design, in particular the design of silver bowls; emotion design focusing on the embodiment and expression of emotion based on movement; and the discussion of relevant theories from emotional psychology and soma-aesthetics. The discussion leads to the development of a soma-semiotic framework to facilitate the complex understanding of emotion in design as guidance for both designing and interpreting artefacts.

Silver Design 'in a Fruit Bowl'

The bowl is a common subject in the practice of silver design, and there are many examples throughout history and in contemporary practice that demonstrate the significance of this modest object. Over time, bowls have served the most mundane needs as well as humanity's most sacred rituals, including, for example, bowls for eating and serving food as well as bowls for libation and ritual washings.

Although the theme of the bowl (*Schale*) is prominent in practice, in theoretical and philosophical discussions more often the vessel (*Gefäß*) has found attention. One key philosophical reference to both the vessel and the bowl is by Elias Cannetti (1960/1973) who reflects on the emergence of artefacts, based on the hands, as a functional object and as a signifier of the development of the human mind:

The hand which scoops up water is the first vessel [*Gefäß*]. The fingers of both hands intertwined are the first basket [...] It is not enough that this or that shape should exist in the surrounding world. Before early man could create it himself, his hands and fingers had to enact it. Empty fruit husks in the shape of cups [*Schale*], like coconut shells, may have existed for a long time, but were thrown away heedlessly. It was the fingers forming a hollow to scoop up water which made the cup [*Schale*] real. (p. 254) [Note: 'Schale' (German for bowl) has been erroneously translated as 'cup'.]

Cannetti's (1960/1973) description invokes the humble nature and simplicity of the vessel/bowl, which is manifest in its shape – at minimum the bowl is a concave form with a usually round or oval opening, the most classic shape being the segment of a sphere – but also its immense significance. It is perhaps this juxtaposition of simplicity and significance that has provided designers and craftspeople with the desire to approach the theme of the bowl over and over again. The simplicity of its function puts little restriction on creative expression and allows it to flourish in the design of the bowl. Bowls have been fashioned in silver in many forms and for many purposes. For example, in tableware, there are serving bowls, dessert bowls, fruit bowls, flower bowls, rose bowls, bowls serving as decorative centre pieces for the table and small-scale sculptural bowls which express aesthetic or conceptual values.

The analysis and interpretation of silver design has traditionally been the domain of historical and critical or curatorial study. Within this domain, the subject of the silver bowl has rarely been discussed on its own. Mostly, silver bowls are discussed as part of the general context of silverware or tableware. Historical overviews e.g., by Schadt (1996), Glanville (1997, 2006) and Müller (2001) provide a useful insights into techniques, provenance, stylistic parallels and influences of silver design. Where the discussion focuses on bowls, the focus tends to be on individual antique or historical examples (e.g., Hendrix, 1999; Karageorghis, 1999; Neumann, 1999; Quast & Tamla, 2010).

Compilations of contemporary silverware tend to come in the form of exhibition catalogues. Some of the best examples are by Weber-Stöber (1992), Valcke et al. (1993), Hund (1995), Goldschneider and Zapletalová (1998), Coatts (1999), and Mendini (2003). These offer, variously, introductions to modern and post-modern silver design, its historical or curatorial context, the understanding and use of contemporary silver, and to the life of practitioners, the development of their style and the education system.

Within these compilations, one can find many different interpretations of the bowl, although the overall characterisation through accompanying essays could be described as formal aestheticism and an occupation with the vessel form per se. A good example is David Huycke's award-winning design from 1995, a set of bowls made up of nested spherical segments, which explores and celebrates the purity of the bowl form in its gentle variations (Huycke, 2012; Weber-Stöber, 1995, p. 45). In contrast, Bennett (Goldschneider & Zapletalová, 1998, p. 58), Gogna (Weber-Stöber, 2001, p. 54) and Niedderer (Weber-Stöber, 2001, p. 86) play with the meaning of the bowl, exploring the relationship of function, form and content while maintaining the basic functionality of the bowl. For example, Bennett's Rose Bowl "Spaghetti Junction", which was presented to Birmingham City Council, reputedly is a humorous commentary on Birmingham's road infrastructure (Figure 3). In an attempt to further question the concept of the bowl, Lee, Tomasi and Schütter (Weber-Stöber, 2001, p. 80 & 110) as well as Clarke (Goldschneider & Zapletalová 1998, p. 63) deconstruct the bowl with the aim to rethink the use and perception of the bowl. David Clarke's fruit receptacles offer perhaps one of the most far-reaching interpretations of this theme (Figure 4).

More recently, some silversmiths have experimented with the bowl form in a different way. They have begun to explore the bowl form with the aim of expressing emotions or interrelationships using aspects of movement. For example, in her piece "Movement No.1", Theresa Nguyen (Gesellschaft für Goldschmiedekunst, 2010, p. 114) approaches the idea of movement symbolically, the shape of the object representing the idea of the wave. Ya-Kyung Shin (Gesellschaft für Goldschmiedekunst, 2010, p. 27) takes a similar approach with "Reunion", a bowl made of used spoons, which symbolise human interaction. In "Sensible Trinkgefäße/Sensitive Cups", Katja Höltermann follows a different path, using movement to heighten the experience of the everyday action of drinking by making the disappearance of the liquid visible through the changing position of the cups (Weber-Stöber 2001, 64; Figure 5). Also

utilising movement, but here in the form of vibration intrinsic to the material/objects form, Ane Christensen has produced bowls from hard-spun domes. By sawing into them, she has expanded and changed the shape of the domes to create elastic movement that makes them quiver (Figure 2). Christensen's bowls are aptly named "Nervous Bowls" (Christensen, 2011; Crafts Council, 2005) to express their emotional appeal.

These four examples demonstrate different ways of utilising movement to express their ideas: the first two examples use a visual or narrative symbolism, the last two examples use our reading of, and empathy with, certain movements to express certain emotions. In what follows, this paper examines more closely the idea of emotion in design, how we read emotion through embodied experience, and how movement can be used to express emotions within design objects.

Expressing Emotion in Design: Three Approaches

The idea of emotion in design has come to prominence in 1999, when the Design and Emotion Society was formed, and with publications such as *Emotional Design: Why We Love (or Hate) Everyday Things* (Norman, 2004). Emotion, however, was of concern before then. For example, Alessi has strongly used a semiotic approach under the lead of Laura Pollinoro to create emotion through visual storytelling (Ciccolo, 1996; Kälviäinen, 2005, p. 88; Pollinoro, 2011). One of Alessi's most iconic objects from this period was the 'Anna' corkscrew (Alessi, 2011a), and some time later the 'Girotondo' series (Alessi, 2011b), which used facial and body expressions to convey happiness in line with semiotic interpretations of anthropomorphic shapes (Kälviäinen, 2005, p. 87). In the early 1990s, the introduction of emotional expression also entered the silversmithing arena with the colourful and sometimes quirky aluminium vessels by Robert Foster (Dietrich O'Callaghan, 1992), or Allan Sharff's vessels in silver (2011).

The extended engagement with design and emotion since 1999 has drawn heavily on the psychological understanding of emotion and its embodiment, including non-verbal communication and movement (e.g., Ekman & Keltner, 1997). This extended understanding of emotion has complemented the semiotic approach with a number of newer developments, including, e.g., semantic (e.g., Demirbilek & Sener, 2003), aesthetic (Crilly, Moultrie, & Clarkson, 2004; Desmet & Hekkert, 2007; Spillers, 2003) and behavioural approaches to emotion (Weerdesteijn et al., 2005). Following Morris (1971), the semantic approach strictly speaking can be seen as a subset of the semiotic approach, which focuses on the reading of a product's function rather than on that of its cultural meaning. The aesthetic approach focuses on the user's sensory experience of pleasure or displeasure and usually follows an appraisal approach (e.g., Desmet & Hekkert, 2002, 2007; Demir, Desmet, & Hekkert, 2009). Touch screen technology and gestural manipulations in smart phones, such as the iPhone, are but one prominent example of this application. In this approach, emotions are generally used as a success element whereby design can evoke feelings of pleasure/success (desired) or annoyance/failure (to be avoided), (Spillers, 2003).



Figure 3. Spagetti Junction [Rose Bowl] (Benny, 1972). Reprinted with permission.

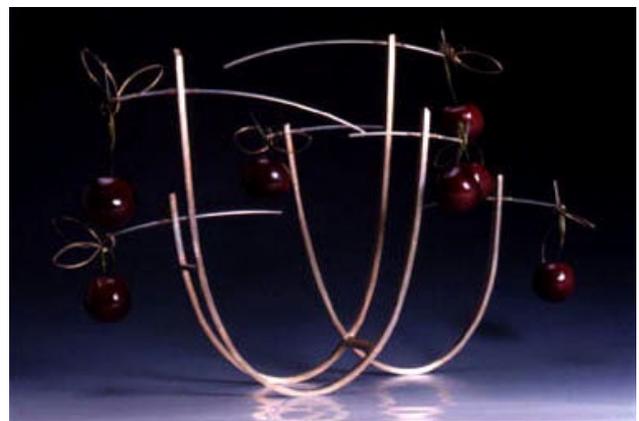


Figure 4. Epergne [Fruit Receptacle] (Clarke, 1997). Reprinted with permission.



Figure 5. Sensible Trinkgefäße/Sensitive Cups [Silver, hollow mounted] (Höltermann, 1999). Since 2001, production also in stainless steel by Fa. Carl Mertens. © Katja Höltermann, Reprinted with permission.

The behavioural aspect of emotion has been addressed by Lee and Nam (2006) and Lee, Park and Nam (2007) who have looked at the emotional response of products within interaction, and by Weerdesteijn et al. (2005) who have explored "the possibility of using expressive movement for creating products that elicit predefined emotional responses" (p.28). Using the case study "Learning to Talk with Your Body", Weerdesteijn et al. (2005) designed six objects, "each expressing a distinct emotion:

anger, fear, sadness, joy, pleasant surprise or attraction” (p.28) with the aim of developing an educational product that can be used to teach children, aged between four and six, how to express themselves emotionally with their bodies. The objects were designed to express the given emotions in their static appearances and (interactive) dynamic movements (p. 28).

Weerdesteijn et al.’s approach (2005) is of particular interest here because it can help us understand how – in certain designs, such as those by Höltermann and Christensen – movement serves to create emotional expression and engagement on several levels: The interrelationship of emotion and bodily action becomes clear if we understand emotion as “brief, rapid responses involving physiological, experiential, and behavioural activity that helps humans respond to survival-related problems and opportunities” (Keltner & Ekman, 2000, p. 163). Weerdesteijn et al. (2005, p. 29) explain that this interrelationship provides an “efficient means for interpreting a person’s emotion [...] by imitating that person’s emotional experience.” Imitating a person’s bodily experience, such as body posture, gesture, movement, or facial expression, creates an empathic experience. Empathic experiences in turn have been shown to have a neurological basis (Shusterman, 2011, p. 155), which allows for the accurate (or mirror) interpretation of that embodied experience by a fellow human. It is this aspect of empathic experience which allows humans to read and interpret objects in a similar way (Kälviäinen, 2005, p. 87), and which is utilised in design to embody and interpret emotions in artefacts and their use. We can thus see how emotion – understood as (bodily) movement – can be designed into an object, or the action involving an object, its use. The means to do so is an object’s function, which can also be understood as a ‘plan for action’ (Kälviäinen, 2005, p. 84; Niedderer, 2007, pp. 9-10; Pearce, 1995, p. 166; Weerdesteijn et al., 2005).

Summarising the above discussion, we can distinguish three different ways of dealing with emotion in design. Firstly, Kälviäinen (2005) emphasizes the semiotic reading and differentiation of emotion in craft and design artefacts. Her interpretation pertains both to emotional expression (Roseman, Wiest & Swartz, 1994, p. 216) as can be found in facial expressions (e.g., in the ‘Anna’ corkscrew) as well as to “denotative, functional [behavioural] and connotative abstract and symbolic meanings” (Kälviäinen, 2005, p. 87). Kälviäinen thus importantly links the aspects of symbolic meaning (Crilly et al., 2004), functional meaning (Demirbilek & Sener, 2003) and emotional expression (Desmet & Hekkert, 2007). Secondly, the aesthetic approach to emotion appears in the literature typically as a reaction of the user e.g., as an indicator of success/failure or as appraisal response

indicating attraction/repulsion, pleasure/displeasure of an object (Crilly et al., 2004; Desmet & Hekkert, 2007, p. 64; Spillers, 2003). Thirdly, Weerdesteijn et al. (2005) focus on the expression of emotion in objects through the embodiment of physical movement, including facial or postural movement, gesture and/or behavioural movement, which – based on the above discussion – I shall call the somatic approach.

Reading Emotion

In the following, two of these three approaches to emotion have been used to reanalyse the two objects ‘Sensible Trinkgefäße’ by Höltermann and the ‘Nervous bowl’ by Christensen to ascertain whether we can gain further insight into the role and relationship of emotion and movement in their design. The semiotic approach by Kälviäinen (including semantic analysis) has been combined with the somatic approach by Weerdesteijn et al. The aesthetic approach has been omitted, because it is inherently judgmental seeking to elicit like or dislike of an object, and because this is contrary to the intention of this study which is to develop the meaningful interpretation of objects.

Reconsidering Höltermann’s and Christensen’s work using the semiotic and the somatic approach, one can now see that the works embody emotion in two different ways, drawing on the behavioural aspect of emotion and on emotional expression respectively. In Höltermann’s work, a second level of meaning can be elicited, which goes beyond the maker’s own claim of heightening the experience of the every-day action of drinking: When in use, the cups tilt more the emptier they get. This is comparable to the expression of sadness in Weerdesteijn’s table of emotions, where sadness is characterised by a relaxed, passive, withdrawal oriented attitude and body posture (e.g., hanging head) as demonstrated in the object that was developed accordingly (Weerdesteijn et al., 2005, pp. 32-33; Figure 6).

In Höltermann’s cups, we do not know whether this is sadness about having finished the drink, about not having been able to stay abstinent or about a friend leaving at the end of the party. This kind of information is dependent on the individual user and the context of use. However, the notion of the movement is (arguably) universal due to the embodied soma-aesthetic experience (Shusterman, 2011; Wallbott, 1998).

In contrast, Christensen’s “Nervous Bowl” draws on emotional expression: in accord with the designer’s naming of her bowl, its quivering movement can be read as nervous trembling. While nervousness is not an emotion commonly encountered in



Figure 6. Sadness is indifferent to manipulation (Weerdesteijn et al., 2005, Figure 2a, p. 30).

the literature, it can be read as a subset of fear or excitement, or a combination of both. Furthermore, quivering can be read in several different ways, for example, as nervousness, fear or (joyous) excitement, or even as the simple acknowledgement of another person in a room. In such cases, the interpretation is dependent on the fine discrimination of various aspects, taking into account the nature and intensity of the movement and the combination with other signs that provide the context.

The discussion of the examples demonstrates that it is useful to combine somatic and semiotic approaches of analysis to allow for a closer reading and understanding of emotion in design where this is related to movement. Indeed, the discussion of Christensen's bowl highlights a challenge for emotion studies in general and for emotion design in particular, which is the fine discrimination of different and complex emotional expressions of movement. In the following section, the somatic and semiotic approaches are therefore amalgamated into a soma-semiotic framework to provide a formal tool for the analysis and interpretation of movement-based emotion in design.

A Soma-Semiotic Framework for Analysing Complex Emotion in Design

The soma-semiotic framework amalgamates the two approaches of semiotic and somatic analysis derived from Kälviäinen (2005) and Weerdesteijn et al. (2005) to enable the analysis and interpretation of complex emotions that are based on movement. The framework is intended as a tool for designing, and for theoretical analysis and interpretation. It distinguishes itself from existing frameworks (Crilly et al., 2004; Desmet & Hekkert, 2007; Weerdesteijn et al., 2005) in three ways.

Firstly, the soma-semiotic framework deals with complex emotions, while existing frameworks tend to focus on simple, discrete emotions, often for the purpose of testing the attractiveness of products (e.g., Crilly et al., 2004; Desmet & Hekkert, 2007), or exceptionally for the design of objects with discrete emotional expressions as emotional teaching tools for children (Weerdesteijn et al., 2005). The term 'complex emotions' refers here to the interference of two or more emotions, which can either enhance, contradict, or cancel each other out, potentially creating new emotional expressions, such as humour, which is based on the combination of contradictory emotions (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009, p. 8; Martin, 2011; Plutchnik, 2001, p. 348).

Secondly, the framework focuses on movement-based emotions in addition to the visual image, using somatic and semiotic cognition, while existing frameworks tend to deal with the visual form only, using aesthetic and semiotic (semantic and symbolic) analysis (Crilly et al., 2004), or with aesthetic, meaning, and emotional experience (Desmet & Hekkert, 2007). Only Weerdesteijn et al. (2005) focus on movement and the somatic aspect of emotions, albeit restricted to simple emotions. The focus on movement changes the view of products from one of being inert (e.g., a product being seen, used and judged as attractive or not),

to one of being active, where people identify with objects as social actors (Ilstedt Hjelm, 2004, p. 196). It is possible to distinguish three different kinds of movement-based emotions: expressive movement, such as in smiling or frowning or clenching fists in anger; functional movements, such as fearfully holding onto a rail in order not to fall off a balcony, cliff, etc. or putting the arms around someone for protection; and behavioural movements, such as putting the arms around someone out of affection.

Thirdly, unlike existing frameworks, the soma-semiotic framework does not adopt an appraisal approach (e.g., Crilly et al., 2004; Desmet & Hekkert, 2007; Demir, Desmet, & Hekkert, 2009), which appears bound to the judgmental appreciation of the user, measuring the attraction of, or pleasure derived from any product. Instead, this framework offers a non-judgmental (mindful) approach (Burgoon, Berger, & Waldron, 2000) to facilitate a richer open-ended interpretation. This allows focusing on the potential of an object to hold and communicate emotions, enabling a rich interpretation that can broaden our understanding of what design artefacts can do/communicate and that can be used as an aid within creative design development. Therefore, at this stage the framework is not presented as a tool for user testing – although it may potentially be used for this purpose – but as a tool for theoretical analysis which is able to inform design decision-making for products in which physical movement is used to embody emotions. This understanding follows March's adoption of Peirce's notions of abductive (also: productive) reasoning as, "the process of forming an explanatory hypothesis [which] is the only logical operation which introduces any new idea..." (Hartshorne & Weiss, 1998, p. 171). As such, abductive reasoning is the most appropriate approach for design inquiry, because it recognises the creative nature of design (March, 1984, p. 269).

Finally, the naming of the framework needs some clarification: The soma-semiotic framework is used here specifically in the context of design, drawing on Kälviäinen (2005), Shusterman (2011), and Weerdesteijn et al. (2005), and does not relate to somatic disorder in the medical sense of psychotherapy as discussed e.g., by Wilberg (2010).

The different aspects of the framework can now be drawn together in a graphic representation as shown in Table 1, below, being structured according to:

- Object indicators (left hand column), including the object's movement (expressive, functional and behavioural) and its visual image.
- The meaning (top line), including the description of the object movement/image and the soma-semiotic interpretation related to each single indicator of emotion.
- Overall interpretation (right hand column): the very right hand column provides space to draw together all the individual observations and interpretations into a holistic interpretation based on the combination of the individual indicators.

The table is intended as an aid for the interpretation of objects, and the blank spaces can be completed accordingly to chart how single and complex emotions emerge from the movements observed.

Table 1. Schema of soma-semiotic framework of emotion.

Meaning Indicator	Description of movement/image	Soma-semiotic interpretation of individual movement/image with regard to emotion	Soma-semiotic interpretation of combined movement/image with regard to emotion
Movement 1 (expressive/ functional/ behavioural)
Movement 2 (expressive/ functional/ behavioural)
Visual image 1

In conclusion, this section has reviewed the bowl as a significant design form within traditional and contemporary silversmithing. Current developments of it have shown the inclusion of movement as an expressive element. Applying theories of emotion design to the analysis of the objects has led to the development of a soma-semiotic framework for the interpretation of complex emotions based on movement.

Designing Emotion through Elastic Movement

The theoretical development of the framework was paralleled by a practical part, which investigated how the theoretical understanding of emotional expression and functional-behavioural emotions can be used to embody emotion within silver design using elastic movement. The aim was to expand current conceptions of silver design. At the same time, the results of the practice served to refine the framework in an iterative process, although the iterative process as such has not been presented in this paper for reasons of economy of exposition. The practical investigation explored the creative opportunities of elasticity in silver design enabled by the combination of Argentium® silver and laser welding. The project focused on functional and non-functional forms of the bowl as a common form in silver design that, due to its simplicity, provided suitable freedom for the exploration. To gain familiarity with the combination of Argentium and laser welding, the project explored briefly different ways of joining silver sheet building on knowledge from a previous project (Niedderer et al., 2006), before considering different ways of constructing elastic movement in relation to existing design examples and insights from the soma-semiotic analysis. From the insights gained, three different ways of constructing elastic movement were selected with which three designs were created exploring the soma-semiotic emotional expression of these movements.

Methodology

The practical enquiry was based on the method of creative exploration, which Durling and Niedderer (2007) define as the “working through of a research problem through designing”, including “ideation, drawing, prototyping, etc” (p. 14). They distinguish two modes of creative exploration, analytical and synthetic, where “the creative aspect of designing has been

brought to bear” ... “within a predetermined research framework” (pp.14-16). In other words, analytical investigation seeks to gain a deeper understanding of a particular concept or phenomenon through systematic design inquiry within a pre-determined conceptual framework while designing as a synthetic process uses real world intervention and observation to capture complex phenomena/situations. Durling and Niedderer (2007) further explain the aim and rationale of creative exploration:

Using designing in this way is useful where it is necessary to gain insight into the complexity of a situation, phenomenon or process, where scientific reduction is unable to provide a sufficiently rich or coherent picture of the subject being investigated. (p. 14)

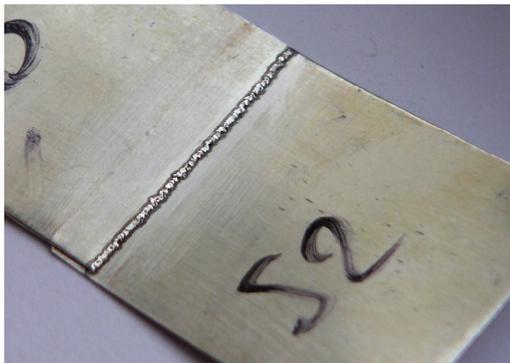
This way of using designing within research is therefore not illustration or demonstration, nor is it necessarily about testing any concept or theory, but essentially it utilises designing to reveal new avenues and opportunities for development, and to gain new insights and understanding. (p.16)

In the case of the present research, synthetic inquiry was used for the first part of the investigation, which considered different ways of constructing elastic movement. The analytical investigation was used to explore the embodiment of emotion through elastic movement guided by the soma-semiotic framework. The research was situated in the real life scenario of design studio practice, drawing on experiential knowledge, scientific data and the soma-semiotic framework as appropriate to enable insightful experimental development (van Manen, 1990, pp. 8, 74) and inform all design decisions.

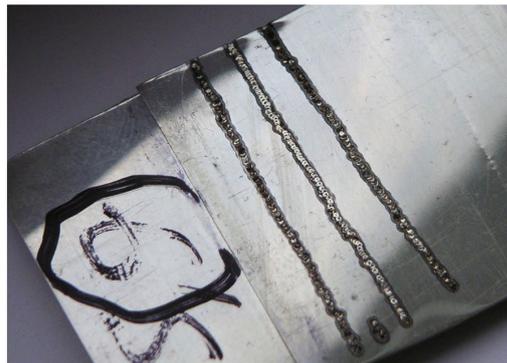
Synthetic Exploration

This part of the practice explored the relationship between material, process and form with regard to the creation of elastic movement based on the combination of thin hard rolled Argentium and laser welding.

This work builds on knowledge gained from a previous project (Niedderer et al., 2006). Firstly, different ways of joining silver sheet using laser welding were briefly explored, including flanges, ridges, welding sheets flat together or flat over edge in order to make seams durable and explore their decorative potential. The decorative aspect was important since – unlike soldering joints – the welding joints would remain visible due to the thinness of the metal sheet used (0.1-0.3mm), (Figure 7; Niedderer, 2009, p. 169).



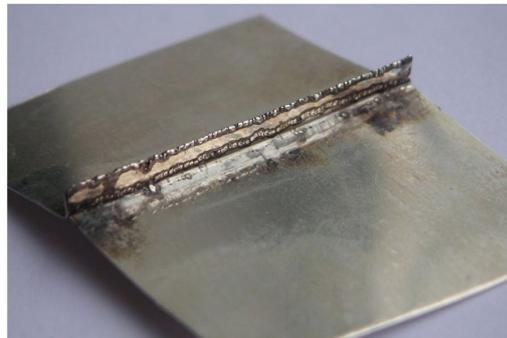
Example 1: welding two sheets over edge



Example 2a: Welding two sheets flat (straight)



Example 2b: Welding two sheets flat (zigzag)



Example 3: two sheets with ridge, welding 1edge/1flat

Figure 7. Examples of laser welding with Argentium® silver (Niedderer, 2009, p. 169).

Secondly, with the different possibilities of joining in mind, different ways of constructing elastic movement within the bowl form were explored using a combination of drawing, model-making and conceptual reasoning. Where possible, this was supported by the formal analysis of relevant examples to understand different ways of creating elastic movement. The difficulty with examples that are available as visual material only is that elastic movement is inherently not visible in a still image, but has to be inferred. Where available, web-links to videos of examples have therefore been included in the text.

In analysing relevant examples, it appeared that there are two ways of creating elastic movement in bowls: firstly, through elasticity of the material by retaining the full bowl shape and, secondly, through deconstruction of the bowl form. Laurenz Stockner's copper bowl falls under the first category. His spherical bowl is made of copper sufficiently thin and hard worked for it to flex (Art Aurea, 2011). Also in the first category is the 'Stretchy

bowl' by Hook n Loop Design (2012), a simple cross-shaped steel frame with a 'trampoline-like' fabric stretched between the four points of the frame. The product information explains that the fabric expands as fruit is put onto it to form a containment. Ane Christensen's bowl would fall into the second category of the deconstructed bowl form, and there are a few other examples of this kind (e.g., Gonsherdesign, 2012) where the deconstruction of the form is achieved through a subtraction of the material.

For exploring the combination of Argentium and laser welding, the second approach of deconstruction was chosen as the most appropriate. In contrast to the given examples, however, this project has used additive construction, which led to the identification of three possible ways of constructing elastic movement intrinsic to the bowl form (Figure 8):

- (1) a strip of silver sheet fixed on one side;
- (2) a looped silver strip;
- (3) joining of two silver strips of different lengths.

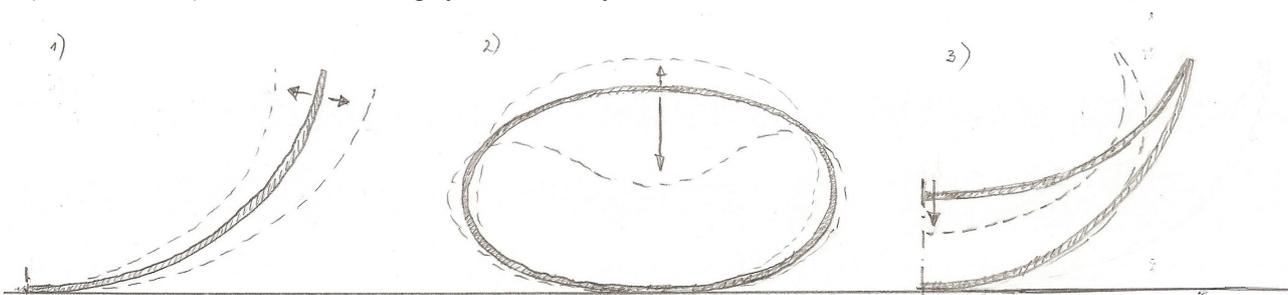


Figure 8. Three ways of constructing elastic movement: 1) single strip, 2) loop, 3) double-layered strip. © Kristina Niedderer.

Due to the time and resource limitations of the project, other potential solutions such as the helix shape, which is found in the example of the Slinky and which had been used in previous work (Niedderer et al., 2006), were not further explored here.

Analytic Exploration

Following the synthetic exploration of the relationship of formal elements and elastic movement, the analytic exploration investigated the relationship of elastic movement and emotion. The synthetic exploration had highlighted the need to design differently to accustomed ways, because of the differences in the construction. An approach of moving from simple to complex in exploring elasticity and emotion was therefore followed to allow for this need. Further, in contrast to Weerdsteijn et al. (2005) who had selected specific single emotions and then determined appropriate ways of expressing them through artefacts, this exploration used an open-ended approach. Starting from an understanding of what movements can be produced using identified formal solutions (synthetic exploration), the analytic exploration sought to understand what emotions these movements can be used to express. In this way, within the theoretical framework, space was given to allow for the creative leap as a characteristic strength of designing to generate novel solutions that may not otherwise be predicted. In the following, the design development of three designs utilising the three different ways of creating elastic movement are described. Each is followed by a discussion of its soma-semiotic characteristics to demonstrate how the framework can provide designers with a deeper insight and enhance their abilities of interpreting and thus understanding their own designs.

The first design utilised slim strips of silver sheet, fixed on one side, to create a bowl, leading to a star-shaped, layered construction, which provided the basis for two small bowls 'Anemone' (Figure 9, Appendix). Each of the bowls is made up of ca. 80 strips of Argentium® (0.1mm thick), which were joined by laser welding in form of an 8 (10) pointed star comprising 10 (8) layers. The Anemone bowls had no explicit practical function but were rather sculptural in character, allowing maximum freedom of experimentation. In principle, the design was similar to that by Christensen in that it was based on unsupported silver strips, which enable it to gently vibrate. As a result, the flowery forms appeared 'alive', fragile looking yet strong and flexible, reacting to any disturbance in the room with a slight vibration. The vibration was however different to that of the 'nervous bowl' in that the vibration of the 'nervous bowl' appears non-directional, while that of the 'Anemone bowls' has an 'inward-upward – outward-downward' direction due to the fixed centre. Using the soma-semiotic framework in relation to tables on the relationship of emotion and movement by Wallbott (1998, p. 893) and Weerdsteijn (2005, pp. 32-33), one can identify the combination of 'vibration' and 'non-directional' in the 'nervous bowl' as attributes of anxiety or fearful anticipation and which are characterised with trembling, fumbling, passivity, little strength and tenseness. In contrast, the 'Anemone' bowls, reacting to any disturbance in the room with a slight upward/outward vibration, communicate a low excitement (like the general acknowledgement of a person in the room)

and a somewhat contented happiness through low movement dynamics and an upward movement for joy (Wallbott, 1998, p. 893). Additionally, the approach-oriented 'embracing' outward movement communicates an aspect of attraction or welcome.

The insights gathered about the use of elasticity gained from the 'Anemone' bowls were transferred into the subsequent design of two fruit bowls. The two fruit bowls used the same principle of construction (star-shaped layering) as the first, but now applied the idea of movement to the design of functional silver objects using solution 2 (looped silver strips) and 3 (double-layered silver strips of different lengths) for fruit bowls one and two respectively.

'Fruit Bowl 1' (Figure 10) used 16 looped silver strips arranged in a 2-layered star shape to create a flattish ball shape, which transforms into a doughnut shape when laden with fruit, visualising the weight of the fruit. This construction is very springy and can be made to bounce as if in 'elated joy', displaying the corresponding movement qualities described by Wallbott (1998, p. 893) for elated joy, i.e. high movement activity and dynamics. Thus far the design's expression was predicted, what was not predicted was that once the 'bowl' was laden with fruit, it sheared also sideways. With the fruit in the middle, the long silver strips on the outside and the rolling movement (combined up-down as well as sideways movements), together, these components



Figure 9. Anemone (Niedderer, 2009).

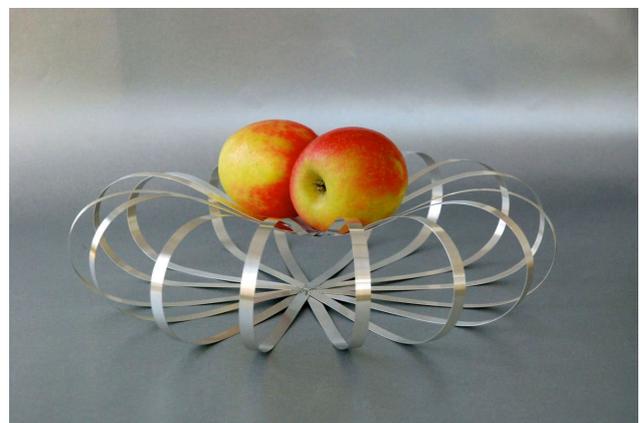


Figure 10. Fruit Bowl 1 (Niedderer, 2009).

made the bowl not just ‘joyous’ but also comical, raising associations to a ‘drunken spider’ (body high up in the middle on long legs ‘wobbling about’). This is due to the combination of two contradictory emotions that of joy (bounce) and fear (image of spider). The ‘wobbly’ sideways movement signifying unsteadiness/drunkenness/incapacitation of a potential ‘danger’ (spider), can be seen to evoke relief as a third emotion. Below is a demonstration of the completed soma-semiotic framework grid (Table 2) to show that it can help with identifying the individual indicators and meanings for the analysis.

‘Fruit bowl 2’ was made of 2 x 20 silver strips of different lengths arranged in a double layered-star shape to create the outline of a double-walled bowl (Figure 11). Like Fruit Bowl 1, when laden with fruit, the shape of Fruit Bowl 2 deforms. However, due to the less flexible construction, there is little movement akin to emotional expression, rather the movement can be described as functional- behavioural: the more the bowl is laden with fruit, the more it closes its ‘fingers’, seemingly protecting its contents (Figure 12). Protection can be interpreted as a derivative of fear (of something being taken away) and attachment (protecting someone or something from danger), indicated through closed movements/ body posture and the image of closing one’s fingers protectively around something (Wallbott, 1998, p. 983; Weerdesteijn et al., 2005, p. 32).

In summary, developing the practical investigation in relation to the soma-semiotic framework has enabled the development and interpretation of the creative work within the parameters of the framework from a maker’s point of view. At the same time, unexpected results of the practice, such as the complexity of emotions, have helped to further define the framework.

Discussion and Conclusion

This study has investigated the idea of expressing emotion through elastic movement in the context of silver design. The review of silver design, which focused on the bowl form, revealed the trend by a small number of designer makers of using movement to express emotions within artefacts. In order to understand better the use of movement as expressive element, the idea of design and

emotion was introduced into the context of silver design. Different approaches of emotion design were discussed and applied to the interpretation of examples from silver design, which led to establishing a soma-semiotic framework as a means of aiding the design, analysis and interpretation of artefacts, in which emotion is embodied through movement.

In parallel with the theoretical development of the framework, designing was used to explore how the theoretical understanding of emotional expression and functional-behavioural aspects of emotion can be utilised to embody emotion within



Figure 11. Fruit Bowl 2, Ø45cm (Niedderer, 2009).

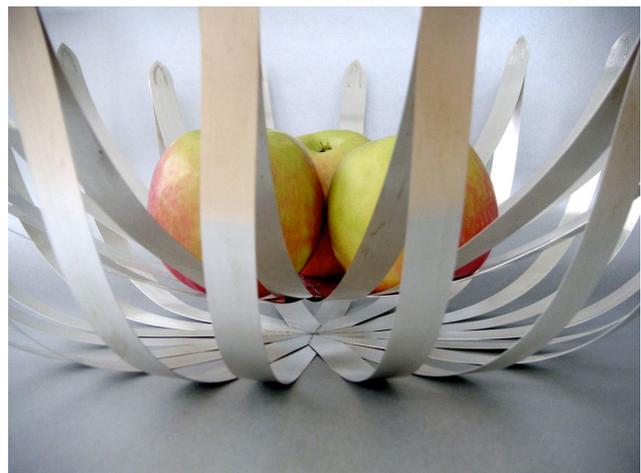


Figure 12. Fruit Bowl 2 [detail with fruit] (Niedderer, 2009).

Table 2. Example of soma-semiotic framework completed for fruit bowl 1.

Meaning Indicator	Description of movement/image	Soma-semiotic interpretation of individual movement/image with regard to emotion	Soma-semiotic interpretation of combined movement/image with regard to emotion
Movement 1 (expressive/ functional/ behavioural)	Bounce + high movement activity and dynamics	Elated joy	Put together, joy (bounce) and fear/scariness (of spider) are a contradiction of emotions, which leads to a humorous reading. Especially when the third component ‘unsteadness/ helplessness is added, which can be read as incapacitating the potentially scary ‘spider’, the image becomes comical and elicits laughter and feelings of ‘fun’.
Movement 2 (expressive/ functional/ behavioural)	Wobbly circular/sideways ‘rolling’ movement	Unsteady, drunken, helpless	
Visual image 1	Visually heavy centre (fruit) + long silver strips emanating from the centre	Heavy centre and centrally emanating strips are read as body and legs, inferring the image of a spider because of the similarity of their relationship/ proportions. Spiders are widely perceived as ‘scary’ and associated with fear.	

silver design using elastic movement. The synthetic exploration investigated the formal aspect of creating elastic movement based on material and form, while the analytical exploration investigated the relationship of movement and emotion. It demonstrated that while being able to predict the movement and emotional expression of the bowls *per se* using the soma-semiotic framework, the final pieces revealed complexities both in terms of the elasticity of the construction and of emotional expression, which went beyond the original predictions and led to the refinement of the framework to include complex emotions.

Reflecting on the practical aspects of creating movement, model making allowed only for limited prediction of the elastic behaviour of the constructions, especially under load. While the main movements (up-down) were predictable, the sideways movements were not. In order to advance this aspect in future, potentially, 3D CAD driven models, e.g., using Solidworks, might offer better predictive powers, although gaining access to professional software required to manage the complexity of the constructions may prove difficult within a normal silversmithing context.

Reflecting on the aspect of creating and interpreting emotion, in particular the fine differentiation and discrimination of emotional responses produced in the bowls exceeded prediction. For example, it was possible to distinguish three very different kinds of ‘quivering’ within three of the bowls discussed in this paper: Christensen’s bowl was found to have a ‘nervous’ quiver associated with anxiety or fearful anticipation; the ‘Anemone’ bowls, reacting to any disturbance with a slight upward/outward vibration, were found to communicate low excitement, contented happiness and welcome. Fruit Bowl 1 was found to combine ‘elated joy’ (bounce) with the potentially scary image of a spider, creating a comical image through the juxtaposition of the different signs, which incidentally is comparable to the boggart turning ice-skating spider for Ron in Harry Potter and the Prisoner of Azkaban (Rowling, 2000, 123ff). These findings mirror some of the difficulties and contradictions experienced in psychological studies of emotion, which describe and measure the recognition of emotional expression and behavioural movements as indicators of emotion (e.g., Roseman et al., 1994; Wallbott, 1998; Weerdesteijn et al., 2005). At the same time, this study demonstrates how complex emotions can be interpreted and embodied in design objects to develop a broader spectrum and vocabulary of complex emotional expression.

Finally, this study is making a two-fold contribution: It has for the first time theorised emotion in the context of silver design; and it has developed a soma-semiotic framework to aid the analysis and interpretation of complex emotions, and their embodiment through the design of objects based on (elastic) movement. This study has focused exclusively on the development of the soma-semiotic framework through a combination of theoretical and practical inquiry. Future work might seek to advance technical aspects using CAD simulation to better develop and predict emotions based on elastic movement, while a user-centered direction might use the framework to design products to embody complex emotions for testing with users.

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References

1. Alessi. (2011a). *Project: AM01 - Anna G. corkscrew*. Retrieved March 2, 2012, from <http://www.alessi.co.uk/ashop-uk/home-design/bar-and-wines-90149/anna-g-corkscrew-580/>
2. Alessi. (2011b). *AKK78 - Mini Girotondo, round tray*. Retrieved March 2, 2012, from <http://www.alessi.co.uk/ashop-uk/design-products/trays-90142/round-tray-mini-girotondo-5037.html>
3. Art Aurea. (2011). *Laurenz Stockner*. Retrieved March 2, 2012 from <http://artaurea.com/modern-classics/175-laurenz-stockner>
4. Benny, G. (1972). *Spagetti Junction* [Rose Bowl]. Birmingham, UK: Birmingham Museum and Art Gallery.
5. Burgoon, J. K., Berger, C. R., & Waldron, V. R. (2000). Mindfulness and interpersonal communication. *Journal of Social Issues*, 56(1), 105-127.
6. Cannetti, E. (1973). *Crowds and Power*. (C. Stewart, Trans.). Greater London, UK: Penguin Books. (Original work published 1960)
7. Ciccolo, E. (1996). *L'oggetto dell'equilibrio. Centro Studi Alessi 1990-1996* [Object of equilibrium. Alessi Study Centre 1990-1996]. Crusinallo, Italy: Alessi.
8. Clarke, D. (1997). *Epergne* [Fruit Receptacle]. Bishopsland, UK: Bishopsland Educational Trust.
9. Clifford, H. (Ed.). (1993). *20th century silver*. London, UK: Crafts Council.
10. Coatts, M. (1999). *A feast of silver*. London, UK: CAA. Retrieved March 2, 2012, from <http://www.caa.org.uk/exhibitions/archive/2000/a-feast-of-silver.html>
11. Cohn, M. A., Fredrickson, B. L., Brown, S. L., Mikels, J. A., & Conway, A. M. (2009). Happiness unpacked: Positive emotions increase life satisfaction by building resilience. *Emotion*, 9(3), 361-368.
12. Christensen, A. (2011). *Kinetic pieces*. Retrieved March 2, 2012, from <http://www.anechristensen.com/silverware/pages/kinetic.html>
13. Crafts Council. (2005). *Jerwood applied arts prize 2005: Metal*. London, UK: Crafts Council.
14. Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: Consumer response to the visual domain in product design. *Design Studies*, 25(6), 547-577.
15. Davis, S., & Johns, P. (2007). *The properties and applications of Argentium® sterling silver*. Paper presented at the 31st

- Annual Conference of International Precious Metals Institute, Miami, FL. Retrieved March 2, 2012, from http://www.argentiumsilver.info/uploads/Files/papers/31st_ipmi_sdavis_pjohns.pdf
16. Demir, E., Desmet, P. M. A., & Hekkert, P. (2009). Appraisal patterns of emotions in human-product interaction. *International Journal of Design*, 3(2), 41-51.
 17. Demirbilek, O., & Sener, B. (2003). Product design, semantics and emotional response. *Ergonomics*, 46(13/14), 1346-1360.
 18. Desmet, P. M. A., & Hekkert, P. (2002). The basis of product emotions. In W. S. Green & P. W. Jordan (Eds.), *Pleasure with products: Beyond usability* (pp. 60-68). London, UK: Taylor & Francis.
 19. Desmet, P. M. A., & Hekkert, P. (2007). *Framework of product experience*. *International Journal of Design*, 1(1), 57-66.
 20. Durling, D., & Niedderer, K. (2007). The benefits and limits of investigative designing. In *Proceedings of the 2nd International Congress of International Association of Societies of Design Research*. Hong Kong, China: Hong Kong Polytechnic University. Retrieved 30 Dec, 2011, from <http://www.sd.polyu.edu.hk/iasdr/proceeding/papers/The%20Benefits%20and%20Limits%20of%20Investigative%20Designing%20%20.pdf>
 21. Ekman, P., & Keltner, D. (1997). Universal facial expressions of emotion: An old controversy and new findings. In U. Segerstrale & P. Molnar (Eds.), *Where nature meets culture: Nonverbal communication in social interaction* (pp. 27-46). Hillsdale, NJ: Erlbaum.
 22. Elastic, 3.a. (n.d.). In Oxford english dictionary online. Retrieved from <http://www.oed.com/view/Entry/60128?redirectedFrom=elastic#eid>
 23. Gesellschaft für Goldschmiedekunst. (2010). *Silver triennial international*. Stuttgart, Germany: Arnoldsche and Hanau, Germany: Deutsches Goldschmiedehaus Hanau.
 24. Glanville, P. (1997). *Silver: History & design*. New York, NY: Harry N. Abrams.
 25. Glanville, P. (2006). *Silver in England*. Oxon, UK: Routledge.
 26. Goldschneider, I., & Zapletalová, A. (1998). *Metalmorphosis: Tradition and innovation in British silver and metalwork 1880-1998*. London, UK: Museum of Decorative Arts Prague and British Council.
 27. Gonsherdesign. (2012). *Collapsible bowl*, 2004. Retrieved March 2, 2012, from <http://www.gonsherdesign.com/includes/content/projects/bowl.php>
 28. Hartshorne, C., & Weiss, P. (Eds.) (1998). *Collected papers of Charles Sanders Peirce* (Vol. 5). Bristol, UK: Thoemmes Press. (Original work published 1931-1958)
 29. Hendrix, E. (1999). A cypriot silver bowl reconsidered—II. The technique and physical history of the bowl. *Metropolitan Museum Journal*, 34, 21-31.
 30. Hill, R., & Margetts, M. (2003). *Michael Rowe*. Birmingham, UK: Lund Humphries.
 31. Hook n Loop Design. (2012). *Stretchy bowl*. Retrieved March 2, 2012, from <http://www.hooknloopdesign.com/product/stretchy-bowl-blue>
 32. Hund, B. (1995). *Silberstreif: Eine Kunstaussstellung*. [Silver lining: An art exhibition]. Esslingen, DE: Neckarwerke.
 33. Huycke, D. (2012). *Works 1996-2000*. Retrieved March 2, 2012, from <http://davidhuycke.posterous.com/pages/works-2000-2005>
 34. Ilstedt Hjelm, S. (2004) *Making sense: Design for well-being* (Doctoral dissertation). Stockholm, Sweden: KTH.
 35. Kälviäinen, M. (2005). Action, movement and bodily relationships in products. In L. Feijs, S. Kyffin, & B. Young (Eds.), *Proceedings of the 2nd Conference on Design and Semantics of Form and Movement* (pp. 84-89). Eindhoven, NL: Koninklijke Philips Electronics
 36. Karageorghis, V. (1999). A cypriot silver bowl reconsidered—I. The iconography of the decoration. *Metropolitan Museum Journal*, 34, 13-20.
 37. Keltner, D., & Ekman, P. (2000). Emotion: An overview. In A. Kazdin (Ed.), *Encyclopedia of psychology* (pp. 162-167). London, UK: Oxford University Press.
 38. Lee, J. -H., & Nam, T. -J. (2006). *Augmenting emotional interaction through physical movement*. In K. Hinckley (Ed.), *Proceeding of the 19th Annual ACM Symposium on User Interface Software and Technology* (pp.95-96). New York, NY: ACM press.
 39. Lee, J. -H, Park, J. -Y., & Nam, T. -J. (2007). Emotional interaction through physical movement. In J. Jacko (Ed.), *Proceeding of the 12th International Conference on Human-Computer Interaction* (pp. 401-410). New York, NY: ACM press.
 40. March, L. (1984). The logic of design. In N. Cross (Ed.), *Developments in design methodology* (pp. 265-276). Chichester, NY: John Wiley & Sons.
 41. Martin, R. A. (2006) *The psychology of humor: An integrative approach*. Burlington, MA: Elsevier Academic Press.
 42. Mendini, A. (Ed.). (2003). *Tea and coffee towers*. Milano, Italy: Electa.
 43. Morris, C. W. (1971). *Writings on the general theory of signs*. The Hague, The Netherlands: Mouton.
 44. Müller, H. (2001). *European silver: The Thyssen-Bornemisza collection*. London, UK: Philip Wilson Publishers.
 45. Neumann, G. (1999). A cypriot silver bowl reconsidered—III. The inscription. *Metropolitan Museum Journal*, 34, 33-35.
 46. Niedderer, K., Harrison, C., & Johns, P. (2006). Exploring the creative possibilities of Argentium™ sterling silver. In K. Friedman, T. Love, & E. Corte-Real (Eds.), *Proceedings of the Conference of Design Research Society*. London, UK: Design Research Society. Retrieved 31 Aug, 2011, from http://www.iade.pt/drs2006/wonderground/proceedings/fullpapers/DRS2006_0203.pdf
 47. Niedderer, K. (2007). Designing mindful interaction: The category of the performative object. *Design Issues*, 23(1), 3-17.

48. Niedderer, K. (2009). Sustainability of craft as a discipline? *Making Futures*, 1., 165-174. Retrieved from <http://makingfutures.plymouthart.ac.uk/journalvol1/papers/kristina-niedderer.pdf>
49. Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. New York, NY: Basic Books.
50. O'Callaghan, J. (1992). Robert Foster. In G. Dietrich (Ed.) *Drei Silberschmiede, drei Länder*. [The eloquent vessel]. Köln, Germany: Museum für Angewandte Kunst.
51. Pearce, S. M. (1995). *On collecting: An investigation into collecting in the European tradition*. London, UK: Routledge.
52. Plasticity, 1. (n.d.). In *Oxford english dictionary online*. Retrieved from <http://www.oed.com/view/Entry/145301?redirectedFrom=plasticity#eid>
53. Poof-Slinky. (2012). *Slinky's fun history*. Retrieved March 2, 2012, from <http://www.poof-slinky.com/check-out-the-online-slinky-museum/slinky-history/>
54. Quast, D., & Tamla, Ü. (2010). Two fifth century AD Byzantine silver bowls from Estonia. *Estonian Journal of Archaeology*, 14(2), 99-122.
55. Plutchik, R. (2001). The nature of emotions. *American Scientist*, 89(4), 344-350.
56. Pollinoro, L. (2011, April 15), *Laura polinoro, i.e. creative affinities*. Retrieved March 2, 2012, from http://www.facebook.com/note.php?note_id=200511066655534
57. Roseman, I. J., Wiest, C., & Swartz, T. S. (1994). Phenomenology, behaviors, and goals differentiate discrete emotions. *Journal of Personality and Social Psychology*, 67(2), 206-221.
58. Rowling, J. K. (2000). *Harry Potter and the prisoner of Azkaban*. London, UK: Bloomsbury Publishing.
59. Schadt, H. (1996). *Goldschmiedekunst. 5000 Jahre Schmuck und Gerät*. [Goldsmiths' art. 5000 years of jewellery and tableware]. Stuttgart, Germany: Arnoldsche.
60. Sharff, A. (2011). *Korpus > Birds*. Retrieved March 2, 2012, from <http://www.scharff.dk/Korpus/Birds/tabid/431/language/en-US/Default.aspx>
61. Shusterman, R. (2011). Somatic style. *The Journal of Aesthetics and Art Criticism*, 96(2), 147-159.
62. Spillers, F. (2003). Emotion as a cognitive artifact and the design implications for products that are perceived as pleasurable. *Cognition*, 7, 1-14.
63. Stern-Leach. (2007). *Laser weldable joints*. Retrieved March 2, 2012, from http://www.argentiumsilver.info/uploads/Files/reports/laser_weldable_joints.pdf
64. Valcke, J., Weber-Stöber, C., Schwarzinger, V., de Laet, J., & Janssen, L. (1993). *A sparkling party*. Brussels, Belgium: VIZO.
65. van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy* (2nd Ed.). Albany, NY: State University of New York Press.
66. Wallbott, H. G. (1998). Bodily expression of emotion. *European Journal of Social Psychology*, 28(6), 879-896.
67. Weber-Stöber, C. (Ed.) (1992). *Silbergestaltung: Zeitgenössische Formen und Tendenzen*. [Silver Design: Contemporary forms and trends] München, Germany: Klinkhardt & Biermann.
68. Weber-Stöber, C. (Ed.) (1995). *11th Silver triennial 1995*. Hanau, Germany: Gesellschaft für Goldschmiedekunst & Kulturamt Hanau.
69. Weber-Stöber, C. (Ed.) (2001). *13th Silver triennial 2001*. Hanau, Germany: Gesellschaft für Goldschmiedekunst & Kulturamt Hanau.
70. Weerdesteijn, J. M. W., Desmet, P. M. A., & Gielen, M. A. (2005). Moving design: To design emotion through movement. *The Design Journal*, 8(1), 28-40.
71. Wilberg, P. (2010). From psychosomatics to somasemiotics: Felt sense and the sensed body in medicine and psychotherapy. Eastbourne, UK: New Gnosis Publications.
72. Wolters, J. (1996). *Der Gold-und Silberschmied, Band 1: Werkstoffe und Materialien*. [The gold and silversmith, volume 1: Materials and substances]. Stuttgart, Germany: Rühle-Diebener Verlag.

Appendix. Video demos for the Fruit Bowl 1.



Fruit Bowl 1

URL: <http://www.youtube.com/watch?v=o6CMaPODZbo>



Fruit Bowl 1 (part 2)

URL: http://www.youtube.com/watch?v=03mvN0jmj_U