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Edited by:

Cristiano Storni

Keelin Leahy

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Erik Bohemia

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Visual Materiality: crafting a new viscosity

ENGBERG Maria^{*}; KOZEL Susan^b and LARSEN Henrik Svarrer

Malmö University

^{*} Corresponding author e-mail: maria.engberg@mau.se

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A re-materialisation of the visual in terms of viscosity is provided by this article. The argument is grounded in practical design processes from on-going research in the integration of archival material into AR/MR environments (Augmented Reality and Mixed Reality). This is an approach to emergent materiality not because new materials are invented but because existing visual, digital and traditional craft materials are re-configured. The archival material we use for this project is visual rather than textual, and it portrays moving bodies. The re-materialisation happens through experimentation with materials, affect and perception. Visual materialities, in this case viscosity, rely on a phenomenological approach to vision whereby design materials cannot be separated from the active perception of the designers, the participants and even the materials themselves. This article outlines the final iteration of the *AffeXity* project where glass was used as a design material to enhance viscous materiality. Viscosity is experienced as depth, layers, stickiness, reflections, motion, and an affective quality of dreaminess or the passage of time.

visual materiality, viscosity, glass, phenomenology, Augmented & Mixed Reality

1 Introduction

This article offers a particular glimpse of research processes centred on the creative integration of archival material into mobile Augmented Reality and Mixed Reality environments (AR/MR).¹ Part of the research program of the Living Archives research project at Malmö University in Sweden, the intent is not simply to present archival material in digital form but to call attention to performative practices of archiving.²

¹ The concepts Augmented and Mixed Reality are sometimes used interchangeably. However, in this paper, we follow the understanding of Mixed Reality as the overarching concept in which Augmented Reality technologies are understood in the context of other technologies (Billinghurst, Clark & Lee, 2014). Augmented Reality, most often understood as a way to “enhance reality with digital content in a non-immersive way” (Billinghurst, Clark & Lee, 2014: 79), is used to refer to specific software in this paper.

² <http://livingarchives.mau.se>

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The goal is to open up visual archival material for an encounter with images that has a greater ability to afford perceptual depth and affective engagement. The material qualities to arise through our experimentation with AR/MR can be grouped under the term *viscosity*. This counts as an emergent material experience not because a new material is invented but because a careful re-configuration of existing design materials can produce a different qualitative experience. Viscosity has haptic, visual and affective qualities. In terms of touch, the texture can be glutinous; visually it exhibits distortion or a play between opacity and transparency; and affectively (where affect is seen to be a convergence between the emotional, pre-reflective, embodied and perceptual (Stewart 2007, Barthes 2005, Kozel 2012) it can be both enticing and disconcerting. Glass acts as a visual lens but also a catalyst for memory and imagination - this makes it powerful for designing ways to open out archival material.

Viscosity is an evocative term that might seem to be a metaphor, but it is a description of perceptual experience and reflects aesthetic choices that were implemented in the design process. Viscosity has a presence in a range of design disciplines, it can refer to how information, interaction, and communication can flow more smoothly across devices (Olsen 2008); or to the cognitive perception of effort in relation to workflow goals (Poelmans 1999), or in computer graphics, it refers to the simulation of highly viscous fluids (Kawabe & Nishida 2016). These uses of the term are not analogous with ours, however research into viscosity in computer graphics does open a range of characteristics that resonate with our sense of viscosity from a phenomenological perspective. Temporality, density, and pressure (Peer et al, 2015) are felt in the MR experience, particularly given that the archival material we use is film and video footage of dancing or moving bodies, and elasticity has a stretchy quality that is textural, temporal and spatial (Kawabe & Nishida, 2016).

This paper is structured around four sections. In the first section the phenomenology of perception as it is relevant to our consideration of visual materialities is grounded in Maurice Merleau-Ponty's reflections on the perceptual experience of the painter and Tim Ingold's reminder that the material world participates in the sentient process. In the second section an overview of the *AffeXity* project is provided with emphasis on visual strategies for using AR/MR to open archival material (Kozel 2012, Kozel et al, 2014, Engberg et al 2017). The focus of this paper is a recent design iteration of *AffeXity* that experiments with the use of hand crafted glass to provide an added layer of viscosity to the experience. In the third section the design process for creating the glass is described: the *how*, the *what* and the *why* of glass in relation to viscosity. The final section is a technical perspective on vision: how the camera and AR/MR code see, in particular what happened when we introduced 3D glass objects into the visual field.

2 Visual Perception

A phenomenology of perception is key to understanding viscosity as a visual material. For this we will rely on Maurice Merleau-Ponty's philosophical thought on the sensing of lived experience, in particular how vision works in the artistic encounter between the eye and the world. Unlike other applications of Merleau-Ponty in HCI which rely on *The Phenomenology of Perception* from 1942 (Giaccardi & Karana 2015, Svanæs, 2013), we draw on his later work, "Eye and Mind" the last work he published before he died in 1961 and *The Visible and the Invisible* incomplete at his death, where he complexified his own account of visual perception by relying less on proprioceptive and anatomical examples and more on artistic and poetic ones (Ingold 2011, Kozel 2007). The reversible and "chiasmic" approach to visual and haptic perception from his later work is more appropriate for understanding the play of viscous materiality when designing the visual layers of Mixed Reality experiences, and for explaining how both the visual sensibilities of the human and the digital camera coincide in our process (Merleau-Ponty 1987, pp.130-155).

Merleau-Ponty's existential phenomenological approach acknowledges and even celebrates the opacity of the world, without trying to tidy up, instrumentalise, or regulate it. The body at the centre of the lived experience is not that of "an information machine", it is embedded in the world and

implicitly tied to other beings, “the others who haunt me and whom I haunt” (Merleau-Ponty, 1985, pp. 160-161). Writing the essay “Eye and Mind” (with the original French title “L’Œil et l’Esprit”) on art in the early 1960s he was still operating with the model of mid-century humanism, but his deep reflections on vision evoked a sort of animism, a vitality of the natural world, objects, and other beings in it, so that the primacy of the human being gave way to “the primacy of perception,” and the ability to perceive was shared by animate and inanimate substances alike. The mountain looked back at Cézanne as he painted. It writhed and heaved. If there was a fundamental category for perception, it was that of movement.

In terms of crafting an approach to visual materiality, a phenomenological approach means that materiality cannot be considered separately from vision and touch: from the body in the very process of seeing and touching, and of being seen and touched. This implies that as designers we do not consider the visual externally as a property of the object or separate from the processes of seeing. Visual materiality is created by the way we see the material and the way the material and the devices look back at us. Materiality is not separable from the body, and the body is “an intertwining of vision and movement” (Merleau-Ponty, 1985, p. 162). Further, touch is not just the domain of the hand, vision not just performed by eyes. What Merleau-Ponty learns from the painter is that vision is “voracious,” inducing “delirium,” and the body is implicated in the world: in fact, the body is able to see precisely because it moves about in the world. Vision is never total, it is always a play between what is seen and what is not seen, touched and not touched, between the visible and the invisible; and touch is not constrained to the haptic, we touch and are touched through resonance, radiation and vibration (Nancy, 2007). With relevance to the play of layers possible with careful crafting of Mixed Reality, the essence of the visual is to have “a layer” of invisibility (Merleau-Ponty, 1985, p. 187). This partial quality of what and how we see means that we are constantly building a visual sense of the world at the same time as the picture changes and certainty is lost. “Vision is not a certain mode of thought or presence to self; it is the means given me for being absent from myself” (Merleau-Ponty, 1985, p. 186). Full transparency is impossible, just as complete archival documentation of the past is impossible.

More than just saying that perception is uncertain or unstable, a close reading of Merleau-Ponty such as that provided by social anthropologist Tim Ingold emphasises how what we see also has a sort of sentient being. There is a deep entwinement between the world and those beings who inhabit the world. The world looks back at us. When he writes that the world does not just expose “only its rigid, external surfaces to perceptual scrutiny” (Ingold, 2011, p. 12), it is possible to take inspiration for how a re-configuration of materials including AR/MR on mobile devices might escape the dominance of the flat cold surface of the screen. If each body is “irrevocably stitched into the fabric of the world, our perception of the world is no more, and no less, than the world’s perception of itself - in and through us” (Ingold, 2011, p. 12). To be sentient is to open up to a world, “to yield to its embrace” (Ingold, 2011, p.12), and to enhance the viscosity of the perception is to let oneself plunge into the visual field as if it were liquid, or to rebound, stroke it, or move through it. Designing for visual materiality in the phenomenological sense is designing for bodily resonance, not just for the eyes.

The “delirium which is vision” in Merleau-Ponty’s words (Merleau-Ponty, 1985, p. 166) can be seen as the magic of “opening one’s eyes upon a world in formation” and more than that, at seeing the world in formation *because of* and *through* our vision (Ingold, 2011, p. 128). This captures the essence of emergence in visual materiality. A deepened account of Merleau-Ponty opens for the designer for an expanded visual approach in the design process as well as his or her own visual perception in the design process. This deepened understanding of the phenomenology of perception in design will only increase in relevance as the development and proliferation of AR and MR technologies increase in coming years.

3 AffeXity

3.1 *AffeXity: Passages & Tunnels (2013)*

AffeXity is a Mixed Reality project that integrates dance and video experimentation with AR browsers running on mobile devices in urban spaces. The first iteration was shown in 2013 as part of the Re:New Festival in Copenhagen. Called *AffeXity: Passages & Tunnels* the goal was to use AR in conjunction with archival material in such a way as to create a sense of travel through time, or at least to a different space of memory and imagination.³ The freely available AR application Aurasma was used to create a layered and performative engagement with archival material. The archival material was from dance, film and artist archives: film and video of bodies & objects moving in time and space is a category of archival material that is difficult to display in 2D static forms, and is often accessed through computer screens or in solitary viewing modes. We experimented with opening possible performative modes for encountering the material (Kozel et al 2014).

We modified the usual QR code triggers for launching the AR media by replacing them with still frames from the video footage of various sizes to launch short video loops. These images were attached to the outside of the Nikolai Contemporary Art Gallery in central Copenhagen. We called these images “tags” and some were quite large. They were tucked into the gothic elements of the architecture and helped to promote a thick affective quality for the performances and guided tours – most of which happened at night (figures 1 and 2).

Figure 1 A view of *AffeXity: Passages and Tunnels* being performed at night. Source: Jeannette Ginslov

³ The research team for *AffeXity: Passages & Tunnels* (2013) included Susan Kozel (artistic direction & concept), Jeannette Ginslov (visuals & concept), Wubkje Kuindersma (dance), Oliver Starpov (dance), Camilla Ryd (image processing & interaction design), Jacek Smolicki (images & sound), Daniel Spikol (technical direction).

Figure 2 A view of an AffeXity target image placed on the building. Source: Jacek Smolicki

Our visual aesthetic for layering media was to play with the opacity of the video (making it semi-transparent). This feature allowed the video to be suspended in the device at the same time as the camera functioned, without blocking or replacing the camera feed. Through the video the tag image could be seen, and the space in between tag and video was also seen. This activation of the space between tag and device remains a key design component of *AffeXity* (Rouse & Barba, 2017). In the *Passages & Tunnels* iteration it became a performance space and enhanced the architecture and spatial elements, in the next iteration it is the location of glass layers and contributes to the visual materiality of viscosity.

3.2 *AffeXity:Glass* (2017)

The interest in glass emerged several years after the first showing with the desire to tour *AffeXity: Passages and Tunnels* to different locations. As this work is embedded in a long-term research project on archiving, with an interest in the GLAM (Galleries, Libraries, Archives and Museums) and cultural heritage sectors, we considered transforming the *AffeXity* approach to visual materiality into something that could be useful for galleries or museums for showing their visual archival material. There were two significant material developments for this second iteration: 1) shift of AR platforms from Aurasma to Argon; and 2) the introduction of glass as a material for the tags.⁴

Why glass? The idea of inserting a glass layer or object over the flat visual tag was based on the desire to escape the seeming 'flatness' of the 2D image that was used to trigger the media in the first version of *AffeXity*. For this first performance prototype, we had the advantage of embedding the 'tags' of various sizes into the crevices and nooks of the gothic architecture of the Nikolai building. The old brick walls and small arches made the tags seem less flat, producing an almost holographic effect.⁵ However, once the work was removed from this specific site we could not reconcile the aesthetic qualities of the MR experience with producing simply flat tags – like photographs or posters. The quality of time-travel or passages would be lost. Glass seemed like a beautiful and evocative way to introduce a layer of density to the space between the tag and the

⁴ The 2017 research iteration of AffeXity called AffeXity:Glass was by Susan Kozel (concept), Jeannette Ginslov (visuals), Maria Engberg (Mixed Reality design), Henrik Svarrer Larsen (glass design) and Colin Freeman (camera vision). See <http://livingarchives.mah.se>

⁵ <https://youtu.be/41gB7exGZGo>

device that could be reduced in size and more able to tour. It also might be a way for museums or galleries to present material in fairly contained spaces with controlled lighting.

In this second iteration, the re-configuration of design materials was our focus: video, still image, mobile device, AR browser, glass and perception. The glass was intended to be experienced both directly and through the layers of visual media. Once interposed between the image and the device, the glass seemed less hard and more gelatinous, fluid or flexible. It had a sort of viscosity when layered with the opaque moving imagery.

4 Using Glass

4.1 The design process

From the perspective of the glass maker, “hot” hand-formed glass is made through the craft of glassblowing, allowing for an intimate engagement with the material as the molten glass is shaped. Paradoxically, glass in its cold form is still a liquid, a “still” liquid. The spectrum of variance in viscosity of different glass batches is what defines them as a malleable material to a blower. For *AffeXity:Glass* the optical qualities of the glass were the focus, given that the glass was combined with the trigger image for the Argon AR browser and had to work with the visual recognition software (more on this below). We limited our explorations to solid glass in rather generic shapes either clear or white with varying opacity; some with inserted bubbles or sand to give inner and outer texture (figure 3). While the shapes were constrained to basic circles, spheres, triangles and rectangles, the making involved was manifold as hand-forming included shaping solids and indenting castings, incorporating bubbles, sand, coloured patches, as well as some glass cutting (figure 4 and 5).

Figure 3 The glass objects that were made. Source: the authors

Figure 4 Shaping of glass. Source: Mads Hoby

Figure 5 Additional glass shaping to add layered qualities. Source: Mads Hoby

Figure 6 A viscous image: shaped glass with a “swoop” and a tracking image underneath. Sources: dancer: Oliver Starpov, still from video: Jeannette Ginslov, photo: the authors.

Some of the glass shapes were made to enhance visual qualities of the images acting as triggers for AR – in particular the ‘swoop’ in the glass shape that was used with one of Oliver Starpov’s dance solos (figure 5 and 6). Other glass textures more abstractly echoed the visual qualities of the movement in the video: the rounded shape picked up on the curve of the archway while the bubbles embedded in the shape added qualities to the layers of media – a watery quality the evoked time or submersion in memory (figure 7). And finally, some shapes were speculations of what might contribute to a viscous experience, emphasising the phenomenological sense of the objects being sentient, inviting us to plunge into the combination of glass and archival material, to swim in it and have it rebound on us, surprise or captivate us.

Figure 7 A round glass shape with bubbles and a tracking image underneath. Sources: dancer: Wubkje Kuindersma, still from video: Jeannette Ginslov, photo: the authors

In the digital realm, glass and glass coatings have been used in interactive products but so far primarily on flat glass (Transparent Intelligence 2017). Until recently, there have been very few efforts with three-dimensional glass, and these have focused mainly on embedding technology within the glass (Dynamic Transparencies, 2017; Olofsson, 2017; Contemporary Glass Society, 2017). Our work speaks to some of these efforts on interactive glass, yet is distinct by drawing the three-dimensionality of glass into visual digital media. *AffeXity:Glass* incorporates the temporal spectra of the moving media in the AR-application and the functions of perception and memory in the person who experiences the designs. The design interest in the layered material is not the duality of seeing an object (picture and/or glass) on its own and then seeing it on the screen overlaid with videos of dancers, but rather in the interplay between image, glass and media, closely related to small movements of the camera and its holder. These micro hand movements of the person holding the camera can include deliberate adjustments to see better or to choose different viewing angles for the 3D glass objects, but they are equally the involuntary trembles of hands and arms, and the negotiation of physical space shared with other bodies who may be using their device to access the media in close proximity. It is possible to focus on the glass placed on the photographic tags or glass with the image embedded within it as a viscous image (see figure 6), however with the *AffeXity:Glass* design research, viscosity refers to the entire material experience, including devices, people, tags and media.

4.2 Cultural reflections

The insertion of glass into our process provoked and inspired our design process, revealing how a material can have both significant cultural and embodied reactions. The obvious initial reactions were sensory and tactile, but also related to our imagination, childhood memories and cultural connections to the glass objects, despite their comparatively neutral shapes. Curiously, our reactions were often negative, in the sense that cultural or personal resonances arose that were not welcome: we did not want them to interfere with our aesthetic and design decisions. Various members of the design team reacted against the glass looking like ubiquitous flat screen displays, Christmas Tree baubles, candle holders, or paperweights. The more we worked with glass, the more glass we saw around us or remembered from past histories.

We wanted to design in such a way as to avoid these associations, then we realised that this was impossible or undesirable. Why design with the desire to be a-cultural, particularly when working in a culture traditionally known for working with glass? The cultural references are unavoidable, a colleague said, so work with them. Another colleague immediately and viscerally said “I hate glass” and did not want to hear anything further about the project. Most people responded to the seductive quality of glass, with imaginative and personal resonances from childhood arising in a favourable light. We found ourselves, while working with the glass prototypes, wanting to touch or stroke them. Our glass maker warned, but too late, that one piece had sharp edges: one of us cut a finger and the dried blood stayed on the piece for some time. This array of unexpected cultural and personal affective resonances around glass almost derailed our process. In particular, *Google Glass* became a counterpoint for us – meaning it is an opposite use of AR, both experientially and in the consumer market – provoking the ironic reference to our work as *AffeXity:Glass*, a working title that somehow stuck.

The push of cultural resonances and the pull of affect impacted the design process. The vocabulary used to describe stages of the process and reactions to what came out reflects a range of phenomenological reactions: yearning, allure, seduction, repulsion, desire to touch, hold, handle, wanting to feel the temperature and how it would fit in one’s hand. Almost ephemeral: seeing through it, seeing into, suspension, reflection, refraction, distortion. We followed the lead of our glass designer who advised that it is more a question of being aware of which culturally coded symbols one incorporates, depending on whether these are helpful or not, for the design intentions. Two guiding forces in particular stood out, one phenomenological and one cultural: viscosity and *Google Glass*. Viscosity accounts for the pull toward the dreamlike quality glass added to the mix of images and video, evoking a play between imagination and memory, making it appropriate for dealing with archival material. *Google Glass* was an opposite configuration in terms of embodiment, media display, materials and market segment. Contradistinction became a mode of cultural critique and a force for design decisions.

5 Materiality in AR/MR Mobile Media

Already in *AffeXity: Passages & Tunnels*, Augmented Reality software for mobile phones was used. This particular class of software combines the abilities of AR (to combine real and virtual content, to provide interactive content, and to correctly register that content in a 3D space) with the mobility and ease of access and use that mobile phones provide. Another way to understand the affordances of AR/MR systems is in terms of location and image recognition. The former uses the mobile phone’s ability to correctly register the device’s coordinates, spatial orientation and movement. The latter uses the mobile phone’s camera and computer graphics abilities to display and recognize visual elements. Generally, the goal of an AR/MR system was primarily to “draw the world” on the screen accurately and to add virtual content meant primarily for the user’s eye.⁶ More recently with the

⁶ AR/MR systems have been primarily defined as concerned with visual virtual content, whether 2D or 3D. However, AR/MR technologies are also used to provide audio or haptic experiences (Billinghurst et al 2014).

increasing computing power, network stability and computer graphics capabilities of mobile phones, these AR/MR applications are capable not only of directing that computational gaze outward in order to display visual content on the screen, but they can also perceive and sense the world around the device. An AR/MR system can now approximate the physical properties of its surroundings: what surfaces, edges and dimensions it should take into account as it maps out its immediate context via the camera. These later developments in terms of visual sensing and perception are crucial for the purposes of this work as we view the digital dimensions of the project as involving a camera that *perceives*.

AR/MR exist in different configurations of hardware and software packages, and as described above, our project focused on the mobile phone as the device. We have tested different software packages and applications. Aurasma was used in the 2013 version of the project. The constraints of Aurasma allowed us to work within a framework that provided a set of interaction models and aesthetic possibilities. However, using this free application required loading our content onto the company's servers. In addition, Aurasma was sold to HP during our design discussions leading to the 2017 version. The decision was made to start working with an open source JavaScript framework for web-based AR/MR developed at the Augmented Environments Lab at Georgia Institute of Technology, called *argon.js*, which in turn functions with the Argon AR-enabled web browser for mobile phones (Speignier et al 2015). The Argon browser allows for computer vision tracking of images and objects, using the Vuforia AR software development kit (SDK) for Android and iOS. Vuforia offers image recognition and sensing, or tracking, capabilities for both flat images as well as more complex objects. In the context of flat images, the SDK detects and tracks features that are naturally found in the image itself by comparing these natural features against a target resource database that is set up by developers. It was at this stage of setting up a target resource database that could contain the 2D images used in 2013 as well as the layered three-dimensional objects that we had in mind for *AffeXity* in 2017.

5.1 Glass and image recognition software

The visual materiality of viscosity arose in the iteration of *AffeXity* in which we introduced glass. Aiming at producing a layered materiality that included the original 2D images and an object that could provide us with a three-dimensional, tactile object that could be displayed in an exhibition context. Glass and its perceptual affordances soon emerged as central: the glass objects, the digital cameras and the specific image capturing and sensing capabilities that they have, and finally, the screens themselves that constitute the visual membrane through which the user would encounter the video material being displayed.

The main aim of the design workshops integrating glass and AR was therefore to apprehend how Vuforia could sense the glass objects, alone or in combination with the previously used Aurasma tag images. In brief, we were attempting to turn glass objects into image recognition targets for augmented reality. We used the Vuforia SDK separately to test the feasibility of using the Argon app. Vuforia's 3D detection is called object targets. These are digital representations of the features and geometry of a physical object. There are a number of ways of constructing a 3D model of an object, ranging from more expensive 3D scanners using laser or other light sensing, to scanning software that use mobile phones' camera to detect the contours of an object. Initially, we used the Android application Vuforia Object Scanner,⁷ to scan the objects by moving around them and recording different viewpoints. These attempts were made by placing the glass objects onto various white, black, and grey matte surfaces (primarily using textiles) and attempting to control the light so as not to create shadows and reflections. As part of this work with understanding the combination of

⁷ <https://library.vuforia.com/articles/Training/Vuforia-Object-Scanner-Users-Guide> The Object Scanner uses a set object scanning target image upon which the object is placed. The mobile phone camera app then captures the contours and features of that object. However, and crucially, an object whose surfaces are shiny, give off reflections, or disturb the sensing process will not render a proper scan.

materials that we were working with, we handled the objects, taking regular photos to understand the difference between what we could apprehend with our vision and what the camera saw (see figure 8).

Figure 8 Scanning the shaped glass and the tracking image starts the video content with some of the glass objects. Sources: dancer: Wubkje Kuindersma, still from video: Jeannette Ginslov, and photo: the authors (from a video: <https://vimeo.com/242722532>)

Our initial attempts to capture our glass objects with the Vuforia Object Scanner app or with a digital camera (images that could then be recombined into a 3D model) did not work. Our assumption was that they did not register as AR tags for one or more reasons:

- Poor lighting on the objects.
- Transparency and refraction creating false tracking points.
- The handheld scanning caused distortions in the scan.
- A combination of the above problems.

The next step in our process of sensing the glass objects as digital 3D objects was to further seek to control the environment of movement and light on the objects as well as the immediate environment by introducing various elements such as a revolving tray that would allow us to rotate the glass object evenly. This set of attempts to use the Vuforia Object Scanner app was made in a studio space with professional light setups and a lighting tent to limit reflections and refractions. The more controlled setting did allow us to scan some of the objects: particularly the ones with clear features such as opaque bubbles or surface details. These scans worked as recognition objects for Vuforia while still in the studio lighting but failed when we tried to use them in different lighting conditions. From this, we concluded that the transparency and refraction present in the glass objects would not work as a 3D target for Vuforia in a non-controlled setting. To confirm that the process would work for opaque objects we scanned an opaque object and the image recognition with a 3D digital object as the trigger worked in Vuforia under different lighting conditions.

Another phase of the prototype workshops involved placing the existing AffeXity images that were used as tags in Aurasma under the glass to create a layered object (or a viscous image). Although looking at the image and glass together with the naked eye produced aesthetic effects that intrigued us, the digital camera saw something else as the glass distorted the image differently at various angles, thus rendering the image recognition process difficult to control. This illustrates the basic phenomenological point that objects in the world, as sentient beings, also have dynamic perceptual processes.

Already at the outset, we knew from previous experience with 3D capture that glass with its refractions, dispersions and reflections would present a challenge for Vuforia's object recognition code--alone or in combination with the *AffeXity* trigger images already used in the 2013 version. However, the allure of experimenting with the layers of glass and their inherent visual and material qualities was important for the project. The contribution of the research proved at this stage to be a rematerialisation of the visual in the context of AR/MR as a sort of viscosity, supported by the phenomenological perspectives of not just the users but the designers and the devices themselves.

6 Conclusion

In current critical discourse the visual has been abandoned too quickly in a turn towards materiality. All the while computer technologies, particularly mobile phones, rely on and expand what visuality means. Our lives are saturated with visual media, much of which is empowered by computational abilities and circulated through social media. This is not likely to change in the near future. This paper focused on engaging with phenomenological and computational visuality using mobile AR/MR technologies to attain a deeper understanding of how the visual can be designed as part of a complex and re-configurable materiality. The haptic and performative are not excluded from this emergent materiality, rather there is a need to understand and design for what we call a viscous materiality based on a phenomenology of visual experience.

This research challenged the current affordances of AR/MR and the current models of interaction and aesthetic of AR/MR applications. The specific case of using archival material for tags and virtual content shown in the device revealed the need to design for the affective qualities of personal and cultural memory, as well as designing for the cultural heritage locations where this material would be open for public interaction. There is, however, wider relevance to this research. Augmented and Mixed Reality applications are growing in significance to designers and the general public, as many consumer and professional products and services implement layered, networked and mobile apps into their existing business models. The general contribution of this paper points to the need for designers to expand their material and perceptual registers to include the sensory and affective qualities of viscosity, and a deeper understanding of the phenomenology of material experience.

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About the Authors:

Maria Engberg is a Senior Lecturer in Media Technology (Malmö University) and a Research Affiliate at Georgia Institute of Technology. Her research focuses on digital media studies; reality media (AR/VR/MR); interactive multimedia film, and digital aesthetics.

Susan Kozel is a Professor with the School of Arts and Communication (Malmö University). She is known for artistic and philosophical work integrating bodies and technologies, and for applying phenomenology to a range of sensory, affective and somatic practices.

Henrik Svarrer Larsen is a Senior Lecturer in Interaction Design at the School of Arts and Communication (Malmö University) and a glassblower. His research and design practice include the aesthetics of tangible Interaction and design as part of critical change processes.