Experimental Material Research — Digital Chocolate

Simon Twose
Rosa du Chatenier
Victoria University of Wellington

ABSTRACT
This research investigates the aesthetics of a shared agency between humans, computation and physical material. 'Chocolate' is manipulated in physical and virtual space simultaneously to extract aesthetic conditions that are a sum of human and non-human relations. This is an attempt to further the knowledge of designing, giving physical and digital materials force in determining their own aesthetics. The research springs from work in speculative aesthetics, particularly N. Katherine Hayles’s OOI (object-oriented inquiry) and Graham Harman’s OOO (object-oriented ontology) and explores how these ideas impact contemporary computational architectural design.

To study this, a simple material has been chosen, chocolate, and used as a vehicle to investigate the dynamics of physical and digital materials and their shared/differing 'resistances to human manipulation' (Pickering 1995). Digital chocolate is 'melted' through virtual heat, and the results printed and cast in real chocolate, to be further manipulated in real space. The resistances and feedback of physical and digital chocolate to human 'prodding' (Hayles 2014) are analyzed in terms of a material’s qualities and tendencies in digital space versus those in physical space. Observations from this process are used to speculate on an aesthetics where humans, computation and physical material are mutually agential. This research is a pilot for a larger study taking on more complex conditions, such as building and cities, with a view to broadening how aesthetics is understood in architectural design. The contribution of this research to the field of architectural computation is thus in areas of aesthetic speculation and human/non-human architectural authorship.
INTRODUCTION
Aesthetics traditionally has human perception at its centre. Recent thinking challenges this, arguing that non-humans contribute, mysteriously, to aesthetic viewpoints (Hayles, 2014). In this research, dynamic performances of matter are given aesthetic priority; they are ‘forceful’ in drawing their own form. This disrupts our imaginative and aesthetic presumptions, particularly when designing built space, prompting unexpected solutions to surface. This research attempts to apply ideas in speculative aesthetics, object-oriented ontology (OOO) and object-oriented inquiry (OOI), to the field of computational architectural design, through a study of comparative physical/digital materialities. Through a series of experiments in forming digital ‘chocolate’, the research pursues a design ontology inclusive of the aesthetic agency of objects and computation. As such, the objectives of this research are to identify and analyse the forcefulness of non-human agents in architectural design in order to speculate as to what their influence might be on architectural aesthetics.

Key contextualizing texts in this area are Hayles' “Speculative Aesthetics and Object-Oriented Inquiry,” in which Hayles outlines an approach to understanding the world through an aesthetic agency shared between humans, objects and artificial intelligences (Hayles 2014); Brian R. Johnson's “Virtuality and Place,” which argues for a blending of physicality and virtuality by claiming that they are inherently both based on experience (Johnson 2002); Graham Harman’s notions of the ‘allure’ objects have to one another (Harman 2002) and work such as Sean Cubitt’s Digital Aesthetics, which speaks of the aesthetics of the digital and their effect on culture and society. These point to a literary context which is extended by the digital design research in this paper.

A key precedent for the research is the installation Skulls by Robert Lazzarini, first exhibited at the BitStreams exhibition in 2001 (Hansen 2003). Skulls is a series of sculptures created by 3D scanning a skull, which is then distorted in digital software and the distorted results prototyped in bone. This creates a set of strange, hybrid objects that allow a human appreciation of aesthetics internal to digital ‘materiality’, confronting viewers with the plasticity of digital space in physical form (Hansen 2003). In essence, the research in this paper investigates physical/digital material hybridity, in which design feedback shuttles between analogue and virtual conditions, allowing the aesthetic decisions in designing to be a sum of more than human factors.
METHOD
This research tested the resistances, affordances and feedback of computational and physical material through a series of ‘chocolate’ experiments; chocolate was deformed virtually and the results cast in real chocolate using 3D prototyped and silicon molds. These experiments are the first steps in testing how designing might be inflected by multiple aesthetic agents. This research will be developed further, encompassing progressively more complex architectural conditions, and go on to inform the design for a public building.

Material Characteristics
Chocolate was chosen for its physical characteristics, its ability to melt and be cast into free-form shape, as well as its sensory potential, giving feedback of smell, touch and taste. Chocolate’s propensity to melt at the touch was chosen as a way to merge human actions with the digital realm. Melting was performed in RealFlow software after experiments simulated manual application of the cursor on virtual chocolate spheres. Successive experiments in melting the sphere were performed through digital equivalents to physical touch to achieve unusual or unruly aesthetic results.

Digital/Physical Modelling Process
A sphere of real chocolate was cast by making a plaster mould from a glass sphere, which was then used to cast molten chocolate. A similar sphere was created in RealFlow by assigning particles in a spherical volume with particle properties resembling chocolate, such as physical qualities of viscosity, particle attraction, melting point and surface tension. A heat emitter was created in the software to transfer heat energy to the particles in the virtual ‘chocolate’ to simulate the melting of a warm finger probing the chocolate. The effects of this on the form of the sphere were animated and rendered to create a virtual version of someone melting the chocolate with their fingers. One thousand iterations were made of this virtual melting, which fine-tuned the digital version of the physical and sensory event of melting chocolate with the fingers.

Casting
The next stage was to transpose the digitally ‘designed’ chocolate into real chocolate. In order to allow the ‘trace of the digital’ (Dixon 2007) to come through into the physically cast chocolate, the unruly meltings were repeated around an axis of symmetry. This allowed the aleatory results of melting through warm virtual fingers to be tied to computation, as this symmetrical duplication was not possible in the real material. This was achieved through two virtual heat emitters, set up at exactly opposing sides of the chocolate sphere, giving an artificial formal logic to performances in formlessness.

In order to cast the digital meltings, the symmetrical chocolate distortions were initially inversely 3D printed to make a mold using Rhinoceros software. The resulting series of chocolate objects was a physical record of formal manipulations through virtual senses of touch. The objects carry the imprint of human play, yet due to their symmetry possess a shape not possible if the play was performed in the physical world. They are
somewhat normal as abstract forms when viewed on a screen yet have a strange physical presence as objects, particularly when placed in relation to one another, rotated in the hand, smelt, melted, or tasted.

The difficulties in removing the chocolate from the 3D printed molds led to interesting textures derived from the resistance of the chocolate to their rigid formwork. The surface only approximated the spheres, and the accidental inclusions added another layer of unruly material forming, becoming a physical approximation of a virtual approximation of human interaction in the real. These inclusions led to a surface texture that bordered on the abject from a human perspective, yet was integral to the aesthetics of the materials and the performances in their making.

The next casting test was to 3D print the melted volumes and create flexible silicone molds around them. This experiment was more successful in casting accurate versions of the digital chocolate, yet had less aesthetic intrusion into the process. The models created with this technique had a striated surface appearance, replicating the 3D printer’s way of making objects from layers of fine filaments. This trace of the manufacturing, as well as the symmetry evident in the form of the chocolate, connected the object to aesthetics inherent to the digital realm, though the object has a singular physical presence in the real. The objects’ strong aroma and presence as possibly edible things—slightly abject confections—deflected them from being dumb physical prints of digital forms, and they became forceful in strange, sensory ways. This ties them to similarly strange hybrid conditions described in the Skulls sculptures, curiously conflating virtual and palpable space.

RESULTS
This iterative design research produced hybrid objects with the trace of both physical and virtual relations. Human actions, such as melting, were simulated virtually in frictionless digital space which produced smooth forms. These forms were impacted by printing and casting, and the sensory objects that resulted. The process provided successive iterations that bound non-human agency in an aesthetic dialogue with human design actions. The result was a test in generating a hybrid aesthetic, part-way between computationally driven material and sensorially-driven human input.

Digital/Material Agency
The digital’s capacity to simulate physical properties and simplified, human ‘design’ actions produced gooey, unpredictable formal results, and by having the computer duplicate these gooey forms across an axis of symmetry, as they unfolded the forms spoke of the frictionless, accurate and plastic aesthetics of the digital. They also spoke of a certain smoothness and lack of resistance to the movements of the human operating the actions. The making of these gooey virtual objects in physical chocolate created a second order of variation, bringing in resistances inherent to physical material. Through melting, molding and unmolding, small imperfections, bumps, bubbles, and variations of tone compromised the perfect symmetry from the digital, and gave the objects a fine surface detail which contributed to an aesthetic unpredictability. Their potential as confectionery added
a curious sensorial feedback. This dialogue between digital and physical aesthetic dynamics bound together unpredictable forces in the forming of the object and rendered an aesthetic agency in designing.

Human Agency

This project is an experiment in deflecting human aesthetic agency, so, despite setting the process into play, there has been an openness to aesthetic feedback from multiple non-human sources. The thinking surrounding OOO and OOI suggests all agency as ontologically equivalent; the smooth plasticity of the digital somehow combines with the recalcitrant ruptures and meltings of the real and the embodied actions of the human, directed by contingent sensorial motives. This is proposed as an intensification of the architectural design process where feedback traditionally comes from multiple processes and materials.

Iterative Process

This research is a simplified version of a typical iterative design process, accentuating the shared agency of humans with their non-human collaborators in design-decision making. Materials, both real and virtual, push back and impress themselves on the design process, creating dynamic relations that are forceful authors of aesthetics.

CONCLUSION

Such hybrid aesthetic influences are being developed in the design for a public building, which follows on from this early work, with the hope that new aesthetic understanding will emerge as architectural complexity is fed into the process. The future work tests in more detail how a design methodology emphasizing human, computational and material collaboration can affect the design of architectural space, be it a building or perhaps, if encompassing larger materialities, a city. The first stage of this has been to melt the urban context for the public building as if it were a found material. A mix of photogrammetry, prototyping, casting, chocolate molding, heating, touching and tasting has shifted the site from a known spatial phenomenon to a complex blend of aesthetic agency, shared between human, computer and material. Other key architectural aspects of the design are being developed in the same way, such as form, tectonics, surface, materiality and programme. The project is a test bed for an architecture of ontological equivalency between real non-us, digital non-us and us.

Feedback loops in the aesthetic development of the design become strange and tightly circular in this mode. Abject forms thrown up by corrupt photogrammetry files or distorted molds are ameliorated by their sensorial richness as melted chocolate, making them candidates as architectural forms whereas they otherwise might be ruled out. This points to a shuttling between the aesthetic forcefulness of computation, things and human that departs from a solely human centered mode where visual perception is dominant. Aesthetics internal to real materials, their relations to each other and their relations to their digital doppelgangers are allowed to emerge through iterative designing and merge with human sensibilities, albeit in ways which are not entirely comfortable. Strangeness is perhaps an inevitable architectural condition of such hybrid sensorial feedback.

The success of this research is that it identifies curious aesthetic conditions at work in hybrid digital/physical design operations that point to further study, both of design methodology and the architecture that might emerge from it. The failures of
this research are that, at present, it has a small scope and small collection of data to back up observations about shared aesthetic agency and feedback. This is an ongoing project and work is continuing on these difficult questions.

This research adds to the field of computational design in architecture through discovery of aesthetic conditions gained from a hybrid, ontological methodology, blending human sensory capacities with those of non-humans: objects, materials, computation. It wonders about what architecture might be, if composed of multiple desires and tastes, spanning human and non-human sensibilities.

**IMAGE CREDITS**

Figures 1–12: du Chatenier and Twose, 2016

Figure 2: Robert Lazzarini, 2000 ©

**REFERENCES**


**Simon Twose** is an architect and Senior Lecturer at the School of Architecture, VUW New Zealand. His work focuses on design research, looking particularly at the crossings and transferences between drawing and built space. Twose has contributed work to four Venice Biennales, Adam Art Gallery and the Prague Quadrennial, PQ15.

**Rosa du Chatenier** is a Masters of Architecture student in her final year at Victoria University (NZ), and is interested in the crossing of physical/digital architectural design approaches to inspire new design methodologies. After her studies are complete, she is looking for work!
Aesthetic material of mutual agency: material/digital/human.