Certainty and Fragility: reassessing the role of automatically generated aids to the making process

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Abstract

This paper considers the role of automatically generated guides, supports and other material that are intended to aid the making process. Increasingly, work and even daily life are supported by systems that automatically create text, lines, images and other forms as an aid for numerous types of activity. These include the auto-suggestions of search engines and messaging apps, and the guides and supports generated by graphics and 3D modelling software. This study focuses on the role of these assistants in the production of media artefacts. It revaluates the temporary creations which support creative processes but which are rarely considered at great length beyond their originally intended purpose.
This paper will discuss how a repurposed 3D printer has been used to reinvent the support material generated by 3D slicer software as drawings and images in their own right. In doing so it describes how the transition from digital proposition to analog realisation often traverses a line between certainty and fragility. It will reflect on what this might reveal about the perceived relationship between human and machine, and between the manmade and the mechanically produced. This in turn invites a reassessment and rebalancing of these roles.

Introduction - The normalization of computer aids

We are now said to live in a ‘post-digital’ world such is the normality and ubiquity of computing. Computing has entwined itself into the everyday not only in the sense of the spread and integration of computing devices as in Mark Wieser’s Ubiquitous Computing [1], but also through the logic of computation that has come to shape and inform our relationship with the world.

We now live in and with what has been termed code/space [2]. This describes the way in which we are dependant on

code for our experience of spaces and the functions that take place within them. Similarly, James Bridle argues that labour is increasingly coded and our social lives mediated through algorithmic processes [3]. This mediation takes place through an array of devices and software that help us to create the things on which our work and social lives have come to depend.

These aids are often cast as 'features' and selling points on devices such as the latest iPhone, offering to automate and guarantee 'perfect' images, or at least images that will be more successful in the 'network of images' [4] they will inhabit. At other times they can be more functional and discreet or mundane such as the auto-suggestions of text messaging software. These everyday uses are easily overlooked precisely because of their ubiquity. Even to those of us used to making our own tools and privileged to have a degree of control and understanding not afforded to most, the role of automated aids to making can be easily overlooked.

The speed with which we access and interact with these aids makes them all the more difficult to observe. An example would be the filters of imaging apps that offer seemingly infinite versions of an image, created in an instant and either selected or immediately discarded. We may not even consider these to be images but only potential images, even though they have been created and displayed, if only briefly. Automation may appear to speed up the process of taking a photo or composing a text, part of the acceleration within contemporary life that Virilio describes and that has been termed accelerated culture [5]. This might suggest that they facilitate a certain dynamism. However, as Goldsmith notes, as we approach Virilio's absolute speed so inertia increases [6]. Instead we might observe a stasis in the uniformity of the results. It has been shown that the auto suggestion of text messaging has changed the way we construct sentences, anticipating and then influencing our choice of language and leading to a reduction in variety. Perhaps unsurprisingly, predictive text leads to predictable outcomes [7]. As Fuller has observed, familiar hi-tech appliances can be "somehow inert, territorialized into certain kinds of highly fixed behaviours" [8].

Meanwhile debates are often concerned with whether machines can be creative while overlooking the fact that we are already surrounded by machine made media such as automated journalism which is indistinguishable from that of humans [9]. This may be aided by the lack of originality or at least a conventionality in the certain types of media.

The way that our tools may shape the things we make has been discussed in relation to everything from word processors [10] to photography [11]. There is always an interplay between the human and the machine, and a "threshold between document and user" [10]. It is this threshold that this paper will examine.

This paper is concerned with the tools and algorithmic processes that aid making. Rather than considering all creative software applications it is interested in the way the aids to making automatically generate material, be it images, text, lines, or supports. This has involved turning to a less instantaneous form of making, 3D printing. Not only is the 3D printing process comparatively

extended, but the products of its automation are more visible and tangible.

An approach is outlined that combines a pragmatic aesthetics perspective with a glitching and deformance attitude to practice. Several images and objects made using a 3D printer are used to explore the role of aids as shaped by several factors. These include how the machine and the human may have differing or 'dual' perspectives on the work at hand, how conceptualising our machines as tools or apparatus may alter our understanding, and the role of risk and error.

Experiencing Technology and Technology as Experience

3D printing a model file involves a number of aids and automatically generated elements produced largely through the use of 'slicer software'. These applications prepare a model for printing including generating the supports and infill added to models to ensure they print correctly. The slicer software also has a large influence on exactly how the model is constructed by the printer, creating a set of instructions in the form of 'G-code' for the printer to follow. Many variations of instructions are possible to print the same model. The process of creating models is not considered here. Creating models using software tools such as Blender or Fusion 360 involves a host of other automated processes and aids which open up a number of debates around authorial control and creativity. Although also relevant here, these debates are not the central focus. Slicer software and 3D printing are typically at the end of a workflow, even if part of a larger iterative process. By deliberately looking at what is perceived as a less creative stage of making it aims to draw attention to what creative possibilities remain.

3D printing usually involves a blend of proprietary, open source and off the shelf tools as well as a high level of custom, hacked and tinkered technology. 3D printing has not yet become the closed off hi-tech appliance that Fuller connects to inertia. It also seems well placed to address both the digital and analog, the virtual and the concrete. Fazi and Fuller note of computational aesthetics that it sets into motion a reorientation of the "circumstances in which art occurs in that it endures as a conjoint condition of the abstract and the concrete" [12].

The approach involved reimagining the 3D printer, not as a means of replication, but one that might produce a variety of results. This was done by playing with slicer settings, subverting the way it would typically be used, aiming to produce variation rather than regularity or uniformity. By attaching a pen to a 3D printer, turning it into a plotter, it was possible to produce 2D images from 3D models and create records of the temporary support material and travel lines of the printer. This process bears relation to some glitch practices which aim to subvert and misuse processes to break the flow of existing relationships with media [13]. It might also be connected to the 'deformance' of McGann [14]. Deformance involves the altering and reworking of a media (often text) and then re-presenting it in order to gain insight into its constructed nature [14]. This is an approach I have expanded on elsewhere [15]. This paper discusses the use of fused filament fabrication or FFF printing although many of the processes are applicable to all 3D printing.

In order to better understand our relationship with the processes in question we might turn to the pragmatic aesthetics of John Dewey [16]. This shifts the focus to the experience of processes as they unfold rather than or as well as the outcomes they can produce. Pragmatic aesthetics has been a used in studying our relationship with computers, informing HCI design. The work of McCarthy and Wright in relation to 'Technology as Experience' extends Dewey to show how it is equally applicable to technology as to our experiences of art [17]. They argue that we don't just use technology but live with it and engage with it in terms of an 'aesthetic engagement'. In this way the aesthetic realm extends beyond and is not the preserve of art. It might equally be applied to all human computer interaction. So a spreadsheet will provide an aesthetic experience just as the greatest works of art. Once thought of in this way we might ask what might be shaping our experiences of these technologies and our perceptions of what they produce?

While McCarthy and Wright might suggest that we don't always consider the aesthetics of our interactions with machines at other times it is more prominent. This can be seen in the products and artworks described in terms of a 'machine aesthetics'. This addresses the existence of, and even a preference for, things which appear machine made or mechanical. Exhibitions such as 'Machine Art' shown at the Museum of Modern Art in New York in 1934 praised machine-made objects for their "precision, simplicity, smoothness, reproducibility" [18] many of the qualities looked for in the perfect 3D print. Broeckmann traces a history of the 'Aesthetics of the Machine' and while we might see these as historically situated attitudes to machines, James Bridle has identified what he calls automation bias [19]. This see us drawn to and preferring the products of algorithms and computers. This might go some way towards explaining our willingness to let our phones dictate what constitutes a 'good' image. Figure 1 shows how the programmed aesthetic sensibility of a digital camera will happily edit out the effects of air pollution.

Figure 1 Twitter posts showing automatic colour correction - @teriarchibbles

Meanwhile Vito Campanelli describes a 'Machinic Aesthetics' that acknowledges the role of imperfection especially in machine making. It is important he notes to understand the creative potential in the error and that machines do not always do what has been asked of them [20] This leads him to suggest a 'dual subjectivity'

– that belonging to the human and that which might be called ‘machinic subjectivity’. This draws attention to the fact that software, computers and machines are not neutral. In fact, he argues to consider them as such is to misunderstand the ‘contemporary condition’. This reminds us that as well as considering our experience of the process we also need to account for the autonomy of the machine.

Dual subjectivity

The employing of software in workflows “does not guarantee creative results” [21]. Indeed, reliance on software, it has been suggested, can stifle creativity leading to derivative results constrained as they are by the conventions encoded into the tools [21]. We need to be “wary and alert” to the way in which software can both “constrain creative practice, as well as opening up opportunities for original solutions” [21] Software is not neutral but influences outcomes and “every computer, every input device has its own personality that cannot not influence the creative process” [20].

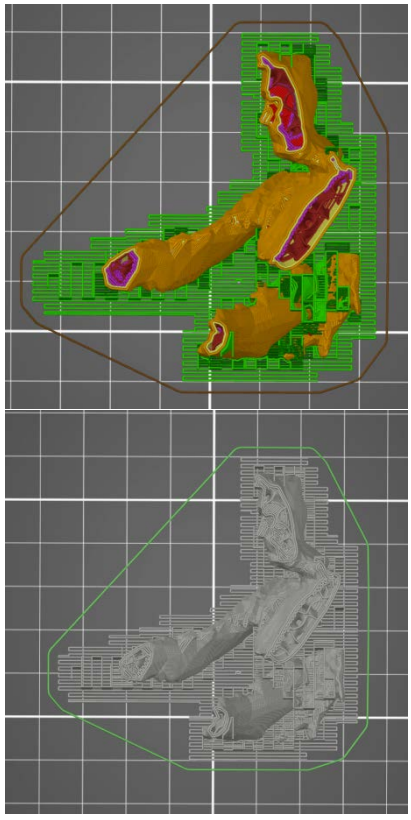
In software, predetermined settings called ‘defaults’, presuppose what acceptable and appropriate results might be. The extent to which we can deviate from these is usually determined by a limited set of options sometimes called ‘preferences’. We often only become aware of these when we need to prevent interruptions to the making process caused by automated defaults and by turning off features. Pold notes the irritation that arises from realising our limited ability to fully control the software tools, as it becomes clear the interface is structured around the principles set up by the ‘sender’ rather than the ‘receiver’ or user [22]. Thus, Pold concludes “my preferences are not purely mine” [22]. The software models itself on its model of the user and in particular what Fuller calls the ‘anticipated user’ [10].

Clearly we might question if such a user exists and how it was arrived at. This is perhaps why those interested in exploring the new possibilities presented by generative art turn to making their own tools. Although even then it is impossible to escape all of the layers of the system and perhaps all we can do is to acknowledge it.

Slicer software typically involves a wide assortment of preferences and defaults anticipating not so much a typical user but a typical use or end goal, that of the ‘perfect’ print. Rather than using these to tailor personal preferences, the human role is often to provide a contextual understanding of how the automated choices of the software are likely to translate to the real world. This includes understanding their own 3D printer’s idiosyncrasies. We are perhaps better placed to know how the effects of gravity may impact an overhang in practice. We also bring contextual understanding of the object’s function in the real world. Which way up is it intended to be, which is the presentation side? This is information the software does not have but it also lacks an understanding of the world. The slicer software’s understanding of the object is confined to its construction not its place in the world.

Here we can see what Campanelli describes as the ‘dual subjectivity’ of the human and the machine [20]. Each having differing understandings of what the aim is and how it can be achieved. Each views the problem at hand from a different perspective. An example of how the machine sees is the way that slicer

software distinguishes between ‘types’ of material’ even though there is usually only one type of material used, either a plastic filament or a resin. This shows how the machine understands the object and its construction. It can distinguish between parts based on function such as supports, shell or infill, or based on their production, such as fan speed, temperature or extruder speed. For the human though the main distinction is between the material to be kept and the material to be removed in post-processing in order to leave the desired object.



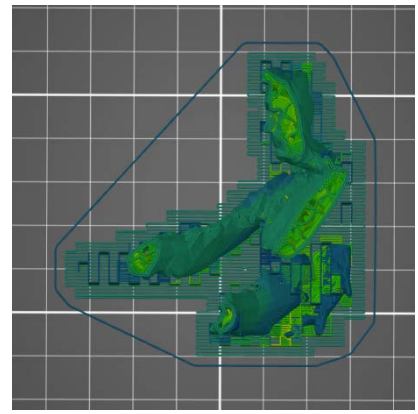


Figure 2, screenshots of slicer software showing colour coding of different ‘types’ of material in a model to be printed

These visualisations of how the software understands the model suggest a complexity that can be visually alluring and enchanting [23]. Much like the exploded diagram, they do not explain how they are made but transfix us with their complexity [24]. They are suggestive of the complexity of the system without fully explaining it. We might take a pleasure in the intricate balance between order and chaos and even a confidence in its abilities which may seem far more detailed and technical than our own. It is this perception of complexity that may lead to the automation bias described by Bridle.

Tools, Machines and Apparatus

How do we conceptualise our relationship with and use of 3D printers? Are they tools or are they machines? Broeckmann notes that a tool is handled but the machine is tended [25], suggesting an autonomy in the machine and a more passive role for the human. This is especially interesting to consider in relation to 3D printers which are typically seen as tools for making the

objects we choose, as any 3D printer owner will attest they also require attending to. Rather than debate whether a 3D printer is a machine or a tool it is more relevant to consider if the way we view them changes how we use them. The question of autonomy raises a number of issues especially in relation to generative art and the creative autonomy of machines, which will not be dealt with here. Instead we might consider whether a perceived greater autonomy changes how we see our own role in making.

The algorithms and digital tools that aid us tend to be integrated in such as way that they are what Heidegger would call 'ready-at-hand', withdrawing as an independent entity [26]. Familiarity with tools tends to see them disappear from view. However, this invisibility is also associated with greater autonomy for the tool. Mario Costa describes 'neo-technologies' which are no longer McLuhanian extensions but tend to become autonomous [27]. As Campanelli explains: "They complete the process begun in the 'technical' era, the 'era of the hand', in which individualized, stable and discrete tools, such as the hammer, respond directly to human needs, and continued into the era of 'familiarism', in which technologies such as electric light and photography give rise to complexes, sequences and hybrids that effectively marginalize the subject." [27]. As Goldsmith notes 'when we use an apparatus eventually it becomes invisible' [28].

Flusser also uses the term 'apparatus' in his description of the camera. Here the user of an apparatus is cast in a subservient role, even when we might think we are using it for our own purposes. So the camera as apparatus leads us to churn out boring repetitive content, making for the apparatus rather than for ourselves [11]. The products are interchangeable with those produced by others – our photos are indistinguishable from those of others. This is a phenomenon that has been explored by artists such as Penelope Umbrico's *Sunset Portraits from Sunset Pictures on Flickr* and Jason Salavon's *100 special moments*. These collages and amalgamations of hundreds of images reveal their similarities and an underlying redundancy. The apparatus seduces us into making content which is ultimately constrained by the limitations of its programming.

If the 3D printer is an apparatus in the vein of Flusser, content produced by a 3D printer is the apparatus itself [11]. That is to say the content is the capacity of the printer to reliably produce an object. While some will print their own model files, most will take their models from sharing sites such as Thingiverse.

One of the most printed objects is the 3Dbenchy. Intended as a so called 'torture test' to put a printer through its paces and ideally produce a flawless copy. An image search for 3Dbenchy (figure 3) shows the range of successes and failures.

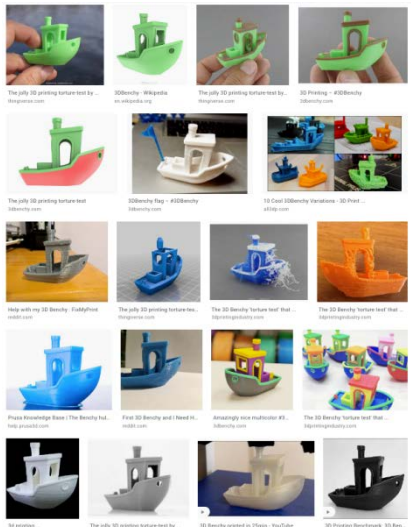


Figure 3 Image search results for 3Dbenchy

And yet what this shows us is the unique character of each of the apparatus. No 3D printer is the same, no operator will tend their machine in the same way. What is interesting is that there is a variety of tools, processes, software all being used not to create something original or that may in itself be considered creative but instead to try and converge on the same thing. In many ways the errors are more engaging. It is as though we want the 3D printer to be an 'apparatus' that can control and constrain the output. And yet to do so requires greater involvement of the operator/user, making modifications and altering settings. A great deal of effort and creative problem solving goes into trying to turn the machine into a tool which responds more directly to our needs.

Error and Risk

It is not anticipated that the slicer software and 3D printing be a 'creative' stage, as opposed to the actual design of a model. It could be considered as what David Pye calls the workmanship of certainty. As Ingold explains, in workmanship of certainty the result is pre-determined before the task has begun and is given in the "settings and specifications of the apparatus of production" [29]. In the workmanship of risk, the use of aids such as jigs and rulers might mitigate risk but crucially the end is not predetermined. As Ingold notes, even when using an aid such as ruler it is not possible to ever draw a perfectly straight line. Seen in this way the 3Dbenchy is aspiring to something that does not exist. It is caught up in a machine aesthetics of perfection but undone by the machinic aesthetics of error.

If perfection is removed as the intention, then other possibilities are presented. Simply by rotating the model to an angle such that it then requires supports, the resulting print is an amalgam of model and support (figure 4). Where one ends and the other starts is not as clear as might be expected and is a matter of interpretation. When looking at the 3D models encased in their supports like the ones in figures 5 and 6), do we read this as error, recalcitrance of the materials or simply the dual subjectivity? A semantic intersection perhaps?

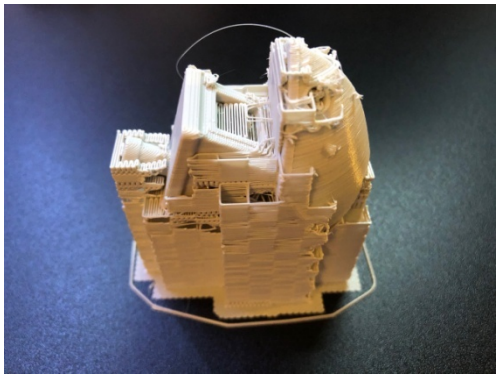


Figure 4 3Dbenchy encased in support material

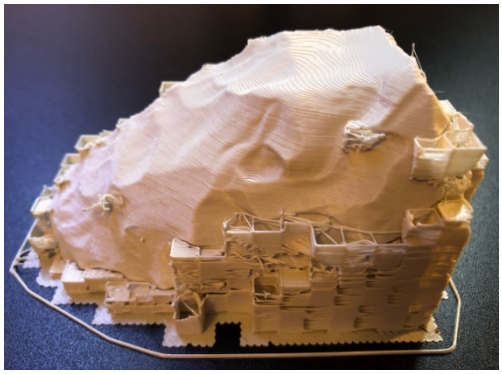


Figure 5 3D print of a handaxe encased in support material

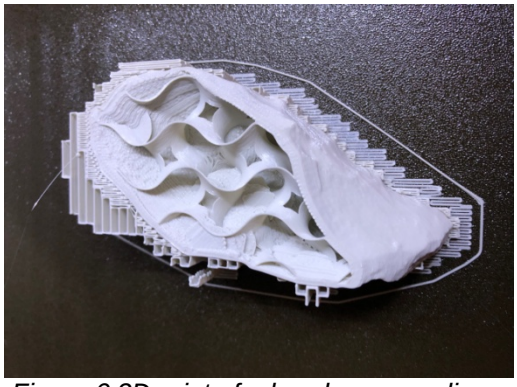


Figure 6 3D print of a handaxe revealing infill and encased in support material

Figures 7, 8 and 9 show drawings produced by replacing the extruder with a pen to turn the movements of the printer into a 2D image rather than a 3D object. The image shows the support material such as the 'brim' that hold the model on the print bed and the infill that gives support to the surface structure. These parts that are usually discarded or not seen are given equal value within the result. These aids that are typically intended to produce a certainty have been opened up to risk. To produce these images a number of defaults need to be disabled, warnings ignored or overridden in order to manufacture the risk.

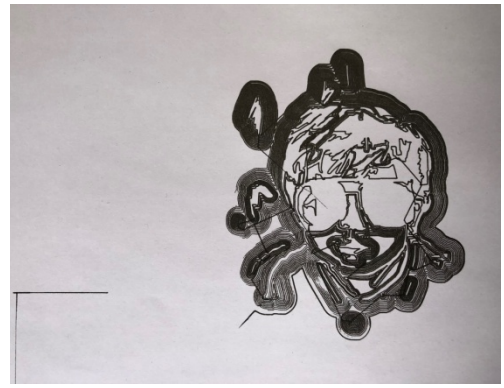


Figure 7 Plotter drawing of support material

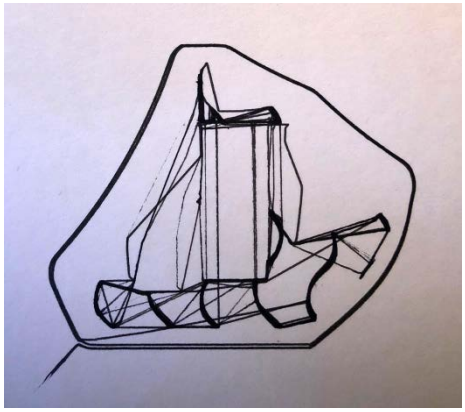


Figure 8 Plotter drawing of 3Dbenchy

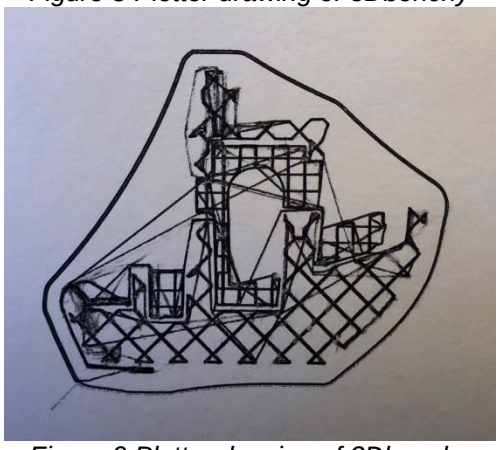


Figure 9 Plotter drawing of 3Dbenchy

How we view our work, as either concerned with certainty or with risk, shapes how we approach making but also how we interpret the results. Even if intended to mitigate error, the possibility for misuse of the apparatus and the reintroduction of risk is always there.

Campanelli argues that allowing the machine to have the upper hand "often means opening up to a genuinely surprising and rewarding universe of options" [20]. Yet if disposed to the workmanship of certainty the machine may need some encouragement to open itself up to such new and surprising possibilities.

Conclusion - Certainty and Fragility

In repurposing the 3D printer as a drawing machine and reimagining it as a tool for inventing new forms, the tension between the human and machine, and between machine and material has come to the fore.

The transition into the physical exposes the fragility of the digital proposition. The certainty of the automated decisions made largely by the slicer software's predetermined 'preferences' gives way to the almost inevitable errors. Risk can never be removed entirely which might suggest that instead it might be more productively embraced. The illusion of control and certainty provided by the unifying grid space [30] of the slicer software is undone. Industrial manufacturing processes can undoubtedly reduce error (or 'tolerances') to the point that they are beyond human perception. But this is just to disguise the relationship rather than to alter it.

For Ruskin the aesthetics of imperfection are superior to the aesthetics of perfection. From this perspective the marks of the machine might be reimagined and valued for their own sake just as the 'principle admirableness' of the Gothic cathedrals was that they were made by the labour of 'inferior minds' out of 'fragments full of imperfections' [31]. Rather than ask whose mind is inferior here, or who is responsible for any imperfections, human or machine, we might reinterpret them as simply being more honest since they acknowledge the process and a meeting of subjectivities.

Impermanence and fragility have been

described as “defining conditions of the digital age” [32]. Despite popular perceptions of digital media and especially ‘cloud’ storage as providing permanence, the digital is and always has been fragile. Susceptible to ‘bit rot’, corruption and even the obsolescence of the machines needed to read digitally stored data.

In trying to look beyond binary oppositions of analog and digital Christiane Paul describes a ‘neo-materiality’ [33]. For Paul neo-materiality strives to describe objecthood such that it “reveals its own coded materiality and the way in which digital processes see our world” [33]. If we do live in a post-digital world of coded materiality in which digital technologies test the thresholds between human and machine perhaps this might best be understood as an interplay between fragility and certainty.

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