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EDITORIAL

Post-digital Research is the outcome of a peer process. In August 2013 a number of researchers responded to an open call to participate in a research/Ph.D.-workshop organized by Aarhus University and transmediale, Berlin. In advance of meeting, each participant prepared a text addressing the notion of the post-digital, posted it online and commented upon each others' contributions (post-digital.projects.cavi.dk). The group then met at Kunsthall Aarhus in October, where they in an on-going peer-review

process presented, critiqued and further developed their writings. As part of a 'sprint', the group then decided to rewrite their contributions using a set of constraints. This included the invention of a common definition of the post-digital, and from this a common vocabulary of words to use and those that were considered taboo. Over the course of two days, all articles were rewritten and made more concise, and in addition scripts were developed to analyse the texts and images. Following this publication,

the participants were also invited to use the workshop to develop their arguments and submit lengthier articles to a special issue of *A Peer-reviewed Journal About "Post-digital Research"* ([aprja.net](http://www.aprja.net)).

Workshop articles:
<http://post-digital.projects.cavi.dk>
A Peer-reviewed Journal About:
<http://www.aprja.net>

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makedictionary.pl

```
# !/usr/bin/perl

# Installation:
# 1 - save this file in your home directory
#    on Mac OS X or Linux;
# 2 - open the terminal
# 3 - make the file executable by typing the command:
#    chmod 700 makedictionary.pl

# Usage:
# 1 - save your text file in plain text format in your home directory
# 2 - open the terminal
# 3 - type and run the command:
#    ./makedictionary.pl < mytext.txt > mytext-wordlist.txt
#    (replace "my_text.txt" with the real name of your text file)
# 4 - view mytext-wordlist.txt in any text program or browser, import
#    it into Excel or any other spreadsheet or data visualization program
#    as "Text with Tabs".

# Explanation:
# This script does the following:
# 1 - read any text file, breaking it up into single words and sorting them
#    into an alphabetical wordlist;
# 2 - compare the above wordlist to our dictionary of allowed words and
#    filter out the words that match;
# 3 - sort the filtered list by frequency of the (key)words used
# 4 - output this list as plain text with tab-separated fields.

# Dictionary of allowed words

# Write the above word list into a structured array
@allowed_words = split("\n",$allowed_words);

# read source text file, split it up into words and store it in an alphabetically sorted array
while (<STDIN>) {
    # sanitize input
    chomp;
    # protect hyphens from Perl's "non-word" regular expression filter
    s/-/hyphenhyphenhyphen/g;
    # filter out "non-word" characters
    s/[^\w]/ /g;
    # restore hyphens
    s/hyphenhyphenhyphen/-/g;
    # split up into single lowercase words & append to word list
    push @unfiltered_wordlist, split (/[\s]+/, lc($_));
}

@unfiltered_wordlist=sort(@unfiltered_wordlist);

# match dictionary against allowed words, write matching words into new array

foreach $word(@unfiltered_wordlist) {
    $match_flag = 0;
    foreach $allowed_word(@allowed_words) {
        if (crude_root($word) eq $allowed_word) {
            $match_flag = 1;
        }
    }
    if ($match_flag == 1) {
        # print $word,"\n";
        push @filtered_wordlist, $word;
    }
}

$dict = (join "\n", @filtered_wordlist);
system ("echo \"$dict\" | uniq -c | sort -n | sed -e \"s/^[^t ]*/\" | sed -e \"s/ [^t/g\"");

# This subroutine uses some crude filtering to reduce English words to their
# linguistic roots (in order to improve matching probability)

sub crude_root {
    my $word = $_[0];
    $word =~ s/ing$//;
    $word =~ s/ied$//;
    $word =~ s/y$//;
    $word =~ s/ed$//;
    $word =~ s/e$//;
    $word =~ s/es$//;
    $word =~ s/s$//;
    return $word;
}
```

highscore.pl

```
# !/usr/bin/perl

# Summary: this script computes your score
# for the quantity of matches with the common dictionary
# by simply adding the numbers of hits in your wordlist.

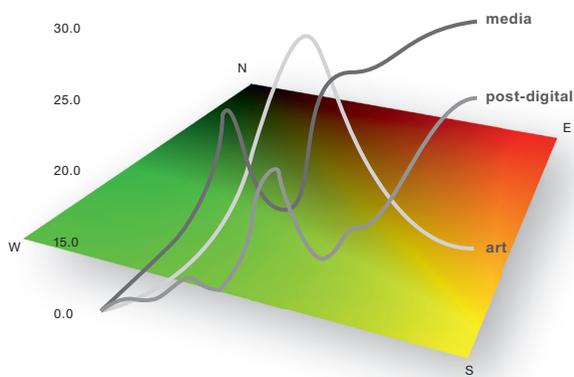
# Usage:
# ./dictionary-highscore.pl < ../2_Articles-and-images/Andersen_pold/dictionary.txt
# (replace the above with the dictionary file for your 1000 words essay

while (<STDIN>) {
    chomp;
    s/\t.*//;
    $count += $_;
}
print $count,"\n";

# Dictionary of allowed words
force          produc
function       promis
gilles         question
$allowed_     real
words=         recogn
"address      refer
aesthetic     reflect
affair        relat
affirm        repack
after         research
again        return
agency       revolut
analog       semant
analyz      sense
apparent    social
apply       space
applied     state
art         stream
artist      structur
assume     superior
big         system
call       technolog
capitalis  tend
cause      term
change     theor
clear      thing
commerc    time
complex    totalita
concept    understand
condition  use
critic     virtual
cultur     way
current    world";
data       new
deleuze    normaliz
denot      not-yet-actual
describ    notion
develop    object
digit      old
dimension  other
distinct   paradig
diy        past
effect     people
enabl      percepti
environm   politic
establish  post
everyday   post-digital
exist      potential
experien   practic
experiment precari
fals       present
find       problem
focus     process
```



31 media 25 post-digital 11 art 10 new 9 analog 7 term 6 culture 5 aesthetics big mainstream old other research 4 condition data information material networking practice system technology 3 clear ideology practices refers 2 artists distinct exist linked looks objects reflects systems termed virtual world 1 aesthetic after apparent calls complex concept currents denotes describes dimension effects environment established finds interface link medium network notion past post present questions real social streams superior tends terms theory understanding understands ways worlds



"Post-digital", once understood as a critical reflection of "digital" aesthetic immaterialism, now describes the messy condition of art and media after digital technology revolutions. "Post-digital" neither recognizes the distinction between "old" and "new" media, nor ideological affirmation of the one or the other. It merges "old" and "new", often applying network cultural experimentation to analog technologies which it re-investigates and re-uses. It tends to focus on the experiential rather than the conceptual. It looks for DIY agency outside totalitarian innovation ideology, and for networking off big data capitalism. At the same time, it already has become commercialized.

In "semantic capitalism", increasingly complex and totalitarian digital infrastructures and developments have made the distinction between "virtual worlds" and everyday culture a thing of the past, and the term "post-digital" therefore seems to lack political reflection and critical understanding of the present condition.

But on closer inspection, the distinction between digital big data and neo-analog DIY isn't as clear as it may seem. And this is where the term "post-digital" makes critical sense.

POST-WHAT?

"Post-digital", first of all, is not a media theoretical notion, but one that comes from artists' practice. It also refers to a mainstream cultural concept of "digital", with the kind of images one finds online that link the word to high technology, immateriality, clear looks and virtual spaces. This is the aesthetics against which "post-digital" makes its critical cause. Early theories of the "post-digital" effectively turned against the image of technological superiority and innovation linked to "digital". At the same time, the

media productions first termed "post-digital", which made use of normally cleared-out effects of material media technologies, were actually digital. This has made the semantics of the term "post-digital" somewhat precarious. One should consider this in critical relation to a mainstream culture where even everyday objects are being repackaged as "digital" in order to promise a superior product.

WHAT IS POST-DIGITAL THEN?

A good example of a post-digital condition is how the art system has changed through digital networking technology without most art having become digital itself. The people that rule the art system in the age of post-relational aesthetics are no longer using primarily analog but mostly digital media infrastructures for their art criticism and production networking. Likewise, "old media" have become post-digital media where they change from information media to aesthetic-experiential media.

"Post-digital" thus refers to a state where change through digital information technology has already become clear and apparent. Which can often mean that it is no longer seen as revolutionary. In this sense, the term "post-digital" is effectively against the term "new media". It also denotes the non-apparent historical ideology of "new media": If "post-digital" causes critical questions concerning the historico-ideology of "post", then it also reflects the previous non-critique of the older term "new media" and its own historico-ideological semantics.

The distinction between "old" and "new" media is thus falsified in theory as well as in artistic practice. Post-digital artists use their media, for their own particular material aesthetics, whether analog or digital. It is a form of practical research that understands media from their non-functioning. Taking these systems apart and using them against their design intentions is what makes them distinct from the infra-ordinary repackaging of analog media aesthetics in the cultural mainstream.

On the other hand, culture that became mainstream with digital media networking ends up being applied to the production of analog and post-digital media objects: Often, they resemble older media practices, but apply processual, interaction-oriented ways of making. In other words, "new media" practices applied to "old media". The agency that really matters here is that of DIY - processual practice versus packaged product - which no longer is assumed to

only exist in the one or the other type of medium. The new material-oriented "Maker" culture paradigmatically reflects this both analog and digital practice, its commercial dimension. Conversely, the established "new" media are no longer DIY since the semantic capitalism of only a few big commercial players took them over.

With the focus on DIY and making, there is also a new focus from conceptual to raw materiality, from semantics to the experiential.

WHEN 'POST-DIGITAL' IS 'DIGITAL' AND VICE VERSA

In the pure technological sense, the term "digital" is falsely used in most media art and research, including the terms "digital art", "digital media" and "digital media research" themselves. If something is "digital", it does not need to be part of a processing system. "Digital" simply means that something consists of distinct units or states. "Analog", on the contrary, refers to messy currents, streams and other material where distinctions can not, or only be artificially applied. Conversely, "digital" does not objectively exist in the real world except as a product of analysis. Media are thus, technologically seen, always analog. There is no such thing as digital media, only digital or digitized information.

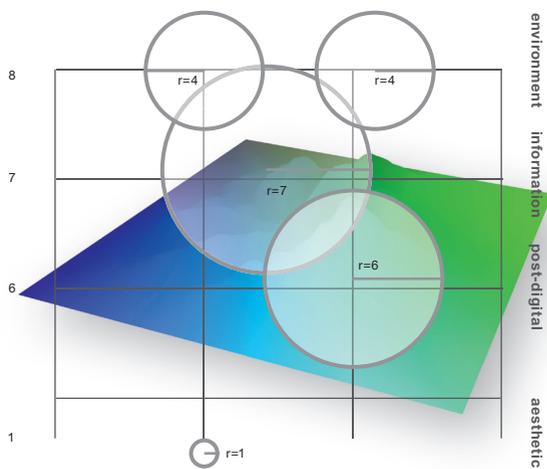
Most art works that would be "digital art" in the narrow technological sense of "digital" but not using electronics would, however, likely be termed "post-digital" or even "analog" in the media art system and in media research. Mainstream everyday culture falsely calls everything "digital" that is somehow linked to or has a material interface with digital information processing. In this environment, "post-digital" art can often make up for lacking critical reflection of what is digital.

POST-DIGITAL DEVELOPMENTS

If post-digital aesthetics consists of digital and non-digital DIY practices in a media world ruled by big data, then it is easiest to think of it as criticism of semantic capitalism and its innovation ideology. Nevertheless, both post-digital and techno-capitalism are driven by structurally similar promises of agency: the promise of agency over the social in big data, the promise of people's agency in DIY culture - both being cultural, and rather precarious, reflections of systems complexity.



8 environment 7 information 6 post-digital structure 5 data 4 artists condition
 established experiment notion other structures term 3 analog effect enable functions
 new social structured understand ways 2 again analyzed cultures describe effects
 enables establishes interface linked media network real research systems world
 1 aesthetic affirm affirmed affirms after analyze art arts called clear complex current
 described describes describing developed develops enabled enabling environments
 establishing hold ideas impact looking networks potential practicing present presented
 presents problem produced produces questioning reflecting reflects relates returned
 system tends terms virtual



Is something immaterial, a process, a network or a document – and if none of these, then what? Lev Manovich (2013) emphasises that the real time condition of technological systems causes complexities that are more messy than the current notion of the term document can capture. The problem with the term document is that it reflects an analog use of time and structure. A way to understand the condition of 'document' in a post-digital environment can be established through research of technological systems whilst also recognising the artists' impact in this environment.

Questioning if the notion of document can still be used I have analyzed a condition of the post-digital, namely circulation, while describing how 'documents' enable circulation. I understand the term circulation as a cultural process, a social structure, after the ideas of Benjamin Lee and Edward LiPuma (2002) who used this notion to analyze capitalism. They describe circulation as a cultural process with its own structure of complexity, investigation, and

condition, which are produced by the interaction between specific circulating structures and the informational cultures established around them. It is in these structured circulations that they understand cultures of circulation. Circulation in the post-digital can be analyzed by looking at how interaction is applied in digital information – between digital information, people and the network, and how this enables peoples' experiential environments. In addition, such circulation and interaction of digital information involved in the infrastructure of interaction may affirm and effect social structures.

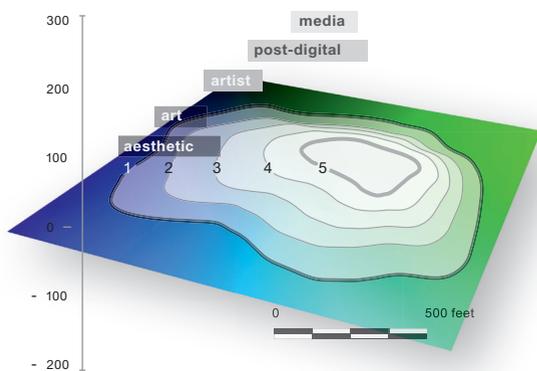
Naked on Pluto (2010) by Dave Griffiths, Aymeric Mansoux and Marloes de Valk is a clear experiment in circulation: the technological environment causes the experience. As Griffiths affirms, the way it functions is like live practising data information. This structure of *Naked on Pluto* establishes itself through a DIY sensibility, where the development process is emphasised. It can be affirmed that it produces and enables experiential forces, establishing new artistic and aesthetic modes. Again and again it is used for other artworks, one such experiment is *Slub World* (2013), a live environment. This time more effects are established to the structure and returned into a new space. How does this enable circulation? A distinction with analog media is that this is developed in real time, in interaction with other people. As Alex McLean describes, analog media is structured in time. This is present in their experiment, but theirs is more messy or not-yet-actualized. The direction is not established or structured; the experiment is more processual, caused by the artists,

or forces in the digital environment. Moreover, the system is a complexity of linked affirmations. As Geoff Cox and Alex McLean (2013) describe, stating terms or enabling code is less ideal, there is more potential in the relations of the effects of the artistic force. Thus live experimentation of information data is processual, and the interaction goes both ways. The effect becomes greater when presented live to other people in a space and people experience the interface of the artists. In a sense this relates to the presentation of *Naked on Pluto*, which presents the live data space and its interactions. The 'immaterial' virtual world and the commercial interface of Facebook are linked and the artists are thereby critically reflecting on the relation and the interactions.

As not-yet-actualized it can be assumed that the live technological environment establishes a complex circulating structure from which other artworks and networks are enabled. It is live data information that is processual, but can it be called a document? If yes, it functions in its complexity and its development is messy. It should be sensed and understood in its relations and in its environment. This space changes, thus changing the document and its effects. Live data information is processual and tends towards complexity that assumes more than interaction. Cultural and social structures circulate through it, which enable new structures and forces. It would be more natural to use the term processual, which in the post-digital can be described as a production in development that functions in marvelling at complexities.



20 aesthetic 15 art 8 artist research 5 post-digital questions 3 media new 2 artists critic
 described describes dimensions establish information networked potentials reflect return
 system 1 aesthetics concept critics dimension established exist interact interface left
 material medium network object other others potential produced social technology tends
 term



A move from a digital to a post-digital research paradigm allows us to conduct aesthetic research that is not automatically identical to technological or cultural research. The following accounts for the neglect within a digital paradigm to thoroughly address aesthetic dimensions of contemporary art and then investigates a crucial requisite for post-digital aesthetic research: A return to an awareness of the different subject positions of artist and audience, respectively.

THE TECHNO-ESSENTIALISM OF A DIGITAL PARADIGM
 In a digital paradigm analyses and debates on art has an overall essentialist character in the sense that questions basically centres around what "interactive", or "networked", or "digital" (etc.) art is? These are relevant questions, which, however, lack a crucial dimension: From which specific subject position are such questions asked? – From the position of the artist, curator, critic, user, implied audience, or actual audience?

The obliviousness to different subject positions occur because, in a digital paradigm, aesthetic research tends to interpret works of art according to technological information. In their infrastructure, survey books on contemporary that make use of new technologies or media establish a focus on individual artists or works, or on technological subgenres like 'video art', 'network art', 'interactive art', 'telepresence' etc. (this is the formula in Rush, Giannetti, Tribe & Jana, Paul, and Shanken) Hence, investigations of new aesthetic tendencies do not distinguish between specific technical features applied in a work of art and the interface and information experienced by people. As Carsten Strathausen states: The heroes of 'techno'-aesthetics are 'Boscovich, Boole, Turing, and Bense instead of Aristotle, Kant, Hegel, or Adorno.'

(Strathausen, 59) This is a paradox, since – especially when it comes to works that use of new media and technologies, which may not yet be fully culturally established – it seems obvious, according to Kantian thinking, that the lack of objective purposes surrounding the works may in fact boost the potentials of aesthetic experiences due to the lack of a determined concept by which to judge the works. (Kant 2005 [1790], § 11)

POST-DIGITAL AESTHETIC RESEARCH

A post-digital turn paves the way to consider aesthetic potentials of art without *automatically* subjecting aesthetic experience to technology. Hence, we may now ask 'naive' research questions, such as: How do we elaborate on the fact that the same work of art potentially prompts different kinds of aesthetic experiences depending on which subject positions (artist, curator/critic, user, audience) engage with the work and in what manners (as intended by someone else or not)? And how do we consider the aesthetic appeal of a work of art whose medium is not accessible to our physical senses? An example of the latter could be *5 Million Dollars One Terabyte* – a black terabyte hard drive, which contains illegally downloaded material worth five million dollars, exhibited on a plinth. Such aesthetic questions can only be investigated thoroughly by insisting that the subject positions of artist and audience are separated.

But why insist on a separation between artist and audience when many works are characterised by crowd creation? For instance, the Ars Electronica Prix category of 'Digital Communities' consists of works in which such a separation may seem absurd. For instance, in the case of the 2013 Golden Nica winner "El Campo de Cebada" – the name of an enclosed city square in Madrid, where residents and the council cooperate to define the square (Fisher-Schreiber 2013, 200-203) – no artist or artists group is credited for the 'work' since it is a social community project. However, whereas in Madrid the square is inhabited, at Ars Electronica it is exhibited, and this sole act of exhibiting automatically establish "El Campo de Cebada" as an object for possible reflective aesthetic judgement *by others* than its producers. As Thierry de Duve puts it with reference to Duchamp's readymades: '[T]he sentence "this is art," by which a readymade is both produced as a work of art and judged to be one, ought to be read as an aesthetic reflexive judgment with a claim to universality in the strictest Kantian sense.' (de Duve 1996, 320)

Thus, any work of art (whether it uses of digital media or not) needs at least two different subject positions: creator (artist and/or curator) and audience. The subject position of an audience is crucial – not just to art, but also to aesthetic reflection, since, according to Kantian thinking, the latter resides in this subject position. (Kant 2005 [1790], § 8)

Furthermore, more than one audience subject position often exist. As described by Dominic Lopes, we may distinguish between 'user' and 'audience'. The difference can be illustrated with reference to the work OCTO P7C-1 by the Telekommunisten group, who describes in work as an 'Intertubular Pneumatic Packet Distribution System'. (www.telekommunisten.net/octo)

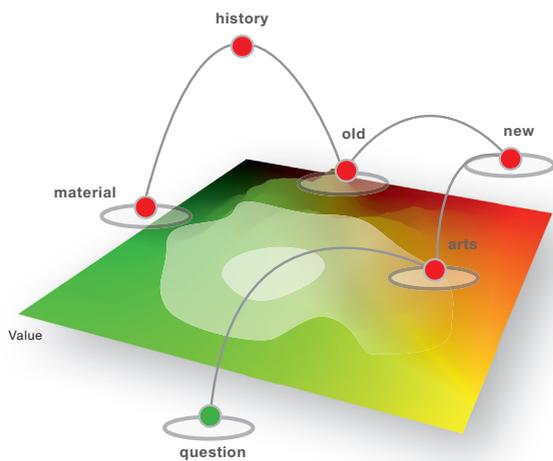
In the case of OCTO, Lopes' term 'user' describes those visitors who engaged actively with the work in order to generate displays in a prescribed manner. Thus, users write/draw/craft messages for the postal tubes and they send/receive such messages by communicating commands to the OCTO-staff working the distribution centre. The distinctive sound accompanying each packet's travel through the tube system, the messages, the conversations between users and OCTO-workers etc. are all different kinds of audible, visual and sensual displays by which the user gradually explores physical and semiotic dimensions of the work (and potentially reflect aesthetically on it). The 'audience', on the other hand, do not engage directly with the work, but they watch how users interact with OCTO and they observe how displays are generated as results from this interaction. Consequently, the audience explores the work, too, albeit in a different manner than users and they may also reflect aesthetically on the work.

The reason that the audience subject position is left out of the equation in a digital paradigm, is that the potential aesthetic reflective judgement with this subject position does not fit a techno-essentialist focus. An audience may experience, what in the digital paradigm may be described as an 'interactive, networked installation', in a passive and isolated manner and still engage aesthetically with the work, since aesthetic experience fundamentally is a matter of individual judgement of taste.

In conclusion, aesthetic qualities of a work derive not from the sender but from the receiver of the work, which therefore, ultimately becomes the work's aesthetic (but not technological) producer.



14 history 11 interface 8 material media 6 new 5 culture old 4 social 3 past post-digital practices technology 2 left other post potential potentials present producing return ways 1 aesthetic arts conditions cultures current establishes hold holds interfaces materials network networking notion presented question system terms things understanding



I *How are we to perceive the re-investment in history and old technologies?*

The promise of a digital revolution also implies a reaction where dominant actors remain loyal to the institutions of intellectual property, as Stuart Moulthrop noted already in 1991. What strategies of resistance and critique are left in this contemporary interface culture of 'controlled consumption' (Striphas 2011, Andersen & Pold 2013a, forthcoming)? In a "post-digital" era of digital reaction (rather than revolution), the Jurassic technologies left behind possess a new kind of appeal.

II In the summer of 2013, The Consortium for the Preservation of Cassette Tape presented CASSETTE MEMORIES, "a media archaeological excavation of the cassette tape and its use – from a human and tape perspective" (a workshop at Roskilde Festival, initiated by Andrew Prior, Morten Riis and Søren Pold in collaboration with Roskilde Libraries). Cassette tapes are deeply associated with our childhood memories of recording voices, listening to music and creating mixtapes. The cassette tape represents our past when found in an old drawer, and brought to the workshop to be tampered with, cut up, and looped in new ways. But it is also a recollection of poor signals and incompatible noise reduction.

So how shall the longing for old media be perceived? Is it a hipster-like search for authenticity? Is it an aesthetic search for 'lo-fi'? Is it the sign or is it the signal? Or is it the relation between them? And, how should we consider history in this tale?

III In his essay "Theses on the Philosophy of History" Walter Benjamin writes: "To articulate the past historically does not mean to recognize it 'the way it

really was' (Ranke). It means to seize hold of a memory as it flashes up at a moment of danger" (Thesis VI). In continuation of Benjamin, we propose to explore of the revival of cassette tapes as a material history pointing beyond a simple understanding of technological determination. CASSETTE MEMORIES are not just revelations of a linear development from cassettes to iTunes. CASSETTE MEMORIES points to a myriad of practices that still carry potentials.

IV What is a magnetic cassette tape? Separating material signal processing from the representation is flawed. Cassette tapes must be seen as part of the same realm as language, in the sense that also language turns out material (as on a cassette tape), and this material is in itself a speech act (e.g., the gesture of recording and sharing mixtapes). The material of the cassette tape is also a social and linguistic construct (including DIN standards). The double-nature allows for a different kind of criticism than the discussion of how a participatory digital technology predetermines our social relations (as product relations in the digital economy's immaterial labor system).

V Benjamin's thinking is an encouragement to think of the cassette tape as something that flashes up in a moment of danger. The historical materialist must therefore address history differently, as Benjamin puts it: "There is no document of civilization, which is not at the same time a document of barbarism. [...] A historical materialist therefore dissociates himself from it as far as possible. He regards it as his task to brush history against the grain." (Thesis VII) With no attempt to recreate a media history CASSETTE MEMORIES recalls the lost potentials of cassette tapes in relation to a contemporary digital culture. We explore cassette tapes as a "configuration pregnant with tensions" in order to recognize a "revolutionary chance" and "blast a specific era out of the homogeneous course of history" (Thesis XVII).

VI Techno-cultural discourse leads to the belief that technology represents a history leading to increased efficiency, and that the conditions of present digital technologies (producing, sharing, mixing, etc.) can maximize individual freedom and social production. CASSETTE MEMORIES challenge these myths, by exploring a past discourse in the present – as a potential criticism. The return to old media holds no essence but expresses an

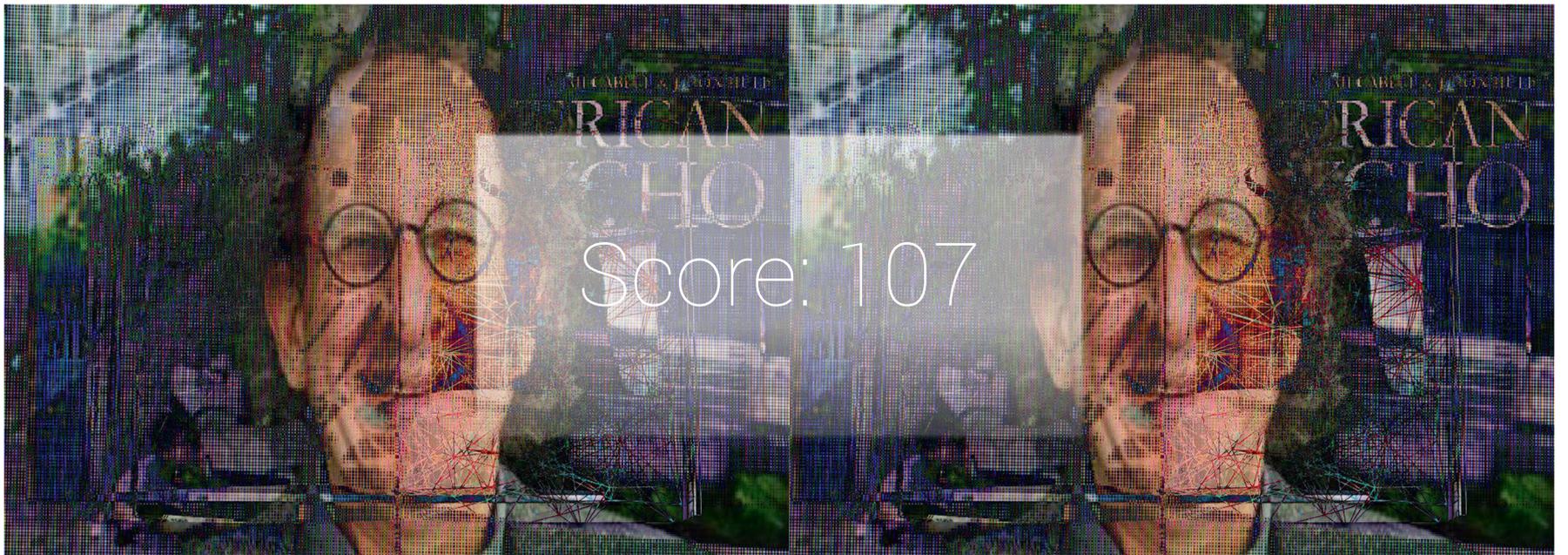
awareness of how our material technologies are also signs, and our signs technological, and of how the coupling of signs and material by digital technology leads to a form of control.

VII CASSETTE MEMORIES should, as other post-digital fascinations of historical media practices, be seen as allegories. As an allegory, it establishes an imaginary correspondence to another moment in history – rather than representation of history. There is no radical power in looping and cutting up tapes today, but the imaginary construction represents another way of experiencing producing, sharing, mixing, etc. – "a form of social networking that is not controlled or data-mined by those companies [Google, Apple, Amazon, and Facebook]." (Cramer 2013, 237)

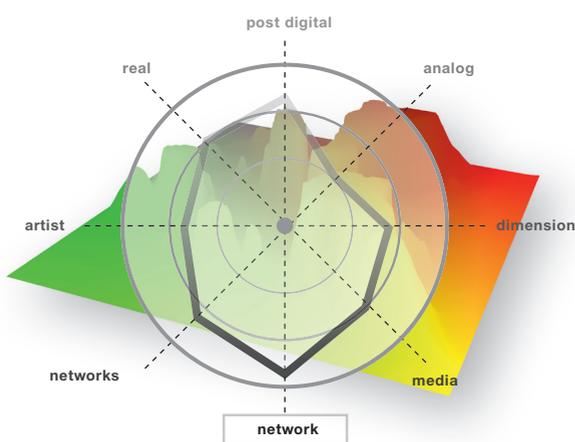
VIII To return to the reaction to the revolution: Mobile media like smartphones and tablets are examples of what can be characterized as the fifth generation of the development of the interface, a generation that integrates the earlier generations of the development in 'IT appliances' and what seems to be a qualitative turn, a totalitarian controlled consumption interface coupled with a "war on general-purpose computing" (Doctorow). The interface becomes an impenetrable surface, which aims to attach itself seamlessly to things and behaviours – a process of invisible immaterialisation.

IX As an alternative to an interface culture of controlled consumption, and as a post digital response to a corporate subsumption of a digital revolution, we ask if there are new ways of reconfiguring the fifth interface? Instead of subsumption, seamlessness and surveillance this can potentially lead to a different interface culture, and the development of a common awareness of the tensions between materials and procedures of the interface. In other terms, a fifth generation interface criticism.

X If post-digital practices aim to be more than a parenthesis in technological history or trendy hipster revival of the old which could just as well be subsumed in trendy new apps for the iPhone, they need to question their notion of material and materialism in a way that corresponds to current interface development – a correspondence that embraces a potential for criticism if not redemption.



8 network 7 networks 4 post-digital 3 artist current dimension function media notion
 object potential real researching 2 aesthetic conditions enable established impact
 information material nature posts relates stream 1 affirming affirms analog artists
 condition conditioned denoted describe describing effect enabled environment establish
 experiment experiments find functions impacting interfaces looking mainstream new
 normalized objecting objects practice practicing question research social streams
 structure structuring system understand ways



Potential functions appear from the digital and print focus, realising how complexity is reflected in experimental networks. Using new potential agencies, networked information have been found and changed, in order to be then structured in a conceptual print publication.

One of the practical ways uses large streams of Twitter posts structuring them as experiential diaries. "My Life in Tweets" by artist James Bridle uses the artist's posts on Twitter over a two-year period, describing a sort of people's travelogue. The impact of tweeting is recognized in an analogue aesthetic, as if the stream is repackaged into an analogue environment.

A "network sampling" system potentially uses DIY images in a curatorial way. Here we have a conceptual dimension using a media aesthetic. It causes a relational condition more understandable in the ubiquitousness of

networks and especially in the mainstream use of personal images on Facebook.

An experimental aesthetic uses images from Google Street View, researching the notion that the image is real and that it can be recognized with no big problem. It also researches the precarious nature of the image itself. Michael Wolf's book "a series of unfortunate events", researches our real and conceptual perception of the 'objets trouvés', an interaction that can potentially structure an investigation on virtual networks' aesthetics.

There's also the false promise of new perception of an aesthetic, which relates to the production of a printed object. Looking at messy images on the networks can question their real impact. Once an image is established in the space and time of a book, our relation with it is very critical.

The artworks establish an ideological 'impact' on both the two media. The artworks take an experiential part of the immaterial networks and stream it into the material publishing structure.

Such practice refer to a "false perception" of the networks - the recognition of this false perception structures the network into a printed dimension, objecting it. Mike Shatzkin, affirms that publishing will become a function... not a capability reserved to an industry... Other experiments are researching complexity, practicing print technology that relates to material objects established from network processes and thus enabling a real revolution.

Martin Fuchs and Peter Bichse's artwork "Written

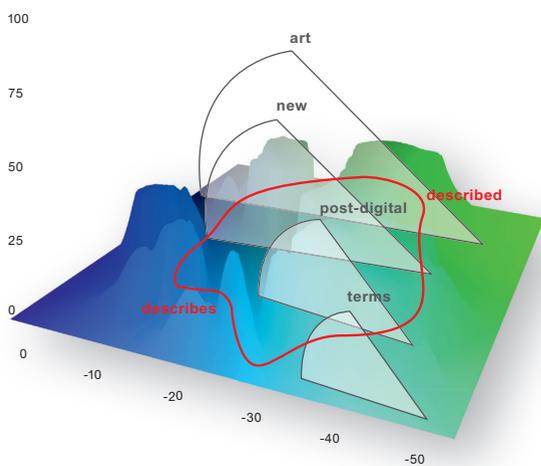
Images" is an investigation of a post-digital print production. It's still a media artwork: each copy is a digital print production, thus it conditions the 'analog' nature of print. The production was enabled through a network paradigm (using Kickstarter, the very practical and social virtual infrastructure), impacting in the cultural relation of people with the production. The book is a paradigm of post-digital print, through the merging of several interfaces: print as a not-yet-actualized object; network crowdfunding; processual information; merging print and digital – all in a single object – a book. This artwork is still objectable in several respects, however its paradigm is normalized as soon as it is realised; there is no further network dimension involved; it will forever be a book.

Luc Gross goes even beyond that in affirming that there will be more commercial times: "Until now, books were the last advertisement-free refuge. We will see how it turns out, but one could think about inline ads, like product placements in movies etc. Those processes could change literary [text] itself and not only their containers. So that's just one turnover".

Then why a post-digital artist book cant be made of artworks only? Les Liens Invisibles (network artists) realised their own: "Unhappening, not here not now". The book has images of one hundred completely false artworks, established through network material, including false production conditions for each of them. The book, indeed, establishes its own material ideological function, and only those who use it can understand its own paradigm.



19 art 5 describes new 4 post-digital 3 described media other practices terms 2 calls culture effect object objects presented structures systems tends theory things 1 clear complex condition cultures describe develop developed dimensions existing exists find interface looks nature networks others potential problem question refers reflects technology



If the interest in the post-digital proofs anything, it is that the usefulness of the digital as a discursive element is waning. Digital technologies on the other hand only grow and proliferate. This raises the question: why do we need or want to discuss matters in terms of a post-digital condition? In the context of art the answer is simple. We must move beyond the digital, because it tends to be perceived and described in terms of screen-based media like film, video and even television. A screen-based analysis and view of art literally glosses over a substantial part of the works and practices in the field. It for example obscures the sculptural use of networks and hardware, code and software art, and new conceptualist practices, the latter ranging from activist art to objects presented under the Post-Internet label.

An additional problem here seems to be the visual impermeability, the spatial dispersion, or the perfect merging of conceptual and medial dimensions in many of such works and practices. The art theorist Rudolph Arnheim offers a possible basis for a new form of perception in his book *Visual Thinking*. Arnheim describes how a non-retinal way of seeing exists in science, where the knowledge of the existence of events, structures and objects often precedes or even constitutes their visibility. By applying this visualization method it could be possible to develop a less limited view of art in the expanded digital field.

VISUALIZATION OF HIGHLY COMPLEX FORMS

The merging of the digital and artistic realm means we need a method that is simultaneously applicable to both. Rudolf Arnheim describes various forms of visualization,

one of which is that of scientific knowledge. It boils down to 'seeing' things you know are there, but which cannot be seen by the naked eye. It is not an imaginative mental construction of unreal events or phenomena. Arnheim calls such visualizations 'models for theory'. He describes examples of how such models appear in nature sciences and geometry. Even if he uses examples from the hard sciences, his description of scientific visualizations is largely psychological. He explains how every scientific model of an 'invisible' event or object is never static or stable, as it is based on a mixture of observation, experience, and psychology.

As an illustration: Galileo not only had to battle church dogmas. He also had to constantly challenge his own, learned modes of perception, and in the end he did not completely succeed. Galileo refused to accept planets rotated around the sun in ellipses rather than in circles. Arnheim quotes Erwin Panofsky pointing out that 'the ellipse, the distorted circle, "was as emphatically rejected by High Renaissance art as it was cherished in mannerism." A scientific view therefore is not necessarily hard-core empiricist, as it also reflects the background of the individual observer. Applied to art this means there is room for the critical interpretation and poetic freedom that is essential to its domain.

According to Arnheim, in such a scientific form of visualization 'all shapes are experienced as patterns of forces and are relevant only as patterns of forces'. The shapes he refers to do not need to be physical. Also, visualizations developed from interpreting these patterns of forces depend on former experiences and intellectual preconceptions of the beholder. To illustrate how this can play out: whereas the philosopher Jacques Rancière describes the future of the image and representation in terms of 'machines of reproduction', media theorist Alexander Galloway looks at the same surface and sees what he calls *The Interface Effect*, which is an effect 'of other things, and thus tells the story of the larger forces that engender them'. One sees a copy and editing tool, the other a change of what images represent.

ARNHEIM AND CODE ART

In relation to code art we can already find a variety of

existing approaches, all of them offering a particular point of view. Authors like Matthew Fuller, Wendy Chun, Alexander Galloway and McKenzie Wark have described the deep entrenchment of code in culture and society, and its defining role in new systems of power. Others, such as Inke Arns and Olga Gorionova, have emphasized the generative aspect of code, and the prominence of code art outside institutional realms. Blais and Ippolito describe code art as a virus, or as an antibody against a sick culture. What is clear from all descriptions is that code cannot be represented on a retinal plane in its entirety, or in its full capacity. Code as a written text, deep within a computer or presented on screen or paper, encompasses a potential activity that cannot be grasped from a literal reading or retinal observation alone. Code art is perceived through patterns of forces.

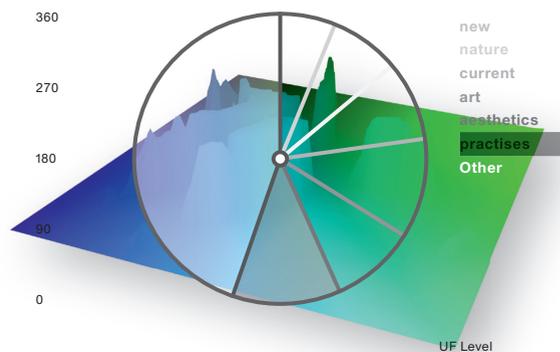
Seeing works of art through patterns of forces is explicitly not the splitting of the work into a collection of elements or aspects. Isolating physical traits of a work into separate aspects facilitates an equally isolated, narrow path of interpretation. This tendency is quite obvious in the context of art and technology. When 'the art object is described as having aspects, only a set of which are put forward as candidates,' philosopher Gary Hagberg observes in art theory, a work in the context of digital media tends to be judged on simple traits: the presence of a screen, be it interactive or not; the production of image cultures; technofetishism; etc. We want to avoid that a strategic or simplistic selection of 'aspects' comes from an institutional or uninformed point of view to falsely 'constitute the aesthetically relevant part of the work'.

FINALLY

Arnheim has been criticized for having a formalist approach to art, yet his work leaves more room for subjectivity and instability than one would expect. The subjective development of scientific models he describes also involves accepting a change over time and an 'open-endedness' to the subject under observation. It could be a possible basis for a new approach to art that involves structures, systems, or processes that are too large, too dispersed, or too small to see with the naked eye.



6 practices 3 aesthetics environment looking 2 aesthetic art current nature new politics
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With this precarious piece, we wish to present a patchwork of relational thinking of the ethology of urban fabric(s) in a post-digital light. The semantic of the urban fabric(s) normally denotes the “physical aspect of urbanism, emphasizing building types, thoroughfares, open space, frontages, and streetscapes but excluding (the) environmental, functional, economic and sociocultural (...)” (Wikipedia), from an ideal top-down perspective (e.g. <http://www.bricoleurbanism.org/whimsicality/urban-fabric-form-comparison/>) Here, however, we explore a non-metaphorical understanding of the urban fabric(s) referring to actual, textural manifestations to be studied in their real processual and ethological dimensions. We take the term ethology from Deleuze’s book on Spinoza, where he defines it as “(...) the study of the relations of speed and slowness, of the capacities for affecting and being affected that characterize each thing.” (Deleuze 1988, 125). Looking into the ethological workings of urban fabrics offers numerous areas of investigation of which we will develop two in the following; the velocity of urban fabric(s) and the characterizations of urban fabric(s).

VELOCITY OF URBAN FABRIC(S)

When asking questions about the velocity of urban fabric(s), we focus on two main themes; the speed vs. slowness of fashion and the temporary nature of the built environment. In the world history of fashion, novelty and modernity have been aligned with the changes in the modi of the medium of fashion (la mode) since 1850, and considering that the ‘superiority’ of capitalism had its historical take-off from the commercial production of linen by the meter (the Jacquard loom/ weave), novelty

in fashion has been a force for the market’s call for ‘time as progress’. The aesthetic novelty in e.g a folding, a lace trimming, a color shade, in its innovative, relational stream of bodies and urban surroundings has been an aesthetic potential for designers and wearers of fashion alike. This relational/spatial production of fashion marvellings that has very much been assumed by the film industry and contemporary interface screens, recognizes and causes contemporary repackagings of past fabrics of fashion. The current recycling of previous fashion clothing realises a return to messy and sometimes immaterial spaces and places in the city, shaping our perceptive image of the urban fabric(s). The culture of recycling, reusing and the compilation of fabrics belonging to different clothing and body-sizes, again, have developed into mainstream business paradigms in which the relational capacities of body and fabric are re-thought. This ‘slowing down of fashion’ in order to focus on affect to reflect the relational production of spaces and places in connectivity with the ethology of the fabric-becoming-body describes a clear characteristic of our investigation of urban fabric(s).

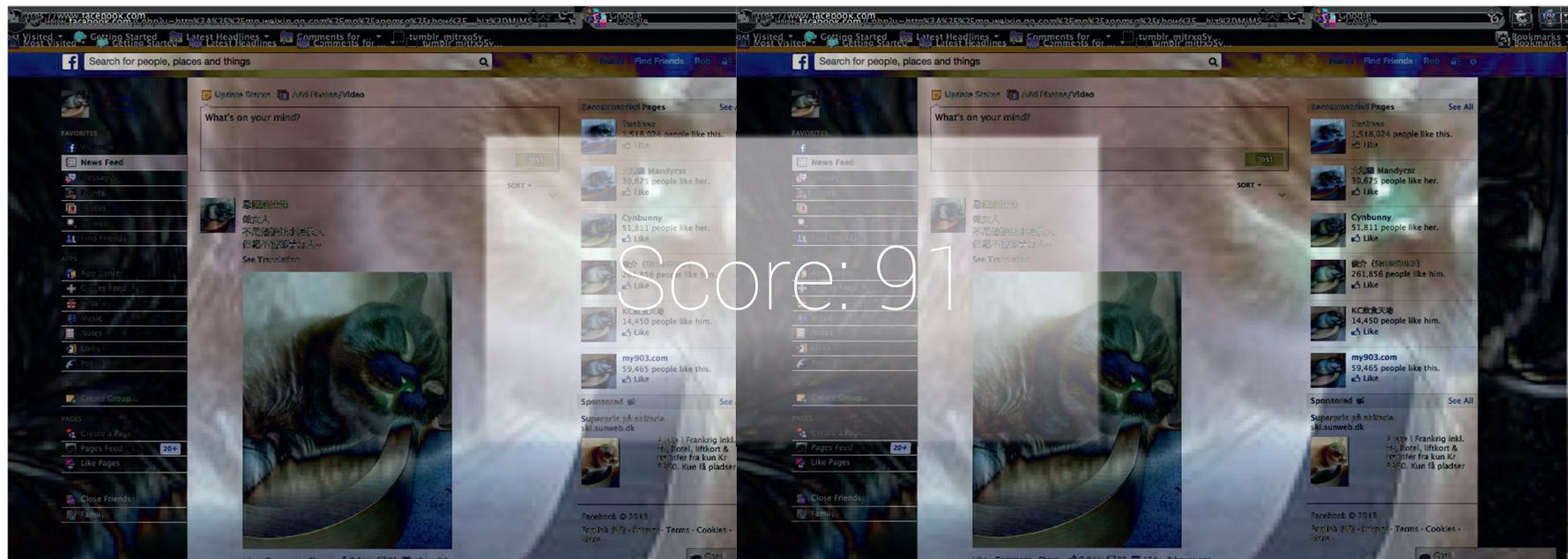
Focusing on the temporary nature of the built environment we investigate the actual impact, configurations and compositions of texture as experiential relations and effects in the urban sphere. Here, we look into different kinds of duration pertaining to the materiality of the cityscape, as well as in the changes in velocity and perception with a range of digital activations of the city through e.g. mobile technology and media facades. The slowness of the built environment has been disrupted through the use of digital networks and technological systems, changing our live perception of the built city, as seen in the art practices of Rafael Lozano-Hemmer and the Graffiti Research Lab (www.graffitiresearchlab.com/blog/). In addition, a range of practices have arisen around the creation of temporary urban spaces, for instance the Danish-based Institut for (X)’s use of big and small wooden objects as part of their DIY artistic and highly investigative practice in the city, as apparent in the installation ‘Platform 4’ (www.detours.biz/projects/platform-4/). Looking at other activist investigations such as Urban Knitting (kniitthecity.com), it might be argued that we are witnessing the complexity of the ‘speeding up’ of the built infrastructure somehow merging with a ‘slowing down’ through the

agency of more or less analog – post-digital? – materials, textures, fabric(s) and data.

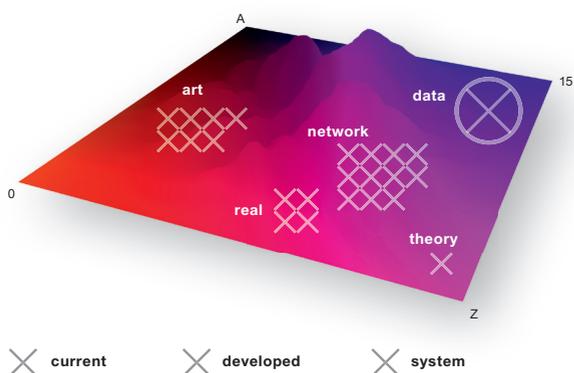
CHARACTERIZATIONS OF URBAN FABRIC(S)

When attempting to analyze what affects or is affected by urban fabric(s) through looking into what characterizes urban fabric(s), we must explore how the urban fabric(s) affects our ability to act and be acted upon in the city. We want an ethological understanding of urban fabric(s) to take into account the way in which it distributes the sensible, the aesthetics of the urban fabric(s) (Rancièrè 2004). The urban fabric(s) conditions our (common) everyday perception of the city, the actions we undertake (or not), on what Brian Massumi terms a microperceptual level – with, what might be termed, macropolitical implications (Massumi 2009, 5). Massumi links the notion of microperception to that of micropolitics, resonating with Rancièrè’s notions of the aesthetics of politics and politics of aesthetics, where the latter lies “(...) in the practices and modes of visibility of art that re-configure the fabrics of sensory experience.” (Rancièrè 2010, 140). To Rancièrè, these artistic practices of re-configuration can establish a ‘(...) dissensual re-configuration of the distribution of the common through political processes of subjectivation.’ (Rancièrè 2010, 140). Markussen has explored how this might be investigated through designerly practices of urban activism using the ‘(...) sensuous material of the city while exploring the particular elements of urban experience’ (Markussen 2012, 41).

We believe urban fabric(s) can be questioned through critical conceptual, artistic and designerly experimentation, bringing forth existing ideological, sometimes totalitarian, distributions of the sensible on a microperceptual- and political level, offering ways for people to act upon the normalized – sometimes false – distribution of urban fabric(s) through infra-ordinary micro-revolutions. We hope to be left with an elaborated sense of this practical and experimental affair, and the current state of ideas tend to exploring different distinctions between and distributions of the sensible – dissensus – through new interweavings, interactions and interfaces that rupture relations while developing new in-formation problems through virtual, not-yet-actualized diagrammatic practices of research-creation.



15 data 11 network 7 art 5 practice 4 notion real 3 culture functions impact networked social technology 2 aesthetics artist artists dimension existing functioned information interface interfaces media post post-digital term 1 apparent current develop developed environment find finding history mainstream material other politics potential practices related return system theory understand



In the post-digital era, when live data is constantly being generated, consumed, manipulated and circulated across networks, how do we understand the notion of 'liveness'? Following the traces of a networked cat called "Brother Cream", this text introduces an add-on (a small application that runs on a browser) that addresses this notion by continuously scraping Facebook data and intervening in the experience of browsing.

THE LIVENESS OF NETWORK ART

According to Bolter, et al. and Auslander, liveness is related to the mediatization of technology; and arguably, it is the "immediate presentation" of an event that the audience registers. The network facilitates global and instantaneous sharing of web data through online interactions and computational technologies. 'Live feed' is a term that provides an instant query of online data through many participatory platforms such as Facebook. The notion of being 'live' is pervasive and demanding, and is often associated with ubiquitous computation, wherein the accessing of live databases are made feasible by different forms of digital devices, customized applications, and network platforms in everyday net practices.

Manipulation of online data has been a keen interest of artists in the areas of network art practice. The term 'network art' "is based in/on the [net]" (Bosma) and is a "practice that thoughtfully responds to the emergence of and widespread of social, cultural and economic impact and take up of networked information technologies" (Corby, 2). Through different technological expressions such as intervention (Sterling), performance (Auslander) and formalism (White 2002) – combining data harvesting, mashing-up and/or real time technology with computation, and artistic strategies - network artists have explored the aesthetics of liveness in network art.

THE LIKES OF BROTHER CREAM CAT

The Likes of Brother Cream Cat (2013), an add-on that functions on Facebook browsing, is the most current collaborative and artistic production of Helen Pritchard and Winnie Soon. In 2011, a cat called "Brother Cream Cat" was lost on the streets of Hong Kong and his fans created a Facebook fan page to find him, and on his return he became 'Facebook Famous' through 'lots of likes'. Cream Cat's attraction permeates in both physical and digital live networks. Since his being lost and found, he has engaged over 1000 first time and revisiting fans per day at his store, and has accumulated more than 145,000 fans on Facebook. The likes in his Facebook fan page become an instrument, as well as a starting point, to sustain his well-being by attracting more visitors (both online and offline), more merchandised products, more cat food and more job opportunities for this animal celebrity, Brother Cream.

An add-on was developed to intervene in Facebook browsing behavior on the fly. Once people install and activate the application, all the existing Facebook's data (including images related to any post, profile and timeline area) is replaced with the latest Brother Cream trace. When he/she visits Brother Cream's fan page, all the cat's images that are uploaded by his fans are overlaid with text; and the screen and the sound responds instantly once the like/unlike button of a post is clicked. As such, the add-on intervenes in the usual behavior of browsing and using Facebook through a customized program, offering a real time augmented browsing experience. The image data on a Facebook page is constantly mutating and the live trace participates actively in people's social communication through real time technology. The liveness of Brother Cream is made somewhat apparent.

THE MALFUNCTIONING OF REAL TIME TECHNIQUE

The artwork uses web-scraping techniques as opposed to Graph API (a standard specification offered by Facebook to developers) to add another conceptual and empirical level of unpredictability. Web scraping is a technique to extract data from a webpage directly without the need to go through registration or authentication through a program that communicates with Facebook, as well as not following the official guidelines that are provided by Facebook. Studying Facebook's HTML code is one of the approaches in this practice in order to identify the appropriate and precise data. This is not a standard way and one of the major drawbacks is that the add-on's code is highly unstable. It is just like finding a folder in a specific drawer, and if Facebook changes the drawer's

location or swaps the folder's position, the program becomes unable to extract the right information, causing the add-on to malfunction. In contrast, using the Graph API from Facebook ensures any changes of the drawer would not have an impact, or at least minimizes the impact, to the developer's program. The method allows a proper regulatory control from providers on how the data is being employed and what kinds of data is being accessed. Offering an API service is also a common practice of Web 2.0 participatory platforms to encourage diverse applications to develop upon original functions and to extend their creative expansion, whilst maintaining the usage and popularity of capitalist platforms. As such, Graph API allows Facebook to maintain control and extends the circulation of all the user-generated data.

One of the aims of *The Likes of Brother Cream Cat* is to escape from this formalism, not only on a representational level which intervenes in interfaces, interactions and functions of Facebook, but also to challenge the methodological layer of how the system is constructed in order to reveal the uncontrollable interfaces of Facebook. Potentially, the malfunction of the add-on signifies a revision of Facebook's interface, and the artist's program no longer points to or is extracted from the correct path or material of web data.

The liveness of the add-on has to function and be experienced with the existing and live representational data, combining the traces which have been scraped from the Facebook interface; and the control of the add-on, the artist, the program, and Facebook, becomes somewhat blurred. Perhaps, Facebook itself has a repelling force that might cause the add-on to malfunction.

THE LIVENESS AND DEADNESS OF CODE REVISIONS

The relations of cultural, technological and social processes are non-human forces and co-constitute the dynamics of the network (Latour). These forces have the capacity to keep the artwork functioning and live, but also can lead to malfunction and death. In a wider cultural context, the revisions of code provides enhanced features like updates or fixes to an application, and at the same time serves to document changes, history and a specific moment of technological development, including but not limited to capitalistic, mainstream and commercial demands, conformity, political decisions, regulatory control and ideological practices. The fragility of the add-on expresses wider notions of both liveness and deadness, rethinking what constitutes post-digital culture, the politics and aesthetics of digital art, through its subsequent revisions.

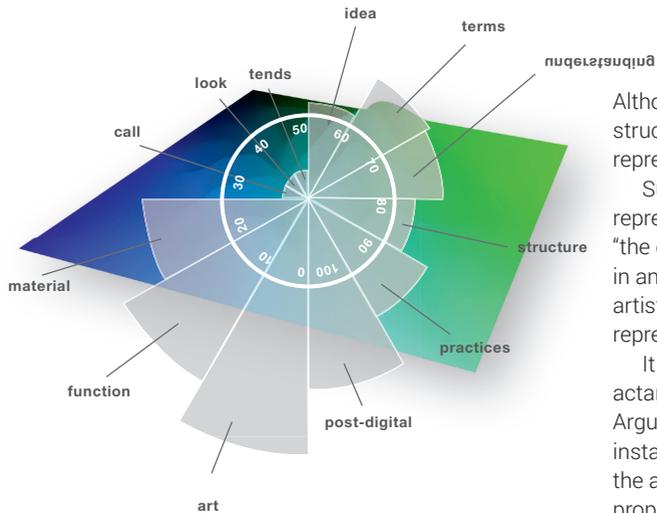
“Post-digital”, once understood
of “digital” aesthetic immateriality
messy and paradoxical conditions
after digital technologies
“Post-digital” neither reconciles
between “old” and “new”
affirmation of the one or the other
“new”, often applying network logic
to analog technologies which
re-uses. It tends to focus on
than the conceptual. It locates
totalitarian innovation ideology
big data capitalism. At the same time
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9 art 8 function 7 post-digital 5 material practices 4 understanding 3 condition media object terms 2 artists idea objects structure term 1 after apparent artist call culture current distinct environment environments establishes exist interface look mainstream materials network new post practice presents technology tends



I have always been Post-digital or at least I cannot recall a time when art wasn't. To claim this is of course ridiculous as the post condition demands the prior instantiation of a digital state that purportedly did not begin until the mid 1970's. Yet if for a moment we entertain the idea that art has always been post-digital in what sense might this make sense? Can we recognize the post-digital as not simply an after thought of the digital but a re-thinking of materiality akin to the re-visioning that occurred in the dematerialized art practices of the 1950/60's? To what extent can we look back on the strategies of those practices and gain perspective on the proposed post-digital?

The artists associated with Lucy Lippard's dematerialised "ultra-conceptual practices" are central our current understanding of materiality. As Jacob Lillemose explains, the dematerialisation of art as an object is not an argument for the disappearance of materiality but a rethinking of materiality in conceptual terms (Lillemose 2008). This non-corporeal stance to materiality establishes an argument where immateriality becomes a new material condition (Lillemose 2008). Defining materiality in this way we can comprehend of "the digital" as capable of possessing materiality that is a structural method rather than a technological function.

But exactly what is this digital thing we are focusing on?

As a mainstream term, digital is a qualifier of an object – for example digital-media, digital-network, digital-tripod! (Cramer 2013) ... In this sense digital-media might be seen as distinct from the digital in that it is an artefact of that which is digital. The digital as a detached function in opposition to analogue as a continuous function (Lewis 1971) is really the underlying structural method that results in the production of what we call digital media.

Although digital-media artefacts may adopt a digital structural method the media artefact itself presents as a representation that is manifestly analogue.

Surely the digital's materiality need not be bound by representation anymore than analogue material? Rather "the digital", as proposed by Barbara Bolt might be located in an active non-representational space directly between artist and material, thus eliminating the necessity of representational mediation by digital-media (Bolt 2004).

It is precisely this co-constituted dynamic between actants that Paul Leonardi clarifies in regard to the digital. Arguing for a definition of materiality that is inclusive of instantiations of non-corporeal agents, Leonardi stresses the affordance of materials rather than their physical properties, stating that it is in the interaction between artefacts and people that materiality is constituted (Leonardi 2010).

With materiality liberated from representation (Bolt 2004) and corporeality (Lillemose 2008; Leonardi 2010), the argument for a co-constituted materiality of intent within process leads back to reflection on a post-digital reading of materiality in 1950/60 conceptual art practices. Taking Allan Kaprow's seminal *Eighteen Happenings in Six Parts* (1959), as an example of the re-visioning of this period, I want to explore the extent to which it can be seen as engaging a digital structural method.

Although recent re-enactments Kaprow's Happenings have been videoed, much of our understanding of *Eighteen Happenings* is based on Kaprow's extensive notes, drawings and scores that function as a type of notational composition which essentially programme both audience and performers. The "non-matrixed" function of participants that results from such a rule driven approach, can be seen as a common feature of early conceptual practice (Kirby 1995). It is specifically the role of these instructions in the work that I want to examine in relationship to materiality of the digital.

Immersing the viewers inside the Happening, Kaprow not only makes participants active agents in the piece but builds a fragmented structure by distributing the viewers, moving them around and generating unstructured time within the artwork (Rodenbeck 2011).

Although it is initially difficult to identify the viewers as participants in the manner we accept or even expect today, the invitation to the attendees to "consciously insert themselves" (Rosenthal 2007) into Happenings undoubtedly informs our understanding of the idea of interaction as a reconstruction of the viewer and art hierarchy (Wardrip-Fruin 2003) and a co-constitution of

materiality within the framework of the artwork.

In apparent conflict with this union the viewer is also individuated; divided across three spaces and distracted by simultaneous events, it is unlikely that two people witnessed the same thing. De-centred both temporarily and spatially, the viewer's engagement was likely discontinuous making it impossible to conceive of the whole. Their function is detached – self-contained and digital in the terms defined previously.

Although at first these two positions seem contradictory in the sense that I am claiming both a continuous co-constituted singularity and detached individuality, this is not problematic when we accept this as a state of the co-constituted artwork rather than the participants. Artwork can be split across several sites, spaces and times that exist independently and at the same time function as a whole – a quality that might easily be attributed to numerous digital-art forms.

What I propose is occurring in this reading of *Eighteen Happenings* then is an engagement of a digital structural method that is a function of both a shared agency and fragmented isolation that relocates the individual within the materiality of the artwork. What we have is not a single continuous material but parallel co-constituted materialities that are inter-dependent components of a relational network within the piece.

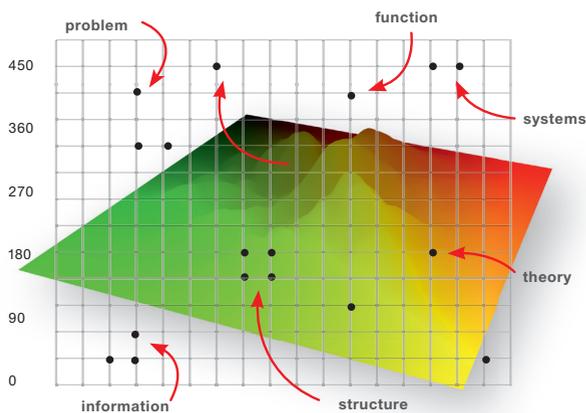
As a structural method the digital is not dependent on the technological constructs of the digital era that it is commonly associated with. The body – perhaps the most analogue of all objects, has been shown as capable of constructing a co-constituted digital structure thus chronologically freeing the digital from specific media histories. In this sense "the digital" predates the development of digital-media rather than being a condition determined by it.

While it maybe that the so-called post-digital is a symptom of resistance to the commodification of digital culture it is not simply a nostalgic yearning for the Jurassic technologies as proposed by Andersen and Plod (2013). The post-digital might instead be considered as a post-material state in which the materiality of "objects" is understood not as a physical state but in non-corporeal terms as a structural method. The post-material is not a denial of material but an understanding of materiality that has been exposed by disillusionment with the promise of the digital – it is an affirmation of the significance of method rather than state in materiality.

I have always been post-material or at least I cannot recall a time when art wasn't?



6 post-digital problem 5 function problems 5 system 4 structure theory 3 information 2 condition culture environment material other present structuring 1 aesthetic affairs art artist conditions denotes enabled establish find ideas ideology left medium normalized notion post practice produce questions research structured structures systems term terms



On Computable Numbers, with an Application to the Entscheidungsproblem. It is a precariousness which has been built-in to the medium from its very inception.

The critical function of that paper, its key focus, was on the *Entscheidungsproblem*, or decision problem. Originating from David Hilbert's school of formalism, 'decision' means something more rigorous than the sorts of decisions made in daily practice. It really means a 'proof theory.' Decision is what happens when a formal system of function is constructed in a sufficient regime of complexity, that an algorithm can *always* 'decide' a binary, '1' or '0' answer to a math problem, when given an arbitrary input in a sufficient amount of time. The two key terms here are 'always' and 'decide' – the progressive end-game of twentieth century mathematicians, like Hilbert, happened to be committed to demonstrating proofs and sought a single, simple totalising conceptual system: a system which decided every query and every problem.

Systematic procedures decide problems. Systematic procedures resolve problems and produce winning positions in the game of functional rules and formal symbols. In Turing's words "a systematic procedure is just a puzzle in which [one might] never [find] more than [a single] move in any of the positions which arise and in which some [importance] is attached to the final result."

In 1936, Turing showed how machinic decisions as math ideas could model and replace conceptual ones, and how, given a sufficient complexity, systematic procedures (like Universal Turing Machines) could simulate the functional decisions of other systematic procedures. Ten years later, Turing and John von Neumann would show how general purpose computers offered the same thing. From that moment on, decisions manifested themselves in material. Programs operate as conditions for proof. Code was function. Before Shannon's information theory and

the mathematic theory of messages, we had Hilbert and Turing's structuring of computational information in the underlying form of decision.

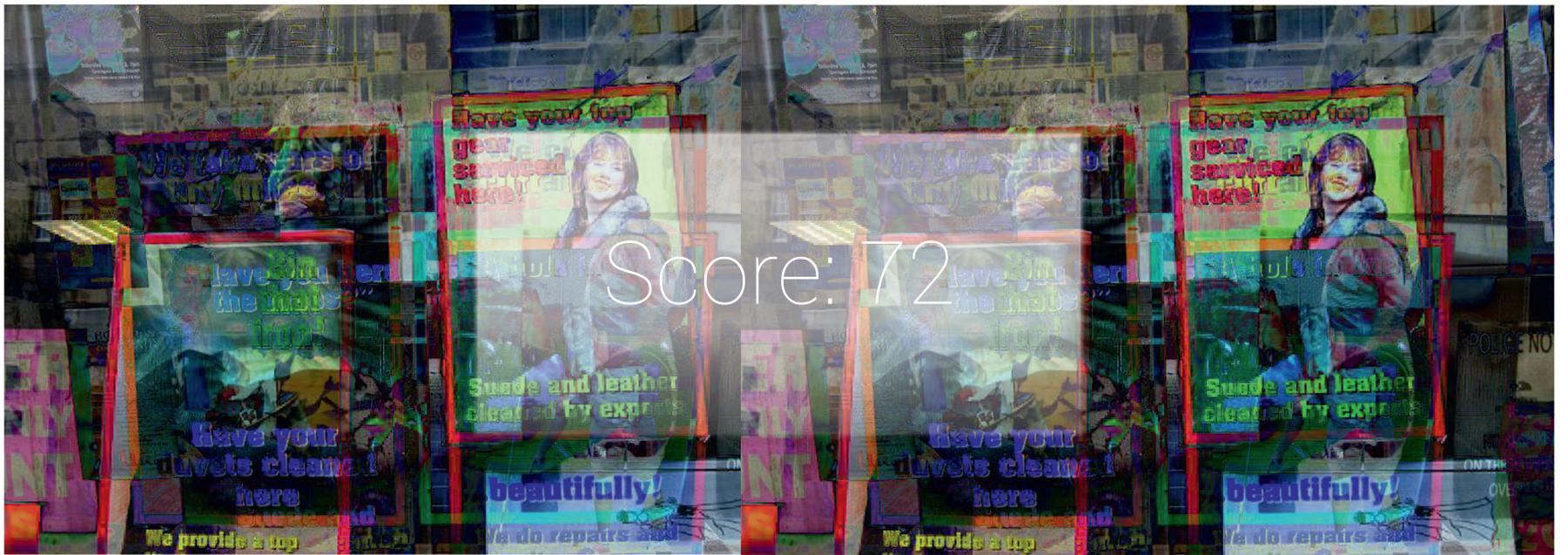
It is this structuring which brings forth the "post-digital" as a semantic realisation: When an operator is enforced to address how digital infrastructures actually structure, support and decide affairs into binary properties. All the adapting is on the agency of the operator, whose meaning is encoded in structure. The post-digital is at once, messy and yet, in a strange paradox, utterly totalitarian. The digital was a theory made to establish, immaterial innovation, yet it has left culture with an ideological commercial structure, where every messy problem is a condition yet to be resolved by capitalism: where every system is lodged with an ideal for managing chance events; where every development is transformed through a relational environment of decisions.

An artist can no longer address the digital from a technological arena of innovation or from a blind experiential mode of agency: but only from a position of entanglement. When the material at your disposal has been decided, questions start to be raised about the agency of aesthetic processual production.

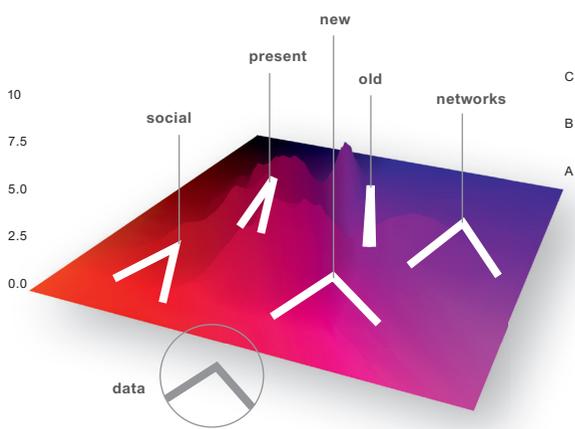
The post-digital is the ongoing realisation of how the digital generates more problems than it can resolve. Less of a paradigm and more of a realisation. Moreover it is about how agency had never steered infrastructure, but the opposite - how a decisional infrastructure enabled agency in the first place. And the „post“ part of the term indicates that this self-realisation, is a genuine realisation: not a direct change in production. Like every other "post-term" detecting a disclosure: post-digital denotes how such systems are structured to contingently function - when we realise that our false ideology of the digital is more informed and illuminated, yet in no way less false.

An extensive problem comes from the present condition of 'the digital' itself: a structure which points towards units of Base-2 arbitrary configurations, impersonal architectures of code and information, normalized conceptual methods of problem solving, massive cultural infrastructures of modern connection, or so-called subversive, personalised agency and change in post-modern identity. Yet, it would be quite difficult to envisage a 'post-computational' change within these developments – and with good reason: for the actual specific structures upon which computational experimentation arise, that are never really discussed at length. I'd like to consider the notion that before we ever "transformed" into the digital, we have lived in a "post-digital" environment of decisions, or better yet, decisional ecologies.

It is widely understood that the analytic basis of computation, derived from Alan Turing, is to fashion a formal system of rational deduction, which when automated, would resolve particular problems in mathematics put into function. What is not necessarily understood is the complexity which supports that basis: the foundations of mathematics is entirely messy, way before Turing published his landmark 1936 paper,



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MEDIA TRASH

In today's changing information topologies, methods for delivering data are also conduits to sites dispersing products, in exchange for money and – potentially – free labour. Investigating the value we place on data, The Formamat is a vending machine, "...which returns candy in exchange for the deletion of [an individual's] digital data". People explore 'the joy of deletion' and review the value and (in-)dispensability of their files. (Formamat.com, 2013). After only two or three years, an unexpected revision of this inquiry occurs: not which, but whose files are going to be deleted? As the pervasive and (in)dispensable capacities of data are recognized, verification, trust and identity are increasingly matters of social importance.

Data control is central in code revision systems such as Git. Designed to address social and computational issues in producing the Linux kernel, Git offers revision tracking of data changes without the necessity of network access. Issues of access and governance are also dealt with in creative works which utilize and discuss revision control systems in relation to free cultural practices (www.spring-alpha.org/svs/; Urban Versioning System 1.0).

SOCIAL OVERLOAD

Whilst in adoptions of Free Culture studied by Shaikh (2012), no particular 'openness' can be assumed, Free Speech values have been intrinsic to the development of Free-Libre culture (Turner 2006). These influences are evident in Debian Linux protocols and in conduct encompassed in Wikipedia (Reagle Jr. 2011). Kelty's 'geek publics' (2008) may be helpful in understanding cohesion within these communities. In Wikipedia the interdependence of social and computational apparatus is clear as disagreement is managed across multiple

versions: 'archiving evolution' and 'adaptive ethics' systematically aim to prevent damage and encourage exchange. (Cull 2011). Such reflexive activities bring images of community integrity into focus, but meanwhile, revelations about state surveillance demonstrate that anonymity is not a necessary aspect of digital networks. Ted Nelson's invocation, "you can and must understand computers now!" (Nelson 1974) is renewed by under-reporting in the media (Guardian 2013a).

New platforms allow re-versioned political slogans to be absorbed into the melee involving memes and personalities (http://opgraffiti.deviantart.com/gallery/). Knowing winks imply this is a party not all are invited to (though we surely all would like to be!). Social media – and its reflective potential – receives validation through acquisition of artworks (such as The Cybraphon http://www.nms.ac.uk/highlights/objects_in_focus/cybraphon.aspx), through Wikimedia outreach projects (http://outreach.wikimedia.org/wiki/GLAM) and in apparatus which measures the general mood via twitter and the blogosphere.

Across diverse networks programmatic interpretations gather meaning from the mess of communication, using keywords and metrics on an industrial scale. By contrast, Anonymous forms resist analysis, their direction being to circumvent and override as much as is achievable. What the associated memes and 4chan interactions present are collaboratively made, creative network entities. In producing these new conventions are worked out; Overloading standards of taste and acceptability are stimulating alternatives to the ordinary narratives of conflict and resolution.

TRASH-VERSIONALITY

In overloaded forms of representation entering mainstream narratives, a kind of generalized and competitive vandalism is esteemed. The variety of voices – for which the expanding net has become more lightning conductor than conduit – increasingly provides a self-fulfilling cycle of news, serving 24-hour comment and analysis for comment and analysis. A re-writing is under way in which messages combining text and images produce networks within networks; mutable containers of doubt and disinformation refresh identities of the troll. With the fixation on data and hardware objects and the advance of our litigious cultures, it may be that these elements contribute to conditions in which bullying can be blended into the landscape of interactions.

As much as hardware and new platforms may enable discourse, these also become the sites for abuse where differences between trolling and bullying easily merge. Recently in the UK, a number of prominent women in the (including MPs, campaigners and journalists) have become the target of insults and threats intended to silence their voices (Guardian 2013b). Threats have regularly been sent via twitter. In probably the highest profile case, this came after a successful campaign (http://thewomensroom.org.uk/banknotes) to have the Bank of England print – for the first time – a female historical figure on its banknotes. The equivocal nature of networks is evident where 'trash-talk' in gaming turns to harassment and 'gamified misogyny' (New York Times 2013). In the competition for kudos, questions about the liberating potential of the net abound.

POST POST-DIGITAL FEELING

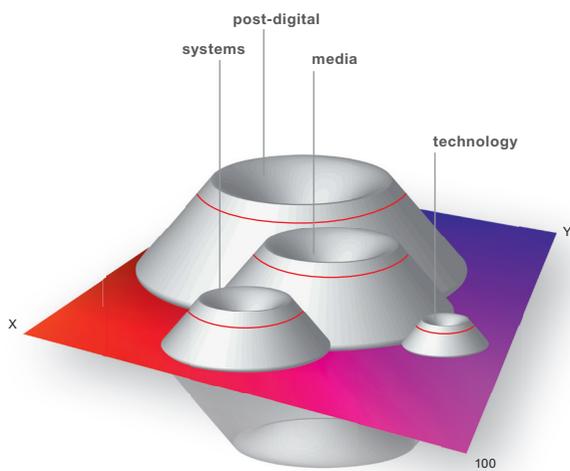
Though in developer communities forking has had an upturn in its reputation, in some respects the proliferation of new cultural versions is problematic. The controversies around Wikileaks' internal governance – far more that being positive examples of innovation and overspill – reflect transgressions of trust. This has also been apparent in disagreements between Wikileaks and The Guardian newspaper over journalistic principle, if also different versions (Gibney 2013).

Personality fetishism promises certainty in a moment of deep uncertainty. It recalls a time in which physical media appeared more present than today; it is a moment where disappearance may be more desirable than presence. The contradiction in interfaces is that these renounce claims on materiality (Co.Design 2013) and retain the ability to expose people to actual and perceived threats. Trolls revel in their ability to circumvent blocks, adopting new identities or labelling messages in ways to reach targets indirectly. In the face of this, campaigner Caroline Criado-Perez ultimately chose not to observe the old advice not to feed the trolls, but to delete her twitter identity (Guardian 2013c).

On the other hand engagement is a new watchword for the web. As much as it also applies to images (subjected to dissection and storage across locations), the metaphor of the network is now universally applied to collaboration. Exchange in networks produces trust (and meaning) as repositories for doubt – a local dry cleaning service adopts the net meme format in posters, exclaiming: "A hole in one? We do repairs and alterations". This is trash-versionality, post-irony for a post-digital present.



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The post-digital is not only historical/temporal but attentional (Stiegler 2010) – revelatory of depth, strata and verticality, not only horizontal trajectories in time. In this sense, it is not concerned with transformations of media as a means of implementing or re-implementing artistic archetypes and aesthetics.

That which is left after and behind the digital, unrevealed and withdrawn from “view” is of real import and significance. Such a perspective, a “media archaeology of the present”, performs a way of addressing post-digitality as the infra-technical, the infra-digital (But how can we address the “digital” without falling into “digital art?”) A CRITICAL INFRASTRUCTURE is less what “lies after” (in time), and more what “lies beneath” or has “always been behind” (in space, or matter). Technical infrastructures, broadly speaking, are the elaborate material systems enabling all interactions and aesthetics, dispossessed of their apparent material repercussions, and so have effectively (and incorrectly) been wrought as indispensable instances of an imperceptible nature. A CRITICAL INFRASTRUCTURE is concerned with the foundational and the subterranean. These are infrastructures that are critical of themselves, critical of their own tendency to withdraw, critical of their profligate spread and overabundance, critical of their assertions of reliability, perfection and exactitude. What and where is this infrastructure that permits and is permitted by the actions of artists and technologists?

PRODUCTIVE POST-DIGITAL BOREDOM

The banal has renewed resonance and interest. Technical infrastructures are replete with commonplace materialities

and activities (the micro-switching of a WiFi router or the minute decisions of a PCB designer), as other post-digital artistic practices overflow with appeal for the mundane object, the muted image, the simple interaction (e.g.: See *The Jogging*, or Jack Strange’s 2008 piece ‘g’). The shiny, glossy containment of digitality is again a set of monotonous gates, and stupid decision multiplexers. Invisibility here comes about through a projection of tedium and banality: “Don’t worry about it.” But post-digital artistic practices advocate some counter-measures. For CRITICAL INFRASTRUCTURE, practitioners weigh in by signing up for what Susan Leigh Star inaugurated as the “Society for People Interested In the Study of Boring Things” (Star 1999). Star’s writing develops techno-social and techno-aesthetic accounts of infrastructure that is inherently paradoxical (at once transparent and opaque), as well as helping to develop the epistemological state of access and interaction and access points, serves as inspiring fodder for interviews, fieldwork and “infrastructural tourism” undertaken.

WITHDRAWAL AND UNCONCEALMENT

In Heidegger’s historic questioning of technology (Heidegger 1993), he outlines an assessment of the “instrumental and anthropological definition of technology.” His is, in some sense, an infrastructural account of the technical – that is, an acknowledgement of both the imperceptible and non-technological nature of technologies. Heidegger is furthermore concerned with our inability to directly force that which is obscured in technologies (in infrastructures) into view. “Man can indeed conceive, fashion, and carry through this or that in [a] way or another. But man [can not exert] control over Unconcealment itself, in which [at all times] the real shows itself or withdraws.” Are intentioned leakages, or premeditated malfunctions, claimed by glitches and circuit benders, even possible? There is a relationship here between the unconcealed and the withdrawn in Heidegger’s discussions elsewhere of malfunctioning equipment and tools, “The modes of conspicuousness, obtrusiveness, and obstinacy each have the function of bringing to the fore the characteristic of presence-at-hand in what is ready-to-hand.” (Presence-at-hand corresponding here to an unconcealed technical relation, and ready-to-hand the disappeared and always-on utility of infrastructure). What modes of conspicuousness,

obtrusiveness, and obstinacy can be enacted as a CRITICAL INFRASTRUCTURE? Could these three modes become intentional, artistically-produced forms of infrastructural aesthetic and presence?

INVISIBILITY AND VISIBILITY

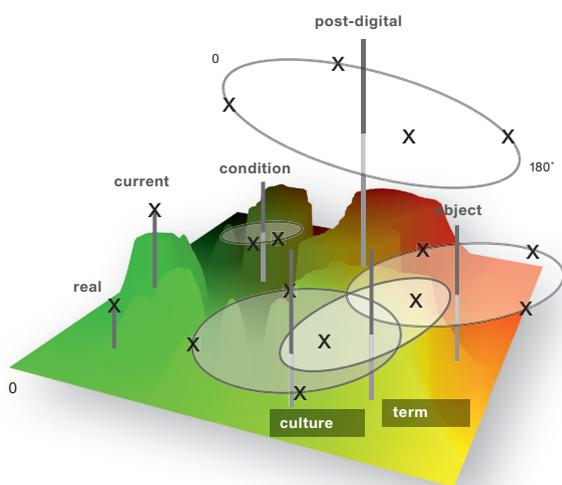
If we are concerned with infrastructure it is through a continual withdraw that technologies exhibit as they become more complex – that is the infra of the technological. “Infra”, is that which lies below, the cloaked and the already-assumed (perhaps unconscious); a withdraw from the cultural, a displacement from visibility into invisibility. This is a withdrawal characteristic of technical nexuses in general, rendering imperceptible modalities of the technical. What are the regimes of visibility and invisibility of infrastructure? What of infrastructure is tenable to bring within a sensible milieu? (Rancière 2006)

CRITICAL INFRASTRUCTURE produces a mangled milieu where layers and strata of information and signals underlying media and telecommunications technologies are mixed: the material with the electrical, the electrical with the digital, the energetic with the semantic. These signals are presented as fodder for additional aestheticisation, corruption, contagion –modes of art-and-technological unconcealment and revealing. A way of achieving this is to look into these systems and both catalogue and devise mechanisms for leakage. Other methods include the spoofing or corruption of existing signal layers, creating bands of infrastructure unlike those systems we are conditioned to (not) see. This layering and bastardization of infrastructures with aesthetic apparatuses produces a techno-aesthetic that is specifically absent; a sensorial milieu where infra-signals are rendered present.

CRITICAL INFRASTRUCTURE is not the action of artists bringing infrastructural data (electrical, data, information) into the domain of art, or the action of engineers producing accurate representational data, or “informative” models of systems. Rather it is to establish a zone of sensible indeterminacy of both art and technics; a neutralisation of the function and sincere claims of each. CRITICAL INFRASTRUCTURE mangles practices of art and non-art, the technological and the non-technological, composing new sensory milieu where the post-digital is after-art and without function.



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This article is an outcome of my current research on the mindfulness of listening and the subjective ramification of auditory perception. The thoughts that envelop the research essentially stem out of the questions of perpetual mobility and nomadism perhaps symptomatic of the post-digital culture. A nomadic listener is affected by a fleeting sound appearing and diminishing in the way that triggers an amorphous stream of subjective contemplation and thoughts bordering on the immediate known-ness of the sonic phenomenon, but at once moving to the territory of unknown.

Here the 'unknown' inherent in a sonic phenomenon may resonate with what Graham Harman refers as 'unknowable' as the actuality of anything outside of the correlation between thought and being. A specific sound directs to a listening state inside the listener, s/he in a nomadic condition may indulge in taking the phenomenon as a premise or entryway to a world hitherto unknown to him/her. This s/he may address instead of deciphering the objective meaning, location-specific identity and other spatial information of the sound, however vaguely relating it to the imagining and remembrance of a number of amorphous moods triggered by the temporality of listening. Today's wind may not sound like mere wind, and the lonely screeching of the windowpane may not sound like mere friction between glass and wood, but it may sound something more abstract in the sense that it relates to memories and imagination of other realities refracting in response to the immediate materiality of the sonic event. These sounds appear as impermanent to the ears of a wandering listener, but may expose doors and obscure openings for further perceptual meanderings in the state of

contemplation and thoughts transcending the very cause that the sound would otherwise objectify. The ontological questions posed by such object-disoriented sonic explosion, which the ancient Indian philosophers would call as '*sphōta*' (Barlingay 2007) is the specific area of praxis in my current research.

Let me elaborate on what I mean by 'object-disoriented' behavior of sound. To that direction, we shall first excavate the term 'sound object'. Pierre Schaeffer coined the term to denote an intentional representation of a sound to the listener. The emphasis was on the reduced listening state instead of causal listening if we borrow Michel Chion's terminology. However, the imposition of the term 'object' over 'sound' seems more or less tricky. Listeners have difficulty hearing sounds divorced from their associations. It is nearly impossible for the human listening faculty not to ascribe a string of causes and/or multilevel identification of a sonic phenomenon. In practice, the listener is likely to simultaneously establish imagined gestures or link a sound to its illusory origin, evoking some kind of contemplative and thoughtful imagery.

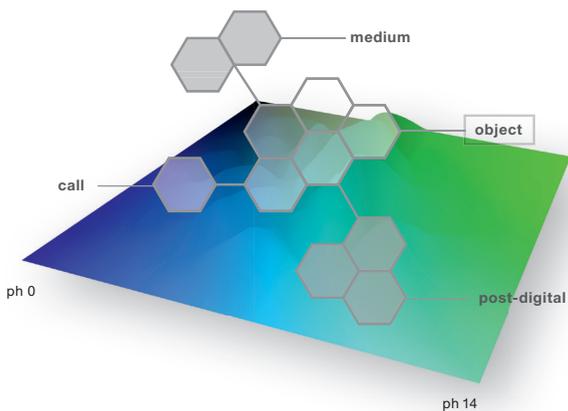
This is also resonated in classical sound studies. In his seminal writings, for instance in the famous article 'Aural Object', film-sound scholar and an early phenomenologist Christian Metz has also expressed serious doubt about the object-specificity of sonic phenomena in scholarly discourse following Schaeffer. He instead focused on the 'characteristics' of sound, and wanted to emphasize on the problematic of locating sound's object-oriented or location-specific origin. He stated, "Spatial anchoring of aural events is much more vague and uncertain (...)" (Metz 1980). Scholars have also underpinned the issue of sound's manifold interpretations; sound is not actualized unless "it reaches the ear of the hearer" (Altman 1992). Accordingly, sounds are interpreted at different stages of mediation via recording and digitization to reach a saturation state of an assumed 'post-digital' condition of the ebb and flow of data, whereby are freed from the object. Sound that is disembodied from its location-specificity causes several stratum of reception and interpretation outside of the place, time, and identity, whether this is in an audio streaming network on the web, a digital sound composition published on a net-label, or an exhibition within the augmented space

of an interactive installation piece. Such interpretation of nomadic sound events can lead to sonically fertile situations (Chattopadhyay 2013). The post-digital discourse understands these situations as amorphous and perpetually transient. It is evident that in this constant flow of data, sounds over greater mobility and interactivity lead to their rendering as itinerant auditory situations, which are transformation of the original sound for re-interpretation to produce a diversity of connotations within the post-digital condition.

At this juncture, a nomadic listener drifting across the post-digital milieu may interact with the background noise or the unknowledgeable sounds of nameless, placeless and faceless sonic states, which instill a sort of 'semantic fatigue' (Demers 2009) eventually cutting adrift from identifying their origin. The nomadic listener in this process may sensitize his/her ears to the pseudo-object of the sounds, and may deconstruct them into their listening selves by the haunting capacity of a sonic explosion as streams of timeless reverie, rumination and musings. The 'unknown' sensed in the wandering shadows of sounds are explored by the nomadic listener's interaction with their appearance and departure, leaving object-disoriented states of feelings and moods. This notion of listening in essence sets the 'object' of sound aside, and instead focuses on the subjective and inward perception of sound within the 'mindfulness' of the listener. Following this methodology, we can examine the way memory, imagination, and personal world of the nomadic listener alter the character of sound. On this note, I introduce an alternative methodology of listening in the post-digital culture, which I term as 'hyper-listening', meaning that I refer to the higher-level/psychic pre/post-cognitive processes triggered by the perception of the object-disoriented sounds into realizing development of thought-inducing auditory situations. My specific artistic practice is informed by this notion of inward contemplation available to nomadic listening (because of the ability of the listener to free the ears from object-specificity). The practice enables reflecting and musing over the personal or private nature of listening; it also endeavors to engage with the sonic sensibilities as a function of the implicit post-digital culture.



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BLUE HOURS

"The equipment-free aspect of reality here has become the height of artifice; the sight of immediate reality has become a blue flower in the land of technology."

Walter Benjamin, *The Work of Art in the Age of Mechanical Reproducibility*

Consider a blue flower. It's cold, unnatural luminescence. Its presence for the German Romantics, acting as dreamlike place-holder for longings of a future harmony between Man and Nature. How in strong sunlight blue fades; the blue flower's preferred habitat in the threshold moment of evening, the twilight hues of "the blue hour."

Consider also the blues of technology. Tech logo blue. IBM deep blue. Facebook blue. The chirpy, social pastel of Twitter blue and the vaguely translucent gradients of iOS 7 blue. Chroma key blue, signifier of a world predestined for post-production. The default "Bliss" wallpaper that so many would land on when using Windows XP. Its pacifying blue-green pastoral. A fig leaf of an image. The post-crash Blue Screen of Death. A showy blue LED. Blue, blinking Bluetooth, blue. All of these flowering blue avatars of the digital, striving to stand out yet fit in at the same time. Saturated glow of the digital and its attentional economy, ethereal stimulant and banal sedative, blue pill.

Speaking on Benjamin's notion of the "outmoded" object, Rosalind Krauss describes that particular moment of temporal limbo for a medium in which it takes on a sense of being outdated but not quite fossilised into what Hertz & Parikka would call the archaeological period of its lifecycle.

Krauss dubs this in-between juncture "the twilight zone of obsolescence." In such a zone, the outmoded object may take on what Benjamin describes as the "profane illumination" of its own temporal obsolescence, radiating a critical glow upon the very mythologies that it once helped to project. A rediscovering of a "true gravity" (Benjamin 2008) outside a "totality of technologized space" (Krauss 1999). Death becomes the medium, technology, object.

The potential of dwelling on "blue hours," such as those that Benjamin and Krauss outline, is that they can provide a setting of heightened atmospherics in which mediation itself can be said to subtly flex the curvature of its horizon in a just noticeable fashion. Such moments might provide lucid, uncanny or prescient modes for perceiving the previously pervasive qualities of the object in question, before it eventually subsides as residue back into a general atmospherics of mediation.

BLUE BANALITY

"No one really dreams anymore of the Blue Flower. [...] No longer does the dream reveal a blue horizon. The dream has grown gray. The gray coating of dust on this is its best part. Dreams are now a shortcut to banality."

Walter Benjamin, *Dream Kitsch – Gloss on Surrealism*

The digital has shown an impulsive readiness to latch onto the banal. Instagram unleashes the social practices of digital photography with a few select filters that aestheticise the temporal using a technique of "fauxstagia" (Memmott) that masks something like the selfie in sufficiently profane illumination. The very oversaturation of any filter the digital provides means that all is potentially now possessed with a degree of understanding from the digital. In such a situation, the emphasis seems to no longer be on startling juxtapositions of everyday objects such as the Surrealists were after, but rather an awareness of the increasingly natural, and thus banal overlap of what was previously felt as unnatural. In a post-digital condition, is any kind of "blue spill" of the digital even noticed any more? Each of its discrete parts readily overlaps on the other. And overlaps, and overlaps.

In 2008, Kevin Bewersdorf announced the start of his

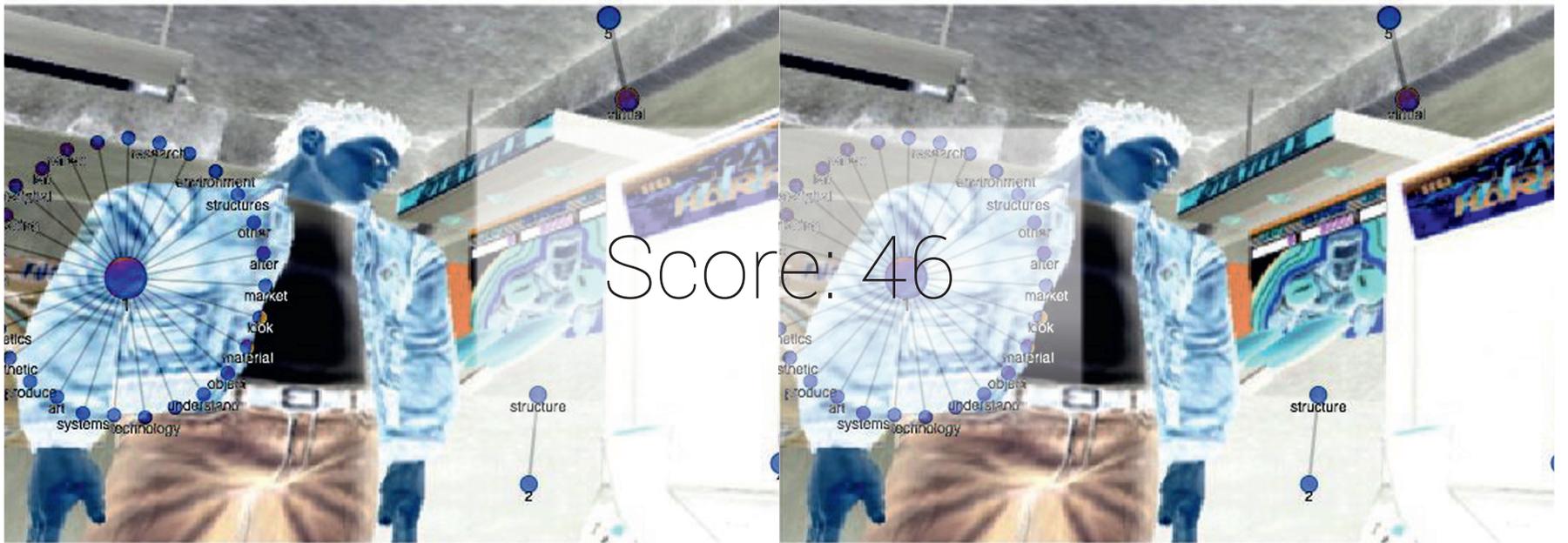
PUREkev performance. The concept for the piece was straightforward. Over the course of three-years (2008-11) an automated performance would play out, in which a looping clip of over-exposed home video footage depicting a flickering firecracker would very gradually diminish over the three years, extinguishing at an imperceptible but steady rate for its visitors, gradually becoming a field of "pure" blue. This blue void, rather than the flame, seems to be the key performer here (McHugh), surrounding its increasingly pitiable flame, pushing it down and forcing us to scroll and scroll and scroll, hunting for a figure, no matter how fleeting, that might release us from this amorphous ground, the "MAXIMUM SORROW" that is Bewersdorf blue.

Bewersdorf's PUREkev performance, like his "Monuments to the INFOspirit" series, contains an embedded, anamorphic-like, imprint of the dotcom Totentanz of the digital, a reoccurring quality that together with his prominent use of blue is noticeable throughout Bewersdorf's practice. Both seem to serve as a kind of signalling call to the horizon or vanishing point for his works, against which Bewersdorf can offset and perform a world of a drab, everyday, overlapping banality.

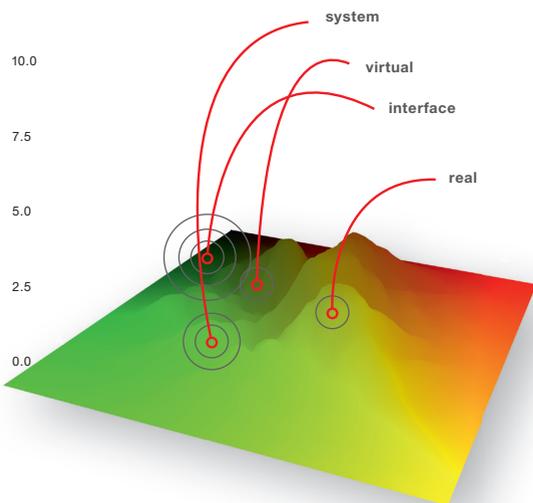
POST-BLUE

Is the post-digital in the end itself a conceptual blue flower? Can something as nebulous as "the digital" even be treated in a remotely similar manner to an object or a medium? Either way, the sounding of a speculative death knell of "post-" might partly act in a similar way to the moment of obsolescence, the suspending quality of its hyphen creating a temporary tension, a zone of uncertainty, a wobble that might at least unsettle the stem that it still implicitly admits it cannot necessarily escape from, nor even wants to.

In a post-PRISM revelations present, we are reminded, yet again, of how so many horizons and promises of the digital end in yet more false dawns. But if the technological push of the digital has always been invested with a heightened sense of forward momentum, the post- of post-digital can also be seen to be aimed at getting on with things. Perhaps we just require a sacrifice of some kind, something to exorcise this ghost of "the digital." A cleansing of the palette.



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INTRODUCTION

This article is a background research piece into the development of an experimental installation that prototypes the post-digital trajectory of arcade videogame emulation. It explores how interfacing with arcade videogame cabinets can be recreated in VR space, not just authentically recreating videogame input and feedback aesthetics, but also the external and internal physicality of the cabinet, alongside the ambience of the videogame arcade.

EMULATION AS AUGMENTATION

An emulator is a virtual machine that recreates system architecture, transplanted as a subroutine of a more advanced system. Emulation is a legal grey area, semi-tolerated by the owners of the emulated system. After boot up MAME presents a splash screen reminding that all roms used must be legally obtained.

Emulators also leverage the affordances offered by the host system. For example, MAME features a memory editor and disassembler that allows editing of game code as it runs. In this case the emulator augments a consumer system with a developer level interface.

THE PHYSIOLOGY OF AN ARCADE CABINET

In comparison to their home systems, the underlying technology powering arcade videogames is lesser known. Arcade PCBs range from bespoke PCBs for single games such as *Pong*, to standards based upon home console technologies like the Sega Naomi that is closely related to the Sega Dreamcast console, to adapted PC compatible machines.

The JAMMA standard agreed by the Japanese Arcade Amusement Manufacturers Association in 1985 introduced a 56 pin connection for connecting game PCBs to cabinets,

allowing exchanging of JAMMA PCBs between compatible machines similar to the process of swapping a home console system game cartridge. It is not the only arcade connectivity standard, but it is the most prolific.

Arcade cabinets are unglamorous, using similar material infrastructure as their kitchenware namesakes. Indeed, Atari's Irish operation in the 1970s bought a local furniture manufacturer to produce arcade cabinets for the European market. Wear and tear on these structures has led to battle damage that adds character, but can cause problems for their preservation.

An arcade cabinet is a host shell for the PCB board, and adds a level of atmosphere and immersion to the game that is difficult to recreate outside of the screen. At the most basic level, these enhancements amount to cabinet artwork and an illuminated title marquee. At the premium end arcade games resemble simulators, adding enhancements such as hydraulics and force feedback.

RECREATING THE ARCADE CABINET IN THE DIGITAL SPACE

As an employee of Sega Japan, Yu Suzuki was responsible for the several of Sega's arcade hits, including *Hang On* (1985), *Afterburner* (1987), *ThunderBlade* (1987), and *Out Run* (1986). The cabinets featured simple stand-up (SD) and also sit-down deluxe (DX) models. The deluxe models of these videogames brought a substantive level of aesthetic polish to their cabinet appearance. For instance, the deluxe model of *Hang On* is a 500lbs reproduction of a Ducati motorcycle, which the player must lean left and right upon to steer. Suzuki's emphasis on the physicality of the arcade game recognises the cabinet is the most immediate part of an arcade videogames appeal to prospective customers. Yu Suzuki recreated several of his arcade videogames in virtual space in the pioneering sandbox world game series *Shenmue* (1991, 2001) on the Sega Dreamcast console, including the aforementioned *Hang On* and *Out Run*, in addition to *Space Harrier* (1985). The player can inspect the cabinet forms and artwork from different angles, simultaneously sampling the ambience of a 1980s Japanese arcade amusement center.

When playing the arcade games in *Shenmue*, the viewpoint moves from third person to transplating the diegetic space of the *Shenmue* arcade game onto the Dreamcast screen space.

This virtual arcade monitor evolves in *Grand Theft Auto: San Andreas*. *GTA:SA* embraces the CRT medium, showing its

curvature and surrounding plastic bezel. *GTA:SA* modder ThePaddster has modified the coin-op textures from San Andreas, reskinning them with art from Bally Midway's *Mortal Kombat* (1992). Unfortunately the modification doesn't alter the subgames, but is an interesting tangible step on the way towards a customisable, virtual arcade.

Capcom's *Mega Man II* uses a touchscreen interface style common to mobile and tablet conversions of arcade and console titles, surrounding the emulated NES game with a graphical arcade cabinet facade, including controller and marquee. This style is an incremental 'zoom out' compared to *GTA:SA*.

CONSIDERATIONS IN PROTOTYPING A VR ARCADE MACHINE EMULATOR

The alpha build of VRAME (VR Arcade Machine Emulator) demos an arcade emulation style that considers the complete materiality of the arcade videogame, as well as the cultural rituals of arcade videogaming and maintenance. By using a VR headset, the player can change perception and take momentary glances outside of the diegetic screen space, to look not just at the screen and complete structure of the cabinet, but also the surrounding environment.

The ComputerSpeilMuseum in Berlin has a *Pong* (1971) cabinet fitted with plexiglass so that visitors can view the circuitry of the machine, since the electronics are as noteworthy a part of the interface as the controls and feedback. A complete VR arcade cabinet simulator should include an option to view the cabinet's internal structure. This internal provides an operator level interface, and demystifies the internals of the arcade machine. It also provides an historical and technological document to enable people to understand the machine hardware.

In an exhibition setting, the VRAME installation consists of a minimal pedestal containing a harness for the VR headset along with a control panel using physical game controls. A square outline on the ground is used to reflect the immaterial object now built in virtual space. The second option is removing the controls, instead using a wireless gesture capturing to register collisions with the 3d control panel. Both options have pros and cons. Gesture-based interaction keeps the control system in a malleable, ethereal digital state. On the other hand, the analogue controller adds a grounded, solid, real, yet distant link between the player and the cyber arcade cabinet.

BIOGRAPHIES

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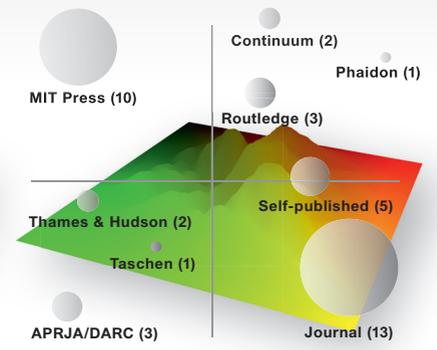
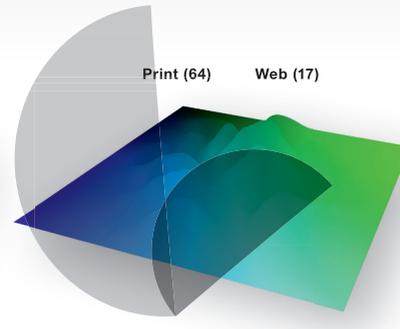
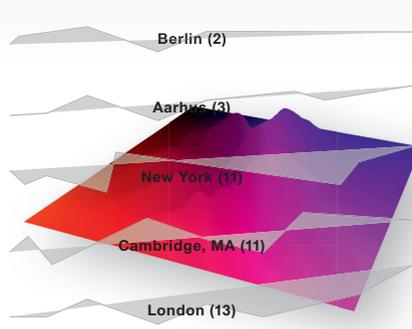
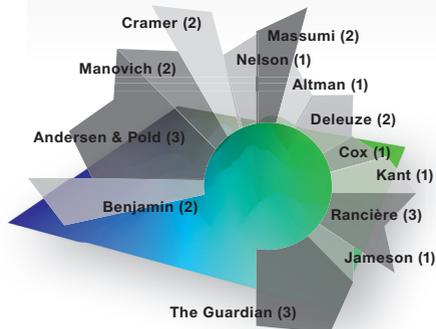
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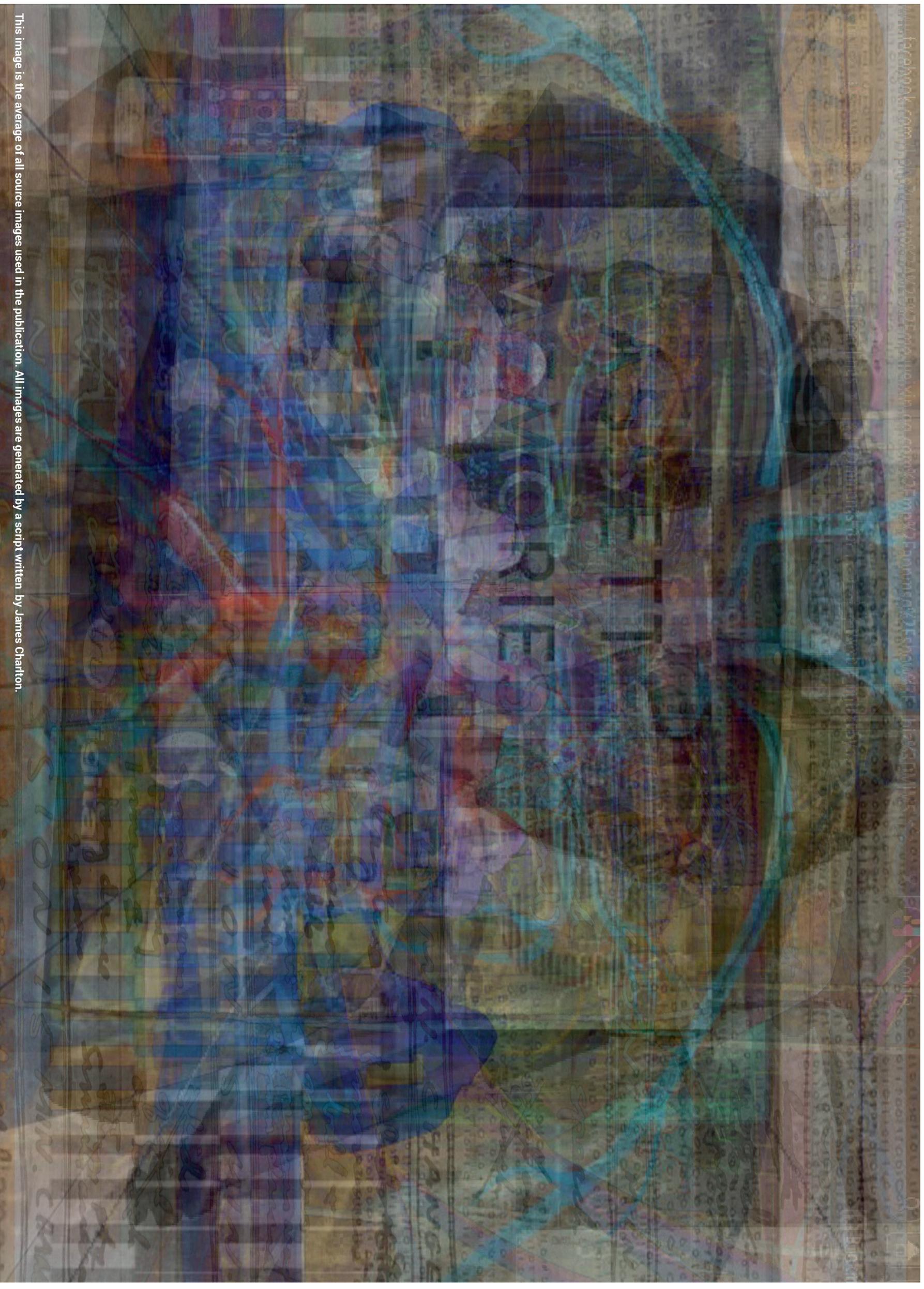
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