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Performing Apps: Touch and Gesture as Aesthetic Experience ^[1]

Maria Engberg

Blekinge Institute of Technology, Sweden

As my finger touches and traces the surface of the iPad, a line appears. The background is shimmering with moving letters in various shades, from white to dark grey. The line attracts letters that fly across the black screen to follow my finger and form sentence fragments along the way. As I trace the letters, I try to read, switching from one direction to another to put the letters in the right reading order. A string of letters and words appear: 'TE TO SPEAK OF IT'. As soon as I lift my finger, the line disappears and the tethered letters float freely again. This is Speak, (2007-2013) a touch-based work on the P.o.E.M.M platform released for download via iTunes and accessible on an iOS device. Jason Edward Lewis and Bruno Nadeau, the people behind Speak and also involved in the Concordia University Laboratory for Experimental Media (obx labs) explain their work:

[we are] interested in living letterforms, massively multi-contributor texts and time-travelling provocateurs. We create artwork that utilizes and motivates the software that we develop and the technologies we repurpose. Our main goal is to provide both the inspiration and the means for others to push the boundaries of computationally-based expression. (obx 2013)

Speak is one of several works that the obx labs have created for the Poetry for Excitable [Mobile] Media platform, or P.o.E.M.M. All the poems were written and designed to be read on touch devices, from large-scale exhibition surfaces to mobile screens. The exploration of touch as the main mode of interaction with a poem is described by the lab's researchers and creators as 'creating work that consciously exercises different affordances of the digital media environment as core components of the meaning-making dimensions of the texts' (P.o.E.M.M 2013). The invocation of living letterforms suggests a strong emphasis on the performativity of the interface and interaction; these are works that come to life through the performance between the material and the user. The work can be aligned with media literary arts, and more specifically digital literature, but the group's work is also engaging a fraught topic of concern for art and aesthetic experiences more generally: what is the value of touch as a performative move and as the principal sensory gateway to an aesthetic experience?

This essay poses that question in relation to contemporary media applications, specifically created with aesthetic experiences in mind. The essay also explores that perceptual moment in which a digital touch interface is used by a user, and ultimately what path to experience and knowledge these digitally mediated touch interfaces offer. By juxtaposing a series of descriptions of the/my experiences of touch-based iPad applications on the one hand, and theoretical explorations of touch in art history, media studies and philosophy on the other, I sketch out the contours of an aesthetics for gesture and touch apps on smart phones and tablet computers. The ubiquity of digital touch interfaces prompts a rethinking of multimodal performative writing and its perception by an audience. The interaction with touch interfaces creates a responsive feedback loop, an event that moves towards the performative. The action required from the reader or user of these works is necessary for the works' aesthetic potentiality to reveal itself, and for the aesthetic experience to truly occur. The works not only explore the affordances of digital media for literary artistic works, but also explore the aesthetic dimensions of what are still primarily commercially oriented media platforms.

Touch interface works such as Speak invoke a dual sense of aesthetics. First, aesthetics as experiencing an artistic, creative, beautiful or sublime work. This understanding of aesthetics relies of course on the tradition since Alexander Gottlieb Baumgarten's reconfiguration of aesthetics as taste or sense of beauty (Hammermeister 2002: 7). Baumgarten subsumed the Greek understanding of *aisthesis* as sense perception and cognition into a theory of art. Despite the efforts since then, by for instance the American pragmatist John Dewey's 1934 *Art As Experience*, the notion of aesthetics as a theory of art has dominated cultural theory. Parallel to theories of aesthetics, theorists of media have articulated the ways in which our senses, cognition and bodies are engaged when we use various media technologies. 'Experience' is often foregrounded. Walter Benjamin argued in "The Work of Art in the Age of Mechanical Reproduction," that various media change the way people perceive the world. For Benjamin newer reproductive media of photography and film did not retain the auratic qualities of painting, and therefore changed the sense perception of its viewers. Marshall McLuhan famously argued that media were all extensions of human senses and physical faculties. McLuhan's concept of medium extended far beyond what is conventionally understood as forms of mediated communication to include any technology that modifies our perception or ability to affect the world: guns, trains, roads, electric light. Touch, for McLuhan, is intimately connected with the 'electric age' and for McLuhan the ultimate medium which invoked all senses at

once, particularly tactility, was television. The television image exerts, McLuhan argued, 'a unifying synesthetic force on the sense-life of [...] intensely literate populations' (McLuhan: 315). Synesthesia is for McLuhan the combination or fusion of senses that certain media, particularly electronic ones, invoke in us. McLuhan's understanding of the tactility of television was wholly based in the kinds of visual experience it brought to its audience. This brings us, however, to the current configurations of media -- digital technologies that function as media platforms and that do offer tactile experiences. In digital media studies theorists have offered different articulations of how we use digital media and in turn what they invoke in us as we do. After the initial domination of metaphors of virtuality, such as cyberspace, there has been a return to appreciating the material configurations and impact of digital technologies. N. Katherine Hayles described, 'the materiality of an embodied text is the interaction of its physical characteristics with its signifying strategies' (Hayles 2010: 103). Even more so, the reader is implicated in a work's materiality through engagement with the text; a materiality that Hayles herself has remarked is 'an emergent property [that] depends on how the work mobilizes its resources as a physical artifact as well as on the user's interactions with the work and the interpretative strategies she develops' (Hayles 2002: 33). Digital media bring those emergent and continuous processes into particular focus.

There is a soothing rain in my ears; raindrops and small bells emanating from my device. The image on the screen of a grey-bluish sky have me imagining that I am lying on the floor underneath a skylight, looking up at the sky. The rain falls on the window. The drops stay for a second before disappearing. The sound of rain melds with the music, tender plucking on guitar strings. If I touch the glassy surface with my fingers the rain falls heavier. The sound grows and overwhelms the music. Another touch makes it stop; only a few drops falling, becoming almost still. When I tap vigorously with several fingertips on the screen the sky shifts in color. Squares appear and an airplane flies overhead. Even more tapping and the music that plays competes with the sounds of the rain in dissonance and assonance. I start to feel uneasy, tapping quickly the sounds become haunting and the rain threatening. Another airplane crosses my line of vision, this time flying too close, just over head. Its roaring engines interrupt the rain, then it all dies down again, and I hear just the rain falling and soft music. *Strange Rain* was designed and developed by Erik Loyer and released in 2010 as an app for Apple touch devices by Opertoone (a studio founded by Loyer, devoted to creating interactive entertainment). The interaction with the touch and motion interface is key to Opertoone's applications. *Strange Rain* defamiliarizes

the screen that you have become accustomed to handling, so the more you touch the stranger the rain and the skies become: 'Before your eyes and beneath your fingers, the familiar becomes strange, and the strange, familiar' (Operto 2010).

I have argued elsewhere (Bolter et al 2013) that a re-articulated sense of aesthetics is needed in order to fully apprehend the complexity and performativity of contemporary media environments. One that properly accounts for the multimodality and multi-sensory engagement that these environments call upon is properly accounted for. The dialectic between the interface design and the engineered interaction of the device, in these cases smart phone and tablet touch screens, extends to the user who through sensory engagement -- gestures and touches -- performs the interaction. The moment of contact moves even beyond 'before your eyes and beneath your fingers' to the sounds of the application and movements of the device itself.

Jonas Löwgren has called for interaction designers to pay attention to what some of these aesthetic experiences do. Löwgren suggests that an attention to aesthetics (as in beauty and perception) can help designers create pliable, fluid and rhythmic interaction. He articulates four concepts for interaction aesthetics (pliability, fluency, rhythm and dramaturgical structure). These suggest particular dimensions of the aesthetic, that is, perceptual and experiential qualities that emerge in the performance of the interaction that has been designed. In his analysis of one of his examples, the generative music application Bloom by Brian Eno and Peter Chilvers, Löwgren suggests that its main interactive element -- the tapping on the screen -- produces a 'rhythmical, repetitive and incremental' experience that can be used as a basis for understanding the design, rather than the conventional use of a design genre or technology (Löwgren 2009: 135).

The mobilised resources of the iPad and iPhone that are particularly important for a work like Speak, Strange Rain or Bloom, then, are touch and gesture. Modern smartphone and tablet users have two main input modalities (apart from physical buttons): users can tap or gesture on a touch-sensitive screen, or they can move the smartphone in physical space and so activate accelerometers or gyroscopes (Negulescu et al. 2012). In his Macworld San Francisco 2007 Keynote Address, Steve Jobs called the touch interface of the iPhone magical, and as each new Apple device was launched the visual and haptic features of the touch technology were improved. The immersive experience that Jobs foregrounded as key to the interaction design and user experience is not just a concern of Apple. Mobile devices are already considered to be highly personal -- and personalized -- devices that we can carry with us. With touch interfaces, media technologies are not just

personal but promise to become intimate. The alluring and directly responsive interface hides of course hi-tech machinery and while the promise is that of an immediate and immersive experience, it is nevertheless a mediated one. While the technology behind devices such as the iPad and iPhone is certainly complex, the relationship with their content seem to most users fluid and seamless. Interaction designers work hard to make smoothness a defining feature, or as Djajadiningrat et al. put it: 'Don't think beauty in appearance, think beauty in interaction.' (2000: 132).

At an aesthetic or literary level, the design for digital media has been characterized as complex. John Cayley, a poet and author of digital media, calls it a potential writing on 'complex surfaces' (Cayley 2005). Cayley notes that 'practices of writing find themselves constrained by at least two embricated cultural formations: institutions of authority governing publication and traditionally perceived characteristics of language-as-material' (n.p.). These cultural formations are not eliminated in digital media contexts; on the contrary, there are strong institutional and economic reasons for established conventions to find their way into newer media forms. That can explain why, to the lament of many digital media theorists, digital writing is by and large still seen as digitized text formats that resemble the printed book but now permit quicker and economically advantageous distribution through various e-book formats. The age of print, and the current moment of a late age of print (Bolter 2001, 2) is a visual age. Despite Martin Jay's claims regarding the assault on the visual by critical theory in the 20th century (Jay 1993), literary criticism largely understood text as apprehended by the visual sense. Reading was visual and, if recognized at all, only marginally tactile. The digital offers a more complex understanding of the tactile, even the visuo-tactile, different from the notions of the feel of a printed page or binding of a book. However, the aesthetic possibilities of a complex writing surface -- with its animated, tactile and sonic capabilities -- are a potential to be explored, not an inherent ever-present quality of any one medium's affordances.

The role that tactility plays in a medium is viewed differently in art history than in interaction design or media theory. Art theory and history have long viewed touch as an inferior mode of aesthetic experience; Panofsky maintained that modern knowledge is predicated upon the eradication of touch from artistic, scientific and philosophical practice (1991). Although his view is challenged today, touch is still, as Fiona Candlin has argued, an adjunct to vision as critical engagement (2010). As Geraldine A. Johnson notes, focusing on Italian sculpture, tactility was for many early influential art historians an abstract concept, and figures such as Alois Riegl and Heinrich Wölfflin 'investigated the

tactile qualities of sculpture or painting; “tactile values,” but not touch as an actual physical practice’ (Johnson 2011: 60). For art history, actual touch turns an aesthetic experience into an un-aesthetic, primitive experience. Touch turns the experience away from the distal senses of vision and hearing to the proximal senses: touch, taste, and smell. More recently, Laura Marks has analyzed mages that invoke tactility, but not actual touch, reconfiguring Deleuze and Guattari’s concept of ‘haptic visuality’ (2002, xis). Accurately critiquing earlier theories of aesthetics for relying on distance (seeing or hearing) when determining beauty in objects, Marks foregrounds instead the proximal senses -- touch, taste and smell -- in her analyses. She argues that these senses are not only hedonic, serving pleasures, but can also be senses of knowledge, vehicles of beauty and ethics (Marks: 2008). Aesthetics as aesthesia: the perception of the world of objects without an a priori judgment regarding the validity or quality of the sense through which the perception comes. Even so, many of the examples in Marks’s arguments in *Touch* (2002) are visual, albeit with strong invocations of tactility, such as the video art and films by Sadie Benning and Ken Jacobs. While the metaphoric distance is reduced, these examples are visual first, tactile second, and do not at any point actually offer a perceptual moment of touch. [{note}]²

Fiona Candlin reminds us, in her discussions regarding touch and museum exhibitions, that the touching of aesthetics objects, often sculptures, are allowed for visitors who are blind or visually impaired (Candlin 2006, 2010). These permitted moments of touch use touch as a way of seeing, first. The rule is to not touch, and therefore the forbidden touch of a cultural artifact, a painting or sculpture in a museum, becomes more than touch as seeing. (Have you ever secretly touched a sculpture in a museum? I once touched a Raymond Duchamp-Villon sculpture, ‘Le cheval majeur’. The empty rooms of an early Wednesday morning became an invitation to a forbidden, private exploration, a quiet dialogue with those wondrous shapes of stone, bronze, and plaster. In an unwatched moment, I walked toward the sculpture, determined to touch it en passant. I could feel my hand hanging unnaturally still by my side, the fingers stretching out to meet the surface of the blackened bronze. How thrilling to let the tips of my fingers trace along its cool, smooth surface for just a few seconds! My eyes however were diverted, concentrating on everything else around me to detect if someone was watching. But really my whole physical being was focused on that touch, that momentary link between the sculpture and me, between its cool metal and my warm skin. All the dimensions of touch came into relief: a proprioceptive awareness, my sense of balance, the movement of my fingers across the

surface, perceptions of texture, pressure, temperature travelled through my body.) Candlin, again, foregrounds the potential of touch in such setting and echoes my experience: it is not a question of 'a static contact between our fingertips and a surface' but rather includes rhythm, balance, cadence, pause and so on (Candlin 2006: 150).

Digital images, as opposed to McLuhan's television images, Marks's haptic visuality, and the cultural objects put out of our reach, can be manipulable interface objects. Media theorist Lev Manovich argued in 2001, before the impact of mobile devices with touch interfaces, that "*new media turn most images into image-interfaces and image-instruments*" (Manovich 2001: 183), which implies a touching and handling of those images, rather than just passive viewing. As Bill Buxton, interaction designer, poignantly has shown, despite their haptic nature, touch interfaces rely on the combination of "look *and* feel" in which the former is still a condition for the latter.³ There are applications that try to shift that design adage toward combinations of sound, image, touch, and gesture.

Biophilia (2011) is an iPad multimedia application/music album by Icelandic artist Björk in collaboration with, among others, designer Scott Snibbe. The app opens up to an interactive image of a cosmos with star constellations that each houses one of the ten songs along with various multimedia animations and instruments. The listener must now explore the interface by spinning and turning through touch the graphics on the screen. Sounds are linked to touch and experiencing the album becomes a journey of exploration of a peculiar universe that is in keeping with the aesthetic that Björk has become known for in her music, music videos and performances. 'Biophilia' means 'the passionate love of life and of all that is alive' (known from psychoanalyst Erich Fromm's work) and centres around the notion that 'humans possess an innate tendency to seek connections with nature and other forms of life' (biophilia hypothesis 2013). Experiencing *Biophilia* means exploring an unknown interface along with unusual naming conventions. For instance, pressing 'play' on an interim screen does not play Björk's songs but rather opens a visuo-sonic instrument in which you play the notes of a particular melody on the images that have been chosen to accompany it. The result is an unfamiliar environment that both invite and challenge the user/audience of Björk's music. 'Crystalline' is one song/environment. Choosing to 'play' you enter into a game-like space where you are invited to catch crystals by tilting the device back and forth. Björk's lyrics link to the action you are engaged in: The line 'Listen how they grow' is repeated but the rhythmic interaction with the iPad app transforms the listening to movement, sight and sound, as the tunnels and crystals appear

before you and 'your' crystal begins to take shape, as you catch more and more image forms. The user's gestures, and touch in other parts of *Biophilia*, build new image constellations, explore sound patterns and invite us to think about a music album as a multi-aesthetic space that we are part of, reacting to and with rather than only receiving. The name, *Biophilia*, becomes a metaphor for the organic design and interaction of the application, invoking life, intimacy and co-creation between artist and audience.

Digital image forms (this time as letters), sounds and playability are key elements of Austrian sound artist Jörg Piringer's Apple device application *abcdefghijklmnopqrstuvwxyz* (2010). Calling it a 'sound toy', a 'performance tool' and an 'art work', Piringer, too, emphasize the multiplicity, complexity and sensory importance of aesthetic touch apps (Piringer 2010). The simple interface allows you to drag letters onto a central white space where they begin to sound and move. As the letters bounce and move, they leave visual and sonic traces across the screen. The user can manipulate their trajectory by tilting the device, and play with combinations of letters and their sounds. Playful and performative, *abcdefghijklmnopqrstuvwxyz* echoes concrete and visual poetry traditions, generative art, digital poetry and sound art. The difference in the application is, then, the user's ability to play (with) the work which becomes a framework of potential performances or moments of the work.

In electronic literature, the idea that the interactive digital text is experienced like an instrument to explore was first introduced about a decade ago. John Cayley suggested, in 2005, that 'we are currently writers trying to build relatively simple textual instruments that are intuitive and, hopefully, both affective and significant when they are played. I mean played as musical instruments or sequencers or mixers are played' (Cayley 2005). The notion of play that Cayley invokes, a performance as in performing on and with an instrument that requires knowledge and training, suggests a moment in which the parameters of engagement are specific and purposeful, yet provide a framework for a number of different experiences.

Moving from one kind of play to another, the multi-sensory touch interfaces also connect to another dimension concerning touch which is often evoked in art criticism (albeit then in a negative sense) namely sensual or erotic dimensions. There is certainly a sensual quality to the commercial invitations to touch these media devices. The recent key tag line of advertisements for various Apple products, such as the iPhone and iPad, has been the most direct: 'Nothing comes between you and what you love' (Apple -- iPad 2013). The promised immediacy lends a sense of intimacy and open up possibilities to reconfigure other habits we have learned over the years with GUI interfaces, icons, and

mouse movements. Sensual images that overtly promise but cannot deliver touch are of course found across the digital visual landscape, from advertisements and commercial websites to erotica and pornographic images. As one consumes such images, unable to touch what they invite us to touch, the experience can become a hunt, a frenzied search for images that in the onslaught of consumable and endless chains of similar imagery becomes an almost undefinable blur; an ever-replaceable series of image variants that both give and defer pleasure. The suggestion that “nothing comes between you and what you love” is only strengthened in images that reside on touch devices. Despite Apple’s promise, the experiences of touching a photo on an iPad or making a video call with a loved one are of course mediated, shaped by design and technologies. Are these interfaces our technological relics, whose closeness (as in familiar, intimate or even sensual) we crave, for salvation, for rapture? And yet, as touch interfaces multiply and we become habituated to their use, there remains a difference between merely watching an image and actually using your hand to manipulate a surface and receive an immediate response in the digital image you touch. Responsive, a performing under the touch of a fingertip, or the light touch of a swipe of several fingers across a glassy surface makes a sensual, perceptual, difference. The question becomes for the designer and the artist how to work with (or against) the potentiality of that perceptual, or as I have put it, polyaesthetic moment. The immediacy that can occur is different than that of Alberti’s notion of a transparent window onto the world, the lure of non-mediated vision through painting. These tactile interfaces suggest a different, tactile immediacy that allows us to touch the medium itself, even as we focus on whatever it mediates.

The apps that this essay analyzes point toward aesthetic explorations that push at definitions and institutional characterizations of genres such as the music album or the visual poem. More importantly, they exemplify a changing relationship between the aesthetic artifact and the event it stages for its audience, an event that is perceived -- and received -- primarily as performative. Consequently, the apps should be addressed as sensory, intellectual, and aesthetic experiences rather than genre-specific digital artifacts, such as games. These touch apps that are partly designed in line with the interaction capabilities and limits of the device manage to extend the definition of the experience and use of the touch interface through their aesthetic explorations. They are, or perhaps more accurately create, performances that give each user at each separate moment a distinct experience -- a perceptual and creative event, at times musical, textual, visual or gestural, most often all of those things at once. McLuhan’s synesthesia gives way to poly-aesthesia,

and to polyaesthetics. The touch interfaces set up complex and multiple sensual relationships that are of course visual but also tactile and proprioceptive. They are mediated as well as immediate -- we are touching interfaces, perhaps even code, as much as we are touching glass after all.

Notes

1 An earlier version of this essay was presented at the ELMCIP seminar 'Digital Textuality with/in Performance' on May 3, 2012, at Arnolfini Bristol. I thank the other seminar participants, in particular Jerome Fletcher, Alexandra Saemmer and cris cheek for their input. Many thanks to Jay David Bolter for extensive comments on earlier drafts.

2 Marks notes the difficulty in writing about synesthetic experiences, asking: 'How can the experience of a sound, a color, a gesture, of the feelings of arousal, anxiety, nausea, or bereavement that they evoke, be communicated in words? They have to be translated. Like synesthesia, the translation of qualities from one sense modality to another, writing translates particular embodied experiences into words' (Marks 2002: ix). And like Marks, I too have to rely by necessity on verbal description, sensory translations of the sorts of experiences that my examples offer.

3 Bill Buxton (Buxton 2013) points out a series of consequences of this dominance of vision over touch regarding touch interfaces' functionality. Apart from the obvious that you need to see what it is that you are touching in order to know what you are doing, there are other consequences such as your finger obscuring small design details on the screen as you try to operate it, and the fact that we are generally not used to using our finger as a stylus for note taking, writing, or, after early childhood, even drawing.

References

Apple -- iPad. <http://www.apple.com/ipad/features/> Accessed 10 May 2013.

Benjamin, Walter (1999 [1955]), 'The Work of Art in the Age of Mechanical Reproduction' in *Illuminations*, London: Pimlico, pp. 211-244.

Björk (2011) *Biophilia* <http://www.bjork.com/#/past/discography/biophilia> Accessed 12 July 2013.

- 'biophilia hypothesis' *Encyclopædia Britannica Online* (2013)
<http://www.britannica.com/EBchecked/topic/1714435/biophilia-hypothesis>. accessed 20 March, 2013.
- Bolter, Jay David, Engberg, Maria and MacIntyre, Blair (2013) 'Media studies, mobile augmented reality, and interaction design', *interactions* 1 (January and February 2013): 36--45.
- Bolter, Jay David (2001) *Writing Space: Computers, Hypertext, and the Remediation of Print*, Mahwah: Lawrence Erlbaum Associates.
- Buxton, Bill (2013) 'Multi-Touch Systems That I Have Known and Loved',
<http://www.billbuxton.com/multitouchOverview.html> 19 March 2013. Accessed 10 May 2013.
- Candlin, Fiona (2006) 'The Dubious Inheritance of Touch: Art History and Museum Access' *Journal of Visual Culture* 5: 137--154.
- Candlin, Fiona (2010) *Art, Museums and Touch*, Manchester: Manchester University Press.
- Cayley, John (2005) 'Writing on Complex Surfaces' *Dichtung Digital* 2: n.pag.
<http://www.dichtung-digital.org/2005/2/Cayley/index.htm>
- Dewey, John (2005 [1934]) *Art As Experience*, New York: Penguin Books.
- Djajadiningrat, J.P., Overbeeke, C.J. and Wensveen, S.A.G. (2000) "Augmenting Fun and Beauty: A pamphlet", in *Proceedings of Conference on Designing Augmented Reality Environments (DARE 2000)*, New York: ACM: 131-134.
- Hammermeister, Kai (2002) *The German Tradition in Aesthetics*, Cambridge: Cambridge University Press.
- Hayles, Katherine N. (2002) *Writing Machines*, Cambridge: The MIT Press.
- Hayles, Katherine N. (2010) *My Mother Was a Computer: Digital Subjects and Literary Texts*, Chicago: University of Chicago Press.
- Hayles, Katherine N. (2012) *How We Think: Digital Media and Contemporary Technogenesis*, Chicago: University of Chicago Press.
- Jay, Martin (1993) *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought*, Berkeley and Los Angeles: University of California Press.
- Johnson, Elizabeth (2011) 'The Art of Touch in Early Modern Italy' in Francesca Bacci and David Melcher (eds) *Art and The Senses*, Oxford: Oxford University Press, pp. 69-84.
- Lewis, Jason Edward and Nadeau, Bruno (2012) *P.o.E.M.M.* <http://www.poemm.net>
Accessed 11 May 2013.

- Löwgren, Jonas (2009) 'Toward an Articulation of Interaction Esthetics' New Review of Hypermedia and Multimedia 15.2: 129--146.
- Manovich, Lev (2001) The Language of New Media, Cambridge: The MIT Press.
- Marks, Laura (2002) Touch:Sensuous Theory and Multisensory Media, Minneapolis: University of Minnesota Press.
- Marks, Laura (2008) 'Thinking Multisensory Culture' Paragraph, 31.2: 123--137.
- McLuhan, Marshall (1994, 1964) Understanding Media: Extensions of Man, Cambridge: The MIT Press.
- Negulescu, Matei, Ruiz, Jaime, Yang Li, and Lang, Edward (2012) 'Tap, Swipe, or Move: Attentional Demands for Distracted Smartphone Input', AVI 12 Proceedings of the International Working Conference on Advanced Visual Interfaces:173--180.
- obx (2013) obx laboratory for experimental media <http://www.obxlabs.net/> Accessed 11 May 2013.
- Opertoona (2010) <http://opertoona.com/2010/11/strange-rain-for-ipad-iphone-ipod-touch/> Accessed 10 May 2013.
- Panofsky, Erwin (1991[1927]) Perspective as Symbolic Form. New York: Zone Books.
- P.o.E.M.M. (2013) <http://www.poemm.net/about/research.html> Accessed 11 May 2013.
- Piringer, Jörg (2010) abcdefghijklmnopqrstuvwxy
<http://joerg.piringer.net/index.php?href=abcdefg/abcdefg.xml> Accessed 11 May 2013.