AN-ICON

The haptics of illusion: an account of touch across theories, technologies and museums

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Haptic
Technology
Illusion
Virtuality
Museums

AN-ICON
Studies in Environmental Images

Issue №2 Year 2022

→ Just an illusion? Between simulation, emulation, and hyper-realism

Edited by Pietro Conte and Lambert Wiesing

The haptics of illusion. An account of touch across theories, technologies and museums

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https://doi.org/10.54103/ai/17297

Abstract

Touch represents one of the latest and most complex frontiers of virtuality: a sense which historically seems to have carried the burden of proof on reality, by definition resistant to illusory environments. The paper begins from this assumption to trace a history of illusion across authors and theorists that have debated the statute of haptics, building a dialogue between philosophical dilemmas and technological developments. Moving both from an aesthetic and psychophysiological viewpoint, the article will root its analysis in an historical-artistic account, augmenting the discussion with a series of case studies from the museum sector. The introduction of haptic technologies within cultural institutions, which dates back to the last three decades, proves an interesting field to test the functions which touch plays in both educational and imaginative scenarios. The open question being whether modern technologies should aim at replicating haptic realism in miming phenomenological accuracy, or whether the most innovative applications need to aspire to a more environmental employment of touch.

Keywords Haptic Technology Illusion Virtuality Museums

To quote this essay: V. Bartalesi, A. Calise, "The haptics of illusion. An account of touch across theories, technologies and museums," *AN-ICON. Studies in Environmental Images* [ISSN 2785-7433] 2 (2022): 133-161, https://doi.org/10.54103/ai/17297

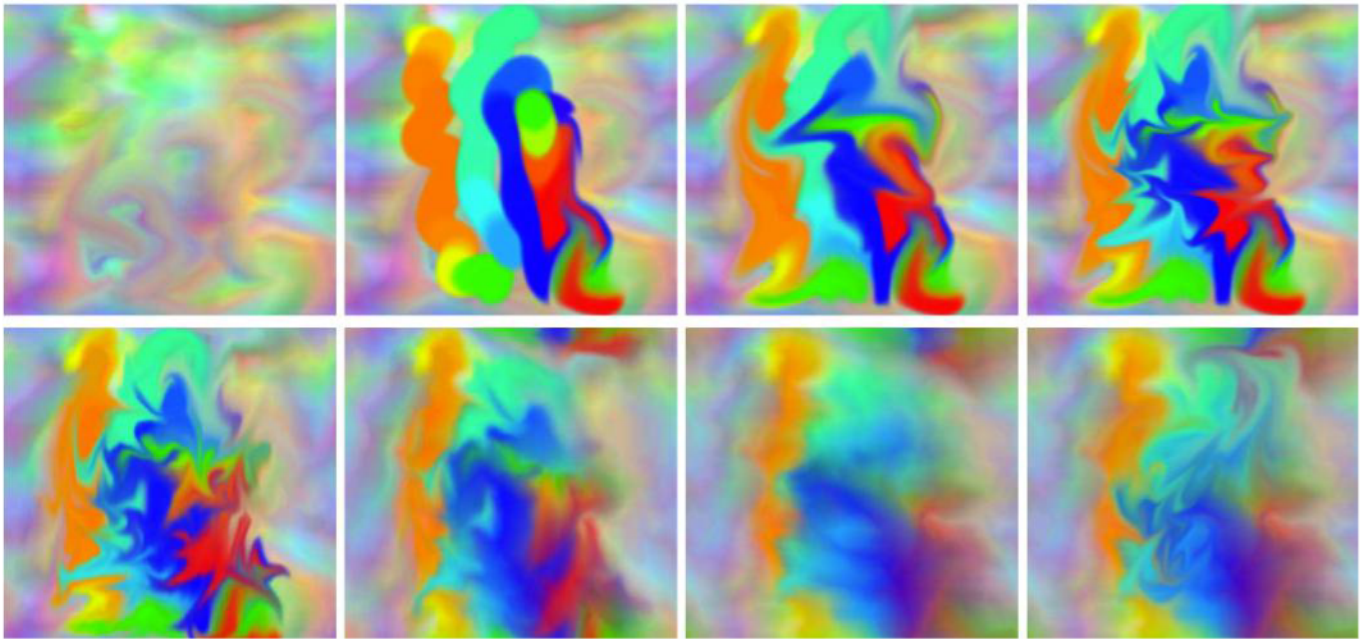

Fig 1. Creation of a new style of media art using digital paints in a harmonization of the senses of vision and touch.

It seems that we have so often been warned not to touch
that we are reluctant to probe the tactile world even with our minds.
Constance Classen
The Deepest Sense. A Cultural History of Touch, 2012

Introduction

In his *Post-Scriptum* addendum, alongside his monumental survey on the polysemy of touch in Nancy through the history of Western philosophy, Derrida denounced a widespread prejudice whereby "one spontaneously has the tendency to *believe* that touching resists virtualization."[1] Through this acute remark, the French philosopher underlies a consolidated *topos* that attributes to the sense of touch the ability to convey a direct and objective knowledge of the things of the world, captured in their physical and even theoretical dimension.[2] By questioning the supposed identity relationship between touch and objectivity, the author opens a new perspective on the subject, widening the ways in which the world of haptics could be conceptualized and practiced. For the purpose of the

1 J. Derrida, *On Touching – Jean-Luc Nancy* (Stanford: Stanford University Press, 2005): 300.
2 Cfr. J.-L. Nancy, *Corpus* (Paris: Metailie, 1992): 76; M. Paterson, *The Sense of Touch: Haptics, Affects and Technologies* (Oxford: Berg, 2007): 2-3; C. Classen, D. Howes, *Ways of Sensing* (New York: Routledge, 2014): 89; A. Gallace, C. Spence, *In Touch with the Future: The Sense of Touch from Cognitive Neuroscience to Virtual Reality*, (Oxford: Oxford University Press, 2014): 3.

argument presented here, Derrida's considerations prove pivotal: the aim will be to try and deepen his assumption, investigating the relationship between illusion, haptic perception and works of art. Addressing the possibility that both the theory and practice which anticipate and guide haptic experiences and technologies account for an illusory character, escaping the grounds of undeniable certainty and adherence to reality which are at times linked to the discourse on touch.

This study will in fact envisage the possibility that illusion imposes itself as a constitutive figure of haptic feeling both on a theoretical level and on a technical one. The research will focus on how the experience of touching plastic objects changes from the analogical dimension to the digital one, first from a theoretical point of view and then across a range of case studies within the museum sector. In the peculiar phenomenon of touching sculpture in a virtual environment employing haptic devices, the *illusion* changes its function: before a theoretical figure, it becomes an experiential strategy. Not necessarily aimed at generating a phenomenological surplus, which as we will see most technologies are not able to offer, but at offering the possibility of a semantic shift on an emotional and aesthetic level. The study will begin with an assessment of Derrida's theorizing on the haptic and on virtuality, highlighting the inherent illusory character that seems to be shared by both virtual haptic museological experiences and the theorizing of "haptic" itself, a link captured by the author already in his work *On Touching*. While borrowing from Derrida the relevance of museum practices as case studies for the discussion on the haptic, this article will however assess evidentiary accounts in the second section of the text. Before addressing the case studies, it was deemed necessary to elaborate two relevant premises. On the one hand, a thorough account of haptic technologies and of the current theoretical issues that guide their design will be presented, with reference to the challenges posed by haptic illusions. On the other hand, a historiographic account of the fundamental role that the concept of illusion

has played in the theorizing of the haptic discourse will be offered. Through this analysis, we aim to hopefully demonstrate the structural role played by the figure of illusion in both theoretical and technological designs, strengthening the rationale which serves as the guiding principle of the discussion at hand. The second section, following Derrida's intuition and using museological haptic technologies case studies, will try to assess how these premises relate to the cultural offer available to the public. Beginning from the relationship between touching and cultural artifacts, and more specifically sculptures, which has played a central role in both philosophical and museological undertakings, a history of touch in museums will be briefly traced, connecting contemporary endeavors to their historical predecessors. Then a series of relevant case studies will be presented, trying to understand, by looking closely at their design and reception, what aspect of the haptic experience they aimed to leverage on, and therefore which epistemic and experiential qualities were privileged. It will emerge that when museums are trying to reinstate the evidentiary nature of the haptic experience, and focus on mimicking a reductive understanding of the phenomenology of touch, the results might be scientifically interesting yet not experientially powerful. By contrast, when the more evocative and illusory qualities of the haptic are investigated, exploiting a more environmental and multifaceted account of the haptic experience, a new and promising use of haptic technologies is possible.[3]

"Tact beyond the possible:"[4] illusion as a figure of the haptic between historiography and psycho-aesthetics

The teleological value of the human hand as a pro toto organ of the sense of touch is a recurring trope in the history of philosophy, from Kant, through Herder, de

3 Although the paper is the result of a collective research and reflection work made by the two authors, the first section was written by Valentina Bartalesi, the second one by Anna Calise.
4 J. Derrida, *On Touching*: 66.

Miran, Husserl, until Katz, Focillon, Révész, and Gibson.[5] In Derrida's analysis the haptic, assumed as a not *stricto sensu*[6] sense that "virtually" involves the sensorium in its obscure intricacy,[7] is qualified by the peculiar "motor activity"[8] of the human hand. Yet, while recognizing the constitutive motility of this sensory faculty, Derrida refuses such preliminary immediacy, claiming with Nancy its "local, fractal, modal" nature.[9] If these adjectives partially complicate the meaning of touching on an ontological level, they seem to encourage the reflection towards a technical sphere, according to an address that Derrida tries to verify. As a proof of the fragility of a way of thinking that *a priori* denies the possibility of virtualizing touch, the philosopher presents a significant case study for that time: the *Haptic Museum* in California.[10]

In spite of the limited evidence still available with regards to this institution, its mission appears clear. As Margaret L. Mclaughlin of the Integrated Media Systems Center (University of Southern California) states:

> Our IMSC team has used haptics to allow museum visitors to explore three-dimensional works of art by "touching" them, something that is not possible in ordinary museums due to prevailing "hands-off" policies. Haptics involves the modality of touch-the sensation of shape and texture an observer feels when exploring

5 J. Derrida, *On Touching*: 41-42, 95, 122, 140. See in this respect: L.A. Jones, S.J. Lederman, *Human Hand Function* (Oxford: Oxford University Press, 2006): 6; A. Benjamin, "Endless touching: Herder and sculpture," *Aisthesis. Pratiche, linguaggi e saperi dell'estetico 4*, no. 1, (2011): 73-92, https://doi.org/10.13128/Aisthesis-10983; H. Focillon, "Éloge de la main" (1934), in *Vie des Formes* (Paris: Presses Universitaires de France, 1981); G. Révész, *The Human Hand* (London: Routledge & Kegan Paul, 1958); J.J. Gibson, "Observations on active touch," *Psychological Review* 69, no. 6 (November 1962): 477-491, https://doi.org/10.1037/h0046962.
6 J. Derrida, *On Touching*: 53, 149.
7 Ibid.: 42.
8 Ibid.: 142.
9 As noted by: "But there again-and this, too, has to be clear only upon the condition that tact does not concentrate, does not lay claim as Descartes's touching does to the privilege given to immediacy, which would bring about the fusion of all the senses and of 'sense.' Touching, too, touching, first, is local, modal, fractal", J.L. Nancy, *Corpus*: 76.
10 J. Derrida, *On Touching*: 300-301; M.L. Mclaughlin *et al*., "The haptic museum," *Conference: Proc. of the EVA 2000 Florence Conf. on Electronic Imaging and the Visual Arts* (March 2000), https://www.researchgate.net/publication/229433104_The_Haptic_Museum, accessed December 11, 2022.

a virtual object, such as a 3D model of a piece of pottery or art glass.[11]

Although presumably the first example of a haptic museum equipped with exosomatic technologies,[12] Derrida's case includes many factors that have become constitutive in subsequent museological proposals. By interacting with the *PHANToM haptic device*[13] or wearing the exoskeleton glove *CyberGrasp*,[14] at those times futuristic apparatuses, visitors could proceed to the manual exploration of virtual artifacts, digitized by employing 3D cameras such as *ColorScan* or *Virtuoso*.[15] Technically, the "haptic human-computer interaction (HCI)" requires a structural triad composed of "human user, interface device, and virtual environment synthesized by computer."[16] Through "haptic-rendering algorithms,"[17] the device provides specific stimuli arising from the interaction between the "haptic device representation" (the user's avatar) and the

11 M.L. Mclaughlin *et al.,* "The haptic museum:" w.p.
12 Among the twentieth-century experiences, one of the first tactile museum exhibitions dedicated to blind people was organized by The American Museum of New York in 1909. While in the 1970s, numerous worldwide museums realized tactile pathways dedicated to the visually impaired, the first Haptic Gallery was opened by the National Portrait Gallery in Washington D.C. on March 1st 1979, as the Smithsonian Archive documentation testifies. See in this respect: H.F. Osborn, *The American Museum of Natural History: its origin, its history, the growth of its departments to December 31, 1909* (New York: The American Museum of Natural History, 1909): 148; Chronology of Smithsonian History, "NPH Haptic Gallery Opens" (March 1st 1979): https://siris-sihistory.si.edu/ipac20/ipac.jsp?&profile=all&source=~!sichronology&uri=full=3100001~!1462~!0#focus accessed December 11, 2022; Council on Museums and Education in the Visual Arts, *The art museum as educator: a collection of studies as guides to practice and policy* (Berkeley: University of California Press, 1978).
13 Designed by the MIT Artificial Intelligence Laboratory in 1994, "PHANToM is a convenient desktop device which provides a force-reflecting interface between a human user and a computer." Inserting the index fingertip into a thimble or interacting with a stick, PHANToM consists in "a system capable of presenting convincing sensations of contact, constrained motion, surface compliance, surface friction, texture and other mechanical attributes of virtual objects." T.H. Massie, J.K. Salisbury, "The PHANToM haptic interface: a device for probing virtual objects," *Dynamic Systems and Control* 55, no. 1 (1994): w.p.
14 Commercialized in 2009, "the *CyberGrasp* device is a lightweight, force-reflecting exoskeleton that fits over a *CyberGlove* data glove (wired version) and adds resistive force feedback to each finger. With the *CyberGrasp* force feedback system, users are able to feel the size and shape of computer-generated 3D objects in a simulated virtual world." Please see: *CyberGrasp, CyberGlove System*: https://static1.squarespace.com/static/559c381ee4b0ff7423b6b6a4/t/5602fc01e4b07ebf58d480fb/1443036161782/CyberGrasp_Brochure.pdf, accessed December 11, 2022.
15 M.L. Mclaughlin *et al.,* "The haptic museum:" w.p.
16 D. Wang et al., "Haptic display for virtual reality: progress and challenges," *Virtual Reality & Intelligent Hardware* 1, no. 2 (April 2019): 137 https://doi.org/10.3724/SP.J.2096-5796.2019.0008.
17 Ibid.: 141-143.

photogrammetric restitution of the object in a virtual environment (the haptic image).[18] Hence, according to the object-relational data model, users receive tactile and kinesthetic feedback geared towards the stimulation of the mechanoreceptors on the fingertip (for *PHANToM*) and on the whole hand surface (if wearing *CyberGrasp*) during the exploration of the virtual object.[19] More specifically, the subject perceives vibrotactile feedback which should make him or her feel those sensations that are connotative of touching the physical object,[20] absent in its *ilemorphic habitus* albeit realistically tangible in its morphological properties of size, weight, surface, and texture.[21]

Beyond the issues more strictly related to the physiology of the experience, it is here relevant to examine how these researchers have recorded the act of touching a virtual object. Unexpectedly, the members of the Californian IMSC, as well as the French philosopher, feel the need to put in inverted commas locutions such as "touching," "remote touching," or "realistic sensations of touching."[22] The grammatical *escamotage* of the quotation marks clearly betrays the necessity, be it more or less incidental, to denounce the presence of expressions bent to a "special or translated" use. In the technical gesture that the Haptic Museum visitor makes exploring virtual artifacts, Derrida glimpses the theoretical locus where "immediate contact"[23] discloses its own illusory and ontologically fictitious dimension, opening a chasm within the very meaning of touch: ultimately, what is the object of touch? Is this an illusion of

18 K. Salisbury, F. Conti, F. Barbagli, "Haptic rendering: introductory concepts," *IEEE Computer Society* 24, no. 2 (March/April 2004): 25-26, https://doi.org/10.1109/MCG.2004.1274058.

19 P.P. Pott, "Haptic Interfaces," in L. Manfredi, ed., *Endorobotics. Design, R&D, Future Trends* (Academic Press, 2022).

20 Even if, according to Salisbury and Srinivasan "the resulting sensations prove startling, and many first-time users are quite surprised at the compelling sense of physical presence they encounter when touching virtual objects," the improvement of haptic feedback constitutes one of the main purposes of this kind of technology. J.K. Salisbury, M.A. Srinivasan, "Phantom-based haptic interaction with virtual objects," *IEEE* (September/October 1997): 6-10, https://doi.org/10.1109/MCG.1997.1626171.

21 As Derrida notes, describing the above-mentioned experience, "we can thus feel the weight, form, and structure of the surface of a Chinese vase while 'holding' a three-dimensional digital model," J. Derrida, *On Touching*: 301.

22 Ibid.

23 Ibid.

touch or what Madalina Diacuno prefers to define in terms of "illusionary touch"?[24] If so, how to illustrate the phenomenology of such an illusion?

The noun "illusion," from the Latin *illudere* (in, "against," *ludere* "to play"), describes an "act of deception; deceptive appearance, apparition; delusion of the mind."[25] However, in the specialist lexicon on haptic perception the expression "haptic illusion" more rigorously recounts a "disruption of the physical coherence between real movement and feedback forces, used to create the illusion of a non-existent feature or to compensate with the illusion the sensation of an undesired detail."[26] As convincingly established by the critical literature since Révész, several haptic illusions have been codified and are currently under investigation.[27] It should also be noted that a similar illusion, even though different in terms of the neurological reaction experienced with haptic prostheses in virtual environments, is daily negotiated by the user in the interaction with touch screens. The most recent media-archeological studies have investigated this ambiguous nature of "touching," recording the hiatus which systematically occurs when the consumer digitally interacts with the contents that pass through the "display."[28] In this regard, Simone Arcagni has recently pointed out how touch screens solicit a kind of experience "as if there were no longer a mediation between the idea of doing and the action that takes place in our hands" by

24 M. Diaconu, "Illusionary touch, and touching illusions," in A. Tymieniecka, ed., *Analecta Husserliana. The Yearbook of Phenomenological Research. Human Creation Between Reality and Illusion*, vol. 87 (Cham: Springer, 2005): 115-125.
25 "Illusion," *Online Etymology Dictionary*: https://www.etymonline.com/word/illusion, accessed December 11, 2022.
26 M. Grunwald, ed., *Human Haptic Perception. Basics and Applications* (Basel: Birkhäuser, 2008): 649.
27 The main haptic illusions include "size-weight illusion," a tangible version of the "Muller-Lyer illusion," the "horizontal-vertical illusion" and the "Ponzio illusion." See in this regard: M.A. Heller, E. Gentaz, "Illusions," in M.A. Heller, E. Gentaz, eds., *Psychology of Touch and Blindness* (New York-London: Psychology Press - Taylor & Francis Group, 2014): 61-78.
28 F. Casetti, "Primal screens," in C. Buckley, R. Campe, F. Casetti, eds., *Screen Genealogies. From Optical Device to Environmental Medium* (Amsterdam: Amsterdam University Press, 2019): 45; F. Casetti, "Che cos'è uno schermo, oggi?," *Rivista di Estetica* 55 (2014): 28-34 https://doi.org/10.4000/estetica.969. According to Francesco Casetti, touch screens represent the most effective type of display (ibid.: 29), a device that the author links to an instant, "passive" and disengaged communication. Consistently to the current hypertrophic consumption of images, Casetti's display "exhibits, not reveals. It offers, not engages" (ibid.) and this happens because the touch screen "puts images in our hands" (ibid.).

intensifying the sensation of proximity between user and content.[29] Raising attention to the dangers inherent in the automation of touching, David Parisi has introduced the military phrase "Fingerbombing," highlighting the "distanced, detached and destructive" nature of interaction with the touchscreen of a *Nintendo DS*.[30] Furthermore, citing Thomas Hirschhorn's brutal video clip *Touching Reality* (2012), Wanda Strauven has denounced the moral and technical break between screen and display, whereby the object of touch results in the screen and not the images passing through it.[31] Once more, what do the subjects touch and what do they perceive by touching and consuming?[32]

In light of this ontological uncertainty, the ability to confer and simulate the highest degree of realism to the haptic experience of virtual content through a heterogeneous range of devices – among the most futuristic devices should be mentioned *AirPiano*,[33] *VibroWeight*,[34] *WeHAPTIC*[35] – is generally considered one of the overriding

29 S. Arcagni, *Visioni Digitali: Video, Web e Nuove tecnologie* (Torino: Einaudi, 2016): 301.
30 D. Parisi, "Fingerbombing, or 'Touching is Good': The Cultural Construction of Technologized Touch," in M. Elo, M. Luoto, eds., *Figure of Touch: Sense, Technics, Body* (Helsinki: The Academy of Fine Arts at the University of the Arts Helsinki, Tallinna Raamatutrükikoja OÜ, 2018): 83.
31 W. Strauven, *Touchscreen Archeology* (Lüneberg: Meson Press, 2021): 112-116. Cfr. W. Strauven, "Marinetti's tattilismo revisited hand travels, tactile screens, and touch cinema in the 21st Century," in R. Catanese, ed., *Futurist Cinema* (Amsterdam: Amsterdam University Press, 2018): 70.
32 See in this respect: M. Racat, S. Capelli, "Touching without touching: the paradox of the digital age," in M. Racat, S. Capelli, eds., *Haptic Sensation and Consumer Behavior. The Influence of Tactile Stimulation in Physical and Online Environments* (Nature Switzerland: Springer, 2020).
33 *AirPiano* constitutes "an enhanced music playing system to provide touchable experiences in HMD-based virtual reality with mid-air haptic feedback". For more information see: I. Hwang et. al., "AirPiano: enhancing music playing experience in virtual reality with mid-air haptic feedback," *2017 IEEE World Haptics Conference* (WHC): 213-218 https://doi.org/10.1109/WHC.2017.7989903.
34 VibroWeight represents "low-cost hardware prototype with liquid metal" employing "bimodal feedback cues in VR, driven by adaptive absolute mass (weights) and gravity shift:" X. Wang *et. al.*, "VibroWeight: simulating weight and center of gravity changes of objects in virtual reality for enhanced realism," *Human Computer Interaction* (2022): https://doi.org/10.48550/arXiv.2201.07078.
35 *WeHAPTIC* (Wearable Haptic interface for Accurate Position Tracking and Interactive force Control) "shows improved performances in terms of finger motion measurement and force feedback compared with existing systems such as finger joint angle calculation and precise force control:" Y. Park et. al., "WeHAPTIC: a Wearable Haptic interface for Accurate Position Tracking and Interactive force Control," *Mechanism and Machine Theory* 153, (November 2020): https://doi.org/10.1016/j.mechmachtheory.2020.104005.

objectives for improving these technologies.[36] Furthermore, even though since the invention of the first haptic device in 1948[37] continuous improvements have been made, contemporary interfaces present both a qualitative and quantitative *deficit* compared to the human haptic sensitivity, calling for "urgent requirement to improve the realism of haptic feedback for VR systems, and thus to achieve equivalent sensation comparable to the interaction in a physical world."[38]

While the expression "haptic realism," coined by the philosopher of science Mazviita Chirimuuta in 2016, opens the hypothesis of a scientific perspectivism based on interaction with the world,[39] the same expression when related to haptic interfaces assumes a more technical connotation. As Sushma Subramanian points out in a conversation during the 2020 World Haptics Conference with Ed Colgate, Professor of Mechanical Engineering at Northwestern University, although haptic technologies still go through a "primitive" state, the short-term goal in their design is to "develop a new tactile language that mimics the kinds of maneuvers we make with three-dimensional objects" in which "the challenging part is to make us feel them."[40] A leading producer such as the Berlin-based Lofelt attempts to make interaction with the touch screen more realistic by combining sounds with the corresponding haptic vibrations

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36 A. Brogni, D.G. Caldwell, M. Slater, "Touching sharp virtual objects produces a haptic illusion," in R. Shumaker, ed., *Virtual and Mixed Reality* (Berlin Heidelberg: Springer, 2011): 234-242; A. Gallace, M. Girondini, "Social touch in virtual reality," *Current Opinion in Behavioral Sciences* 43 (February 2022): 249-254, https://doi.org/10.1016/j.cobeha.2021.11.006. It should be noted how the design of "pseudo-haptic feedback" is also nodal to the experience of touching in virtual environments. See in this regard A. Maehigashi et. al., "Virtual weight illusion: weight perception of virtual objects using weight illusion," *CHI '21 Extended Abstracts* (May 2021), https://doi.org/10.1145/3411763.3451842. Furthermore, the design of an effective haptic illusion in a virtual environment is related to scale and precisely to the so-called "Body-scaling effect": P. Abtahi, "From illusions to beyond-real interactions in virtual reality," *UIST '21: The Adjunct Publication of the 34th Annual ACM Symposium on User Interface Software and Technology* (October 2021): 153-157, https://doi.org/10.1145/3474349.3477586.

37 As David Parisi reports, the invention of the first mechanical force feedback master-slave manipulator in nuclear field is due to the engineer Raymond Goertz of the Atomic Energy Commission for the Argonne National Laboratory. D. Parisi, *Archaeologies of Touch. Interfacing with Haptics from Electricity to Computing* (Minneapolis, London: University of Minnesota Press, 2018): 220-221.

38 D. Wang, "Haptic display:" 137.

39 M. Chirimuuta, "Vision, perspectivism, and haptic realism," *Philosophy of Science* 83, no. 5 (December 2016), 746-756 https://doi.org/10.1086/687860.

40 S. Subramanian, *How to Feel. The Science and Meaning of Touch* (New York: Columbia University Press, 2021): 250-251.

so that the user participates in an immersive experience. As Lofelt founder Daniel Büttner asserts: "it is all an illusion, but it seems incredibly real."[41] In a similar direction, the most advanced research conducted by the *Intelligent Haptic* program of the Max Planck Institute for Intelligence System aims to implement the sensitivity of electrovibrations.[42] Evidence that haptic perception is one of the most promising experimental fields for the virtual world is reflected in the great number of HORIZON programs supported by the European Union in the last five years,[43] mainly dedicated to *Mid-Air* and *Mixed Haptic Feedback* technologies. Ultrahaptics, launched in 2013, consists in a haptic device system in which the force feedback is positioned

above interactive surfaces and requires no contact with either tool, attaching to the surface itself. Instead, haptic sensations are projected through a screen and directly onto the user's hands. It employs the principle of acoustic radiation force whereby a phased array of ultrasonic transducers is used to exert forces on a target in mid–air.[44]

H-Reality devices, on the other hand, employing mixed haptic feedback technology "aim at combining the contactless haptic technology with the contact haptic technology and then apply it into virtual and augmented reality

41 R. Banham, "Haptic happenings: how touch technologies are taking on new meaning," *Dell Technologies* (October 21, 2019): https://www.delltechnologies.com/en-us/perspectives/haptic-happenings-how-touch-technologies-are-taking-on-new-meaning/, accessed December 11, 2022.
42 Y. Vardar, K.J. Kuchenbeker, L. Behringer, "Challenging the design of electrovibrations to generate a more realistic feel," *Haptic Intelligence Max Planck Institute for Intelligent Systems* (April 6, 2021): https://hi.is.mpg.de/news/challenging-the-design-of-electrovibrations-to-generate-a-more-realistic-feel, accessed December 11, 2022.
43 Among them we point out: Horizon 2020 (CORDIS), *TACTIle Feedback Enriched Virtual Interaction through Virtual RealITY and beyond,* (July 1, 2019-September 30, 2022): https://cordis.europa.eu/project/id/856718/it, accessed December 11, 2022; Horizon 2020 (CORDIS), *Multimodal Haptic with Touch Devices* (March 1, 2020-February 29, 2024): https://cordis.europa.eu/project/id/860114/it, accessed December 11.
44 T. Carter *et. al*., "Ultrahaptics: multi-point mid-air haptic feedback for touch surfaces," *UIST '13: Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology* (St. Andrews, UK: October 8-11, 2013): 505-506.

technologies."[45] These projects encourage "to achieve high-fidelity sensations through technology that is easy and comfortable to use, for both interactive augmented reality (AR) and immersive virtual reality (VR) experiences";[46] rendering potentially less unreachable that horizon of touch virtualisation from which Derrida took his cue.

In assessing the role that illusion plays for the effective functioning of haptic technologies, it can be questioned whether this prevalent position is distinctive of the digital era or if it represents a consolidated trope in haptic historiography, often centered on the theoretical and practical opportunity to touch – or not! – sculpture, at times accused of being the least illusory of the arts.[47] In undertaking the investigation from "haptics"[48] to "haptic,"[49] we will proceed in a parallel line to the essentially optical one

45 "H-Reality," FET FX. Our future today (2020): http://www.fetfx.eu/project/h-reality/; see also: X. de Tinguy, C. Pacchierotti, A. Lécuyer, "Capacitive sensing for improving contact rendering with tangible objects in VR," *IEEE Trans Vis Comput Graph – IEEE Transactions on Visualization and Computer Graphics* 27, no. 4 (December 2020): 2481-2487, https://doi.org/10.1109/TVCG.2020.3047689.

46 Horizon 2020 (CORDIS), Mixed Haptic Feedback for Mid-Air Interactions in Virtual and Augmented Realities (October 1, 2018- March 31, 2022): https://cordis.europa.eu/project/id/801413/it, accessed December 11, 2022.

47 Is given below the renowned passage in Benedetto Varchi's *Paragone* (1547) in which painters vituperate sculpture by stating: "They argue again from the difficulty of art, where, distinguishing the difficulty into two parts: in fatigue of body, and this as ignoble they leave to sculptors: and in fatigue of wit, and this as noble they reserve for them, saying that, besides the different manners and ways of working and coloring, in fresco, oil, tempera, glue and gouache, painting makes a figure foreshorten, [it] makes it seem round and raised in a flat field, making it break through and seem far away with all the appearances and vagueness that can be desired, giving to all their works lumens and shadows well observed according to the lumens and reverberations, which they hold to be a most difficult thing; and in conclusion they say that they make appear what is not: in which thing they seek effort and infinite artifice", B. Varchi, *Lezzione. Nella quale si disputa della maggioranza delle arti e qual sia più nobile, la scultura o la pittura* (Firenze: Fondazione Memofonte, 1547): 38.

48 The plural noun *haptics*, deriving from the Greek feminine *haptikós* and the Neo-Latin *hapticē*, a term coined in 1685 by Isaac Barrow in *Lectiones Mathematicae XXIII*, is literally translated as "science of touch". Haptics refers to the science of touch in a techno-media perspective, denoting the tactile feedback generated by those devices which, by sending artificial stimuli at proprioceptive, limbic and muscular levels, simulate the sensation of actual contact: "Haptics," *Merriam-Webster Dictionary* (online): https://www.merriam-webster.com/dictionary/haptics, accessed December 11, 2022.

49 The Greek etymon *haptō*, from which derive the word *haptos* (tangible, sensitive), the predicate *háptein* and the adjective *haptikós*, from which derive the French *haptique*, the German *haptisch*/*Haptik* and the English haptic, means variously "able to come into contact with" (*haptikós*) and "to clasp, grasp, lace" (*háptein*).

stabilized by Riegl,[50] bearer of a critical fortune culminating with the later reworkings elaborated by Deleuze,[51] Maldiney,[52] Dufrenne[53], Marks[54] and Barker.[55] Concerning the covertly panoptic conception of the haptic that had been spreading in German *Kunstwissenschaft* since Hildebrand's studies,[56] it is necessary to turn our attention to the developments taking place in the psychophysiological area around the same years. In the wake of Heinrich Weber's pioneering studies on the sense of touch, in which sensory illusions after limbs amputation[57] (the so-called *Phantom Sensations*)[58] were classified as not accidentally probed; the first use of the term haptic in 1892 by another eclectic Berliner, Max Dessoir, was systematized almost simultaneously by Edward Titchener.[59] The rehabilitation of this

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50 As Andrea Pinotti notes via Révész, "It is significant that, the year after the publication of *Kunstindustrie*, in an article in which he argues with Strzygowski, Riegl admits that the term *taktisch* (*tastbar,* from the Latin *tangere*) can lead to misunderstandings, and declares himself willing to adopt instead the term haptisch (from the Greek *hapto*), which the physiological literature had since long employed in its research on sensoriality. Perhaps a way, that of moving from Latin to Greek, to avoid any possible reference to the actual manual palpation and reaffirm the fundamental strength of the *haptisch,*" A. Pinotti, "Guardare o toccare? Un'incertezza herderiana," *Aisthesis. Pratiche, linguaggi e saperi dell'estetico* 2, no. 1 (2009): 186, https://doi.org/10.13128/Aisthesis-10953, trans. mine. For a first bibliographical framing of Riegl's haptic construction see: M.R. Olin, *Forms of Representation in Alois Riegl's Theory of Art* (University Park: Pennsylvania State University Press, 1992); M. Iversen, *Alois Riegl: Art History and Theory* (Cambridge, MA: MIT Press, 1993); S. Melville, "The temptation of new perspectives" (1990), in D. Preziosi, ed., *The Art Of Art History. A Critic* (Oxford: Oxford University Press, 2009): 274-283; G. Vasold, "'Das Erlebnis des Sehens'. Zum Begriff der Haptik im Wiener fin de siècle," *Maske und Kothurn* 62 (2016): 46-70.

51 G. Deleuze, *Francis Bacon. Logic of Sensation* (1981), trans. D.W. Smith (London-New York: Continuum, 2003): 122, 189.

52 See in this regard: A. Pinotti, "Style, rythme, souffle: Maldiney and kunstwissenschaft," in J.-P. Charcosset, ed., *Parole Tenue: Colloque du Centenaire du Maldiney á Lyon* (Milan: Mimesis Edizioni, 2014): 49-59.

53 See in this respect: A. Pinotti, ed., *Alois Riegl. Grammatica storica delle arti figurative* (Macerata: Quodlibet, 2018), XLVI.

54 We refer specifically to the postcolonial construct of haptic visuality that Laura Marks derives and resemantizes from the lesson of Regl's heritage: L.U. Marks, *Touch: Sensuous Theory and Multisensory Media* (Minneapolis-London: University of Minnesota Press, 2002): 4-7; L.U. Marks, *The Skin of the Film. Intercultural Cinema, Embodiment, and the Senses* (Durham-London: Duke University Press, 2000): 162-171.

55 J.M. Barker, *The Tactile Eye. Touch and the Cinematic Experience* (Berkeley-Los Angeles-London: University of California Press, 2009): 37-38.

56 See in this regard: A. Pinotti, *Il corpo dello stile. Storia dell'arte come storia dell'estetica a partire da Semper, Riegl, Wölfflin* (Milano: Mimesis, 2001). See specifically the third section entitled "Occhio e mano:" 179-221.

57 M. Grunwald, M. John, "German pioneers of research into human haptic perception," in M. Grunwald, ed., *Human Haptic Perception. Basics and Applications* (Basel: Birkhäuser, 2008): 19.

58 T. Weiss, "Phantom sensations," in M. Grunwald, ed., *Human Haptic Perception. Basics and Applications* (Basel: Birkhäuser, 2008): 283-294.

59 D. Parisi, *Archaeologies of Touch*: 105.

obsolete Greek term, already Homeric and Aristotelian,[60] reflects Dessoir's will to deepen the investigation on touch by distinguishing the sensations of contact from the active exploration (*Pselaphesie*).[61] This distinction, destined to become normative, emerged in the context of a network of experimental psychology laboratories scattered throughout the United States and orbiting around the Harvard Psychological Laboratory, inaugurated in 1875 by William James, although active only since 1892.[62] While in 1890, James was able to discuss the "fallacy of the senses," taking his cue from the prominent Aristotelic finger illusion,[63] consulting Harvard Laboratory appendix for the two years 1892-1893 shows how scientific trials on touch proceeded simultaneously to the study of optical illusions.[64] A similar experimental path would culminate in 1893 with the presentation of the *Apparatus for Simultaneous Touches* by William Krohn at Clark University.[65]

On the plexus mentioned above, the aesthetical and historiographical discourses are inserted and intertwined, sanctioning the passage from the properly physiological illusion of touching to a metaphorical one, embodied by the rhetorical figure of "as if," direct relative of Derrida's inverted commas. That such a rhetorical stratagem constitutes a much older matter is recalled by the well-known *querelle* of Herderian uncertainty. As already pointed out by Andrea Pinotti, in his aesthetic treatise *Plastik*, Herder seems to allude to the possibility of a virtual touch, reproaching the sculptor who has never touched, not even in a dream,

60 M. Perniola, *Il Sex Appeal dell'Inorganico* (Torino: Einaudi, 1994): 95.
61 M. Dessoir, *Über den Hautsinn* (Separat-Abzug aus Archiv für Anatomie und Physiologie: Physiologische Abtheilung. 1892): 242.
62 G. Bruno, "Film, aesthetics, science: Hugo Münsterberg's laboratory of moving images," *Grey Room* 36 (Summer 2009): 88-113, https://doi.org/10.1162/grey.2009.1.36.88.
63 W. James, *The Principles of Psychology* (Ontario: York University, 1890): 87.
64 H. Munsterberg, *Psychological Laboratory of Harvard University* (Harvard: Harvard University Press, 1893). Munsterberg recorded notes include: "Instrument for studying the fusion of touch sensations. After Krohn; made in Cambridge"; "Instrument for touch reaction, etc;" "Touch-reaction instrument, with twenty different stimuli. By Elbs, Freiburg. $20". See also: Bruno, "Film": 101-102.
65 W.O. Krohn, "Facilities in experimental psychology in the colleges of the United States" (1894), in C.D. Green, ed., *Classics in the History of Psychology* (Toronto: Tork University): https://www.sapili.org/subir-depois/en/ps000128.pdf; D. Parisi, *Archaeologies*: 144-147.

his creation.[66] "The illusion has worked,"[67] the philosopher will add, when the eye takes on the movements of the hand and then of a very thin ray, an emissary of the soul, which kinaesthetically embraces the sculpture as it becomes a body. In the wake of Konrad Lange's *Illusionsästhetik*[68] and J.H. Kirchmann and E. Von Hartmann's doctrine of illusional feelings, the already mentioned Dessoir would achieve an even more drastic conclusion. Declaring that every work of art mainly satisfies a single sensory channel, this sensorial limitation "guarantees its illusory character," generating the paradoxical situation of "a conscious self-deception, of a continued and deliberate confusion of reality and illusion."[69]

However, it was not until the art-historical debate of the early 1950s – while the earliest haptic devices were designed – that an open polarization was reached regarding whether or not sculptures should be touched. On the one hand Herbert Read, moving from the psychological studies of Arnheim, Wundt, Lowenfeld, and Révész, could argue that "for the sculptor, tactile values are not an illusion to be created on a two-dimensional plane: they constitute a reality of being conveyed directly, as existent mass. Sculpture is an art of palpation."[70] On the other hand, a fervent detractor such as the modernist Greenberg would have drastically overturned this assumption.[71] Both consistent readers of Berenson, whose normative and ambivalent

66 A. Pinotti, *Guardare o toccare*: 189; J.G. Herder, *Sculpture. Some Observations on Shape and Form from Pygmalion's Creative Dream* (1778), ed. J. Gaiger (Chicago-London: The University of Chicago Press, 2002): 41.
67 A. Pinotti, *Guardare o toccare:* 189; J.G. Herder, *Some Observations*: 41.
68 For an introduction to the subject see: D. Romand, "Konrad Lange on 'the Illusion of Materials' in painting and visual arts: revisiting a psychoaesthetic theory of the perception of material properties," in J. Stumpel, M. Wijntjes, eds., *Art and Perception. An International Journal of Art and Perception Science, Special Issue: The Skin of Things: On the Perception and Depiction of Materials* 7, no. 3-4 (2021): 283-289.
69 M. Dessoir, Aesthetics and Theory of Art. *Ästhetik und Allgemeine Kunstwissenschaft* (1906), trans. S.A. Emery, (Detroit, Wayne State University Press, 1970): 53.
70 H. Read, *The Art of Sculpture* (London: Faber & Faber, 1954): 49.
71 We are referring specifically to Greenberg's harsh and inflexible review of Read's monograph: C. Greenberg, "Roundness isn't all," (November 25, 1956), in J. O' Brian, ed., *Clement Greenberg: Collected Essays and Criticism* 3 (Chicago: The University of Chicago Press, 1995): 272.

"tactile values"[72] find a more truthful attestation in the corollary categories of "ideated sensations," "ideated satisfactions" and "ideal sensation of contact,"[73] Read and Greenberg finally reached an unexpected consonance. Whilst Read claimed the experience of sculpture as distinctive of haptic perception and, specifically, for the prehensility of the hand; Greenberg denied the appropriateness of such fruition, attributing tactile stimuli to the visual sphere. Meanwhile, Herder's uncertainty remains. Indeed, as David J. Getsy noted, it is ultimately unclear whether Read wished for a knowledge of the plastic work through its palpation or maintained such contact on a substantially preliminary and physiological condition.[74]

In order to enrich the *corpus* of sources of such a *querelle* numerous other examples could be made; nonetheless, one of the most promising scenarios for its analysis, as prophetically announced by Derrida, is offered by the exploration through haptic interfaces of digitized artifacts in museums. When the veto of touching the work of art lapses and the distinction between actual and fictional flattens out, which horizons are opened by the possibility of touching? Will it be a "tactile vertigo" in the sense of Baudrillard, in which the virtual object expired at the status of a *trompe-l'œil* image soliciting a "tactile hyper presence of things, as though one could hold them," despite its phantasmagorical essence?[75] Can these finally touchable bodies add much

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72 A. Brown, "Bernard Berenson and 'tactile values' in Florence," in J. Connors, ed., *Bernard Berenson: Formation and Heritage* (Cambridge, Massachusetts: Villa I Tatti, The Harvard University Center for Italian Renaissance Studies, 2014). For an analysis highlighting the subtle pantheism underlying Berenson's work, see: A. Pinotti, "The touchable and the untouchable. Merleau-Ponty and Bernard Berenson," *Phenomenology 2005* 3, no. 2, (2007): 479-498.
73 B. Berenson, *Aesthetics and History* (New York: Doubleday & Company, 1948): 24-25, 74.
74 As David J. Getsy pointedly notes: "Read did not necessarily argue that the viewer must touch the sculpture in order to appreciate it, as Greenberg would have us believe. Rather, it was the aggregate experience of tactility that provides us with an ability to assess ponderability and the non-visual traits of any object. Our haptic sensibility and our sense of the physical environment are both closely tied to our own ever-developing repertoire of tactile and physical experiences"; D.J. Getsy, "Tactility or opticality, Henry Moore or David Smith: Herbert Read and Clement Greenberg on *The Art of Sculpture*, 1956," in R. Peabody, ed., *Anglo-American Exchange in Postwar Sculpture, 1945–1975* (Los Angeles: Getty Publication, 2011): 111-112.
75 J. Baudrillard, *Seduction* (1979), trans. B. Singer (Montréal: New World Perspectives. Culture Text Series, 1990): 62-63.

to the illusory palpation of the work of art on a semantic level, if not on a phenomenological one?

Haptic technologies and museums, the imaginative frontiers of the phenomenology of touch

In order to present a critical account of how haptic technologies are being employed in museums, and to investigate to what extent the projects designed within these environments fully explore the illusory potential of virtual haptic experiences, a preliminary discussion on analog touch in museums is needed. The use of haptic technologies within museum settings,[76] which has widely increased in the last decades, is in fact not something new to cultural experiential models,[77] and more the reinstatement of practices which had been common policies in museums from their foundation to the middle of the nineteenth century. While today it is "generally taken for granted that museums collections are not for touching"[78] seventeenth- and eighteenth-century museum visitors were customarily free to pick up precious and delicate relics, enjoying their sense of touch as a fundamental part of their overall experience. More specifically, touch in early museums was used for four different reasons:[79] learning (as touching an object provided relevant information that through sight could not be obtained, like its weight), aesthetic appreciation (touch was considered to allow an embodied understanding of the

76 For a comprehensive account on how the importance of touch has been re-evaluated in the museum sector in the past three decades please cfr. G. Black, T*he Engaging Museum: Developing Museums for Visitor Involvement* (Oxford: Routledge, 2005); E. Pye, *The Power of Touch: Handling Objects in Museums and Heritage Contexts* (Walnut Creek, CA: Left Coast Press, 2007), H. Chatterjee, *Touch in Museums: Policy and Practice in Object Handling* (Oxford: Berg, 2008); F. Candlin, *Art, Museums and Touch* (Manchester: University of Manchester Press: 2010), and S. Dudley, ed., *Museum Objects: Experiencing the Properties of Things* (London: Routledge, 2012).

77 C. Classen, *The Deepest Sense. A Cultural History of Touch* (Chicago: University of Illinois Press, 2012): 136-146.

78 Ibid.: 137.

79 A synthetic account of the reasons why touch was a common practice in museums can be found in Classen, *The Deepest Sense*: 139-142. For other discussions on the topic please cfr. D. Howes, "Introduction to sensory museology," *The Senses and Society* 9, no. 3 (2014): 259-267 https://doi.org/10.2752/174589314X14023847039917 and R.F. Ovenell, *The Ashmolean Museum*, 1683–1894 (Oxford: Clarendon Press, 1986).

nature of the display), imaginary potential (by holding an artifact visitors could get emotionally in touch with its original owner or maker) and healing powers (especially religious relics, when touched or eaten,[80] where deemed able to cure illnesses and pains). As it appears evident already from this first account, not all yet some of the functions of touch in museums had to do with the potential to empower imaginative accounts, associating the role of touching not only with evidentiary information, yet also with intangible and elusive, even powerful, qualities. From the mid of the nineteenth century touch was banned from museums:[81] conservation matters became more and more relevant, while parallelly touch in itself came to be classified as a secondary sense, one "associated with irrationality and primitivism."[82] These two reasons account for two extremely different discourses, one linked to practical aspects and to the preservation of cultural heritage, the second pertaining to a conceptual sphere, having to do with epistemic premises and their museological consequences.

Today, well into the third decade of the 21st century, the situation in museums seems to be closer to that of three centuries ago than to the end of the last Millenium. Touch seems to have regained its epistemic status,[83] and modern haptic technologies allow its employment without the need to endanger precious artifacts. The great difference, however, is that machines and proxies mediate the haptic experience, defining its phenomenology. The question which arises, at this point, seems to be to what extent these technologies are and will be designed with the aim

80 For a historical account of the healing powers of ancient religious relics cfr. K. Arnold, "Skulls, mummies and unicorns' horns: medicinal chemistry in early english museums," in R.G.W. Anderson *et al., Enlightening the British: Knowledge, Discovery and the Museum in the Eighteenth Century* (London: The British Museum Press, 2003), also E. Brown, *An Account of Several Travels through a Great Part of Germany* (London: Benjamin Tooke, 1677), and D. Murray, Museums: *Their History and Use*, vol. 1. (Glasgow: James MacLehose and Sons, 1904): 40, 50, 73.

81 For an account of the historical reasons which led to this change cfr. Classen, *The Deepest Sense*: 143-146, and F. Candlin, *Art, Museums and Touch*.

82 C. Classen, *The Deepest Sense. A Cultural History of Touch*: XIV.

83 For a discussion on the epistemic value of touch please cfr. C. Classen, *The Book of Touch* (Oxford: Berg Publishers, 2005), M. Peterson, *The Senses of Touch* (London: Routledge, 2007), M.P. Gadoua, "Making sense through touch. Handling collections with Inuit Elders at the McCord Museum," *The Senses and Society* 9, no. 3 (2014): 323-341 https://doi.org/10.2752/174589314X14023847039719.

to mirror the original analog functions of touch, or whether they will be built and employed with the goal to expand the potential of the haptic experience. With regards to this, it will be important to understand on which of the qualities of touch – amongst the seventeenth century list aforementioned – they will leverage on. Whilst, on the one hand, they could aim at faithfully reproducing the phenomenological qualities of touch, the paragraphs above have shown how there is a wider illusory character that these technologies could be aiming at capturing, one which could hopefully open up new experiential frontiers.

Whilst there isn't one single comprehensive account which maps the state of the arts of haptic technological development in the museum system, literature in this field has been growing recently. This thanks to researches that discuss the regained relevance of touch in educational settings, together with publications which analyze individual projects designed and carried through by museum research centers.[84] A vast number of these studies highlight how haptic technologies allow visitors to "explore new paradigms of interaction"[85] leveraging on the "quality and usefulness of computer-based exhibits."[86] This is granted as the sense of touch "is an essential part of how we interact, explore, perceive and understand our surroundings"[87] and therefore incorporating object based learning in museum

84 For other interesting case studies analyzing the role of haptic technologies in museums please cfr. R. Comes, "Haptic devices and tactile experiences in museum exhibitions," *Journal of Ancient History and Archeology* 3, no. 4 (2016) https://doi.org/10.14795/j.v3i4.205; F. Fischnaller "The last supper interactive project. The illusion of reality: perspective and perception," in G. Amoruso, ed., *Putting Tradition into Practice: Heritage, Place and Design, Lecture Notes in Civil Engineering* 3, (Cham: Springer International Publishing, 2018) https://doi.org/10.1007/978-3-319-57937-5_73; M.H. Jamil *et al.*, "The role of haptics in digital archaeology and heritage recording processes", *2018 IEEE International Symposium on Haptic, Audio and Visual Environments and Games* (HAVE) (2018): 1-6 https://doi.org/10.1109/HAVE.2018.8547505.

85 A. Frisoli *et al.*, "Evaluation of the pure-form haptic displays used for exploration of works of art at museums," report on the project findings, 2005 retrieved at https://www.researchgate.net/publication/228584199_Evaluation_of_the_pure-form_haptic_displays_used_for_exploration_of_works_of_art_at_museums/ related on the 31/01/2022.

86 S. Brewster, "The impact of haptic 'touching' technology on cultural applications," in J. Hemsley, V. Cappellini, G. Stanke, eds., *Digital Applications for Cultural Heritage Institutions*, (Aldershot: Ashgate, 2005): Chap. 30, 273-284, 282.

87 M. Novak *et al.*, "There is more to touch than meets the eye: haptic exploration in a science museum," *International Journal of Science Education* 42, no. 18 (2020): 3026-3048 https://doi.org/10.1080/09500693.2020.1849855.

experiences increases autonomy and satisfaction.[88] The information that visitors can acquire through touch appears today relevant as it did at the beginning of museum history, and it has become obtainable without endangering the artifacts. 3D replicas of material artifacts associated with a range of wearable or desktop devices are the predominant technologies used across museum experiments, engaging users through mainly force feedback and kinetic stimuli.[89] While providing an account of the state of the arts of the literature and case studies in this sector is not one of the goals of this essay, a series of examples have been chosen as they have been deemed relevant to the research at hand: assessing to what extent haptic museum experience expand and explore their full – at times illusory – potential.

A widely discussed experiment in the field is the Museum of Pure Form, "a collective project ran in the early 2000s by a series of European museums creating 3D digital replicas of their artifacts and making available a technology which allowed for the haptic experience of them."[90] This pivotal program engaged a series of museums across Europe[91] who collected a shared archive of digital replicas of their statues, and then produced a touring exhibition which installed wearable devices (exoskeleton wearable arm) and or desktop devices (two robotic arms departing from support columns placed in front of the visualization screen) in front of the original statues.[92] Overall, findings on the experiment registered both amusement (70% of attendees) and instructiveness (39%) across visitors.[93] The shared belief, confirmed by the analysis conducted simultaneously as the

88 M. Novak *et al.*, "There is more to touch that meets the eye:" 3044.
89 In the literature it is possible to find studies which evaluate both collaborative endeavors and researches ran by single institutions. Overall, the collaboration between universities or tech companies and cultural institutions seems a fundamental premise in order to allow for trials and studies that evaluate the impact of these projects.
90 A. Frisoli, "Evaluation of the pure-form haptic displays used for exploration of works of art at museums."
91 The Galician Centre for Contemporary Arts in Santiago de Compostela, the Museo dell'Opera del Duomo in Pisa, the National Museum of Fine Arts in Stockholm, the Conservation Centre at National Museums Liverpool and the Petrie Museum of Egyptian Archaeology in London.
92 A. Frisoli, "Evaluation of the pure-form haptic displays used for exploration of works of art at museums:" 2.
93 Ibid.: 6.

project, was that the opportunity to use a device to touch the digital replica of a statue while looking at it enforced the learning experience. Something which, as aforementioned, was deemed constitutive of the relevance of touch in early museum experiences. As this case study shows, together with many that have followed, it seems that one of the main concerns of museum professionals and researchers in designing digital haptic experiences seems to be supplying to the lost opportunity to touch the artworks, thus enabling the visitor to enjoy a wider range of information regarding the statue and, consequently, enriching the learning experience. This, however, faces a series of relevant limitations on the phenomenological level, as discussed above with reference to Wang's analysis in *Haptic Display.* It appears, from this first account, that the use of haptic technologies is not necessarily seen as a strategy to experiment and widen the cultural experience, yet instead as a way to recuperate something that contemporary curatorial practices do not allow – namely to touch originals. With reference to this point, it is interesting to see that there are several researches actually comparing the haptic experience that visitors can have touching the replica of an artifact or its 3D version.[94] It appears that "the comparison between the haptic device and the replica showed that the multi-finger tactile interaction with the replica produced considerably richer information than the single-point contact of the haptic device."[95] What the citation implies is that the technology used provided a less phenomenologically rich experience

94 Interesting accounts on this debate can be found in M. Dima, L. Hurcombe, M. Wright, "Touching the past: haptic augmented reality for museum artefacts," in R. Shumaker, S. Lackey, eds., *Virtual, Augmented and Mixed Reality. Applications of Virtual and Augmented Reality.* VAMR 2014. *Lecture Notes in Computer Science*, vol. 8526. (Cham: Springer, 2014) https://doi.org/10.1007/978-3-319-07464-1_1. Also cfr. S. Ceccacci *et al*., "The role of haptic feedback and gamification in virtual museum systems," *Journal on Computing and Cultural Heritage* 14, no. 3 (2017) https://doi.org/10.1145/3453074, and F. Stanco *et al*., "Virtual anastylosis of Greek sculpture as museum policy for public outreach and cognitive accessibility," *Journal of Electronic Imaging* 26, no. 1, 011025 (2017) https://doi.org/10.1117/1.JEI.26.1.011025.

95 M. Dima, L. Hurcombe, M. Wright, "Touching the past: haptic augmented reality for museum artefacts:" 6.

compared to the touching of the printed replica, which if possible is deemed a better alternative.

As of today, the technical limitations that most devices used in museums present contribute to a scenario where physical touch, even if of replicas, seems to be favored. The reasons why haptic technology is preferred are not experiential factors; they have to do with practical and managerial concerns, such as the fact that digital replicas do not occupy physical space and that they can be experienced also remotely. It appears that these technologies, if competing on a purely phenomenological level and trying to mirror haptic experiences that occur in reality, are destined to have a limited contribution to cultural experiences, being the only alternative yet not a solution which in itself holds value.

Other case studies can however add further layers to the use of haptic technologies in museum settings, offering opportunities that neither physical statues nor printed replicas could elicit. A research published by the *Journal of Electronic Imaging* illustrates the case of the virtual anastylosis of a Greek sculpture, operated by digitally combining a head and a torso held in two different heritage sites in Sicily.[96] The two ancient pieces, one hosted in the Museum of Castello Ursino in Catania and the other in the Archeological Museum of Siracusa, were hypothesized by archeologists to be parts of the same statue due to stylistic features. This theory was, however, never proved as neither of their hosting institutions was willing to dislocate one of the pieces for the necessary analysis to be performed. Through digital imaging and 3D rendering it was however possible to demonstrate the perfect match of the two parts of the statue, creating a new object that was then made accessible through the use of haptic technology – in this case the haptic device 3D Systems Touch – and thanks to the collaboration with the Center for Virtualization and Applied Spatial Technologies, University of South Florida. A

96 F. Stanco *et al.*, "Virtual anastylosis of Greek sculpture as museum policy for public outreach and cognitive accessibility."

dedicated effort was made to ensure that the new technology would account for people with cognitive and physical disabilities, another potentiality that haptic technologies hold and on which research is being tailored.[97] Whilst this case highlights the strategic contribution that modern technologies can provide to both research and fruition, it could be argued that the added value here is given by the fact that this statue could have otherwise never been *seen or felt*, yet not in a manner which depends, from a specifically phenomenological perspective, on the haptic technology itself. Hence reinforcing the understanding that the main use of these technologies is directed towards reinstating the original – and lost – hard value of touch, not necessarily adding new levels of experience.

Another case, involving virtually touching the torso of Michelangelo's *David* at Monash University,[98] can prove useful to enrich the discussion on the use of haptic technologies in museums. What emerges from this study, which in terms of research methodology mirrors the vast majority of cases in the literature in creating a 3D digital replica and then experiencing it through the *Phantom*, is that the images reproduced digitally "allow the user to focus on particular details that they may overlook otherwise."[99] What appears here is that the virtual experiential setting creates the opportunity for the user to actually grasp some details of the statue that he would have not been able to experience with either the original or with a 3D printed

97 There are a number of experiments within the field of haptic technologies which focus specifically on accessibility for people with impared cognitive and physical abilities. An interesting research center is the one of the University of Glasgow, which ran two trials in this field, one called *Senses in Touch II,* and the other *MultiVis project*. A complete account of the two researches can be found in Brewster, "The impact of haptic 'touching' technology on cultural applications:" 279-282. Another interesting research which discusses the potential of haptics for the visually impaired is G. Jansson, M. Bergamasco, A. Frisoli, "A new option for the visually impaired to experience 3D art at museums: manual exploration of virtual copies," *Visual Impairment Research* 5, no. 1 (2003): 1-12 https://doi.org/10.1076/vimr.5.1.1.15973. Also cfr. R. Vaz, D. Freitas, A. Coelho, "Blind and visually impaired visitors' experiences in museums: increasing accessibility through assistive technologies," *The International Journal of the Inclusive Museum* 13, no. 2 (June 2020): 57-80, https://doi.org/10.18848/1835-2014/CGP/v13i02/57-80.

98 M. Butler, P. Neave, "Object appreciation through haptic interaction," *Proceedings of the 25th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education* (Melbourne: Ascilite, 2008), 133-141.

99 Ibid.: 140.

replica. The flexibility of digital images, their potential to be modulated, modified and enlarged, appears, in this case, to actually add a further layer to the visitor experience. The higher attention to detail deepens and expands the experience in a manner that is specific of, and exclusive to, digital haptic technologies.

Whilst this last example seems to slightly brighten the scenario described, the cases discussed so far account for an employment of haptic technologies which struggles to emancipate itself from a traditional understanding of touch in cultural experiences. The three cases analyzed, far from providing a comprehensive account of the multitude of programmes that have been carried out across the museum sector in the past years, have however been chosen as they are representative of the main trends found in the literature. Overall, researchers seem to have been focused mainly on trying to bring back an aspect of experience which was lost, and less keen on the advanced possibilities that haptic technologies might hold. With reference to the technological and historical discussion presented above, regarding haptic illusions, it does not appear that these seem to be at the center of experimental designs in the museum sector, where the understanding of touch seems to recall more the “hard undeniable evidence” school than the more subtle and rich understanding of the haptic which encompasses its illusory character. This depends on a number of reasons, related to both cultural, professional and economic factors. A further fundamental aspect to take into account, when discussing the use of haptic technologies in museums, is in fact the high cost of these devices. The more sophisticated they are, the higher their prices, which makes it difficult for museums to afford them, even harder to update them. Main advancements with haptic technologies are in fact usually in other fields of research with richer funding, such as medicine and engineering. This leads to the second limitation, namely that to innovatively experiment with these technologies, technical and diverse professional skills are required. Even though most programmes within museums are run in collaboration

with universities and research centers, the degree of complexity that pertains to these projects needs a pull of professionals which is hard to put together and coordinate in the current economic and professional climate.

There are, however, a few interesting cases that, at times even without the use of high budgets and elevated skills, seem to leverage on the wider range of possibilities that these technologies offer. Interestingly enough, these also relate to two of the original functions of touch valued in early museums: the aesthetic enrichment of the experience and the emotional potential of haptics. It appears that when haptic technologies are being employed with the aim of enacting and recalling these elements – as opposed to when they try to give back the evidentiary character of touch – the result are more imaginative endeavors, allowing for the creation of a further semantic level of experience.

One first interesting case is a very recent experiment conducted at University College London, where a student has designed a device which, through the use of capacitive touch sensors, wants to "help us understand what an artist felt at the time they created their work by recreating their sensory experiences."[100] The project idea, which rests on the theoretical background of embodied knowledge as an extension of the mind and of embodied practice as a means to feel the emotions of an artist,[101] was inspired by an artwork: *The Face of Christ* by Claude Mellan, hosted in the UCL Art Museum. By looking closely at the artwork, the author of the project realized that the whole drawing had been made through the design of one single spiraling line, a unique technique. His idea was therefore to design a device which could enable the viewer to create

100 F. Taylor, "Recreating sensory experience: how haptic technology could help us experience art in new ways," *UCL Culture Blog*, (July 13, 2020) https://blogs.ucl.ac.uk/museums/2020/07/13/recreating-sensory-experience-how-haptic-technology-could-help-us-experience-art-in-new-ways/ on the 31/01/2022, accessed December 11, 2022.

101 When the author discusses embodied knowledge as an extension of the mind the reference is I. Martínková, "Body ecology: avoiding body–mind dualism," *Loisir et Société / Society and Leisure* 40, no. 1 (2017): 101-112, https://doi.org/10.1080/07053436.2017.1281528; whilst when discussing embodied practices as a means to feel emotions of artists the specific reference in the literature is D. Freedberg, V. Gallese, "Motion, emotion and empathy in esthetic experience," *Trends in Cognitive Sciences* 11, no. 5 (2007): 197-203, https://doi.org/10.1016/j.tics.2007.02.003.

a contact with the motion that had originated the artwork, building a direct emotional connection with the artist. As the author describes it "through an audio feedback loop, the device I designed takes in touch inputs from a viewer of the artwork and returns a religious-sounding choral soundtrack when the spiral gesture from the engraving is drawn correctly with a finger. The spiral gesture," he adds, "was directly extracted from *The Face of Christ* with the help of a custom python script which made use of various image analysis libraries."[102] What can be highlighted in reading about this project, which at this point consist of just a first artisanal prototype, is the way in which haptic technologies are used to explore unusual and often overlooked aspects of artworks. Whilst the potential of these technologies in broadening the field of aesthetic experience is well established, there are some developments specific to this case worth expanding on. Interestingly enough, the author refers specifically to the idea of building a connection with the painter who made *The Face of Christ*, recuperating the same reasoning that mid eighteenth-century museum goers had when holding a precious object.[103] In comparing the attempt to get in touch with the past before and after haptic technologies, moreover, the added value brought by the device seems clear. Whilst in the original case a visitor had to actively exercise the power of imagination in order to build a connection, in this instance the device guides the user into the experience, leveraging on the emotional potential of a multisensory environment which starts from the drawn line, develops into an haptic apparatus and is then sublimated through sound. What emerges with regards to this example, and in contrast with the ones analyzed before, is the way in which the designer of the project has overcome the need to merely attempt to replicate the touching experience, and decided to exploit both the phenomenological and the imaginative potential of the technology

102 F. Taylor, *Recreating sensory experience: How haptic technology could help us experience art in new ways.*

103 A detailed account of an emotional and imaginative encounter between a museum goer and an artifact can be found in S.A. La Roche, *Sophie in London, 1786: Being the Diary of Sophie Von La Roche*, trans. C. Williams (London: Jonathan Cape, 1933): 107-108.

at his disposal. Further, this has been done in an artisanal and experimental fashion, not through the use of excessive resources and a big team of professionals.

Another experimental program worth considering, in this case definitely a more costly and collective endeavor, is an exhibition held at Tate Britain in 2015, Tate Sensorium (Fig. 2).[104] The research background behind this project refers to a scientific field which experiments with the power of haptics to elicit emotions. More specifically, these projects study how mid-air haptic technology – a specific subset – is able to condition human emotions (e.g., happy, sad, excited, afraid) through tactile stimulation.[105] While the literature in the field of mid haptics is still at a very early experimental stage, and definitive conclusions are yet to be drawn, progress has been made in mapping the correlation between aspects of haptics and emotional states. What was done at Tate was to organize an exhibition which built a fully sensory environment around four paintings: *Interior II* by Richard Hamilton, *Full Stop* by John Latham, *In the Hold* by David Bomberg, and *Figure in a Landscape* by Francis Bacon. In a detailed article[106] presenting a study on the exhibition, the specific experience of *Full Stop* is analyzed. What the curators did was to position a mid-air haptic device in front of the painting, and synchronize a range of mid-air haptic patterns inside the device with a self-developed software that could read Musical Instrument Digital Interface (MIDI) inputs. The design was curated by a sound designer who could control the mid-air haptic patterns (frequency, intensity, and movement paths) to create a desired experience synched with music. As detailed through the article, this exhibition was the first time that mid-air haptic technology was used in a museum context

104 *Tate Sensorium* website, https://www.tate.org.uk/whats-on/tate-britain/ik-prize-2015-tate-sensorium, accessed January 31, 2022.
105 M. Obrist *et al.*, "Emotions mediated through mid-air haptics," *Feeling and Communicating Emotions*, (Seoul: Crossing, 2015): 2053-2062 https://doi.org/10.1145/2702123.2702361. A discussion on the futuristic potential of mid air haptic technologies was anticipated above, with reference to the incentives that the European Union is making available to further these research fields.
106 C.T. Vi *et al.*, "Not just seeing, but also feeling art: mid-air haptic experiences integrated in a multisensory art exhibition," *International Journal of Human-Computer Studies*, vol. 108 (Elsevier Ltd, 2017): 1-14 https://doi.org/10.1016/j.ijhcs.2017.06.004.

over a prolonged period of time and integrated with sound to enhance the experience of visual art. This "work demonstrates how novel mid-air technology can make art more emotionally engaging and stimulating, especially abstract art that is often open to interpretation,"[107] as it was proved by collecting positive feedback from over 2500 visitors. The aim of the authors, as clearly stated across the research, was to advance understanding of multisensory signals in relation to art, experiences and design, based on novel interactive technologies. Referencing back to the reasons why touch was valued in early museums, this experiment seems to fit in the category which uses haptics to enhance the aesthetic experience of the visitors: anticipating that haptics carry value not only on a purely informative sensory level, but eliciting a wider level of complexity.

Conclusions

Overall, there seems to be a wide potential for using haptic technologies in museum settings and leveraging on the ways in which these devices can contribute to the cultural experience of artifacts. The two final case studies here examined clearly exemplify how haptic technologies can help in generating a new experiential layer, one which rests on a complex phenomenological understanding of the haptics and establishes an active dialogue with the entire sensorium of the experiencer. Both cases show a designed synchronization between the tactile experience and the sense of hearing, suggesting that one of the ways to experiment with the haptic is by interrogating a more environmental and organic understanding of the relationship between the senses. Interestingly, the more complex and enhancing experiences are characterized by stimuli that do not just mimic the act of touching, thus attempting to reinstate the lost chance of touching the artwork, yet play with the illusory potential of haptics and with the other

107 Ibid.: 1.

qualities of touch valued in early museums: the evocative and imaginistic potential of the haptic experience.

The analysis from the museum sector, when linked to the technological and historical accounts regarding the link between the haptic and the figure of illusion, suggests the value of exploring the ways in which haptic technologies can emancipate us from a reductive understanding of touch. Certainly, all museum endeavors and experiments will have to take into account a variety of practical and concrete concerns, which also play an important part in defining the destiny of cultural projects. It is not given that exploring the illusory potential of haptic technologies represents in itself the best choice for a museum research. Yet, it can be concluded that when designed in an open dialogue with our whole sensorium these technologies appear empowered in their visionary potential, making Derrida's observation more actual than ever: the nexus between touch and virtuality is as real as it gets.

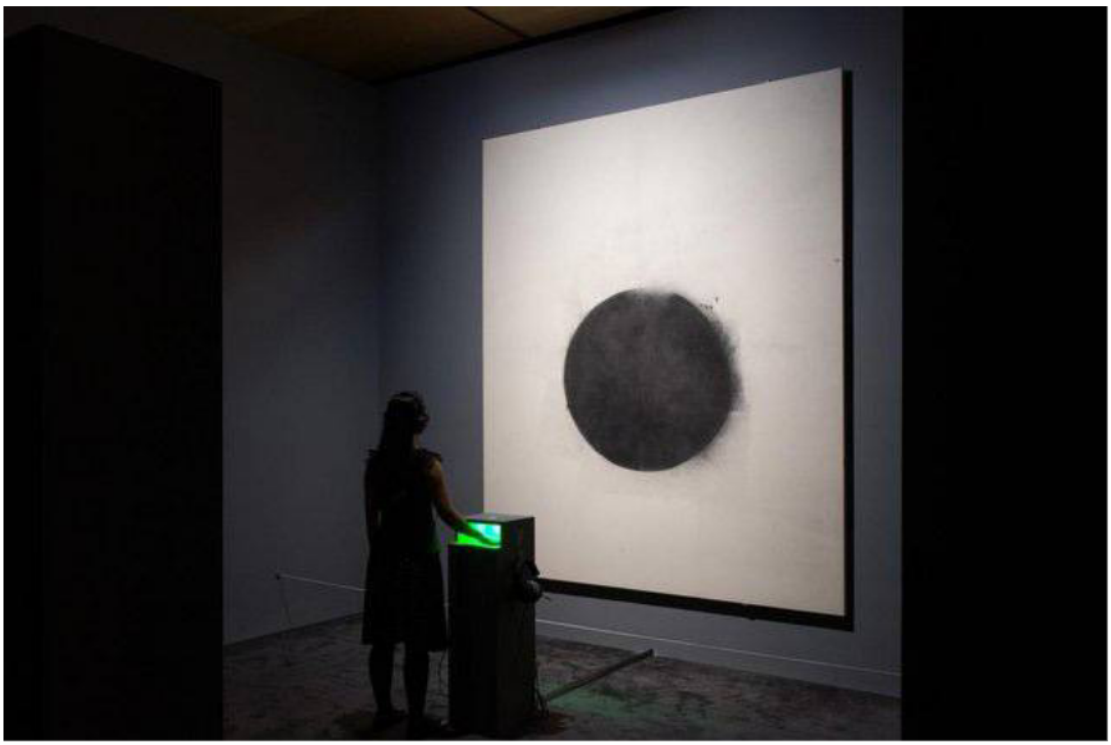

Fig 2. Tate Sensorium exhibition at Tate Britain in 2015, installation shot of *Full Stop* (1961) by John Latham © John Latham Estate. Photo: Tate. Illustration of a participant experiencing the second painting combining vision, auditory, and haptic.

AN-ICONOLOGY
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UNIVERSITÀ DEGLI STUDI DI MILANO
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"PIERO MARTINETTI"

AN-ICON has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme. Grant agreement No. 834033 AN-ICON.
The project is hosted by the Department of Philosophy "Piero Martinetti" – Department of Excellence at the State University of Milan.