

Refining Data by Pointing the Index Finger

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Abstract

This essay argues that data analysts refine data that is rendered visible through data visualizations by pointing the index finger. On the basis of an observation made from Werner Herzog's documentary *Lo and Behold: Reveries of the Connected World* (2016), I argue that pointing makes the voice of data accessible through communicative reading and modeling work. Pointing is applied as an embodied method for cinematic knowledge production. The essay also proposes that the history of the invisible hand, introduced as market metaphor by Adam Smith, has to be updated by film and media studies and must be written towards active knowing processed through fingers. This article brings together perspectives from the history of art, media culture, social and economic theory.

Freeing Fingers for Pointing Work

Considering documentary films as a medium for the study of cultural and communication processes,¹ it becomes clear that pointing index fingers play a central role in the age of Big Data. This is particularly clear if one takes a closer look at Werner Herzog's documentary *Lo and Behold: Reveries of the Connected World* (2016). The film deals with the past, present, and future of

¹ In the context of Niklas Luhmann's system theory, culture is understood to be a second level of observation that allows for studying communication; see, for instance, Niklas Luhmann, *Gesellschaftsstruktur und Semantik: Studien zur Wissenssoziologie der modernen Gesellschaft* (Frankfurt am Main: Suhrkamp Verlag, 1995), pp. 32–51. The sociologist Armin Nassehi recently has argued that under the condition of big data and digitization, data adds a third level of observation. Data are observers par excellence making the form of observation, that is their own method as well, relevant for the study of data; see Armin Nassehi, *Muster: Theorie der digitalen Gesellschaft* (München: C. H. Beck, 2019), p. 109. A film's capacity to be understood as a medium to make communication processes observable is highlighted, once more, in Rebecca Boguska's and Vinzenz Hediger's introduction for John Mowitt, *Tracks from the Crypt* (Lüneburg: meson press, 2019), pp. 7–18 (p. 17). From this point of view, documentary film allows all viewers to be critically engaged theorists of their own social framework, which is an idea that is evident also in Emma Rothschild's work on the use of the invisible hand. See Emma Rothschild, 'Adam Smith and the Invisible Hand', *The American Economic Review*, 84.2 (1994), 319–22 (p. 320).

the Internet, and, in the manner of Herzog's interest, the human component of technology. From the title alone, the film puts an act of indexing at the center and lets representations of pointing index fingers become observable. The film contains six scenes in which pointing index fingers are put to work by collections and visualizations of data: computer scientist Danny Hills points to addresses in an imaginary telephone book during his interview; the Internet pioneer Ted Nelson is staged in his office on a houseboat using his index finger to explain visualizations of interconnectivity on his computer screen; the computer scientist Adrien Treuille gesturally emphasizes the helical structure of an RNA molecule by pointing; autonomous car engineer Raj Rajkumar displays data dots, which are not visible in the trunk of a car where the dots are actually translated into driving commands, in his office on a screen; safety analyst Shawn Carpenter illustrates the placing of a Trojan by imitating the click on a computer mouse with an index finger; and, robotics engineer J. Michael Vandeweghe uses his index finger to explain on a screen how the robot Chimp perceives the world.

Media history shows that the pointing index finger processes the guidance of attention. In Michelangelo's *The Creation of Adam* the pointing indicates the animation of life through the production of relationships between God and humans. The creation of man takes place right before our eyes, embodied in the pointing gesture the image depicts, but also through the depiction as pointing gesture itself.² The pointing gesture is ubiquitous in Leonardo da Vinci's works, where it signifies the binding of the spiritual and the sensual by indicating directions through and out of the image to guide the spectators' view.³ The didactic function of the use of the pointing finger is even more obvious when looking at media practices such as reading. For instance, as Mary Lee Griffin has found pointing with index fingers is a nonverbal action children use to communicate, allowing them to underline parts of texts to generate extra focus or to indicate page and read changes by literally touching the book through 'nudging, tapping, poking'.⁴ Jonathan Crary relates such generation of attention to the history of vision and refers to, among other works, Edouard Manet's *In the conservatory* to show that the pointing finger is representing an unstable perceptual entity in need of guidance. In the painting, the pointing, as Crary puts it, envisions a binding energy within a 'system of deflection, in which vision is bound up in a relational field within which every point of fixation is a deferral and relay to another one'.⁵ In the field of Science and Technology Studies pointing finger

² See Paul Barolsky, 'Michelangelo and the Spirit of God', *Notes in the History of Art*, 17.4 (1998), pp. 15–17.

³ Walter Isaacson elaborates this perspective considering da Vinci's *Saint John the Baptist*, *The Last Supper*, and *Saint Anne* among many others. See Walter Isaacson, *Leonardo da Vinci* (New York: Simon & Schuster, 2018). Particularly pp. 278–92 and pp. 463–74.

⁴ Mary Lee Griffin, 'Why Don't You Use Your Finger? Paired Reading in First Grade', *The Reading Teacher*, 55.8 (2002), 766–74 (p. 768).

⁵ Jonathan Crary, *Suspension of Perception: Attention, Spectacle, and Modern Culture* (Cambridge, MA: MIT Press, 2001), p. 113.

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work is exemplarily discussed in Morana Alac's study of fMRI images, arguing that seeing as knowing becomes an embodied process through the coordination of gesture, talk, and screen.⁶

In film studies, the connection between knowledge, embodiment, and fingers has been previously emphasized by Vivian Sobchack, who introduces the concept of 'habituated knowledge' and 'embodied intelligence'. She argues that knowing relies on the ability to bodily grasp and sense what one sees.⁷ Wanda Strauven has taken up this notion, arguing that the film experience is '(still) embodied' under the condition of so-called passive gaming practices that require highly 'sophisticated finger skills'.⁸ From a broader media theoretical point of view, Till Heilmann states that digitality, which constantly motivates acts of touching, tipping, swiping and clicking, is built on touch to give sense to the senses and emphasizes that the hand acquires its meaning only because of its jointedness.⁹ Thus, it becomes clearer what Flusser meant when he hypothesized that the future person will be the handless fingering human being.¹⁰

Against the background of these observations and references, this article argues that the pointing index finger is subject to a change from symbol, object of depiction, and representation to being an embodied method to refine data. This change is indicated in Tess Takahashi's work on data visualization when introducing the analogy between pointing finger and vision to suggest, metaphorically, that the voice of data is speaking to the human eye, 'with the subtlety of a road sign, with a finger pointing the way'.¹¹ Sobchack also refers to this separation between metaphorical and actually felt, sensed knowledge. As method, even more, the pointing index finger mediates between object and theory, between data visualization and the knowledge that is supposed to be contained in the data.¹² The pointing gesture makes the object accessible and

⁶ See Morana Alac, 'Working with Brain Scans: Digital Images and Gestural Interaction in fMRI Laboratory', *Social Studies of Science*, 38.4 (2008), pp. 483–508.

⁷ See Vivian Sobchack, *Carnal Thoughts: Embodiment and Moving Image Culture* (Berkeley: University of California Press, 2004). Particularly see the chapter 'What My Fingers Knew', pp. 47–70 (pp. 64–67).

⁸ See Wanda Strauven, 'The Observer's Dilemma: To Touch or Not to Touch', in *Media Archaeology: Approaches, Applications, and Implications*, ed. by Erkki Huhtamo and Jussi Parikka (Berkeley: University of California Press, 2011), pp. 148–63.

⁹ See Till A. Heilmann, 'Digitalität als Taktilität: McLuhan, der Computer und die Taste', *Zeitschrift für Medienwissenschaft*, 2 (2010), 125–34 (p. 126).

¹⁰ See Vilém Flusser, *Medienkultur* (Frankfurt am Main: Fischer Taschenbuch Verlag, 1997), p. 188.

¹¹ Tess Takahashi, 'Data Visualization as Documentary Form: The Murmur of Digital Magnitude', *Discourse*, 39.3 (2017), 376–96 (p. 377).

¹² This notion can be found, among others, in see Karin Knorr Cetina, 'Viskurse der Physik: Wie visuelle Darstellungen ein Wissenschaftsgebiet ordnen', in *Konstruktionen Sichtbarkeiten. Interventionen 8*, ed. by Jörg Huber and Martin Heller (Wien, New York: Springer Verlag, 1999), pp. 245–64 (p. 249); Nick Srnicek, *Plattform-Kapitalismus*, trans. by Ursel Schäfer (Hamburg: Hamburger Edition, 2018), p. 56 and p. 99; Rita Raley, 'Dataveillance and Counterveillance', in *"Raw Data" is an Oxymoron*, ed. by Lisa Gitelman (Cambridge, MA: MIT Press, 2013), pp. 121–45 (p. 123).

enables knowledge to be formed. As embodied method, the pointing index finger generates value in and through the relations it establishes, or not.

The second chapter of *Lo and Behold* carries the subtitle ‘The Glory of the Net’, and stages the computer scientist Adrien Treuille, who is working at Carnegie Mellon University in Pittsburgh with Dr. Rhiju Das, a physicist from Stanford University. Treuille has invented the computer puzzle-solving game Eterna, which combines citizen science with deep learning algorithms.¹³ Eterna takes advantage of the Internet’s capability to bring people and their minds together in order to build the best RNA models, aiming to predict the most likely structure RNA will form in the future.¹⁴ Overall, Eterna’s goal is to decipher the secrets of RNA’s robust folding capacities to cure cancer, HIV, and other diseases.¹⁵

When Eterna comes into play in *Lo and Behold*, the pointing index finger of data scientist Adrien Treuille is put to work to indicate, select, and communicate data dots that are generated through the game and made visible in RNA models. A close-up shows a model that appears to be a digital woollen knot. Treuille highlights properties by circling the model with the help of his computer mouse first. With the click on the mouse he pulls one end of the model to demonstrate its shape from different perspectives, allowing an almost all-round view in the virtual 3D space of the screen. The camera zooms into the image to get closer to the visualization and Treuille’s clenched hand, with his index finger sticking out, appears from behind to the left of the camera and outlines the shape and size of the model twice — without touching the laptop screen, however. (fig. 1) By surrounding the model, Treuille emphasizes what was previously shown by the all-round view of the model. Equal to processes of weighting, his gesture emphasizes the model’s shape in relation to individual data threads. In the second part of the scene, the procedure of weighting comes into play again when Treuille is staged holding a real 3D model of RNA in his hands. He puts the model in one hand to free the other (his hands act like scales) to stretch his index finger out and circles the model defining its shape in a live voice-over once more: ‘It forms a helix’.¹⁶

Bringing Data into Circulation

The pointing finger supports the shaping of data visualizations as an embodied method to transform data into circulable knowledge. The scene

¹³ See EternaSoft Website, <<https://software.etergame.org/>> [accessed 11 February 2020].

¹⁴ See ‘What Is the EteRNA Game?’, Carnegie Mellon University Channel, Youtube, 10 January 2011, <[https://www.youtube.com/watch?v=\[JhHg89h7bo\]](https://www.youtube.com/watch?v=[JhHg89h7bo])> [accessed 5 February 2020].

¹⁵ See ‘Online Game Helps Unravel Secrets of RNA’, Carnegie Mellon University Website, Robotics Institute Archive, 1 January 2011, <<https://www.ri.cmu.edu/online-game-helps-unravel-secrets-of-rna/>> [accessed 5 February 2020].

¹⁶ The whole scene can be watched in *Lo and Behold: Reveries of the Connected World* (Werner Herzog, 2016).

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stages the pointing index finger and renders the directing of knowledge visible on three levels: by guiding camera movements, the observer's eyes (of data scientists at their workplaces and in front of their work desks, the director Werner Herzog, and the spectator), and the interpretation of visualized data by making data as object of knowledge accessible. The pointing gesture draws attention to single aspects within the data visualization by deviating attention from others. The gesture motivates the audience to leave its 'subsidiary awareness of the finger' behind, as Michael Polanyi calls the fact that one follows the index finger to look at an object, but does not pay attention to the pointing finger itself.¹⁷

Inspired by this reading, the pointing gesture not only directs the interpretation of visualized data. It also creates an object of knowledge by making data accessible. Rather, the pointing gesture becomes an applied method of cinematic knowledge production itself as it answers a problem that arises at the interaction between data analyst, the public of data science, and data visualizations — or, more generally, it refers to, and occurs at the interaction between human and machine. In contrast, Tess Takahashi claims that data has a 'voice' that is embodied in data visualizations that show the way to the eye. The metaphorical use of the pointing gesture becomes a method performing an action and allowing the data expert to sensually touch what he or she *sees/knows*.



Fig. 1: *Lo and Behold: Reveries of the Connected World* (Werner Herzog, 2016). Screen capture.

¹⁷ See Michael Polanyi, 'Sense-Giving and Sense-Reading', *Philosophy*, 42.162 (1967), 301–25 (p. 301 and p. 316).

This transformation is processed by the shifting gesture of the pointing index finger. As the scene with Treuille shows, the pointing is repeated,¹⁸ always moving towards the image and away from it. The movement itself embodies the change between three-dimensionality, which Treuille's body and the real RNA model have in space, and the virtual 3D model presented on the two-dimensional screen. In and through this movement the finger processes the generation of meaning, which needs to be stabilized as it is fragile because it is caught in relationality.¹⁹ Theories of indexicality, as presented by Rosalind Krauss in reference to Roman Jakobson, for instance, have emphasized this movement. It is in a state of relational change and it processes a shifting relationship that shows that after all it is the index that means nothing, but produces meaning by establishing values through relational connection.²⁰ Between the data visualization that is embodied in the screen and the reading, listening, and interpreting process that is performed by the embodied method of the expert and his/her pointing finger, the gesture switches between and interconnects the value of data with the value of the linguistic sign aiming to communicate knowledge.

Refining Data

Within the history of economy, this paper argues, the index finger processes refining work, insofar as the pointing gesture contributes to the creation of economic value by the execution of a division, which allows the distribution and sharing of knowledge with an audience. Pointing, similar to zooming, divides data visualizations into visible and no longer visible, more important and no longer important, focused and unfocused aspects of the visualized data that the analyst decides to communicate. This division answers to the circumstance that the visualization *says/knows*, to a certain extent, too much. Pursuant to a decision forming part of an ordering process,²¹ the pointing selects data dots and combines them with what the data has communicated to the eyes of the analyst.²²

¹⁸ On the repetition and temporality of gestures, see Rebecca Schneider, *Performing Remains: Art and War in Times of Theatrical Reenactment* (New York: Routledge Publishing, 2011), p. 37.

¹⁹ On the production of value through the linguistic sign, see Ferdinand de Saussure, *Grundfragen der allgemeinen Sprachwissenschaft* (Berlin: De Gruyter, 2001).

²⁰ See Rosalind Krauss, 'Notes on the Index: Seventies Art in America', *October*, 3 (1977), 68–81 (p. 70); see also E. C. Evans, 'On Pointing', *Philosophy*, 38 (1963), 366–69.

²¹ Hartmut Winkler points to the organization of access within media constellations arguing that the finger is, introduced by television and the practice of zapping, a tool of choice, decision even. See Hartmut Winkler, 'Zugriff auf bewegte Bilder: Video on Demand', in *Medien und Ästhetik: Festschrift für Burkhardt Lindner*, ed. by Harald Hillgärtner and Thomas Küpper (Bielefeld: Transcript, 2003), pp. 318–31 (p. 323f).

²² The process of selecting, combining, and relating are central for the work of narration, which Wolfgang Iser considers as acts that enable affection for and access to the world. See Wolfgang Iser, *Das Fiktive und das Imaginäre: Perspektiven literarischer Anthropologie* (Frankfurt am Main: Suhrkamp Verlag, 1991), pp. 42–51.

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The economist Brian J. Loasby, referring to Friedrich August von Hayek's works introducing knowledge as the central aspect for economic growth, emphasizes that knowledge grows by division only and that the 'primary means of increasing the division of knowledge' is the division of labor.²³ This division takes place not only on the organizational level of the game Eterna, which from a market perspective exploits the participation of amateur computer gamers to 'harvest [...] the "cognitive surplus"',²⁴ as reported by the *New York Times* about the potentials of the game, but also by means of the jointedness of hands and the division of the visualization which the pointing index finger performs. Eterna shows, on the one hand, that finger work is being performed by letting thousands of gamers perform invisible finger work exercised at private desks when solving puzzles. On the other hand, Treuille's analysis of the output of the game serves as an example to show to what extent knowledge is only divisible when applied as 'active knowledge',²⁵ embodied in the pointing act allowing the distribution, consumption, and sharing of knowledge.

Recently, Shoshana Zuboff in *Surveillance Capitalism* argues with reference to the sociologist Émile Durkheim that the division of knowledge is now the dominant principle of ordering processes in a society in which data is understood to be the opportunity for potential knowledge and the ultimate resource for economic growth. She even speaks of a division of learning, according to different accesses to knowledge production.²⁶ In a similar vein, Nick Srnicek emphasizes the crucial role of data as a resource in his argument that data does not necessarily contain knowledge, but data must firstly be transformed into knowledge. Like other raw material, the refining process of data includes storage, standardization, recording, visualization and analysis.²⁷ If one follows Enzo Rullani, who stresses that, in a knowledge economy, it is crucial to recognize the motor of value creation leading towards increasingly interactive communicative, intellectual, creative, and advisory work activating and distributing knowledge based on data,²⁸ the pointing finger mediates this work and represents the knowing how to apply pointing as embodied method.

²³ See Brian J. Loasby, *Knowledge, Institutions and Evolution in Economics* (London: Routledge Publishing, 1999), p. 135f.

²⁴ John Markoff, 'RNA Game Lets Players Help Find a Biological Prize', *New York Times*, 10 January 2011, p. 4.

²⁵ The economist Enzo Rullani suggests this term in Enzo Rullani, *Ökonomie des Wissens: Kreativität und Wertbildung im Netzwerkkapitalismus* (Wien, Berlin: Verlag Turia+Kant, 2011), p. 370. The knowing in action, what motivates people to actively produce knowledge, is discussed in Christoph Wulf, 'Unknowing and Silent Knowledge as a Challenge: Iconic, Performative, Material Perspectives', in *Non-Knowledge and Digital Culture*, ed. by Andreas Bernard, Matthias Koch and Martina Leeker (Lüneburg: meson press, 2018), pp. 123–40 (p. 128f).

²⁶ See Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (London: Profile Books, 2019), p. 19, p. 32f and p. 88.

²⁷ On the processing of data as raw material, see Srnicek, pp. 39–53.

²⁸ See Enzo Rullani, 'Wie wird durch Wissen Wert geschaffen?', in *Kognitiver Kapitalismus*, ed. by Isabell Lorey and Klaus Neundlinger (Wien, Berlin: Verlag Turia+Kant, 2012), pp. 133–57.

As a dividing process, the pointing mediates the expertise of computer scientist Treuille, who becomes a communication expert just by producing connections. This is a notion that can be found, for example, in a concert hall the moment an orchestra conductor functions as a communication hub, or (musical) mediator par excellence.²⁹ The moment the data analyst literally pulls single strands of data, Treuille expresses a specification of knowledge that is put into circulation. Viewed this way, the pointing finger guarantees the authenticity of what experts communicate, also because of the movement that repeatedly indicates and protocols the authentication of the object of knowledge to which the speech refers. The movement of the embodied method not only ensures the binding of the object of knowledge, the speech, and gesture of knowing, but also, the refinement of data by pointing to an aesthetic method of knowledge production.

This method is based on revelation. When the observer follows the pointing finger, the eye zooms in even more than the camera does and the image is divided by the gaze. The finger removes layers and comes even closer to the image through the sense of touch than the eye appears to be able to achieve. This notion of pulling apart threads is considered an act of ‘artful revelation’ in Catelijne Coopmans’ work. Coopmans shows that data visualizations are made accessible by following the construction of the story to be drawn from them. Thus, in order to uncover the value of the data in the image and generate commercial success, the image itself is processed and evaluated.³⁰ Such notion can be found in Michel Serres’s work on the senses, in which Serres writes that revelation requires tact to unravel the state of things, and can only be unveiled by using the sense of touch.³¹ More precisely, Serres states that unveiling is being patiently performed with a respectful tact and argues that the sensitivity of touch makes information accessible as it opens information: ‘a soft correlate of what was once called the intellect’.³²

The revealing division of data visualizations, which the pointing gesture transacts and which also mediates the production of surplus in a knowledge economy based on data. It is a dividing process that is also found in Wolfgang Iser’s literary theory, in which Iser refers to the division that the reading and narrating process performs with regards to the ground and building of a figure of narration. Exemplified in Treuille’s case, this division is expressed by the

²⁹ See Jürgen Osterhammel, ‘Kühle Meisterschaft: Dirigenten des frühen 20. Jahrhunderts zwischen Selbstdarstellung und Metierbeschreibung’, in *Kommunikation in Musikleben: Harmonien und Dissonanzen im 20. Jahrhundert*, ed. by Sven Oliver Müller, Jürgen Osterhammel and Martin Rempe (Göttingen: Vandenhoeck & Ruprecht, 2015), pp. 154–78 (p. 159).

³⁰ See Catelijne Coopmans, ‘Visual Analytics as Artful Revelation’, in *Representation in Scientific Practice Revisited*, ed. by Catelijne Coopmans, Janet Vertesi, Michael Lynch, and others (Cambridge, MA; London: MIT Press, 2014), pp. 37–60 (p. 52).

³¹ See Michel Serres, *Les Cinq Sens: Philosophie des Corps Mêlés* (1985), Engl. transl. *The Five Senses: A Philosophy of Mingled Bodies* (New York: Continuum 2008), p. 81.

³² Serres, p. 84.

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repetition of the pointing gesture towards and away from the screen. The gesture itself becomes a figure (in motion between the virtual model on the screen and the execution of the gesture as a figure during the act of pointing) that models air that fills the space between screen and body. The pointing index finger refines data by supporting the communicative work that the data visualization demands from the eyes by making it figurative and even touchable. In this way, the refining process, which one could imagine and discuss, for example, in relation to oil as a dirty and mechanical process, becomes an embodied, directed, and gentle process performed through withdrawn but repeated knowing how to touch with fingers.

From the Invisible Hand towards Knowing how of Fingers

One must assign the data analyst's pointing finger a central place in the media cultural history of the invisible hand. This refers to the usage of Adam Smith's metaphor, which was introduced in moral philosophy in *An Inquiry into the Nature and Cause of the Wealth of Nations* in 1776. However, it has been part of a history of film and moving images because Adam Smith's metaphor easily serves as a model to set imagination and the rewriting of history in motion. As political philosopher Susan Buck-Morss emphasizes, Smith's theory actually enabled the documentation of the activities and 'effects of the invisible hand' by graphically representing them via charts.³³ Viewed in this way, the history of the invisible hand and the history of its visualization stand for the principle of knowing how to give body to knowledge via moving images.

With regards to the ubiquity of data visualizations in data-based economies, an update of the metaphor of the invisible hand must be carried out by film and media studies because film and moving images not only own the capacity to show, but rather demand work from fingers to deal with non-knowledge. Through Alfred Dupont Chandler's work *The visible hand: the managerial revolution in American business* published in 1977, this metaphor has already been adjusted in managerial studies. Film scholar Lee Grieveson relates this update to a 'replacement' of market systems that has taken place through the course of a change of capitalist systems from small proprietary businesses to large corporate and managerial companies that integrate various functions at different levels.³⁴ The metaphor of the invisible hand had to have been corrected under these circumstances to some extent, precisely because these enterprises required more coordination through managers.³⁵ Data economies and data

³³ See Susan Buck-Morss, 'Envisioning Capital: Political Economy on Display', *Critical Inquiry*, 21.2 (Winter 1995), 434–67 (p. 354f).

³⁴ See Lee Grieveson, *Cinema and the Wealth of Nations: Media, Capital, and the Liberal World System* (Oakland: University of California Press, 2018), pp. 45–53.

³⁵ See Alfred Dupont Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, MA: Harvard University Press, 1977), pp. 484–500. See also Grieveson, pp. 37–50.

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visualization challenge these understandings and coordination once more as they place the sense of touch and its relationship to moving images in the center of economic value production, which relies on the application of fingers and its tacit communication to produce knowledge by evaluating it.

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