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Beyond the predominance of the visual empire: A functional model on haptics & more

Claus-Christian Carbon; Department of General Psychology and Methodology, University of Bamberg; Bamberg, Bavaria/Germany

Abstract

In perceptual sciences we face a clear predominance of the visual domain. Actually, even job opportunities and textbooks orient to this trend which was already initiated by the first scientists who systematically addressed perceptual phenomena. One reason might be the relative ease of testing visual stimuli; another reason might be a particular focus on visual phenomena also in everyday life. Due to this 150 years lasting neglect of other sensory domains, we face a huge lack of knowledge of holistic perception comprising multisensory experience. This results in a problem in understanding multisensory phenomena particularly in product usage where specifically the interaction between haptics and vision plays a major role. Here, I will present a functional model of haptic aesthetics that is aimed to link the domain of haptics with other modalities.

The predominance of the visual empire

The predominance of visual research in the perceptual sciences is now so evident that some people even seem to interpret perceptual sciences with a pure visual direction—and if other sensory modalities are addressed, then mostly in footnotes or minor chapters in textbooks [see for instance, 1]. In my major field of research, empirical aesthetics, this is even more pronounced [2]. Although we experience a rich variety of aesthetic phenomena in haptics (e.g., the touch of your partner's skin), olfaction (e.g., the smell of our favorite perfume) and gustation (e.g., the taste of an aged Barolo wine) in everyday life, we clearly focus on visual phenomena. One reason for this might be the relative ease of scientifically processing visual stimuli in an experiment; another reason might be that also in everyday life we tend to reduce most experiences to visual ones—although emotional effects (e.g., to get fascinated by a certain feel-and-touch interaction) as well as memory effects (e.g., the Proust phenomenon) impressively demonstrate how powerful experiences of other sensory effects are for many truly deep psychological experiences.

The specifics of haptic exploration

The scientific endeavor to understand other sensory modalities beside vision is not a mere academic kind of extending the research view in a *quantitative* way. Tactile experiences, for instance, are also *qualitatively* very different from visual counterparts. Whereas vision is always unidirectional in the sense of that we only build up some visual representation of a viewed object but that we do not change the object by doing so, the haptic exploration does also change the object as such. Touching always evidently means "being touched" [3].

There is an additional quite remarkable qualitative difference between visual and haptic experiences: While visual exploration is always a more or less elaborated scanpath determined by eye fixations and saccades, which is only mildly affected by expertise or familiarity in the general way of processing [4], haptic exploration can be characterized by a multi-methodological approach [5]: we can explore objects haptically with *lateral motion* for scanning texture, with *pressure* for revealing hardness, by *static contact* for assessing thermal aspects, by *unsupported holding* for estimating weight, with *enclosure* for investigating the global shape and also via *contour following* to detect the shape of an object.

Quite characteristically for haptic exploration is also the gut feeling which directly emerges—the tactile experience is mainly a very direct and affective one; it is marked by clear-cut and fast evaluations without the typical need as in the visual domain to elaborately describing it [6].

A functional model for understanding haptics

On basis of these characteristics of the haptic sense, we created a functional model of haptic aesthetics [2] whose logical structure is a series of subsequent stages marked by continuous increases of specificity, complexity, and elaborateness towards the haptically to be explored object. Thus, haptic experience is defined as a complex microgenetic process [7, 8] with several feedback loops being able to modulate and refine the process continuously.

Processing stages

The whole process starts with a haptically unidentified object with the goal to identify this object at the end of the process and to assign meaning to it. During the first phase, low-level analyses are employed with unspecific *exploration* of the haptic entity. After this exploration phase where local haptic aspects are processed, more elaborate processing, the so-called *assessment*, takes place integrating the local aspects into more global qualities. The last phase is characterized by deep cognitive and emotional *evaluations* strongly associated with individual memory representations and personal experiences activated and modulated by these evaluations. By continuously increasing the specificity and complexity of the processes, the material properties are increasingly integrated and elaborated: The haptically inspecting person gains knowledge and understanding of the object and creates an emotional episode while processing it. The main processing structure of the functional model follows a strict feed-forward logic with three main phases: (1) *exploration*, (2) *assessment* and (3) *evaluation*

Figure 1 illustrates the complex interplay between the different processing stages and the feedback loops; it also shows the detailed processing capabilities that can be executed within each phase.

Feedback loops

Importantly, besides the feed-forward main processing logic, additional recursive feedback loops for each of the main processing phases are assumed, i.e. (1) *expectation*, (2) *integration* and (3) *familiarity*, respectively. These loops modulate and refine the phase-specific process. Furthermore, the embedment of the unspecified object provides helpful context information to assist the subsequent processes in categorizing the object.

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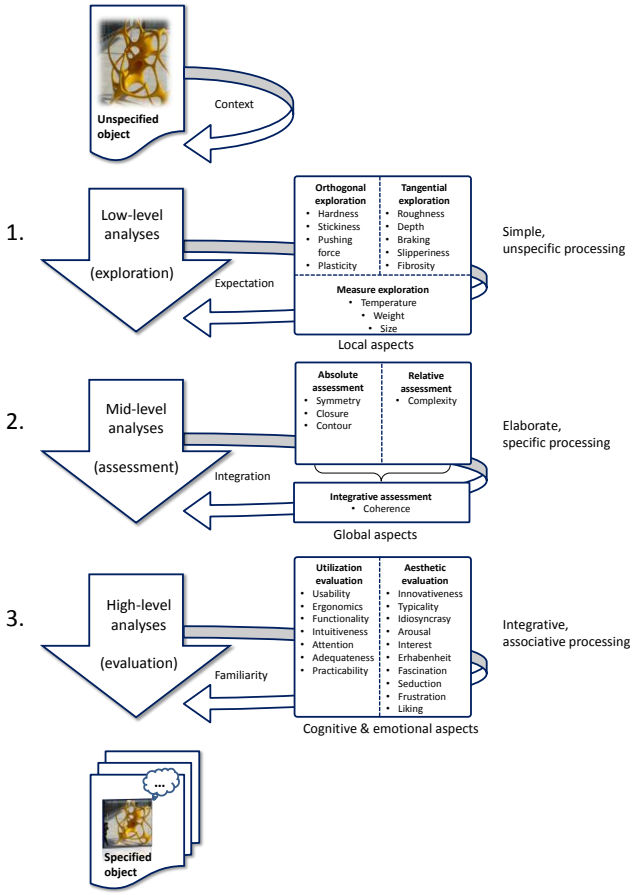

Figure 1. The functional model of haptic aesthetic processing proposed by Carbon and Jakesch in 2013 [2].

Multi-sensory Interaction

The here proposed and described haptic processing model shows a series of connection points for multi-sensory integration. First of all, the starting point of the model, the (haptically) unspecified object is provided within a certain context. This context can be described in many terms, also by different sensory inputs. It is assumed that the unspecified object is never context-less, but is embedded in a context of meaning. In an approach which we called "scenario-based touching" [9] we demonstrated how powerful contextual effects are for the modulation of subsequent processing stages. The first feedback loop "expectation" is also potentially fed by multisensory channels; for instance, if a surface is visually perceived as metallic, it will induce quite surprising haptic explorations if the material does not feel "thermally cold". Additionally, the "integration" feedback loop which specified the assessment of the object can be fed by other than tactile signals—they have the power of further integrate the partial information on an object. Finally, the "familiarity" feedback loop will get information about possible associations with the semantic network via all available sensory and semantic inputs. Here again, multisensory integration is possible and explicitly proposed.

Conclusion and Outlook

We hope that the application of the haptic processing model as described here will help to systematize and understand the multisensory integration and interaction and will work as a powerful framework to inspire innovative research on this promising field of research.

References

[1] E.B. Goldstein (2009) Sensation and Perception. 8th ed. 2009, Wadsworth, Belmont, CA.

[2] C.C. Carbon; M. Jakesch (2013) "A model for haptic aesthetic processing and its implications for design," Proc Ieee. vol. 101, no. 9, pp. 1-11.

[3] J.J. Gibson (1962) "Observations on active touch," Psychol. Rev. vol. 69, no. 6, pp. 477-491.

[4] C.C. Carbon; F. Hutzler; M. Minge (2006) "Innovation in design investigated by eye movements and pupillometry," Psychology Science. vol. 48, no. 2, pp. 173-186.

[5] M.H. Sonneveld; H.N.J. Schifferstein (2008), The tactual experience of objects, in Product Experience, H.N.J. Schifferstein and P. Hekkert, Editors. Elsevier: Amsterdam, pp. 41-67.

[6] M. Jakesch; C.C. Carbon (2012) "The Mere Exposure Effect in the domain of haptics," PLoS ONE. vol. 7, no. 2, pp.

[7] T. Bachmann (2000) Microgenetic approach to the conscious mind Advances in consciousness research. 2000, John Benjamins, Amsterdam, Netherlands. xiv, 298.

[8] T. Bachmann (2006. "Representation and revelation: microgenesis as seen from the perceptual retouch theory perspective. 2006.

[9] M. Jakesch, et al. (2011) "Scenario-based touching: On the influence of top-down processes on tactile and visual appreciation," Research in Engineering Design. vol. 22, no., pp. 143-152.

Author Biography

Claus-Christian Carbon studied Psychology (Dipl.-Psych.), followed by Philosophy (M.A.), both at U Trier. After receiving his PhD from FU Berlin and his "Habilitation" at U Vienna, he worked at Delft University of Technology. Now he is Head of Department of General Psychology and Methodology at U Bamberg and head of Forschungsgruppe EPAEG—a research group devoted to enhancing the knowledge, methodology and enthusiasm in the fields of cognitive ergonomics, psychological aesthetics and design evaluation..