

ESF Exploratory Workshop on

QUALITIES IN PERCEPTION SCIENCE

Rovereto (Italy), 2-6 November 2009

Convened by:
Liliana Albertazzi

SCIENTIFIC REPORT

1. Executive summary

The workshop concerned a basic fact, i.e. that in perceptual experience, quality is not reducible to quantity, also avoiding to take into account top down components, due to geographical, cultural, linguistic, social environment, emotional or aesthetic phenomena, or phenomena of subjective preferences, which naturally are considered components of qualitative type. However, when dealing with qualitative phenomena, science treats them almost exclusively in quantitative terms, i.e. in terms of primary qualities (stimuli).

In order to develop a science of qualities and/or of qualitative perceiving, it is necessary to outline a detailed descriptive theory of qualities, to find the relationships among stimuli, neuronal elaboration and visual experience in terms of a new theory of information; to formulate a new method for measurement of visual appearances, especially in the sense of visual operations that form the basis of perception and phenomenal experience. What is evidenced by a descriptive analysis, then, brings necessarily to the recognition of the existence of an emergent qualitative level of reality and of its relative non-independence from the stimuli of the physical world.

Current scientific hypotheses at hand, like the inferential or the ecological theory of perception present reductivistic aspects which render them not suitable for developing a theory of qualitative perceiving. However, a descriptive, a psychophysical and a neuronal approach to perception are not necessarily and mutually in contradiction: for example, the subjective contour in amodal shapes is phenomenologically explained as a product of the visual system, while from a neuronal point of view the underlying mechanism is ascribed to the apparent contour to the neuronal activity in V2. Both are correlated analyses dependent on one another but the phenomenological analysis is not reducible to the neuronal one as sometimes it seems to be suggested by neuroscientists working in the field. On the contrary, a descriptive theory of observable phenomena can be of great help for the development of neuroscience, too. Kanizsa's descriptive analysis, for example, has given excellent prompts in finding out a neurophysiologic correlate of amodal contours; similarly for the Gestalt principle of figure/ground segregation in the analysis of numerous phenomena.

What is still needed is essentially a qualitative psychophysics of the operability of actual perceiving.

The exploratory workshop

The exploratory workshop took place in Rovereto, 3-5 November 2009. The host was the University of Trento at Rovereto, Department of Cognitive Sciences and Education. All participants were lodged in the 'Novecento Hotel', near the University. The participants at the workshop arrived on November 2nd and left on November 6th.

Participants came from Italy (5), Holland (5), Great Britain (4), France (1), Germany (2), Turkey (1), Greece (1). A second planned participant from Greece at the last minute could not participate, while the presentation of the scholar from Turkey, who could not attend the workshop due to advanced pregnancy, was given by a colleague participating in the workshop. From outside Europe two scholars came from USA, one from Japan. The

workshop showed a balanced participation of male and female scholars and of senior and junior scientists as well.

2. Scientific content of the event

The workshop has been conceived in different sessions, each addressing basic issues of perception studies. Each speaker was given an hour, essentially divided in 45 minutes speech and 15 minutes for the discussion, which continued each day after dinner too.

The workshop started with a detailed presentation of the nature and goals of the European Science Foundation (ESF) and of the potential actions that might follow the workshop. Since at the last minute the representative of ESF (Dr. Sabine Krolak-Schwerdt) could not attend the conference, the presentation was held by Dr. Voltolini of the administration of Trento University (Department of support to scientific research), who gave the general information about ESF goals and initiatives, and answered the questions posed by the audience.

03/11/2009

Introduction: General topic

The topic of the workshop has been introduced by the convenor, Liliana Albertazzi, who explained the motivations for the conference, and focused on the intended level of investigation (i.e. appearances), the methodologies needed to be developed, and discussed some errors to avoid in experimental research.

Morning session

The first session of the morning comprised two mainly theoretical presentations, given by Jan J. Koenderink and by Rainer Mausfeld. The two presentations acted as introductory themes to the successive specific analyses to follow. Koenderink focused on the quality of shape as a surface quality in visual perception and art, maintaining that shape is pre-cognitive and comes before lexical meaning, be it abstract, symbolic or linguistic. Mausfeld discussed the concept of representational primitives, to substitute to the widespread concept of feature in computational theory of perception.

Afternoon session

In the afternoon Ronald Fleming focused on the role played by qualitative aspects in our perception experience, starting from surface properties to the perceptual organization of 3D shape. Dhanray Vishwanath presented an analysis of depth perception and of the plastic effect as the perceptual presentation of the statistical reliability of egocentrically scaled estimates of depth.

In the second part of the afternoon there were three presentations. Ilona Kovács, taking an ontogenetic perspective on the emergence of perceptual qualities, showed that qualities only arise in the interaction with the environment, and that interaction between sensory input and internal patterns is extremely input-determined early in life. Gert van Tonder presented a hypothesis that many of the visual processes investigated in relation to early and higher vision share proto-counterparts at the very earliest levels of vision, ascribing to the retina the role of cradle of a considerable share of the rich qualities experienced in vision. Julia Simner presented the cognitive, linguistic, neural and developmental basis of synaesthesia, arguing

that synaesthetes and non-synaesthetes lie on a continuum of cross-sensory association, but where neuro-developmental differences allow synaesthetes to experience these cross-modal perceptual qualities to a conscious level.

04/11/2009

Morning session

During the first morning session there were the presentations of Sylvia Pont and of Maarten Wijnties, relating to the modes of appearance of light, of light field and of some material qualities. In particular, Pont focused on the specific properties of the 'visual light field' and addressed newly developed methods to describe, measure and visualize light fields in 3D spaces. She showed how human observers are able to perceive certain light qualities, and described some implications for visual assessments of light qualities in architecture and light design, not least the quality of the atmosphere which is an expressive quality. Wijnties analysed the implication of the velvet material property for 3D shape perception, induced by inverse shading, and underlined the necessity to adopt a non ambiguous categorization of adjectives related to light appearances.

The second part of the morning session has been devoted to the discussion of colour and of transparency appearances. Anya Hurlbert reviewed the phenomenon of colour constancy, by which our brains construct (nearly) invariant object colours under changing environmental conditions; analysed the surface chromaticity properties of natural objects and what these mean for colour constancy; and presented evidence for the role of colour in material appearance and object classification. She gave argument to consider colour perceptively as an imperfect measurement of an intrinsic object property and cognitively as a symbol that acquires meaning and engenders affect through its associations. Osvaldo Da Pos proposed some basic elements of a qualitative psychophysics of the transparency phenomenon, which should enable to make qualitative predictions in relation to the occurrence of the transparency effect and to its relevant characteristics, and a simple and sound conversion to an intra-perceptual model of phenomenological type.

Afternoon session

In the first part of the session, we had two presentations focusing on the spatio-temporal structures of perceiving. Wim van de Grind's presentation focused on a heretofore overlooked cue to material quality, i.e. the spatio-temporal structure in the visual information. For the class of moving objects, contingencies between two material qualities - surface shininess and rigidity - and 3D shape have been discussed. Katja Dörschner's presentation was given by Ronald Fleming. In her work she faced the problem of how the visual system accomplishes reliable estimation of material qualities, on the basis of the spatio-temporal structure in the visual information. Results suggest that image motion may be a useful dimension, also in the quantification of the rather intangible concept of material.

In the second part of the afternoon session there were three presentation on theoretical issues concerning perception. Liliana Albertazzi set out the elements of a theory of visual presence as a preliminary step towards the development of an adequate methodology and a modelling of qualitative aspects of perceptual experience. The primitives of such visual

geometry, like boundary, line, surfaces, etc. are very different from physics and a number of different axioms are to be assumed in order to develop a model of actual perceiving. Walter Gerbino tackled the question of the difference between primary and secondary qualities in relation to the difference between stimuli and percepts, arguing that the Galilean gap can be bridged by reconsidering the structure of psychophysical domains. Baingio Pinna gave examples of how to extend the laws of organization to a further principle of meaning in terms of an underlying elemental structure as basic to define the syntax of the primitive visual language.

05/11/2009

Morning session

In the first part of the session there have been two presentations of Agn s Desolneux and of Agiro Vatakis. Desolneux explained how the Helmholtz' principle can be used and can become computationally efficient when it is combined with the grouping principles of Gestalt Theory.

She maintained that we are able to reconstruct the way we perceive the environment starting from stimuli and organizing them neither with the methods of inverse optics nor recurring to physical world statistics, but on the basis of Gestalt principles considered as a priori categories. This method offers surprisingly simple, adequate and consistent results.

Vatakis presented some experiments in audiovisual temporal perception, showing as the temporal window within which synchrony is perceived has also been demonstrated to exhibit great variability across different studies. The emerging problem is how it is possible to quantify subjective time in a way which is consistent to phenomenology.

The second part of the session was devoted to eminently modelling presentations in object recognition and representation. Irving Biederman focalized on qualitative aspects of the representation mediating the recognition of objects and scenes, while Steve Zucker analysed the intermediate-levels in which the arrangement of boundaries effects the organization of space.

Afternoon session

In this part Lewis D. Griffith, starting from the question whether qualitative categories are just a pragmatic partitioning of the internal multi-dimensional measurement space or do they correspond to qualitative aspects of the external stimulus, demonstrated that extending the analysis from what symmetry the image must have, to what symmetry it most probably has, the quantitative to qualitative gulf can be bridged and a useful system of image features can be defined.

The last talk was given by Henk Barendregt on the method of insight meditation (Vipassana)- recently made better known by so called mindfulness training-where one learns to observe inputs and mind states and their effect on outputs of next mind states.

End of the works and final discussion

After the concluding remarks of the convenor, there was the discussion of the follow-up activities which lasted till eight o'clock p.m. Several items were discussed, among which

future actions to undertake, topics to be focused, others to be added at the proposed research project (see assessment and future directions below).

3. Assessment of the results, contribution to the future direction of the field

As stated in the declaration of intents, the workshop *Qualities in Perception Science* aimed to explore emerging ideas within the field of perception studies and open up new strategic directions in research that will have potentially significant impact on new developments in the science. Specifically, the Rovereto workshop focused on qualitative phenomena central to perceptual experience, to which, traditionally, little attention has been paid. As it is well known, in perception science scientists have focused almost exclusively on establishing the relationship of *quantitative perceptual judgements with either externalized physical attributes or neuronal activity* (the programme of classical psychophysics).

The event has been successful beyond the convenor's expectations. The theme, in fact, according to the type of workshop, was highly innovative and highly risky as well. Presentations and discussions ranged over philosophical perspectives, empirical psychophysical results/analyses, computational and mathematical models/analyses, and neurophysiology (see scientific content above).

The *objective* has been clearly outlined during the three days of the Workshop and an *agreement* has been reached by the participants, through lively discussions which, as mentioned, continued after dinner, often after midnight indeed. The unusual time-table has been widely appreciated by the speakers, who realized the importance of confronting their own ideas and interpretations of the talks given by the colleagues during the daily sessions. Given the interdisciplinary fields of the participants, in fact, among the other factors, synonymy might have played a role in mutual misunderstanding.

To visualize the difficulty of the task, it may be noticed that only at the end of the second day was a full clarification and agreement reached among the participants. An important aspect of the agreement was about the difference between the nature of *physical* and *perceptual* objects, a preliminary step in order to outline a theory and an experimental programme of applied qualitative research in perception theory.

An effort has been made to identify the *different types of analyses* related to the *different levels of existence* which lie at the basis of qualitative perception, in order to find the stages of the development of the perceptual structure. Particularly interesting has been the agreement on the proposal of considering the complexity of natural, qualitative perception as *the starting point* guiding psychophysical and neural correlated investigation and not the way round. Convergence has been found in considering the diverse analyses as mutual integrating parts of the perception science.

Specifically, the participants *now* agree on the need for: (i) a descriptive theory able to identify the specific components, primitives and laws of the phenomenal level of perception, which maintain and go beyond the classical laws of organization; (ii) to find the right correlation and laws of interdependence among physics, stimuli, neuronal correlates and qualitative percept; (iii) to design new experimental methodologies, both quantitative and

qualitative; (iv) the development of a suitable type of computational or quantitative (metric) framework for its modelling.

A *second objective*, then, has been reached, i.e. the project to work together towards integrating the specific researches and data in an unified theory. A consequence has been the agreement to present the common project in more than one EU actions. Because of the administrative endeavour required by major actions, the participants agreed in presenting different actions, addressing the diverse needs, i.e.: (i) forming young researchers working in perception from the new perspective; (ii) organizing conferences for networking and proceeding in tuning the several and specialized individual researches; (iii) proposing a systematic framework of the creative project.

On the side of the participants, it is worth noticing the shared conviction of the originality and innovative nature of the project, and the appreciation of the multifaceted choice of the participants, including the younger ones. There was great enthusiasm to the idea of being working in the direction of a possible change of a scientific paradigm. Finally, there has been the appreciation and the consideration for the steps already reached in previous publications and meetings of the convenor, to be seen as the coherent development of a rigorous research program to take in serious consideration.

From the common discussion emerged the necessity to identify instruments, objects, ideas and languages apt to characterize the specificity of the qualitative field in perception studies. Finally, appreciation has been showed also for the lodging, the place in which the workshop has been held, and the exciting atmosphere created by the encountering of top level scientists on a common problem.

Outcome and further collaboration

During the workshop much time has been devoted to discussion, as mentioned, even after dinner. This choice proved to be extremely successful, because gave the possibility to the participants to discuss at large points which might have been not clearly understood during the presentation, because of the diverse disciplinary competence. During the workshop and after dinner the participants had time also to inform each other about their current researches, in order to find common interests and viable common further developments.

As a first outcome of the workshop, the organizer and the participants agreed to publish the outcome s of the workshop as a book. Because of the originality of the approach, MIT Press declared to be preliminary interested in having a book on the topic, edited by Liliana Albertazzi. The full proposal will be submitted by Albertazzi during January 2010, while the submission deadline for manuscript is August 2010.

To develop the research program, several actions have also been considered, like a COST action to maintain and develop networking among the scholars, a Marie-Curie action for organizing the research and invest also on young people, and an Advanced Grant, to frame more precisely and in detail the theoretical project. At the moment some participants declared themselves to be ready to present each one of the different actions considered.

4. Final programme

Monday 2 November 2009

Afternoon *Arrival*
20.15 *Dinner, Hotel Rovereto*

Tuesday 3 November 2009

09.30-09.40 **Welcome**

09.40-10.00 **Presentation of the European Science Foundation (ESF)**
Samanta Voltolini – University of Trento, Italy)

10.00-10.30 **Introduction**
Liliana Albertazzi (University of Trento, Italy)

10.30-10.45 *Coffee Break*

10.45-12.45 **Morning Session**
Chairman: Irving Biederman

10.45-11.45 **“Surface shape & the eye”**
Jan J. Koenderink (EEMCS, Delft University of Technology, The Netherlands)

11.45-12.45 **“Intrinsic multiperspectivity, the internal attribute of realness, and semantically underspecified conceptual forms”**
Rainer Mausfeld (University of Kiel, Germany)

12.45-15.00 *Lunch, Hotel Rovereto*

15.00-20.15 **Afternoon Session**
Chairman: Wim van de Grind

15.00-16.00 **“Qualitative representations of the physical properties of objects”**
Roland W. Fleming (Max Planck Institute for Biological Cybernetics, Tübingen, Germany)

16.00-17.00 **“Quality in depth perception”**
Dhanraj Vishwanath (University of St. Andrews, UK)

17.00-17.15 *Coffee break*

17.15-18.15 **“Human development of perceptual qualities”**
Ilona Kovács (Budapest University of Technology and Economics, Hungary)

18.15-19.15 **“Very early origins of visual qualities”**
Gert van Tonder (Kyoto Institute of Technology, Japan)

19.15-20.15 **“Synaesthesia: Cross-modal qualities in perception”**
Julia Simner (University of Edinburgh, UK)

20.15 *Dinner, Hotel Rovereto*

Discussion

Wednesday 4 November 2009

- 08.30-12.45** **Morning Session**
Chairman: Walter Gerbino
- 08.30-09.30 **"Spatial and form-giving qualities of light"**
Sylvia Pont (EEMCS, Delft University of Technology, The Netherlands)
- 09.30-10.30 **"Visual perception of Lambertian and velvety, real and rendered shapes"**
Maarten Wijntjes (Delft University of Technology, The Netherlands)
- 10.30-10.45 *Coffee Break*
- 10.45-11.45 **"Colour as symbol or colour as quality?"**
Anya Hurlbert (University of Newcastle upon Tyne, UK)
- 11.45-12.45 **"A qualitative representation of relevant stimuli relationships in the perception of achromatic transparency"**
Oswaldo Da Pos (University of Padova, Italy)
- 12.45-15.00 *Lunch, Hotel Rovereto*
- 15.00-20.15** **Afternoon Session**
Chairman: Anya Hurlbert
- 15.00-16.00 **"What a new class of breathing- and rocking motion illusions can tell us about visual-attribute combination"**
Wim van de Grind (Helmholtz Institute, Utrecht University, The Netherlands)
- 16.00-17.00 **"The role of motion in material classification"**
Katja Dörschner (Bilkent University, Ankara, Turkey)
- 17.00-17.15 *Coffee Break*
- 17.15-18.15 **"Presence: A theory of visual perceiving"**
Liliana Albertazzi (University of Trento, Italy)
- 18.15-19.15 **"Perceptual qualities and the Galilean gap"**
Walter Gerbino (University of Trieste, Italy)
- 19.15-20.15 **"What is a visual meaning? From the perceptual organization to the visual language"**
Baingio Pinna (University of Sassari, Italy)
- 20.15 *Dinner, Hotel Rovereto*
- Discussion*

Thursday 5 November 2009

- 08.30-12.45** **Morning Session**
Chairman: Jan J. Koenderink
- 08.30-09.30 **"Helmholtz principle for visual perception"**
Agnès Desolneux (University of Paris Descartes, France)
- 09.30-10.30 **"The concept of psychological time and the case of audiovisual temporal perception"**
Argiro Vatakis (Institute for Language and Speech Processing, Research Centers "Athena", Athens, Greece)
- 10.30-10.45 *Coffee Break*
- 10.45-11.45 **"Qualitative aspects of the representation of objects and scenes"**
Irving Biederman (University of Southern California, Los Angeles, USA)
- 11.45-12.45 **"Organizing intermediate-level visual features"**
Steven W. Zucker (Yale University, New Haven, USA)
- 12.45-15.00 *Lunch, Hotel Rovereto*
- 15.00-20.15** **Afternoon Session**
Chairman: Steven W. Zucker
- 15.00-16.00 **"Symmetry type as a categorical system for local image structure"**
Lewis D. Griffin (University College London, UK)
- 16.00-17.00 **"Observing mind states & existential fear"**
Henk Barendregt (Radboud University, Nijmegen, The Netherlands)
- 17.00-17.15 *Coffee Break*
- 17.15-20.15 **Discussion on follow-up activities**
- 20.15 *Dinner, Hotel Rovereto – End of Workshop.*

Friday 6 November 2009

Morning *Departure*

5. Final list of participants

Convenor

1. **Liliana ALBERTAZZI**
Dept. of Cognitive and Education Science
University of Trento
Italy

Participants

2. **Henk BARENDREGT**
Institute for Computing and Information Sciences
Radboud University Nijmegen
The Netherlands
3. **Irving BIEDERMAN**
Department of Psychology
University of Southern California
United States of America
4. **Oswaldo DA POS**
Department of General Psychology
Faculty of Psychology
University of Padova
Italy
5. **Agnès DESOLNEUX** (Young Scientist)
Université Paris Descartes
France
6. **[Katja DÖRSCHNER]-Presented by R. Fleming** (Young Scientist)
Department of Psychology
Bilkent University
Turkey
7. **Roland FLEMING** (Young Scientist)
Department Bülthoff
Max Planck Institute for Biological Cybernetics
Germany
8. **Walter GERBINO**
Department of Psychology
University of Trieste
Italy
9. **Lewis D. GRIFFIN**
Department of Computer Science
University College London
United Kingdom
10. **Anya HURLBERT**
Institute of Neuroscience
University of Newcastle upon Tyne
United Kingdom

- 11. Jan J. KOENDERINK**
Department of Industrial Design
Delft University of Technology
The Netherlands
- 12. Ilona KOVACS**
Department of Cognitive Science
Budapest University of Technology and Economics
Hungary
- 13. Rainer MAUSFELD**
Department of Psychology
Christian-Albrechts University Kiel
Germany
- 14. Baingio PINNA**
Department of Language Science
University of Sassari
Italy
- 15. Sylvia C. PONT**
Department of Industrial Design
Delft University of Technology
The Netherlands
- 16. Julia SIMNER** (Young Scientist)
School of Philosophy, Psychology and Language Sciences
University of Edinburgh
United Kingdom
- 17. Wim VAN DE GRIND**
Helmholtz Institute and Functional Neurobiology
Utrecht University
The Netherlands
- 18. Gert VAN TONDER**
Dept. of Architecture & Design
Kyoto Institute of Technology
Japan
- 19. Argiro VATAKIS** (Young Scientist)
Institute for Language and Speech Processing
Greece
- 20. Dhanraj VISHWANATH**
School of Psychology
St. Mary's College, University of St. Andrews
United Kingdom
- 21. Maarten W. A. WIJNTJES** (Young Scientist)
Department of Industrial Design
Delft University of Technology
The Netherlands
- 22. Steven ZUCKER**
Department of Computer Science
Yale University
United States of America

6. Statistical information on participants

Origin

European countries

France	01
Germany	02
Greece	01
Hungary	01
Italy	04
The Netherlands	05
Turkey	01
United Kingdom	04
<i>Total</i>	<i>19</i>

Non-european countries

Japan	01
USA	02
<i>Total</i>	<i>03</i>

Gender

Masculine	14
Feminine	08

Age

Young Scientist	06
Senior Scientist	16