EXPERIMENTAL PSYCHO-AESTHETICS: BRINGING ART INTO THE LAB AND SCIENCE INTO THE MUSEUM

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Preliminary notes

• LEP, visual perception, arts?
• Methusalem, Parallelelepieda
• audience
• multi-layered lecture on experimental psycho-aesthetics:
  – main part: experimental psycho-aesthetics as a discipline
  – shell around it: implications for psychology as a whole
  – deep inside: “the story of my life”
Contents

1. (historical) introduction to experimental psycho-aesthetics
2. variety of research topics and research styles
3. implications for psychology as a whole
4. some Parallelepipeda projects
5. towards a new kind of experimental psycho-aesthetics?
1. (HISTORICAL) INTRODUCTION TO EXPERIMENTAL PSYCHO-AESTHETICS
Experimental psycho-aesthetics

• “aesthetics”
  – originally: ability to receive stimulation from one or more of the five bodily senses
  – since Alexander Gottlieb BAUMGARTEN (1714-1762): taste or sense of beauty based on feelings of pleasure or displeasure (as opposed to judgment based on the intellect)

• “experimental psycho-aesthetics”
  – scientific discipline devoted to the understanding of the factors that determine aesthetic appreciation
  – origin: “Vorschule der Aesthetik” (1876) by Gustav Theodor FECHNER (1801-1887)
Gustav Theodor Fechner

° 19/04/1801
† 28/11/1887

• 1834: prof physics (Leipzig)
• 1839: eye disease (in studying color afterimages)
Gustav Theodor Fechner

• “strange guy”
  – chemical and physical papers
  – poems and humorous texts (pen-name “Dr. Mises”)
    • “Vergleichende Anatomie der Engel” (1825)
  – mysticus and metaphysicus
    • “Das Büchlein vom Leben nach dem Tod” (1836)
    • “Zendavesta, oder über die Dinge des Himmels und des Jenseits” (1851)
Gustav Theodor Fechner

- **panpsychism**
  - everything in nature has a soul ("beseelt")
  - "Nanna, oder über das Seelenleben der Pflanzen" (1848)

- **monism**
  - he rejects the Cartesian dualism of mind and body
  - he defends a monistic view on the relation between the physical and the mental as two aspects of the same (identity)
Gustav Theodor Fechner

- he wants to map the functional relation between the physical and the mental and thus develops *psychophysics*, the exact science of the functional relation between the body and the mind

- "*Elemente der Psychophysik*" (1860):
  - start of psychophysics
  - milestone in the development of psychology as a science
“Elemente der Psychophysik”

- two volumes:
  - “outer psychophysics”: the relation between the intensity of the physical stimuli (R for “Reiz”) and the intensity of the sensation (S)
  - “inner psychophysics”: the relation between the intensity of the neural excitation (E) and the intensity of the sensation (S)
Weber-Fechner law

- Psychophysical measurement requires a starting point and a measurement unit.
- Fechner realized that the absolute threshold (RL) could be used to determine the starting point and the JND to determine a measurement unit.
- This way, he derived from Weber’s law \( k = \Delta R/R \) the so-called Weber-Fechner law:
  \[
  S = k \log R
  \]
Negative Sensation = $-S$

Sensation = $+S$

$S = k \log R$

Liminal stimulus = $r$
Sensation magnitude ($\psi$)

Stimulus intensity ($\phi$)
Importance of psychophysics

- scientific basis of psychology
  - S-O-R
  - mind-brain problem

- S.S. Stevens (1951, p. 1): “When description gives way to measurement, calculation replaces debate”

- also relevant for psycho-aesthetics
Experimental psycho-aesthetics

- centuries of philosophical speculations about principles determining aesthetic appreciation → “De gustibus non est disputandum”
- Fechner
  - proposes formal laws of beauty that can be tested experimentally
    - beauty caused by perfection, realized in right proportions, harmonious arrangement of parts
    - also elements of imperfection
    - Leibniz: perfection = harmony = unity within variety
    - Birkhoff (1932): $M = O / C$ (aesthetic measure defined by ratio of order and complexity)
    - Eysenck (1942): $M = O \times C$
The Golden Section

- $B/A = A/(A+B) \approx 0.618$
- $A/B = (A+B)/A \approx 1.618$
\[(a + b) \text{ is to } a \text{ as } a \text{ is to } b\]

\[
\frac{a + b}{a} = \frac{a}{b} = \varphi
\]
The Golden Section

- \( \frac{B}{A} = \frac{A}{A+B} \approx 0.618 \)
- \( \frac{A}{B} = \frac{A+B}{A} \approx 1.618 \)
- golden rectangle
$a + b$ is to $a$ as $a$ is to $b$

\[
\frac{a + b}{a} = \frac{a}{b} = \varphi
\]

\[
\varphi = \frac{1 + \sqrt{5}}{2} \approx 1.6180339887\ldots
\]
The Golden Section

- $B/A = A/(A+B) \approx 0.618$
- $A/B = (A+B)/A \approx 1.618$
- golden rectangle

- Parthenon by Phidias (480 BC – 430 BC)
The Golden Section

- \( B/A = A/(A+B) \approx 0.618 \)
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- golden rectangle
- Parthenon by Phidias (480 BC – 430 BC)
- “Modulor” by Le Corbusier
The image includes a diagram with measurements and ratios, as well as a photograph of a modernist building. The diagram on the left shows a human figure with dimensions, and the right side of the image has a series of measurements and ratios, including a calculation involving the golden ratio $\phi$, where $\frac{1}{\phi} = 0.618...$. The photograph appears to be of a modernist architectural structure, likely related to the principles of design and proportion discussed in the diagram.
The Golden Section

- $B/A = A/(A+B) \approx 0.618$
- $A/B = (A+B)/A \approx 1.618$
- golden rectangle
- Parthenon by Phidias (480 BC – 430 BC)
- “Modulor” by Le Corbusier

- research by Fechner (1865): small average preference for rectangle of 21 x 34 cm but large interindividual differences
- research by Boselie (1992) with Mondriaan paintings

Some references


2. VARIETY OF RESEARCH TOPICS AND RESEARCH STYLES
Different dimensions

• Nature vs nurture
• Focus on object side
• Focus on subject side
• Maximizing experimental control (using simple stimuli)
• Maximizing ecological validity (using real artworks)
Nature vs nurture (1)

  - rooted in Darwin’s ideas of successful adaptation
  - preference for landscapes explained by prospect-refuge theory
    - direct vs indirect prospects (panoramas, vistas)
    - natural vs man-made refuges (shelters, hides)
Landscape with Banditti round a tent (1752) by Richard Wilson

Elements of refuge and of direct and indirect prospects.
Jay Appleton (1975) “The experience of landscape”
- rooted in Darwin’s ideas of successful adaptation
- preference for landscapes explained by prospect-refuge theory
  - direct vs indirect prospects (panoramas, vistas)
  - natural vs man-made refuges (shelters, hides)
- innate categories but learning processes needed for interpretation and communication
- research: preference for landscapes more complex
  - fashions evolve
  - currently: mixture between natural and designed
• Daniel Berlyne (1971) “Aesthetics and psychobiology”
  – exploratory behavior and curiosity
  – optimal stimulation level
  – aesthetic preference (and hedonic value) determined by average arousal potential
Berlyne’s arousal potential theory of aesthetics

Can be applied to explain wide range of appreciation phenomena.
Nature vs nurture (2)

• Daniel Berlyne (1971) “Aesthetics and psychobiology”
  – exploratory behavior and curiosity
  – optimal stimulation level
  – aesthetic preference (and hedonic value) determined by average arousal potential
  – not too simple, not too complex
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  – not too simple, not too complex
  – moderately familiar
Berlyne’s arousal potential theory of aesthetics

Can be applied to explain wide range of appreciation phenomena. Can be transformed into long-term dynamics of preferences.
• Daniel Berlyne (1971) “Aesthetics and psychobiology”
  – exploratory behavior and curiosity
  – optimal stimulation level
  – aesthetic preference (and hedonic value)
    determined by average arousal potential
  – not too simple, not too complex
  – moderately familiar
    • in contrast to mere exposure effect
    • underlying cyclic fashion trends
    • MAYA principle in design (“most advanced yet acceptable”)
Nature vs nurture (3)

- Cognitive “arousal”: discrepancy with schemata in memory
  - assimilation vs accommodation
  - preference for music
  - preference for houses
    - novices:
      - more prototypical = more attractive (less interesting)
      - less prototypical = more interesting (less attractive)
    - experts:
      - less prototypical = more interesting = more attractive
Focus on object vs subject side

- **object characteristics**
  - structural aspects like composition and balance
  - semantic aspects (symbols)

- **subject characteristics**
  - in general: very large interindividual differences (but also some consistent cross-cultural universals, e.g., symmetry, curved vs angular shapes)
  - gender, age, expertise effects
Rudolf Arnheim (1904-2007)


Experimental control vs ecological validity

- Maximizing experimental control: very simple, artificial stimuli (rectangles, geometric shapes, polygons)

- Maximizing ecological validity: very rich stimuli (real art works)

- Examples of research on this continuum
  - One extreme: polygons
  - Other extreme: Leyton’s process theory linking perception to art
  - Intermediate cases
• shape perception = reconstruction of its causal history
  – causal explanation of shape by undoing asymmetries
Leyton (1992) “Symmetry, causality, mind”

- shape perception = reconstruction of its causal history
  - causal explanation of shape by undoing asymmetries
  - seeing processes in static pictures

- aesthetic response = evaluation of causal explanation (as solution to a problem)
Example-analysis

“Les Demoiselles d’Avignon” (1907)
Pablo Picasso
Process 1: “Stretching”
Process 2: “Overcoming rigidity”
Process 3: “Overcoming resistance”
Process 4: “Pulling open”
Process 5: “Branching out”
Process 6: “Tearing apart”
Leyton (1992)
“Symmetry, causality, mind”

• shape perception = reconstruction of its causal history

• aesthetic response = evaluation of causal explanation (as solution to a problem)

• interesting but
  – pure speculation, no empirical evidence
  – rather arbitrary

• alternative approaches in-between two extremes?
Intermediate case (1)


- “visual rightness” theory: organisational structure of a “visually good” composition
  - is visually salient
  - appreciated more than another version
  - tested with 16 existing paintings
  - in 4 experiments
<table>
<thead>
<tr>
<th>Title</th>
<th>Artist</th>
<th>SCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract works</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Path 1</td>
<td>Liberman</td>
<td>A/L</td>
</tr>
<tr>
<td>2. MZ 308, Gray</td>
<td>Schwitters</td>
<td>A/L</td>
</tr>
<tr>
<td>3. The golden wall</td>
<td>Hofmann</td>
<td>A/P</td>
</tr>
<tr>
<td>4. Small’s paradise</td>
<td>Frankenthaler</td>
<td>A/P</td>
</tr>
<tr>
<td>5. White sea</td>
<td>Avery</td>
<td>SA/L</td>
</tr>
<tr>
<td>6. Against modernism</td>
<td>Schnabel</td>
<td>SA/L</td>
</tr>
<tr>
<td>7. Tyrol series</td>
<td>Marin</td>
<td>SA/P</td>
</tr>
<tr>
<td>8. The red cloud</td>
<td>Mondrian</td>
<td>SA/P</td>
</tr>
<tr>
<td><strong>Representational works</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Composition with a leaf</td>
<td>Leger</td>
<td>SR/L</td>
</tr>
<tr>
<td>10. Arrowform to the left</td>
<td>Kandinsky</td>
<td>SR/L</td>
</tr>
<tr>
<td>11. The washerwomen</td>
<td>Serusier</td>
<td>SR/P</td>
</tr>
<tr>
<td>12. The piano</td>
<td>Vuillard</td>
<td>SR/P</td>
</tr>
<tr>
<td>13. Still life with mortar and pestle</td>
<td>Matthiasdottir</td>
<td>R/L</td>
</tr>
<tr>
<td>14. Silent seasons summer</td>
<td>Barnet</td>
<td>R/L</td>
</tr>
<tr>
<td>15. Still life, red peppers on white table</td>
<td>Vallotton</td>
<td>R/P</td>
</tr>
<tr>
<td>16. The daughters of Edward Darley boit</td>
<td>Sargent</td>
<td>R/P</td>
</tr>
</tbody>
</table>

A = abstract  
SA = semi-abstract  
SR = semi-representational  
R = representational  
L = linearly  
P = painterly
“The golden wall”
Hofmann
“The daughters of Edward Darley bois”
Sargent
Experiments 1-2

- **Experiment 1**
  - naïve subjects (50 psychology-students)
  - preference for original: 55%
  - “goodness rating”
    - general = +0.37
    - representational = +0.54
    - abstract = +0.19

- **Experiment 2**
  - expert subjects (12 art-teachers)
  - preference for original: 64%
  - “goodness rating”
    - general = +0.83
    - representational = +0.73
    - abstract = +0.92
Experiments 3-4

• Experiment 3
  – in-between subjects (187 design-students)
  – placing free element
Experiments 3-4

- Experiment 4
  - naïve subjects (100 psychology-students)
  - choice between 3 versions:
    - original
    - slightly perturbed (1)
    - strongly perturbed (2)
Fig. 1. Outline renditions of the pictures used as stimuli. The number of each picture corresponds to the number assigned to it in Table 1. The original, perturbed version 1 stimuli, and perturbed version 2 stimuli are shown in the left, middle, and right columns, respectively. The elements repositioned in each perturbed version are shown in black. To illustrate that the entire landscape above the river in Serusier’s perturbed version 2 composition (shown in the right column of row 7) was reflected about the central vertical axis of the work, striated lines have been drawn through this region in the picture.
Table 1
Titles and artists of the art stimuli, percent of each version selected as the original, and corresponding chi-square values for each picture

<table>
<thead>
<tr>
<th>Title</th>
<th>Artist</th>
<th>Version</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Original</td>
<td>Perturbed 1</td>
<td>Perturbed 2</td>
<td>$\chi^2$</td>
<td>$\chi^2$</td>
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</tr>
<tr>
<td><strong>Abstract works</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1 Path 1</td>
<td>Liberman</td>
<td>45</td>
<td>34</td>
<td>21</td>
<td>8.7</td>
<td>1.53</td>
<td></td>
</tr>
<tr>
<td>2 The Golden Wall</td>
<td>Hofmann</td>
<td>49</td>
<td>32</td>
<td>19</td>
<td>13.8*</td>
<td>3.56</td>
<td></td>
</tr>
<tr>
<td>3 MZ 308, Gray</td>
<td>Schwitters</td>
<td>51</td>
<td>31</td>
<td>18</td>
<td>16.8*</td>
<td>4.87</td>
<td></td>
</tr>
<tr>
<td>4 White Sea</td>
<td>Avery</td>
<td>57</td>
<td>25</td>
<td>18</td>
<td>26.2*</td>
<td>12.48*</td>
<td></td>
</tr>
<tr>
<td><strong>Representational works</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Still Life with</td>
<td>Matthiasdottir</td>
<td>47</td>
<td>36</td>
<td>17</td>
<td>14.0*</td>
<td>1.45</td>
<td></td>
</tr>
<tr>
<td>Mortar and Pestle</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6 Still Life, Red Peppers on White Table</td>
<td>Vallotton</td>
<td>43</td>
<td>44</td>
<td>13</td>
<td>18.8*</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>7 The Washerwomen</td>
<td>Serusier</td>
<td>42</td>
<td>36</td>
<td>22</td>
<td>6.4</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>8 The Daughters of</td>
<td>Sargent</td>
<td>45</td>
<td>41</td>
<td>15</td>
<td>15.4*</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Edward Darley Boit</td>
<td></td>
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</tr>
</tbody>
</table>

*Note: Results of the chi-square tests (df = 2) performed separately on the frequencies for the three versions of each picture are shown in the first column of chi-square values. The second column of chi-square values (df = 1) are the results of tests performed separately on the original and perturbed version 1 frequencies for each picture.

* $p < 0.006.$
Intermediate case (1)

- "visual rightness" theory:
  - testable but not obvious
  - receives some empirical support but not very strong
Intermediate case (2)


- **Question**
  - how does the processing of style and content develop in real time and how are the two sub-processes interrelated?

- **Experimental ideas**
  - systematic variation of style and content
  - systematic variation of presentation times (PTs)
  - task should allow to assess style-related processing irrespectively of expertise (art-related vocabulary)

- **Method**
  - Participants: no special background in art or art history (3 groups of 24 persons)
  - Stimuli: 192 pairs of pictures according to the 2 x 2 factors
    - *style* (same style / different style)
    - *content* (same content / different content)
Materials:
systematic variation of style and content:
- artist x motiv
- 48 pictures
The 2 x 2 conditions of the stimulus material

<table>
<thead>
<tr>
<th>Content</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>same</td>
<td>same</td>
</tr>
<tr>
<td>different</td>
<td>different</td>
</tr>
<tr>
<td>same</td>
<td>different</td>
</tr>
<tr>
<td>different</td>
<td>same</td>
</tr>
</tbody>
</table>
Methods

Procedure

- PTs: 10, 50 ms, 202, 3000 ms
- dependent variable: similarity (scale 1 to 7)
- trial scheme:

```
<table>
<thead>
<tr>
<th>fixation</th>
<th>blank</th>
<th>stimuli &amp; judgment</th>
<th>blank</th>
<th>mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td></td>
<td>Wie ähnlich sind die beiden Bilder?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 ms</td>
<td>150 ms</td>
<td>10, 50, 202, 3000 ms</td>
<td>80 ms</td>
<td>200 ms</td>
</tr>
</tbody>
</table>
```

sehr unähnlich 1 – 2 – 3 – 4 – 5 – 6 – 7 sehr ähnlich
Results

- Effects of **content**: significant at all PTs (already at 10 ms)
- Effects of **style**: increases with PT (from 50 ms onwards)

- Processing of style starts later and develops more slowly than processing of content
- Non-experts exhibit processing of style on the basis of very early information
Intermediate case (2)

- microgenesis of art perception:
  - possible
  - connects art perception to other visual perception
  - starting point for more work along these lines
3. IMPLICATIONS FOR PSYCHOLOGY AS A WHOLE
Psycho-aesthetics as a prime example of psychology as a whole

- everything comes together here:
  - internal, private experience
    - mind/brain problem
    - difficult to access
  - perception/cognition/emotion interplay
  - determined by many different factors
  - some general principles but large degree of interindividual variability
  - challenge to investigate properly
    - tension between experimental control and ecological validity
    - aesthetic "response" (questionnaire, psychophysiology, "thrills")
    - dilemma: what is interesting, is hard to study (and vice versa)
Hopeless?

- No, face the challenge ...
- ... try something new