

BeauVis: A Validated Scale for Measuring the Aesthetic Pleasure of Visual Representations

IEEE VIS 2022, October 16-21, Oklahoma City, Oklahoma, USA.



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Aesthetics

- Aesthetic Pleasure



Aesthetic Pleasure (or Beauty)

A pleasurable subjective experience that is directed toward an object and not mediated by intervening reasoning.

[Reber et al., 2004]

Aesthetic Pleasure In Visualization

- Focuses on a visualization's **visual appeal or beauty**
- **NOT** related to how understandable, informative, or memorable it is

**Do not need to understand
the visualization's meaning or its data**

Aesthetic Pleasure

An Important aspect of Visualization

- **Affects usability and effectiveness**
[Cawthon & Vande Moere, 2007; Healey & Enns, 2022]
- **Has the potential to communicate
and to engage viewers**
[Brath et al., 2005]
[Bach et al., 2013; Tateosian et al., 2007]
- **Has been identified as one of the
heuristics of some subfields**
e.g., ambient visualization [Mankoff et al., 2003]

How to measure aesthetic pleasure?

Rating scales

Scale for measuring the aesthetic pleasure of ...

websites

websites

designed artifacts

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International Journal of
Human-Computer
Studies
1st J. Human-Computer Studies 60 (2004) 289–298
www.elsevier.com/locate/ijhcs

Assessing dimensions of perceived visual aesthetics of web sites^{1,2}

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Received 18 July 2003; accepted 17 September 2003

Abstract

Despite its centrality to human thought and practice, aesthetics has for the most part played a petty role in human-computer interaction research. Increasingly, however, researchers attempt to strike a balance between the traditional concerns of human-computer interaction and considerations of aesthetics. Thus, recent research suggests that the visual aesthetics of computer interfaces is a strong determinant of users' satisfaction and pleasure. However, the lack of appropriate concepts and measures of aesthetics may severely constraint future research in this area. To address this issue, we conducted four studies in order to develop a measurement instrument of perceived web site aesthetics. Using exploratory and confirmatory factor analyses we found that users' perceptions consist of two main dimensions, which we termed "classical aesthetics" and "expressive aesthetics". The classical aesthetics dimension pertains to aesthetic notions that predominate from antiquity until the 18th century. These notions emphasize order and clear design and are closely related to many of the design rules advocated by usability experts. The expressive aesthetics dimension is manifested by the designers' creativity and originality and by the ability to break design conventions. While both dimensions of perceived aesthetic are drawn from a pool of aesthetic judgments, they are clearly distinguishable from each other. Each of the aesthetic dimensions is measured by a five-item scale. The reliabilities, factor structure and validity tests indicate that these items reflect the two perceived aesthetic dimensions adequately.

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doi:10.1016/j.ijhcs.2003.09.002

[Lavie & Tractinsky, 2003]

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ScienceDirect
International Journal of
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1st J. Human-Computer Studies 60 (2010) 689–709
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Facets of visual aesthetics

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Received 17 January 2010; received in revised form 1 May 2010; accepted 27 May 2010
Communicated by G. Lindgaard
Available online 4 June 2010

Abstract

Visual aesthetics has been shown to critically affect a variety of constructs such as perceived usability, satisfaction, and pleasure. Given the importance of visual aesthetics in human-computer interaction, it is vital that it is adequately assessed. The present research aimed at providing a precise operational definition and to develop a new measure of perceived visual aesthetics of websites. Construction of the Visual Aesthetics of Website Inventory (VIAWI) was based on a comprehensive and broad definition of visual aesthetics so that the resulting instrument would completely describe the domain of interest. Four invariant facets of perceived visual aesthetics of websites were identified and validated in a series of seven studies. Simplicity and Diversity have especially been treated as formal parameters of aesthetic objects throughout the history of empirical aesthetics. Color was a critical property of aesthetic objects, and Craftsmanship addresses the skillful and coherent integration of the relevant design dimensions. These four facets jointly represent perceived visual aesthetics, but are still distinguishable from each other and carry unique meaning. The subscales contained in the VIAWI demonstrate good internal consistencies. Evidence for the convergent, divergent, discriminative, and concurrent validity of the VIAWI is provided. Overall, the present research suggests that the VIAWI appears to be a sound measure of visual aesthetics of websites comprising facets of both practical and theoretical interest.

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Keywords: Aesthetic Assessment; Beauty; Design; Measurement; Website

1. Introduction

The question of what constitutes beauty has been given a variety of answers over the past centuries (e.g., Feagin and Maynard, 1997; Ferrer, 1996; Osborne and Bullock, 1960). Many theories conceived beauty as a property of an object that produces a pleasurable experience in any perceiver. In contrast to this objective view, the subjectivist view proposes that anything could be beautiful as long it pleases the senses. Beauty is regarded as a mere function of idiosyncratic qualities of the perceiver, rather than being directly determined from attributes of an object. Most modern philosophical analyses, however, reject the

objective versus subjective distinction and adopt an interactionist perspective: Beauty is seen as a function of both, properties of an object and characteristics of the perceiver, that is, beauty emerges from patterns in the way perceivers and objects relate. In line with this interactionist viewpoint, the philosopher Susanto (1955) describes three defining features of beauty: Beauty is value positive, intrinsic, and objectified. Beauty is value positive, because it provides pleasure. Beauty is intrinsic, because an object is perceived without any reasoning about expected utility. This feature of beauty implies that aesthetic responses occur immediately at first sight, rather than being the result of a long-lasting cognitive analysis. Finally, beauty is objectified, because people experience beauty as something that lies in an object, rather than exclusively being the result of a positive operation of the body. This is not to be confused with the objective viewpoint on beauty: Beauty is not objective, but directed toward an object.

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doi:10.1016/j.ijhcs.2010.09.006

[Moshagen & Thielsch, 2010]

Available online at www.elsevier.com/locate/ijhcs
International Journal of
Human-Computer
Studies
1st J. Human-Computer Studies 60 (2004) 289–298
www.elsevier.com/locate/ijhcs

The Aesthetic Pleasure in Design Scale: The Development of a Scale to Measure Aesthetic Pleasure for Designed Artifacts

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Received 18 July 2003; accepted 17 September 2003

Abstract

There is a lack of consistency regarding the scales used to measure aesthetic pleasure within design. They are often drawn up ad hoc or adapted from other research fields without being validated for designed artifacts. Moreover, many scales do not measure aesthetic pleasure in isolation, but instead include its determinants (e.g., usability, "functionality") and/or other constructs such as perceived usability, pleasure and related scales to measure its determinants for the design artifacts. This paper reports on the development of a new measure of aesthetic pleasure and its determinants across product categories. In the validation phase, we confirmed three findings across different countries (Australia, the Netherlands, and Taiwan): The final scale consists of 9 items: "beautiful", "intricate", "pleasing to see", "nice to see" and "like to look at". This together reliably captures the construct of aesthetic pleasure. Several recommendations are formulated regarding the application of this scale in design studies and beyond.

Keywords: aesthetic pleasure, design, scale development, determinants of aesthetic pleasure

Research into aesthetic pleasure or appreciation is often confined to art perception and appreciation (Hekkert, 2010a). Although works of art are often what we say "were" often created

to delight the perceiver, for beauty purposes, they are clearly not what we call "objects" that can be pleasant to look at, listen to, or touch. We can aesthetically appreciate a landscape or a photograph of that same landscape; we find beauty in faces, buildings, and other man-made things; we can even be aesthetically pleased by, and motivated to create, beauty by, for instance, a three-motif, or a scientific proof (De Silva, Chilly, & Hekkert, 2015). Any object can be aesthetically appreciated, and objects are often deliberately designed to induce aesthetic pleasure (Ponert, 2003). Accordingly, we see an increasing interest in measuring aesthetic pleasure derived from everyday objects such as products and websites as design research, consumer research, and human-computer interaction (HCI) research (e.g., Bijllevens, Thurgood, Hekkert, & Schoutman, 2012; Hekkert & Moon, 2010; Hekkert, Soulé, & Van Wieringen, 2005).

While applied research into what people find aesthetically pleasing exists in design, marketing, arts, and psychology literature (e.g., Bijllevens et al., 2012; Bloch, 1995; Hekkert, 2006, 2010a, 2010b; Hekkert et al., 2003; Hoyt & Washburner, 2012; Lohr, Burke, Osborne, & Aspinall, 2004; Lohr, King, & Dowling, 2012; Schoutman & Robinson, 1997; Steiner, 2013; Versey & Hutchinson, 1998) research into how aesthetic pleasure for designed artifacts should actually be defined and subsequently be measured has received little attention. More specifically, in the design field, most research focuses on how certain determinants

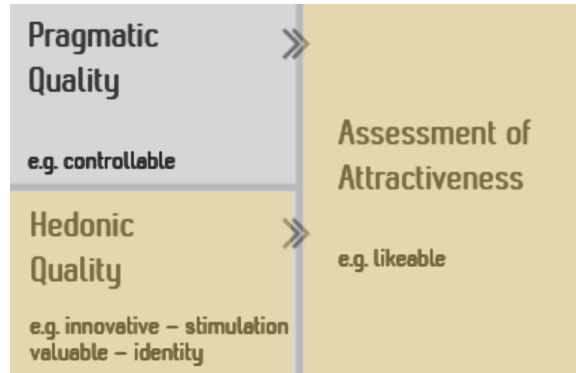
This article is intended for publication in the International Journal of Human-Computer Studies. This article is intended for publication in the International Journal of Human-Computer Studies.

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[Bijllevens et al., 2017]

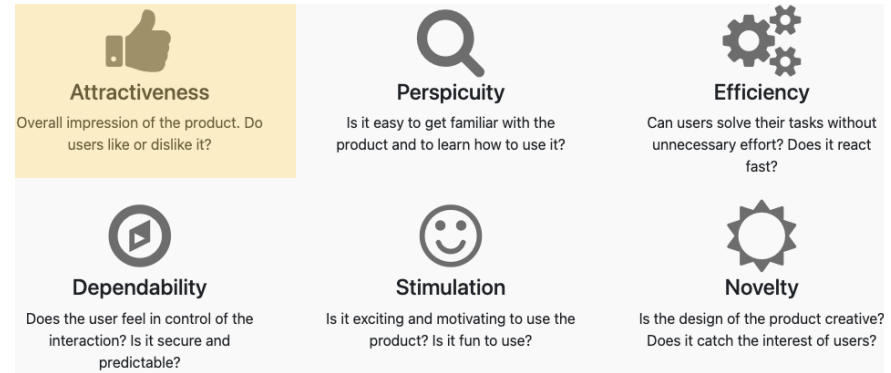
AttrakDiff Questionnaire

[Hassenzahl et al., 2003]



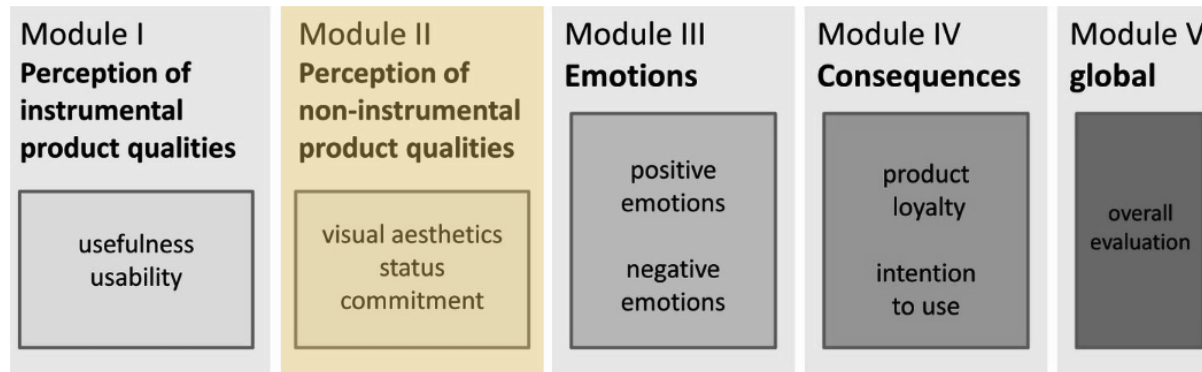
User Experience Questionnaire (UEQ)

[Schrepp et al., 2017]



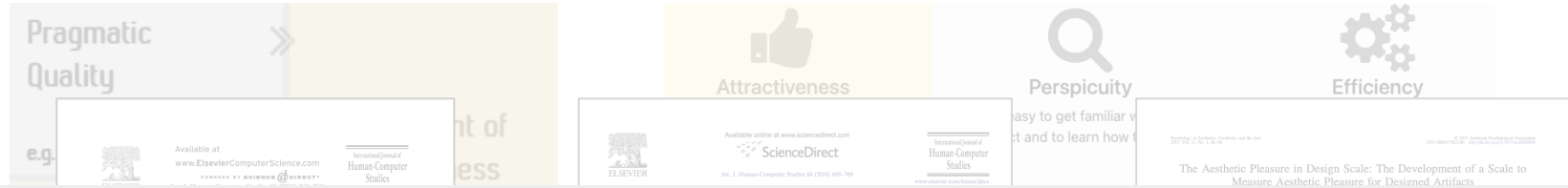
meCUE Questionnaire

[Minge et al., 2017]



AttrakDiff Questionnaire
[Hassenzahl et al., 2003]

User Experience Questionnaire (UEQ)
[Schrepp et al., 2017]



No validated scale targeted for measuring aesthetic pleasure in the visualization field



is and weaknesses of both images and rate each on a Likert scale between poor and excellent. For each pair, participants also indicated which image was better for a task, which image was more **aesthetic**, and which image was more visually appealing. These questions were answered with one 5-point Likert scale per image pair. The possible answers were *clearly left*, *no preference/I don't know*, *rather right*, *clearly right*, and *clearly left*.

[Jenny et al., 2021]

		Mean	SD
1	The visualization was enjoyable	3.75 (2.09)	5.0 (1.0)
	Using the visualization aid		

[Albo et al., 2016]

3.5 Aesthetic Requirements

Participants rated the display they were exposed to on semantic differential scales. Participants rated the display as predominantly **Attractive, Beautiful,** and Interesting, with no negative responses being listed in these categories. One participant rated the display they saw during

[Rodgers and Bartram, 2011]

the criteria: (1) **Ease/difficulty in understanding the baseline visualization;** (2) **Ease/difficulty in using the visualization for comparison;** (3) **the aesthetic appearance of the visualization.** In addition, we also asked for their general feedback.

Results

[Chen et al., 2021]

As expected, we observed only two borderline differences. Memex was rated faster in terms of perceived time (average rating of 5.7 v. 4.8 for FacetMap) in terms of **aesthetic appeal,** FacetMap scored higher (average rating of 5.3 v. 4.1), $t(18)=1.9$, $p<.05$. User satisfaction ratings are provided in Table 1.

[Smith et al., 2006]

- Redundant – Informative,
- Hindering – Helpful,
- Boring – Entertaining,
- **Ugly – Elegant.**

We asked the participants to rate each of these active features (i.e., cartogram-switching and

[Duncan et al., 2021]

is and weaknesses of both images and rate each on a Likert scale between poor and excellent. For each pair, participants also indicated which image was better for a task and which image was more **aesthetic**, and which image was more visually appealing. These questions were answered with one 5-point Likert scale for each image pair. The possible answers were *clearly left*, *no preference/all don't know*, *rather right*, *clearly right*.

[Lopez et al., 2021]

the criteria: (1) Ease/difficulty in understanding the baseline visualization; (2) Ease/difficulty in using the visualization for comparison; (3) the **aesthetic appearance** of the visualization. In addition to these questions, we also asked for their general feedback.

Results

[Chen et al., 2021]

Self-selected terms: Not sure about the **reliability** or **validity**

3.5 Aesthetic Requirements

Participants rated the display they were exposed to on semantic differential scales. Participants rated the display predominantly **Attractive**, **Beautiful**, and **Interesting**, with no negative responses being listed in these categories. One participant rated the display they saw during the experiment as **ugly**.

[Rogers and Bartram, 2011]

- Redundant – Informative,
- Hindering – Helpful,
- Boring – Entertaining,
- **Ugly – Elegant.**

We asked the participants to rate each of the features on a semantic differential scale. The active features (i.e., cartogram-switching and

[Duncan et al., 2021]

BeauVis Scale

To what extent do you agree that this visual representation is ... ?

strongly disagree strongly agree

enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
likable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pleasing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
nice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
appealing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

BeauVis scale in its recommended version

Methods

Scale Development

Step 1: Term Generation → 209 Terms

- Literature Review
- Expert Suggestion

Step 2: Term Filtering → 31 Terms

- Filtering on Occurrence and Semantics
- Expert Review

Step 3: Exploratory Phase → Final Scale

- Crowdsourced Experiment
- Exploratory Factor Analysis
- Reliability Evaluation
 - Cronbach's Alpha

Scale Validation

Step 4: Validation Phase

- Crowdsourced Experiment
- Confirmatory Factor Analysis
- Reliability Evaluation
 - Cronbach's Alpha
- Validity Evaluation
 - Convergent Validity
 - Discriminant Validity
 - Differentiation by Known Groups

Step 1: Term Generation

Literature Review: VIS Literature

Terms from
68 out of 3189 IEEE VIS, TVCG and CG&A papers



Spreadsheet for collecting terms

... and weaknesses of both images and rate each on a 5-point likert scale between poor and excellent. For each image pair, participants also indicated which image was better for a task. The results for each image pair were more **aesthetic**, and which image was better for the task. These questions were answered with one 5-point likert scale. The possible answers were *clearly left better*, *clearly right better*, *roughly equal*, *roughly left better*, and *roughly right better*.

[Jenny et al., 2021]

... criteria: (1) Ease/difficulty in understanding the visualization; (2) Ease/difficulty in using the visualization for comparison; (3) the **aesthetic appearance** of the visualization. In addition, we also asked for their general feedback.

results

[Chen et al., 2021]

Statement	Mean Rating	Standard Deviation
The visualization was enjoyable	3.75 (2.09)	5.0 (1.0)
Using the visualization aid		

[Albo et al., 2016]

... We observed only two borderline significant differences: Memex was rated faster in terms of preparation time (average rating of 5.7 v. 4.8 for FacetMap) and in terms of **aesthetic appeal**, FacetMap scored higher (average rating of 5.3 v. 4.1), $t(18)=1.9$, $p=0.07$. User satisfaction ratings are provided in Table 2.

[Smith et al., 2006]

5.5 Aesthetic Requirements

... participants rated the display they were exposed to on semantic differential scales. Participants rated the display predominantly **Attractive**, **Beautiful**, and **Interesting**, with no negative responses being listed in these categories. Only one participant rated the display they saw during the experiment as **Ugly**.

[Rodgers and Bartram, 2011]

- **Redundant** – Informative,
- **Hindering** – Helpful,
- **Boring** – Entertaining,
- **Ugly** – Elegant.

We asked the participants to rate each visualization on a 5-point semantic differential scale for each active feature (i.e., cartogram-switching, zooming, etc.).

[Duncan et al., 2021]



Journal	Title	doi link	filename	search term	ikert term	adjective: To what extent do you agree that this visualization is ...	whether I saw the whole questionnaire (source code) only papers I found relevant	excluded term	participant feedback	participant feedback content	path
TVCG	Evaluating Cartogram Effectiveness	https://doi.org/10.1109/TVCG.2015.2562109	07792176.pdf	ikert:aesthetic	??? (5-point: entertaining - boring); ??? (5-point: elegant - cheap); ??? (5-point: innovative - conventional); ??? (5-point: easy to understand); ??? (5-point: showing magnitude clearly - poorly)	entertaining;boring;cheap;innovative;conventional;understand;clear;			helpful;understanding;interested to use later;		./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2021/11100637.html
VIS	Charm: Reviving Chart Images with Data Embedding	http://dx.doi.org/10.1109/TVCG.2020.3030381	11110a037	ikert:aesthetic	aesthetic: appeal (7-point)	aesthetic;					./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2020/6_infvts_srmh.html
VIS	FacetMap: A Scalable Search and Browse Visualization	http://dx.doi.org/10.1109/TVCG.2008.142	08_infvts_srmh	questionnaire:aesthetic;	aesthetic: appearance (5-point: nice, more or less nice, neutral, somewhat ugly, ugly);	aesthetic;nice;ugly;	no	satisfaction	health;bridge;metaphor;		./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2008/6_infvts_srmh.html
VIS	Co-Bridge: Pairwise Visual Connection and Comparison for Multi-Item Data Streams	http://dx.doi.org/10.1109/TVCG.2020.3030411	11110b612	ikert:questionnaire;aesthetic;	aesthetic: preference (7-point: totally disagree - neutral - totally agree/readability); locally agree/readability (7-point: totally disagree - neutral - totally agree); aesthetic: preference (7-point: strongly preferred -)	aesthetic;preference;readability;	no				./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2021/09612.html
VIS	StreamStream: Improving the Readability of Streamgraphs by Minimizing Sine Illusion Effects	http://dx.doi.org/10.1109/TVCG.2020.3030408	11110b634	ikert:questionnaire;aesthetic;	aesthetic: preference (7-point: strongly preferred -)	aesthetic;					./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2021/11100634.html
VIS	The Influence of Colour on Similarity Perception of Star Glyphs	http://dx.doi.org/10.1109/TVCG.2014.2346428	2291_20wg12-fuchs2346428	ikert:questionnaire;aesthetic;	aesthetic: well-designed;	aesthetic;well-designed;					./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2014/2346428.html
VIS	VisHeritage: Visual Analytics Approach on Grids Wall Painting Degradations	http://dx.doi.org/10.1109/TVCG.2013.213	13_vast_zhang	questionnaire:aesthetic;	aesthetic: visual design; aesthetic: expressive/identifiable;	aesthetic;visual design;expressive;identifiable;					./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2013/13_vast_zhang.html
VIS	Calliope: Automatic Visual Data Story Generation from a Streamgraph	http://dx.doi.org/10.1109/TVCG.2020.3030403	11110a043	ikert:questionnaire;aesthetic;	aesthetic: well-designed; aesthetic: (11-point: 0 - 10); visual design (11-point: 0 - 10);	aesthetic;well-designed;			satisfied;nice design;thoughtful design;		./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2021/11100643.html
VIS	VisMap: Interactive Visual Analysis of Station-Based Observation Data on Climate Change	https://doi.org/10.1109/TVCG.2014.2346438		questionnaire:aesthetic;	aesthetic: (5-point); aesthetic;	aesthetic;	no				./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2014/2346438.html
VIS	Augmented Reality Graph	https://doi.org/10.1109/TVCG.2014.2346438		questionnaire:aesthetic;	aesthetic: (5-point); aesthetic;	aesthetic;	no				./Vis-ai_fall_per_pdfs/vis-aesthetic-results/Vis-ai-2014/2346438.html

Step 1: Term Generation

Literature Review: Literature from Related Field

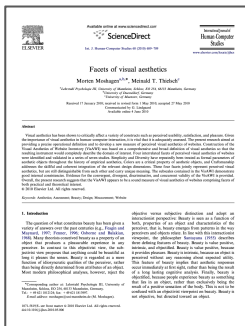
Terms from
4 aesthetics-related scales development papers



Spreadsheet for collecting terms



[Lavi & Tractinsky, 2003]



[Moshagen & Thielsch, 2010]



[Blijlevens et al., 2017]

Pragmatic Quality >>

e.g. controllable

Hedonic Quality >>

e.g. innovative – stimulation valuable – identity

Assessment of Attractiveness

e.g. likeable

[Hassenzahl et al., 2003]

	AtrakDiff	Blijlevens, 2017	Lavi, 2003	Moshagen, 2010
aesthetic		aesthetic	aesthetic	
appealing	appealing/appealing	appealing		appealing
attractive	attractive	attractive		appealingly positioned; attractive; balanced; there are too many elements in o
balanced				
beautiful		beautiful	beautiful	
clean		clean	clean	
cluttered				
creative	creative	creative	creative	creative
elegant				
harmonious			harmonious	
inviting	inviting	inviting		
modern			modern	modern; contemporary
nice		nice		
organized			organized	pleasantly organized
overloaded		overloaded	overloaded	overloaded
pretty		pretty		
tasteful			applies good taste	
well-designed		designed	skillfully designed	
artistic		artistic	artistic	
boring	dull		dull	boring
delightful		delightful		
engaging			enjoyable	
entertaining			exciting	
exciting			fascinating	
fascinating			fascinating	
good			good	
color-harmonious				
interesting		interesting		interesting; lacks interesting design details
likeable	likeable	like		
motivating	motivating	motivating		
pleasing	professional/unprofessional	pleasant/pleasurable	pleasing/pleasant	a pleasant effect
professional		professional	professional	professional
provoking				
satisfying				
sophisticated		sophisticated	sophisticated	
lowely				
dynamic		dynamic	dynamic	dynamic
crowded				crowded; too many elements
drab			monotonous	monotonous
high-quality		confers quality		
stylish	stylish			well proportioned
well-proportioned				
informative				
colorful			colorful	colorful; too few colors
eye-catching				

Step 1: Term Generation

Expert Suggestion

Invitation email sent to **57 visualization experts**

Subject: Survey Invitation - How to Judge the Aesthetics of Visualizations?

To: [email of an expert in visualization]

Dear [expert's name],

We are currently working on a research project about generating a validated scale for rating the aesthetics of a visualization. An important step in the generation of a scale is to elicit terms from experts. Given your expert status in our domain we would much appreciate it if you could spend 2-3 minutes of your time and fill out our short survey.

To participate, please access the survey here:[survey link]

Please notice that this study has a two-stage evaluation process. After this survey, we would like to contact you again for a second very short survey.

We thank you a lot in advance and would be happy to share the results of our work with you if you are interested! Just let us know.

Best regards,
Tingying He, Petra Isenberg, Raimund Dachsel, and Tobias Isenberg

Survey for collecting terms (**31 responses**)

You decided that you want to ask people to rate the visualization using a 7-point scale like the one below.



Your task is to find good terms with which to capture this subjective opinion of participants about the **aesthetics** of the visualization. This means: you really only care about what the visualization looks like and NOT about how well people understand the data that it visualizes. So you decide to ask:

To what extent do you agree or disagree with the following statement:
This visualization is _____.

Which terms would you put in the blank? Give us as many alternative terms as you can think of, but please give us **at least 3 terms related to aesthetics**.

This is the last question in this survey. Please take at least a minute to think about your answer before clicking "Next". Thank you.

Please fill in at least 3 answers

Term 1	<input type="text"/>
Term 2	<input type="text"/>
Term 3	<input type="text"/>
Term 4 (optional)	<input type="text"/>
Term 5 (optional)	<input type="text"/>
Term 6 (optional)	<input type="text"/>
Term 7 (optional)	<input type="text"/>
Term 8 (optional)	<input type="text"/>

If you have any comment or additional terms, please put them here.

Step 1: Term Generation

209 Terms

aesthetic	emotion	cognitive	data-aesthetic
<i>a poor visual focus</i>	alienating	<i>a poor visual focus</i>	<i>expressive</i>
aesthetic	<i>appealing</i>	appropriate	<i>informative</i>
<i>appealing</i>	appreciating	attention-catching	suitable
artistic	averageness	categorizable	
asymmetrical	awe	challenging	
attractive	boring	clear	other
awesome	bring me closer to people/separates me from people	<i>clattered</i>	a printing effect
balanced	<i>calm</i>	compelling	admirable
beautiful	comfortable	comprehensible	alive
bold	connective	conceptless	amateurish
<i>calm</i>	cool	confusing	bad
captivating	delightful	contemplative	botched
cautious	desirable	cumbersome	cheap
clean	disagreeable	easy to grasp	colorblind-safe
<i>clattered</i>	disturbing	elicit associations	consistent
color-harmonious	dramatic	<i>informative</i>	convenient
colorful	elation	inspiring	convenient
complex	emotive	interpretable	<i>conventional</i>
conservative	energetic	intuitive	easy on eyes
contrastful	engaging	meaningful	easy orientation
<i>conventional</i>	enjoyable	memorable	easy to navigate
creative	entertaining	practical	easy to use
crisp	evocate	readable	fauvist
crowded	evoking feelings	slick	fit together
discouraging	exciting	stimulating creativity	flowing
distinctive	fascinating	stimulating curiosity	fluent to process
drab	favorable	straightforward	good
elegant	fun	structured	hectic
<i>expressive</i>	gratifying	undemanding	<i>high-quality</i>
eye-catching	happy	understandable	human
familiar	hideous	<i>use of color is successful</i>	<i>innovative</i>
geometric	integrating		it is possible to discover new things even when looking at the page for a longer time.
harmonious	intense		manageable
has enough free space	interesting		noisy
<i>high-quality</i>	intriguing		one-sided
illuminating	intrusive		pleasantly animated
<i>innovative</i>	isolating		premium
inventive	likable		professional
inviting	motivating		restless
just eye-candy	moved		romantic
lack imagination	perfection		shows complete ignorance of human visual perception
looks great, but does not enable to get insight	pleasing		some elements seem out of place
lovely	positive		sophisticated
made with care	powerful		static
modern	predictable		stucco
nice	preferable		technology
novel	provoking		the control instructions are too static
old-fashioned	relaxed		the number of images is adequate
orderly	satisfying		the page contains too much text
ordinary	stimulating		too little happens on the page
organized	striking		unique
original	sublime		unruly
overloaded	the page changes too little due to user actions		uses special effects
painterly	thrills or chills		varied
patchy	touched		versatile
presentable	warm feeling		well-combined
pretty			well-finished
realistic appearance			wretched
rejecting			
simple			
streamlined			
stunning			
stylish			
symmetrical			
tacky			
tasteful			
thoughtful			
thrown together			
ugly			
unimaginative			
unique			
up-to-date			
<i>use of color is successful</i>			
vulgar			
well-crafted			
well-designed			
well-proportioned			

Filtering on Occurrence and Semantics

6 Objective Criteria by Authors

1. The terms needed to be **related to *aesthetic pleasure*** rather than *understanding* or *comprehension* of a visual representation or its data (e. g., we excluded “informative,” “clear,” or “confusing”).
2. The terms had to have **appeared at least twice** in one of the three resources we used for our item generation: visualization papers, other relevant aesthetics scale papers, or expert suggestions.
3. The terms should be **usable in a rating scale** and have a **clearly good or bad connotation** (e. g., we excluded “complex” because a complex aesthetic could be seen as positive or as negative).
4. The terms should be **easy to understand** (e. g., we excluded “consistent” because it would be unclear according to what aspect a visual appearance would be consistent) and their **interpretation should be clear** (e. g., we excluded “novel” because it would require people to know what “old” visualizations look like; we also excluded “drab” as a rare term that is not easily understood by many non-native speakers of English).
5. The terms had to **clearly apply to an assessment of a visual representation** (e. g., we excluded “dynamic” because, within visualization, the term may be read as referring to the property of being animated or interactive, rather than a dynamic aesthetic).
6. The terms should **not be pairs of opposite adjectives**. We only retained negative terms that did not have a clear positive opposite (e. g., we excluded “ugly” as the opposite of “beautiful”).

Step 2: Term Filtering

Expert Review

Invitation email sent to **56 visualization experts**

Subject: Invitation for new short 4min survey - Terms to judge the aesthetics of a visualization

To: [\[email of an expert in visualization\]](#)

Dear [\[expert's name\]](#),

You have previously received an email from us about a first quick survey regarding how to judge the aesthetics of a visualization. If you had a chance to participate, thank you very much! We received a lot of useful input and comments that we will address! If not - don't worry - you still have a chance to participate in this second survey.

To clarify, our project is about developing a simple instrument to gauge the aesthetic pleasure of a visualization – meant to provide a few simple rating questions that can accompany other types of experiments (quantitative or qualitative).

In the first phase of our work we asked you to provide a few terms that you consider to be usable in an aesthetic rating. In addition to terms provided by experts like you, we have also assessed the literature and come up with a final list of 37 terms; narrowed down from a list of > 200 terms. An important second phase in scale development is to ask experts to rate the appropriateness of the terms we collected. As such, we would much appreciate it if you could spend around 3-4 minutes of your time to fill out our second survey. We hope that at least as a small reward seeing the list of terms may already be useful or inspiring to you.

To participate, please access the survey here: [\[survey link\]](#)

We thank you a lot in advance and would be happy to share the results of our work with you if you are interested! Just let us know.

Best regards,
Tingying He, Petra Isenberg, Raimund Dachsel, and Tobias Isenberg

Survey for reviewing terms (**25 responses**)

The aesthetic pleasure of visualization is the pleasure people derive from looking at a visualization for its own sake, as a source of immediate experiential pleasure in itself, and not essentially for its utility in producing insight or knowledge gain or something else that is either useful or pleasurable.

The table below includes terms that have been suggested or used in the literature by visualization experts like you for studying the aesthetic pleasure of a visualization. Imagine that these terms would later be used in a rating scale that asks participants to select to what extent a visualization is „[term]“.

Below we would like you to rate these different terms according to how relevant you consider them for actually judging the aesthetic pleasure of a visualization. Please note that we only care about aesthetic pleasure in terms of what a visualization looks like and not how well people can comprehend the data that it shows.

How relevant do you think the following terms are for judging or describing the aesthetic pleasure of a visualization?

	1 = not at all relevant	2	3	4	5 = very relevant
sophisticated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
beautiful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
appealing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
likable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
cluttered	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
tasteful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
modern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
aesthetic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
clean	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
color-harmonious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
satisfying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
delightful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
entertaining	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
exciting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Step 2: Term Filtering

31 Terms

aesthetic	emotion	cognitive	other
<i>appealing</i>	<i>appealing</i>	<i>cluttered</i>	professional
artistic	delightful		sophisticated
attractive	engaging		
balanced	enjoyable		
beautiful	exciting		
clean	fascinating		
<i>cluttered</i>	interesting		
color-harmonious	likable		
creative	motivating		
elegant	pleasing		
harmonious	provoking		
inviting	satisfying		
lovely			
nice			
organized			
pretty			
tasteful			
well-designed			

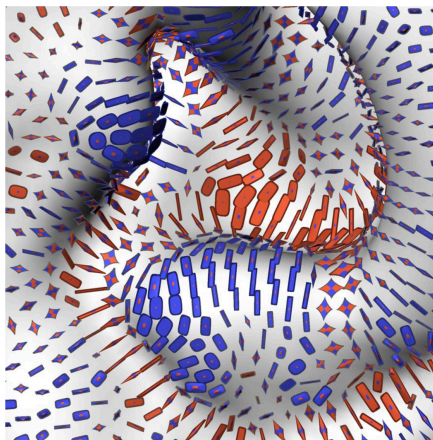
Step 3: Exploratory Phase

Crowdsourced Experiment

- **1001** participants
 - **15** data representations
- Each participant rated 3 representations

*To what extent do you agree or disagree with the following statement:

The visualization is ____.



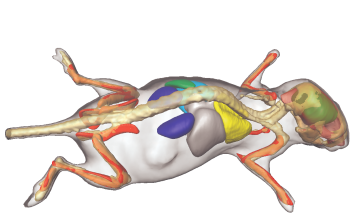
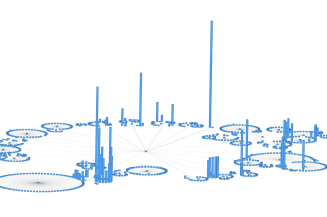
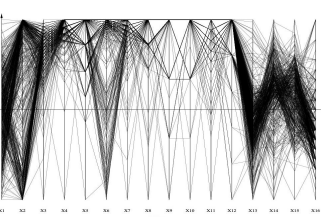
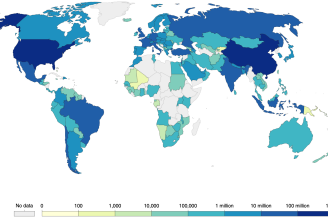
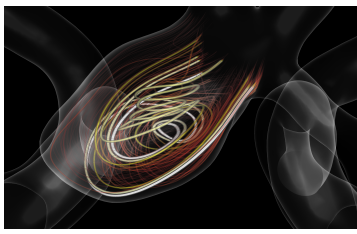
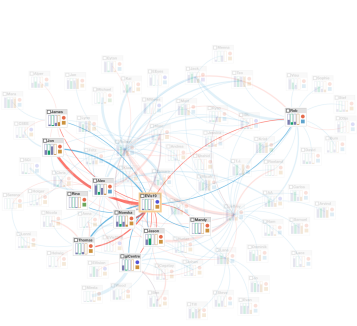
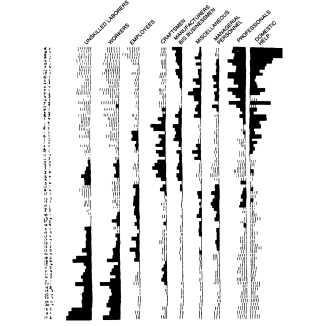
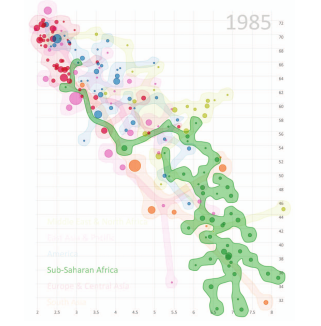
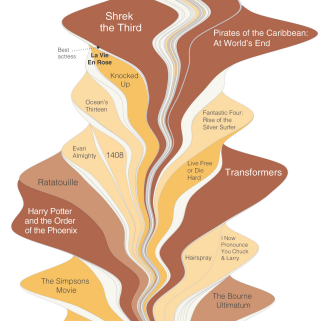
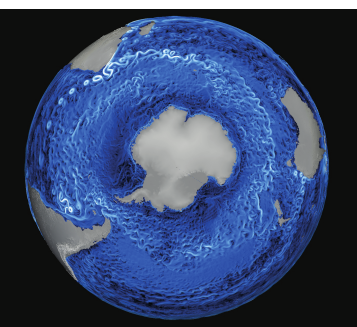
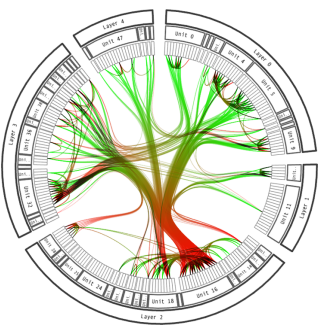
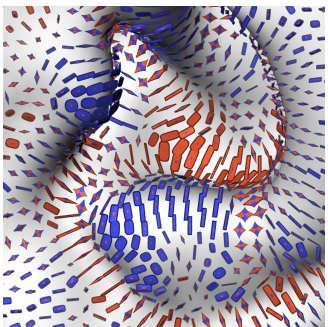
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provoking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
engaging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
clean	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
aesthetic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
beautiful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pretty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pleasing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
fascinating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
elegant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly		Slightly		Slightly		Strongly

Previous

Next

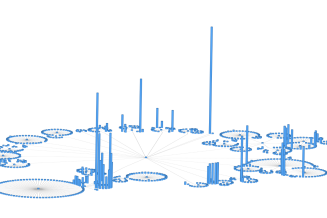
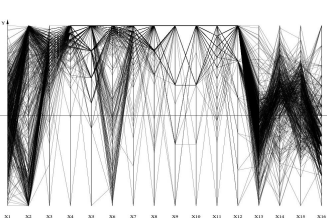
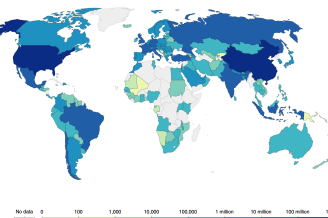
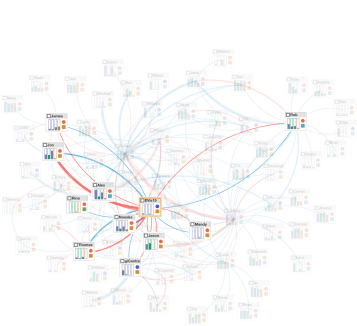
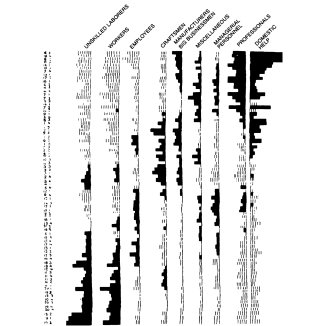
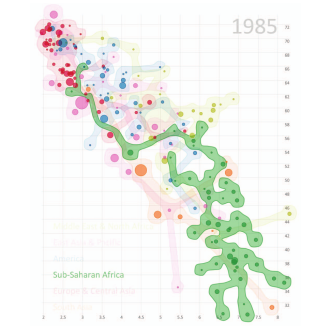
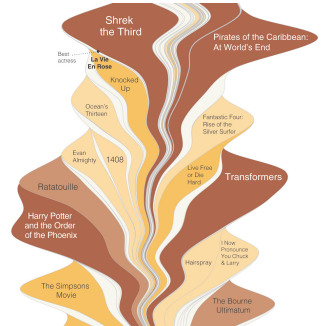
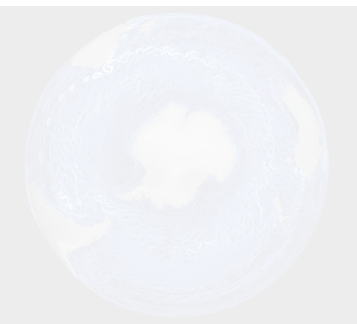
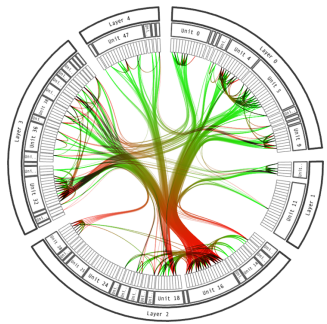
Exploratory experiment screenshot

15 data representations we used in our exploratory experiment



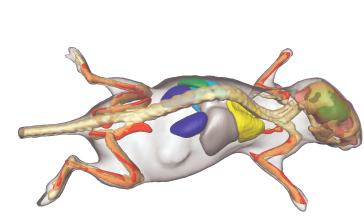
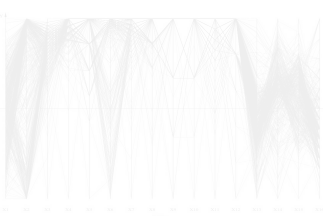
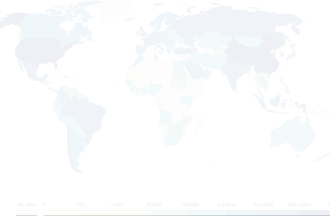
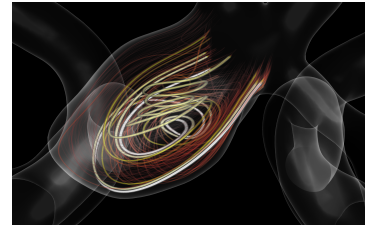
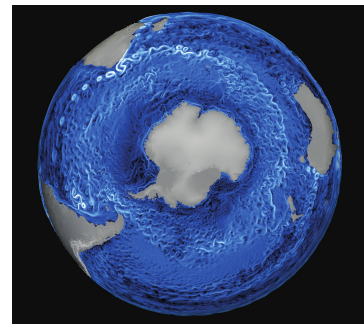
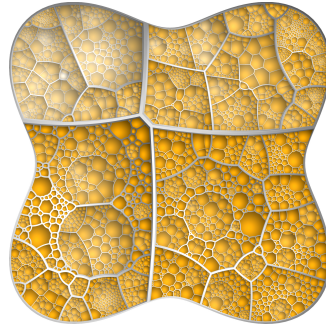
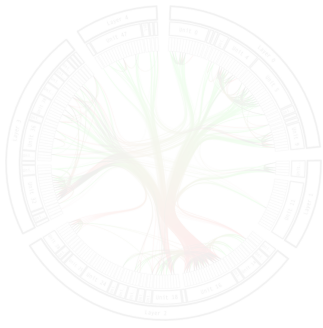
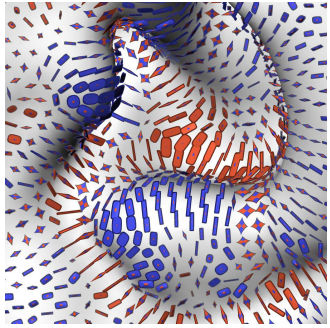
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2D vs. 3D

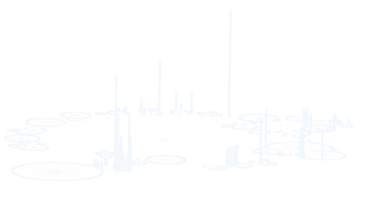
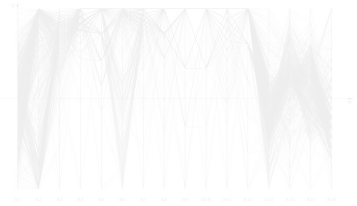
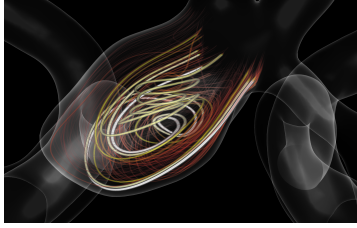
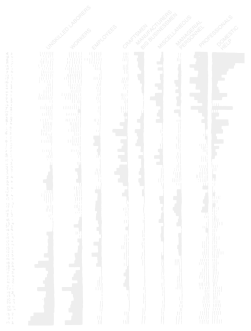
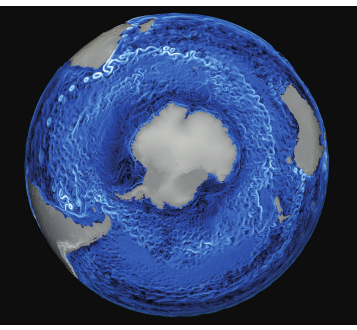
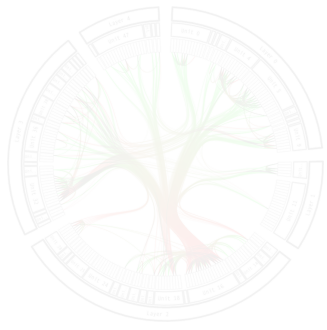


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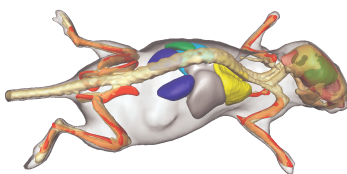
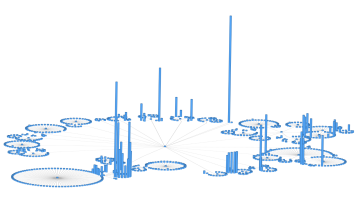
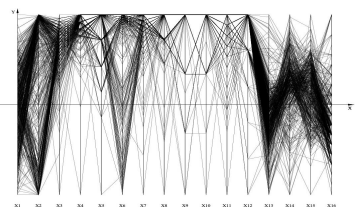
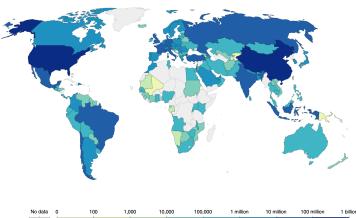
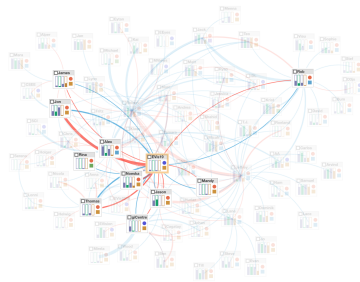
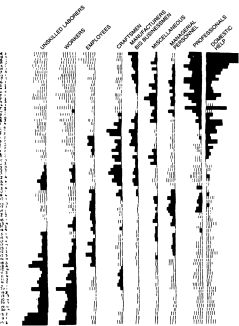
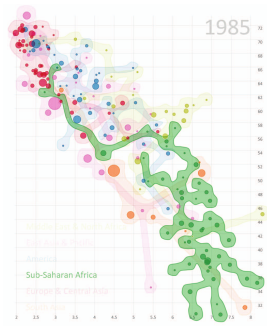
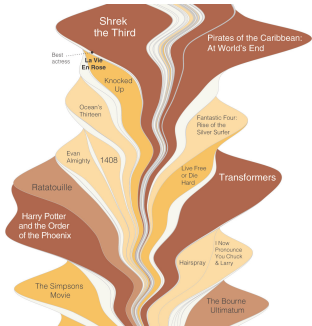
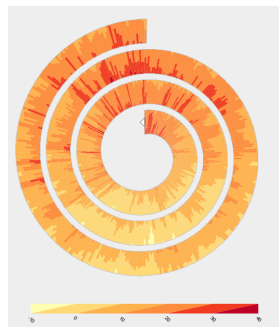
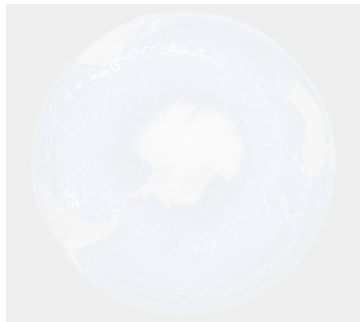
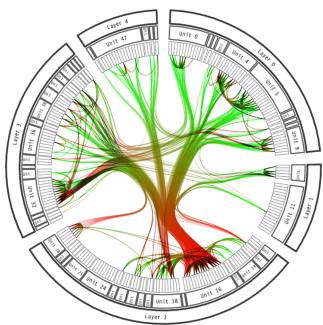
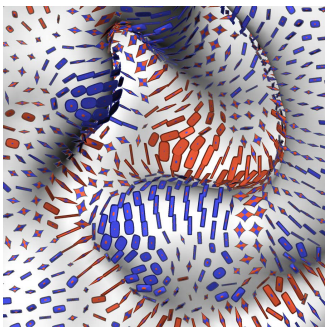
2D vs. 3D



Black background vs. White background

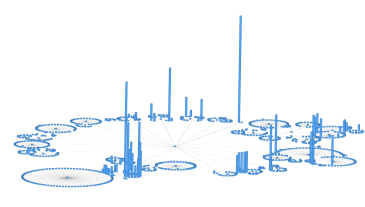
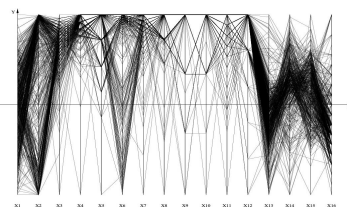
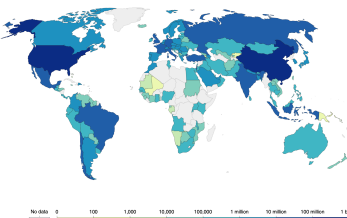
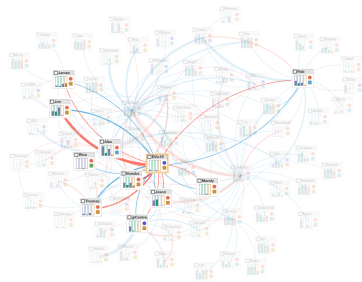
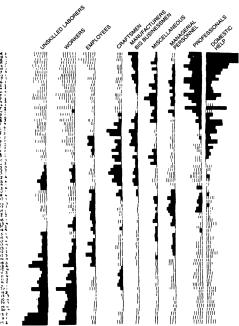
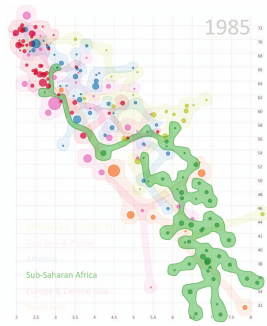
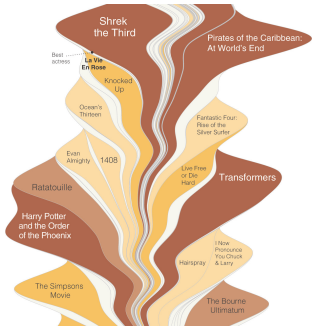
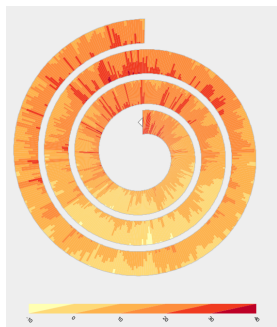
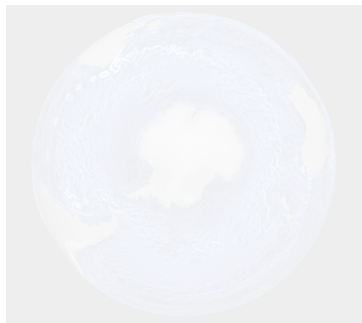
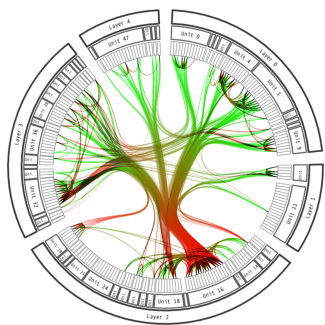
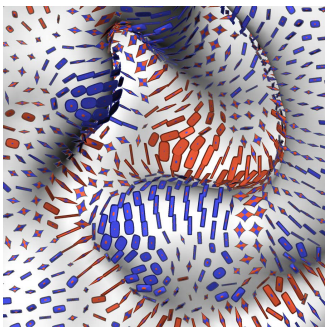


Black background vs. White background



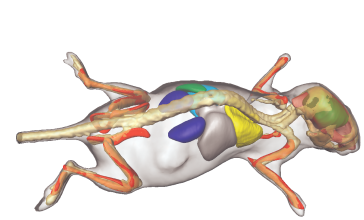
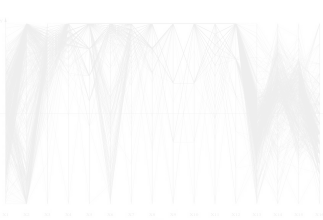
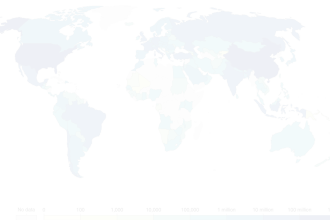
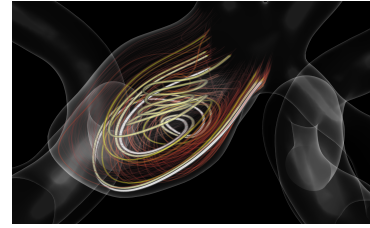
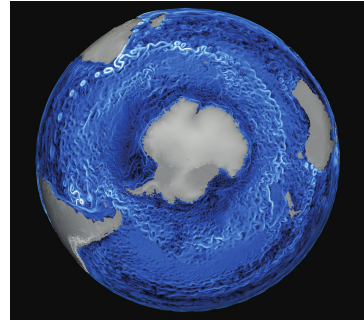
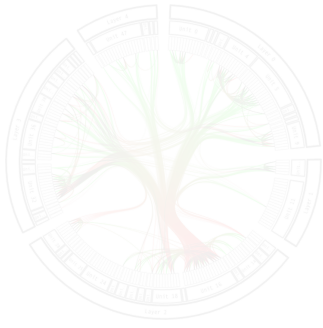
Images from other people's papers, used with permission, see our paper for details.

Abstract vs. Physical content

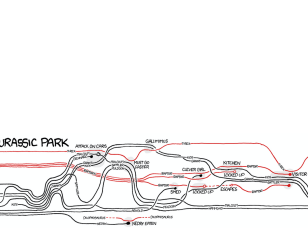
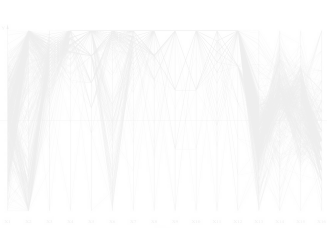
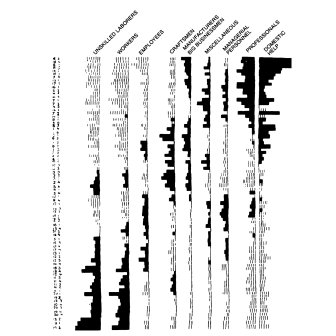
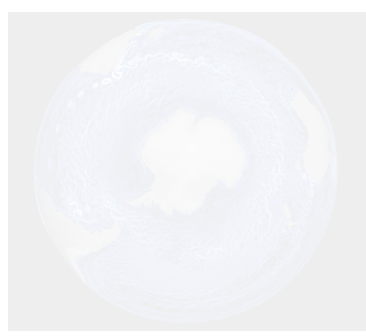
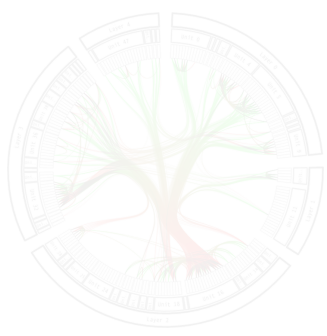


Images from other people's papers, used with permission, see our paper for details.

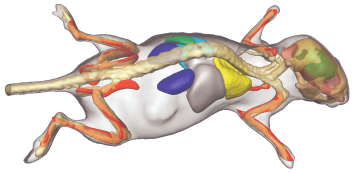
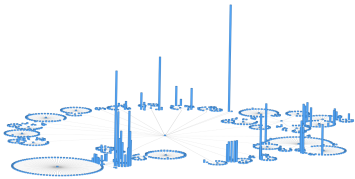
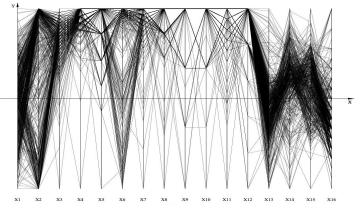
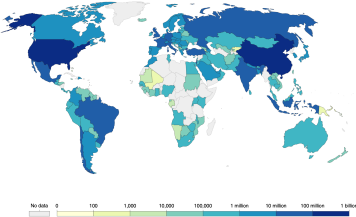
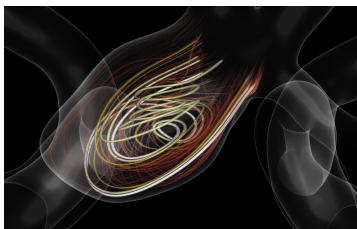
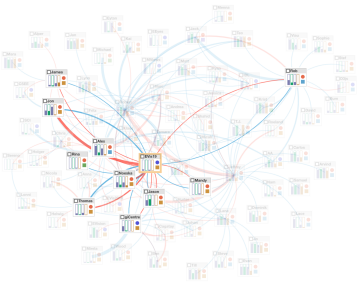
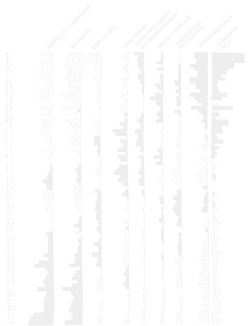
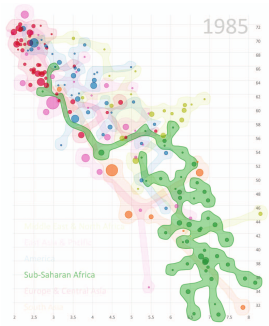
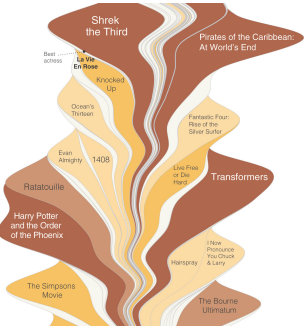
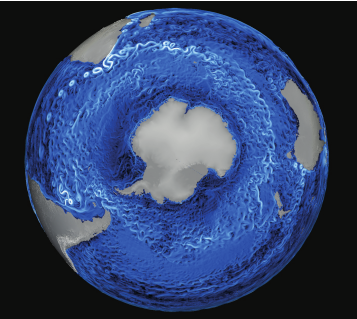
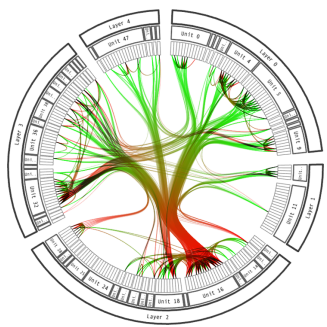
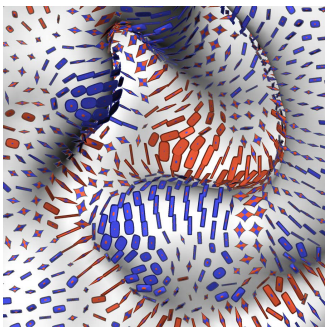
Abstract vs. Physical content



Handcrafted (appearance) vs. (clearly) Computer-generated

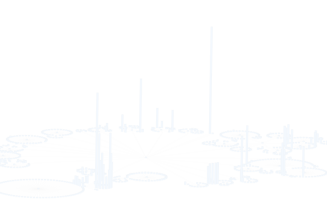
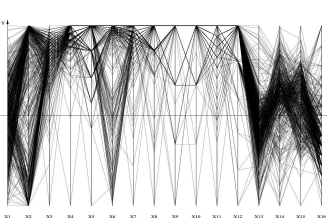
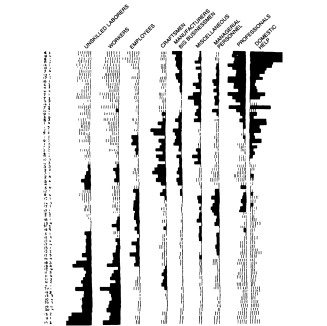
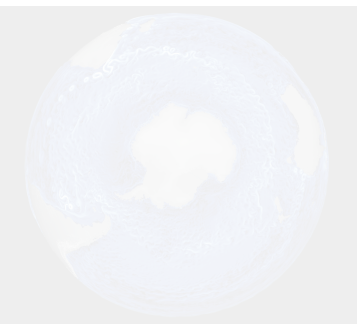
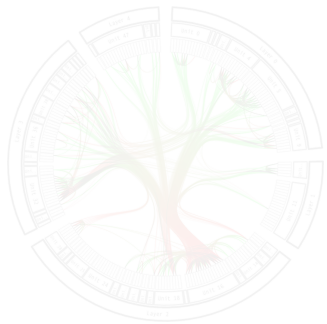


Handcrafted (appearance) vs. (clearly) Computer-generated



Images from other people's papers, used with permission, see our paper for details.

Black and white vs. Colorful

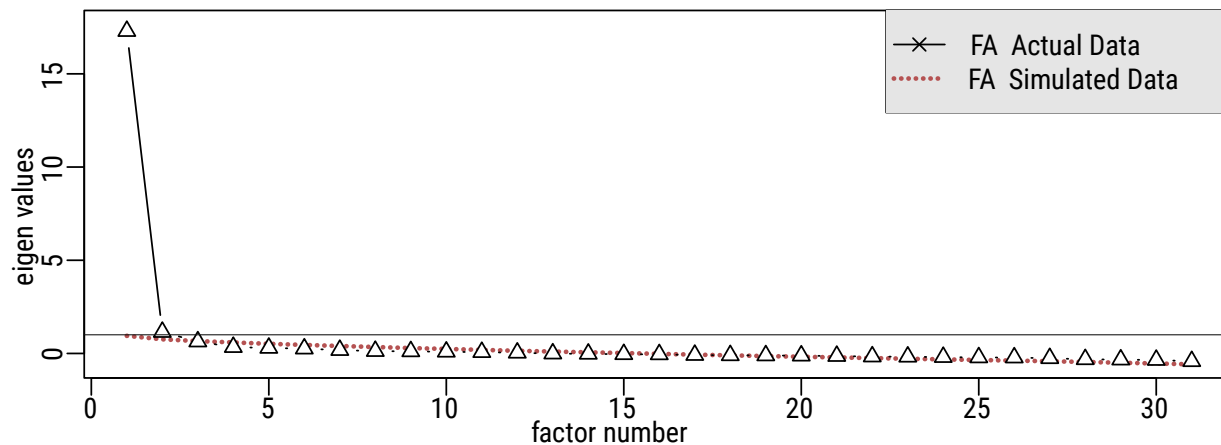


Images from other people's papers, used with permission, see our paper for details.

Step 3: Exploratory Phase

Exploratory Factor Analysis

Potential factor structure of our scale: **1 factor**



Scree plot for Image 1 (3D surface glyphs), see our paper for details

Step 3: Exploratory Phase

Exploratory Factor Analysis

terms / image	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Average
likable	0.91	0.79	0.88	0.87	0.86	0.84	0.90	0.88	0.84	0.86	0.85	0.89	0.87	0.87	0.89	0.87
pleasing	0.85	0.80	0.84	0.88	0.89	0.87	0.90	0.84	0.80	0.88	0.87	0.88	0.87	0.84	0.88	0.86
enjoyable	0.87	0.78	0.83	0.86	0.86	0.84	0.88	0.87	0.84	0.87	0.85	0.88	0.83	0.85	0.89	0.86
appealing	0.85	0.80	0.80	0.84	0.87	0.83	0.88	0.85	0.85	0.88	0.85	0.88	0.88	0.83	0.90	0.85
nice	0.90	0.81	0.81	0.82	0.87	0.83	0.87	0.87	0.81	0.85	0.84	0.82	0.89	0.82	0.89	0.85
attractive	0.84	0.78	0.81	0.81	0.86	0.87	0.89	0.84	0.84	0.86	0.85	0.87	0.86	0.84	0.85	0.84
delightful	0.86	0.74	0.78	0.85	0.83	0.81	0.89	0.82	0.79	0.82	0.86	0.88	0.89	0.84	0.88	0.83
satisfying	0.77	0.73	0.77	0.83	0.85	0.80	0.90	0.80	0.82	0.85	0.86	0.87	0.85	0.81	0.84	0.83
pretty	0.85	0.76	0.77	0.78	0.81	0.81	0.88	0.79	0.76	0.80	0.84	0.85	0.83	0.86	0.85	0.82
beautiful	0.84	0.77	0.76	0.79	0.84	0.78	0.87	0.81	0.76	0.82	0.85	0.85	0.78	0.82	0.84	0.81
lovely	0.85	0.75	0.78	0.82	0.80	0.77	0.83	0.81	0.74	0.81	0.86	0.86	0.83	0.79	0.83	0.81
inviting	0.83	0.74	0.71	0.73	0.82	0.80	0.84	0.85	0.78	0.78	0.83	0.78	0.84	0.76	0.83	0.79
engaging	0.79	0.70	0.76	0.74	0.78	0.78	0.82	0.83	0.74	0.76	0.79	0.77	0.80	0.73	0.80	0.77
tasteful	0.78	0.64	0.68	0.72	0.77	0.78	0.80	0.81	0.81	0.80	0.82	0.76	0.81	0.77	0.83	0.77
exciting	0.79	0.66	0.72	0.76	0.81	0.76	0.81	0.77	0.70	0.77	0.82	0.77	0.79	0.75	0.79	0.77
motivating	0.74	0.65	0.71	0.77	0.83	0.78	0.84	0.75	0.75	0.77	0.78	0.71	0.83	0.76	0.77	0.76
elegant	0.83	0.76	0.71	0.78	0.74	0.68	0.83	0.69	0.71	0.84	0.76	0.80	0.78	0.74	0.80	0.76
harmonious	0.79	0.69	0.76	0.75	0.82	0.74	0.74	0.74	0.69	0.80	0.77	0.80	0.76	0.75	0.81	0.76
well designed	0.76	0.71	0.67	0.77	0.81	0.73	0.69	0.71	0.73	0.74	0.76	0.81	0.81	0.66	0.76	0.74
fascinating	0.68	0.64	0.73	0.77	0.70	0.72	0.80	0.71	0.72	0.66	0.73	0.77	0.76	0.70	0.71	0.72
interesting	0.70	0.70	0.71	0.74	0.76	0.71	0.73	0.74	0.61	0.64	0.70	0.73	0.74	0.59	0.74	0.70
balanced	0.69	0.63	0.61	0.73	0.71	0.69	0.59	0.70	0.65	0.77	0.74	0.66	0.68	0.71	0.74	0.69
clean	0.73	0.70	0.71	0.64	0.70	0.60	0.66	0.70	0.60	0.68	0.71	0.71	0.63	0.73	0.67	0.68
sophisticated	0.68	0.63	0.62	0.63	0.61	0.62	0.73	0.65	0.66	0.63	0.63	0.75	0.71	0.71	0.71	0.66
organized	0.59	0.61	0.62	0.74	0.67	0.59	0.55	0.60	0.59	0.66	0.64	0.66	0.65	0.62	0.65	0.63
creative	0.53	0.49	0.55	0.60	0.67	0.62	0.66	0.70	0.62	0.68	0.65	0.64	0.58	0.54	0.65	0.61
artistic	0.52	0.49	0.51	0.59	0.66	0.63	0.69	0.61	0.56	0.66	0.64	0.69	0.55	0.58	0.67	0.60
professional	0.63	0.67	0.52	0.61	0.62	0.53	0.60	0.46	0.50	0.61	0.52	0.67	0.67	0.62	0.60	0.59
color harmonious	0.65	0.59	0.63	0.63	0.64	0.63	0.48	0.55	0.43	0.62	0.51	0.62	0.43	0.64	0.64	0.58
provoking	0.17	0.20	0.22	0.28	0.28	0.33	0.19	0.37	0.32	0.27	0.40	0.32	0.22	0.22	0.35	0.28
cluttered	0.30	-0.33	0.03	0.15	0.39	0.18	0.27	0.34	0.41	0.45	0.21	-0.05	0.12	0.05	0.24	0.18

Factor Loading > 0.7 : High

[Hair, 2009]

Retained 12 terms

with a factor loading > 0.7
for all 15 images

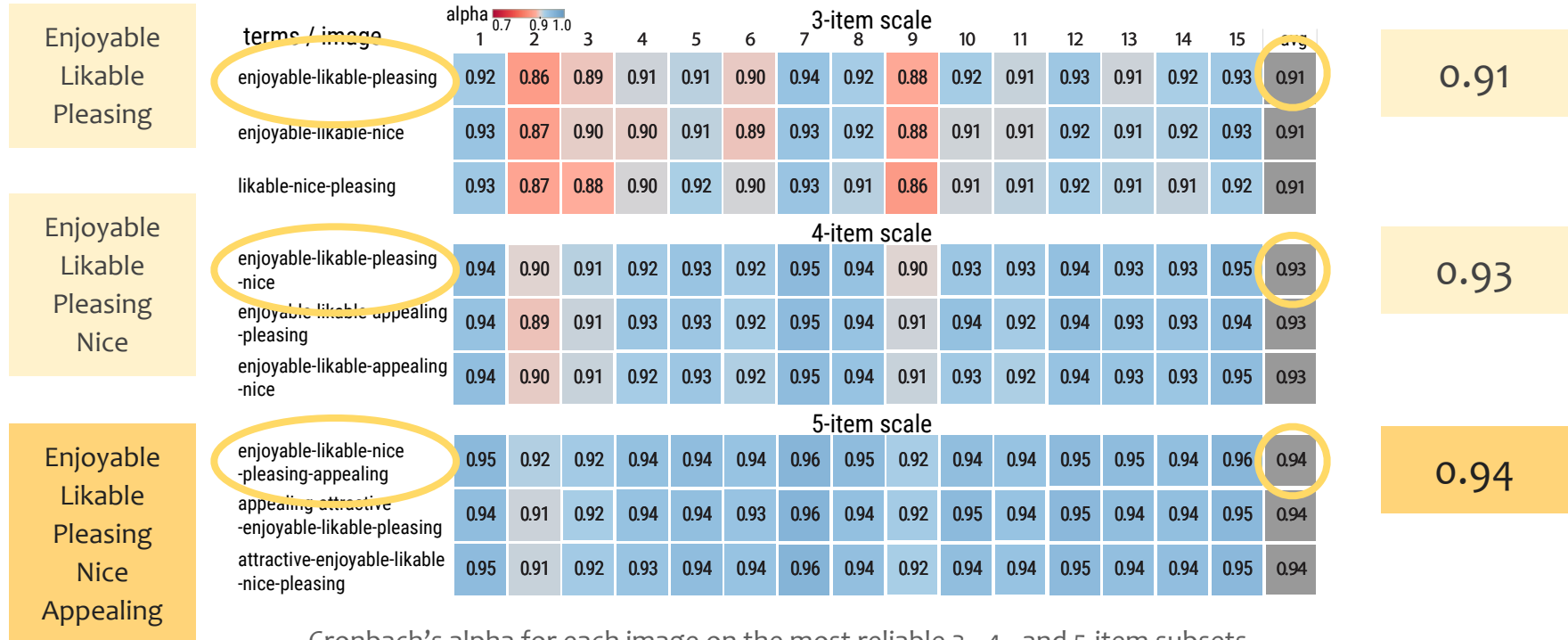
Factor loadings for all 31 terms and 15 images

Step 3: Exploratory Phase

Reliability: Cronbach's Alpha

Alpha > 0.7 : Reliable

[Boateng et al., 2018]



Cronbach's alpha for each image on the most reliable 3-, 4-, and 5-item subsets of the remaining 12 terms with factor loading > 0.7.

BeauVis Scale

To what extent do you agree that this visual representation is ... ?

strongly disagree strongly agree

enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
likable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pleasing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
nice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
appealing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

BeauVis scale in its recommended version

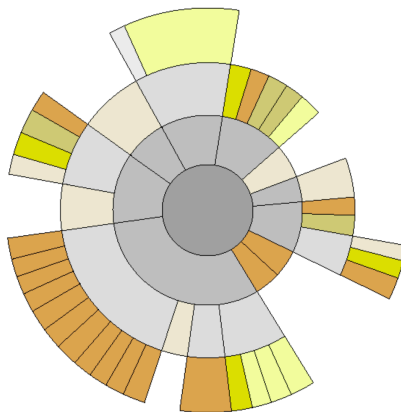
Step 4: Validation Phase

Crowdsourced Experiment

- 201 participants
- 3 data representations

★ To what extent do you agree or disagree with the following statement:

The visualization is ____.



	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
likable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
symmetric	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
clean	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
appealing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
pleasing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
aesthetic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
nice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

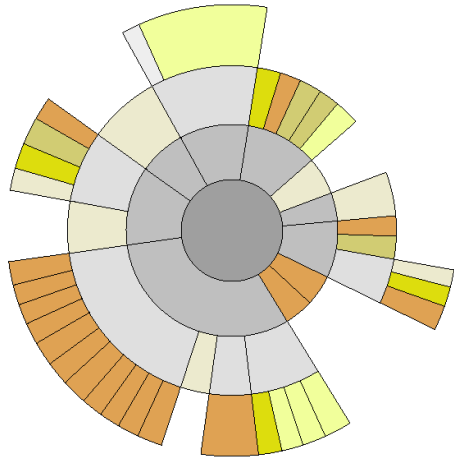
Previous

Next

Confirmatory experiment screenshot
Terms from the BeauVis scale and Lavie and Tractinsky's scale

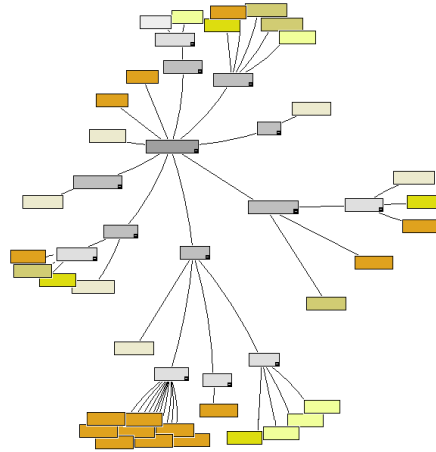
3 data representations we used in our confirmatory experiment

Ranking for aesthetic pleasure in the previous study. [Cawthon & Vande Moere, 2007]

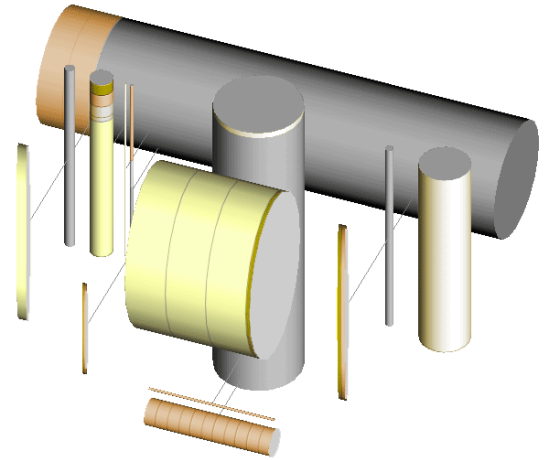


SunBurst

Most beautiful



StarTree



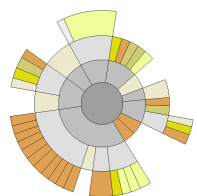
BeamTree

Most ugly

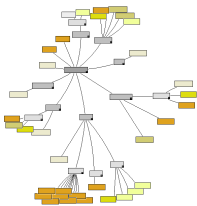
Step 4: Validation Phase

BeauVis Replicated the Aesthetic Ranking [Cawthon & Vande Moere, 2007]

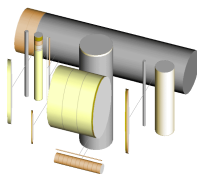
Ranking in previous study
("Known groups")



SunBurst
Most beautiful

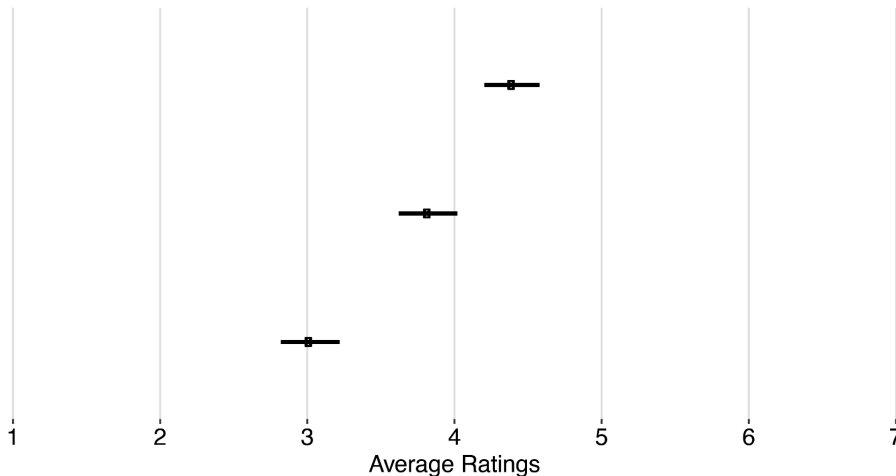
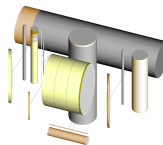
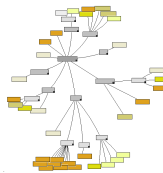
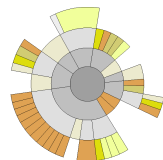


StarTree



BeamTree
Most ugly

Results with BeauVis scale
(Differentiation by known groups)



Step 4: Validation Phase

Confirmatory Factor Analysis

	SunBurst	StarTree	BeamTree
<i>p</i> -value (χ^2)	0.290	0.222	0.016
TLI	0.998	0.996	0.982
CFI	0.999	0.998	0.991
SRMR	0.009	0.011	0.014
RMSEA	0.034	0.045	0.095

Goodness of fit indices

Item	Factor Loading		
	SunBurst	StarTree	BeamTree
enjoyable	0.893	0.878	0.911
likable	0.914	0.925	0.874
pleasing	0.889	0.895	0.893
nice	0.845	0.877	0.888
appealing	0.910	0.842	0.889

Standardized factor loading for 5 items

Reliability

	SunBurst	StarTree	BeamTree
Cronbach's Alpha	0.95	0.946	0.95

Cronbach's alpha for each visualization

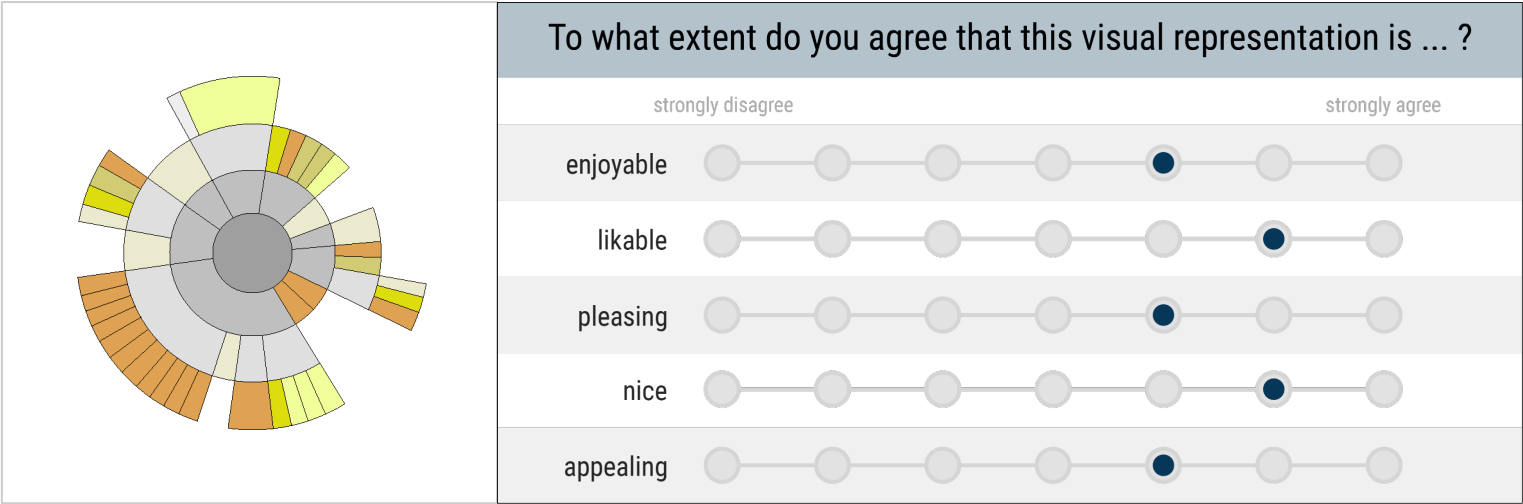
Validity

	SunBurst	StarTree	BeamTree
Classic Aesthetic	0.84	0.88	0.87
Age	0.07	0.12	0.14

Pearson correlation

Usage of the BeauVis Scale

Rapidly **compare** the aesthetic pleasure of different visual data representations.



Recommended form of using the BeauVis scale

Usage of the BeauVis Scale

BeauVis Scale



Other Research Methods

To what extent do you agree that this visual representation is ... ?

strongly disagree

strongly agree

enjoyable



likable



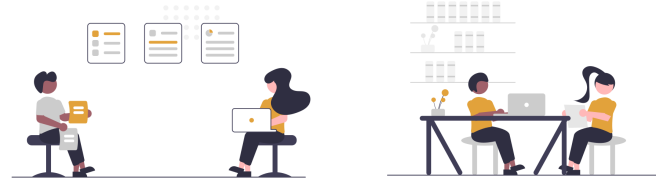
pleasing



nice



appealing



BeauVis: A Validated Scale for Measuring the Aesthetic Pleasure of Visual Representations

IEEE VIS 2022, October 16-21, Oklahoma City, Oklahoma, USA.



Tingying He, Petra Isenberg, Raimund Dachzelt, and Tobias Isenberg