

On the Usage of Gestalt Principles for the Comparative Visual Analysis of Digital Humanities Data

Stefan Jänicke

Göttingen Dialog on Digital Humanities 2016

May 2, 2016



@vizcovery

<http://www.vizcovery.org>



Close and Distant Reading Visualizations
for the Comparative Analysis
of Digital Humanities Data

Der Fakultät für Mathematik und Informatik
der Universität Leipzig

eingereichte

D I S S E R T A T I O N

zur Erlangung des akademischen Grades

DOCTOR RERUM NATURALIUM
(Dr. rer. nat.)

im Fachgebiet

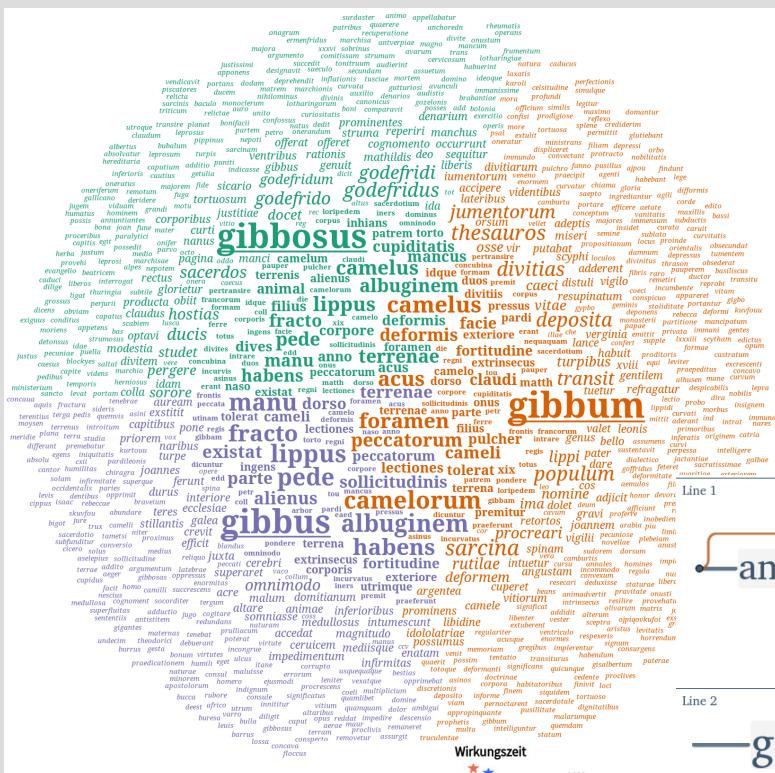
Informatik

vorgelegt

von Dipl.-Inf. Stefan Jänicke

geboren am 17. März 1982 in Oschatz

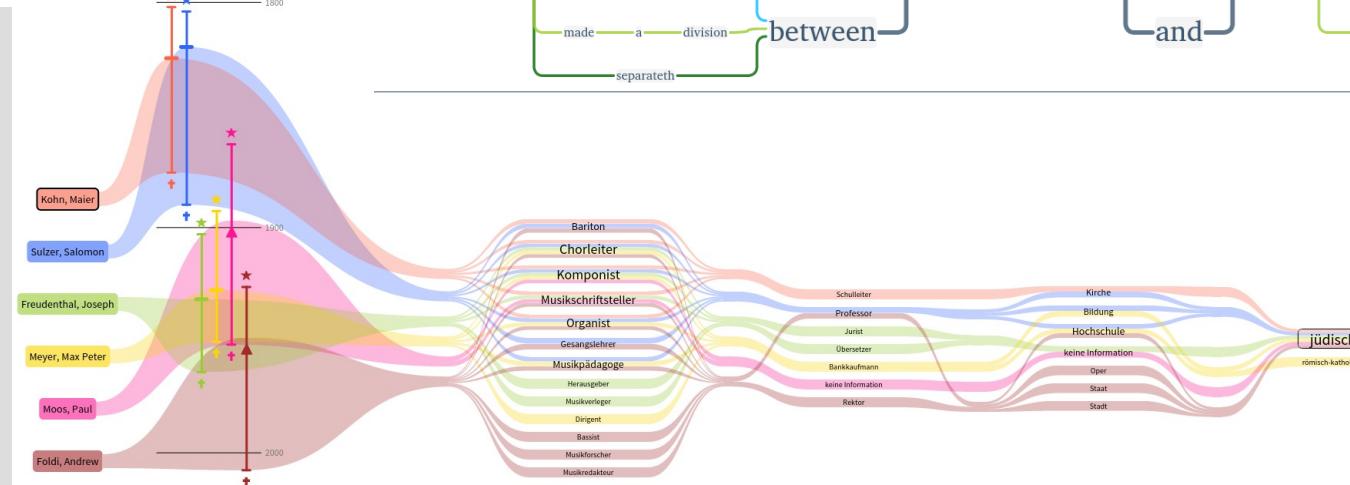
Leipzig, den 11. Februar 2016



Line 1
and god saw the light that it was good and

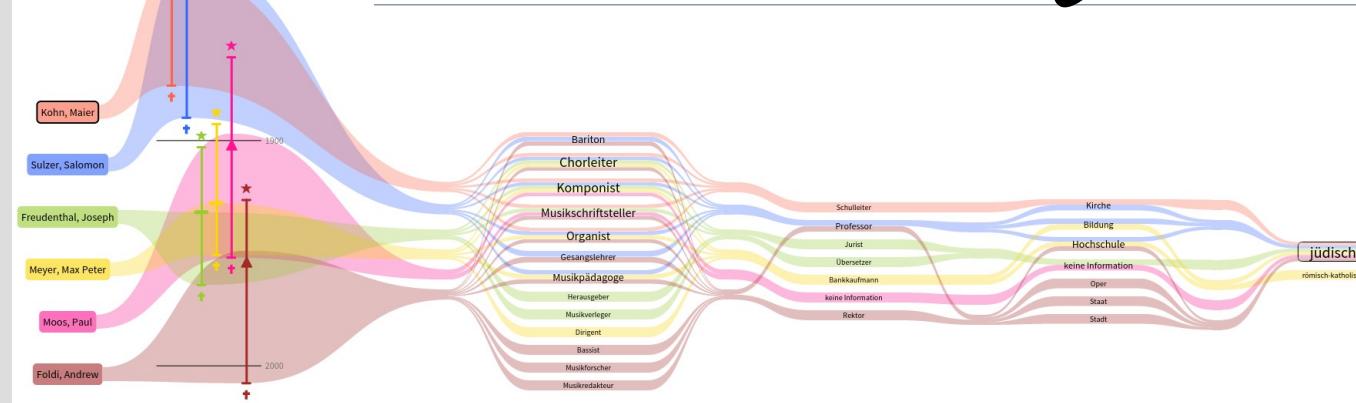
Line 2
god divided the light from the darkness and

Diagram illustrating the structure of the first two lines of the creation narrative. The words "and", "god", "saw", "the", "light", "that", "it", "was", "good", "and", "god", "divided", "the", "light", "from", "the", "darkness", and "and" are connected by lines, with some lines grouped together by brackets labeled with their definitions.





readability!!!



Close and Distant Reading Visualizations
for the Comparative Analysis
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DISSERTATION

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DOCTOR RERUM NATURALIUM
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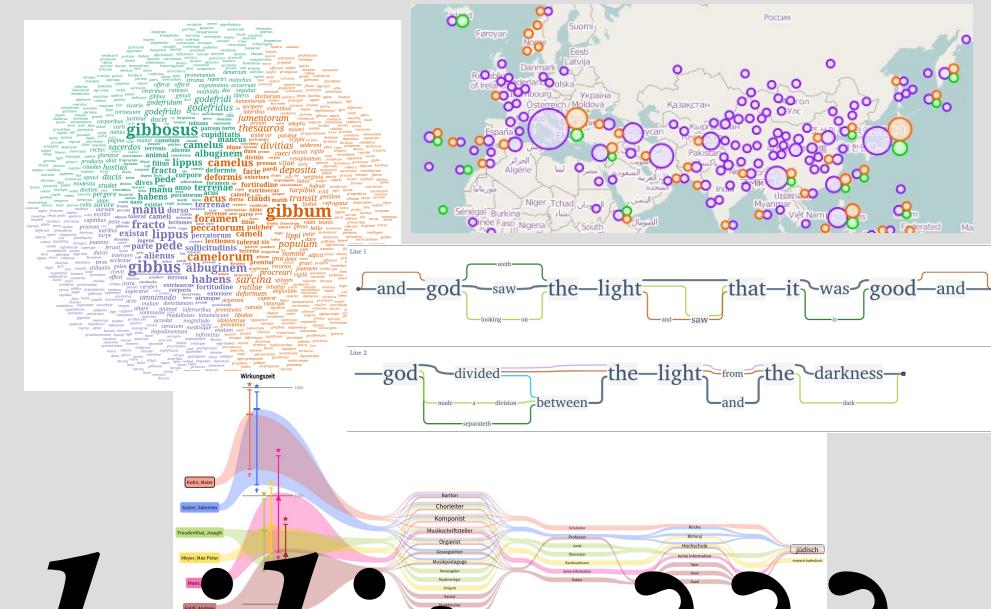
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readability???

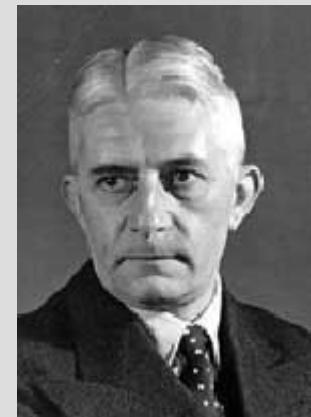
©Valessio S Brito

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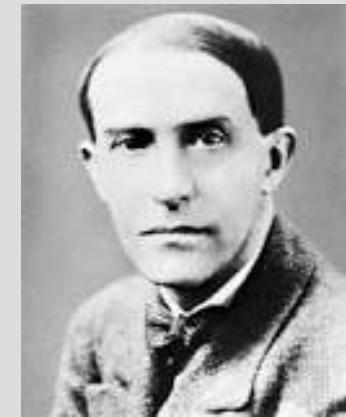
GESTALT
theory



Max Wertheimer
(1880-1943)



Wolfgang Köhler
(1887-1967)



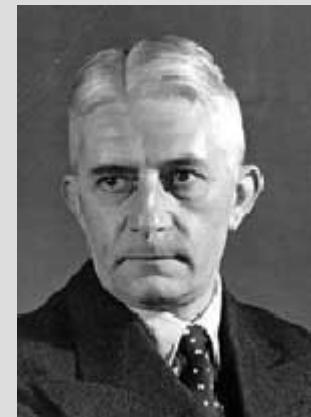
Kurt Koffka
(1886-1941)

“The whole is other than the sum of its parts.”

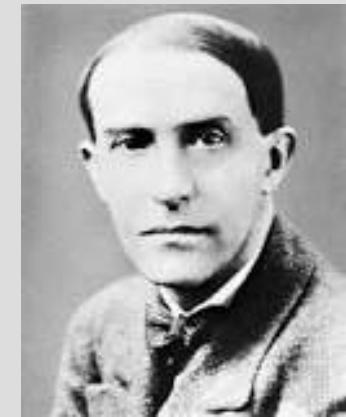
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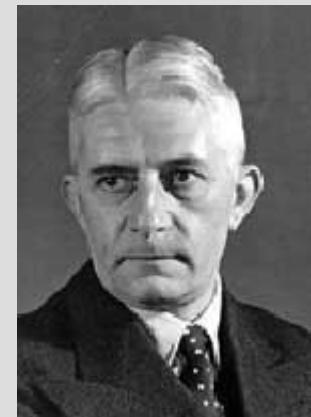
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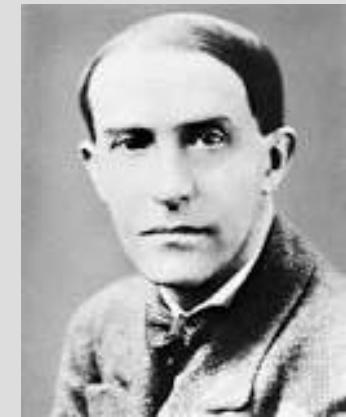
The logo consists of the word "GESTALT" in a bold, sans-serif font. The letter "G" is stylized with a grid of small squares. The letter "S" has a vertical bar through it. The letters "T", "A", "L", and "T" are each composed of two parallel diagonal lines forming a striped pattern.
theory



Max Wertheimer
(1880-1943)



Wolfgang Köhler
(1887-1967)



Kurt Koffka
(1886-1941)

“The whole is other than the sum of its parts.”





GESTALT

theory

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Why do we see one thing as foreground and the other thing as background?

How does the impression of *form* emerge?

What are the reasons for recognizing a *form* easily and quickly?

What is a “good“ *form*?

How and why do we see relationships between things?

What makes the detection of relationships or differences easier or harder?

What features let us perceive a thing as a *form* that differs from other *forms*?



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How do we perceive complex sceneries?



Why do we choose from numerous possible interpretations of an image always the same, logical one?

What are the reasons for recognizing a *form* easily and quickly?

How does the impression of *form* emerge?

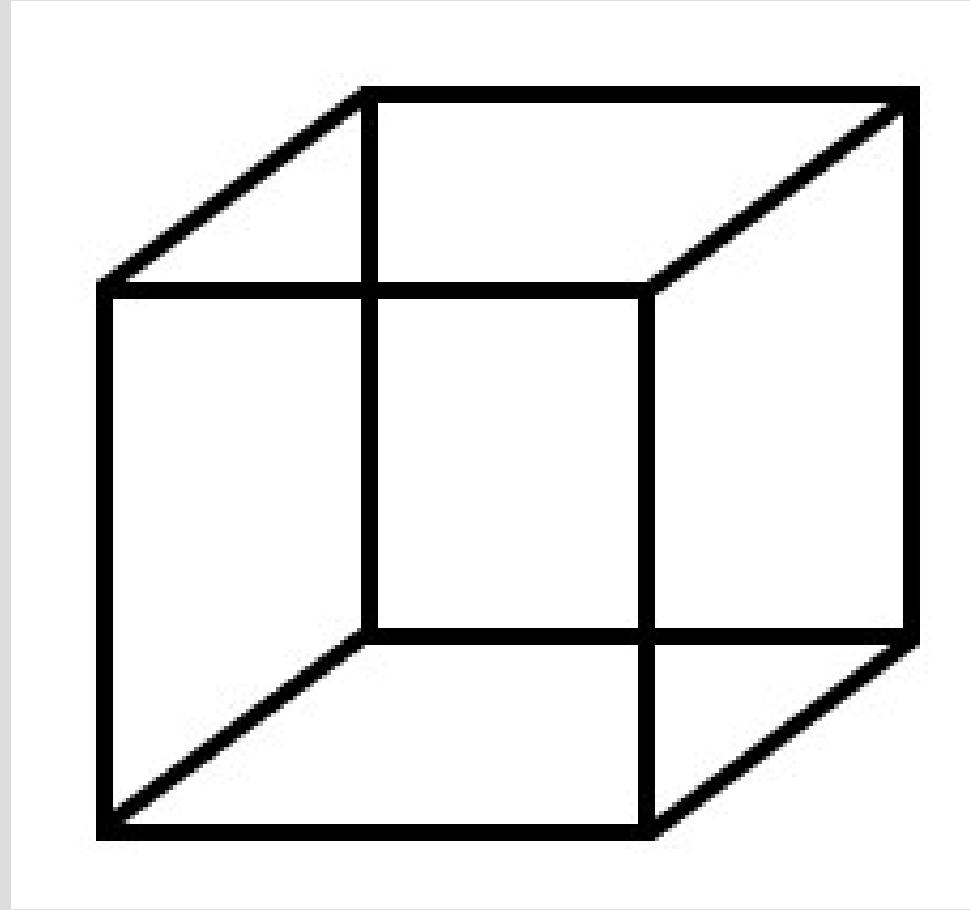
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GESTALT
theory



GESTALT

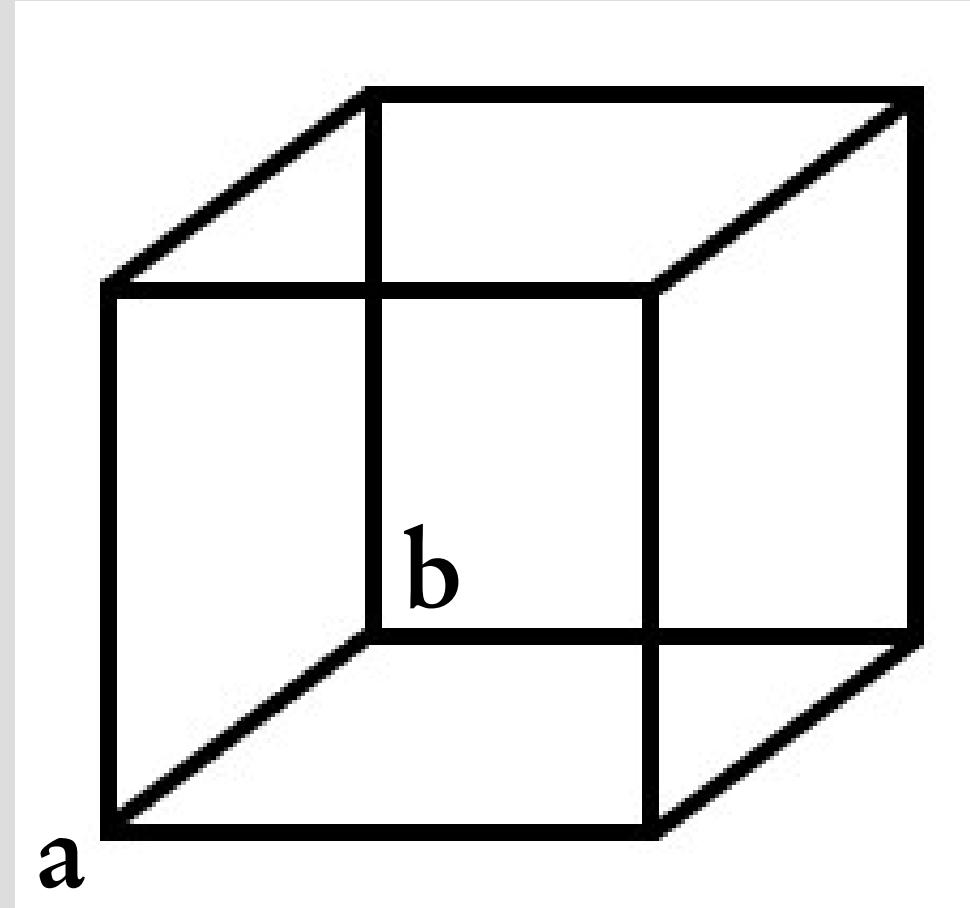
theory

The word "GESTALT" is written in large, bold, black capital letters. The letter "S" is unique, composed of a solid black circle on top and a grid of small squares below. Below "GESTALT", the word "theory" is written in a smaller, italicized, black serif font.

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GESTALT

theory



GESTALT

theory

The word "GESTALT" is in a bold, black, sans-serif font. The letter "S" is unique, composed of a black circle with a grid of smaller squares inside, and a vertical bar with diagonal stripes extending from its center. Below "GESTALT", the word "theory" is written in a large, italicized, black serif font.

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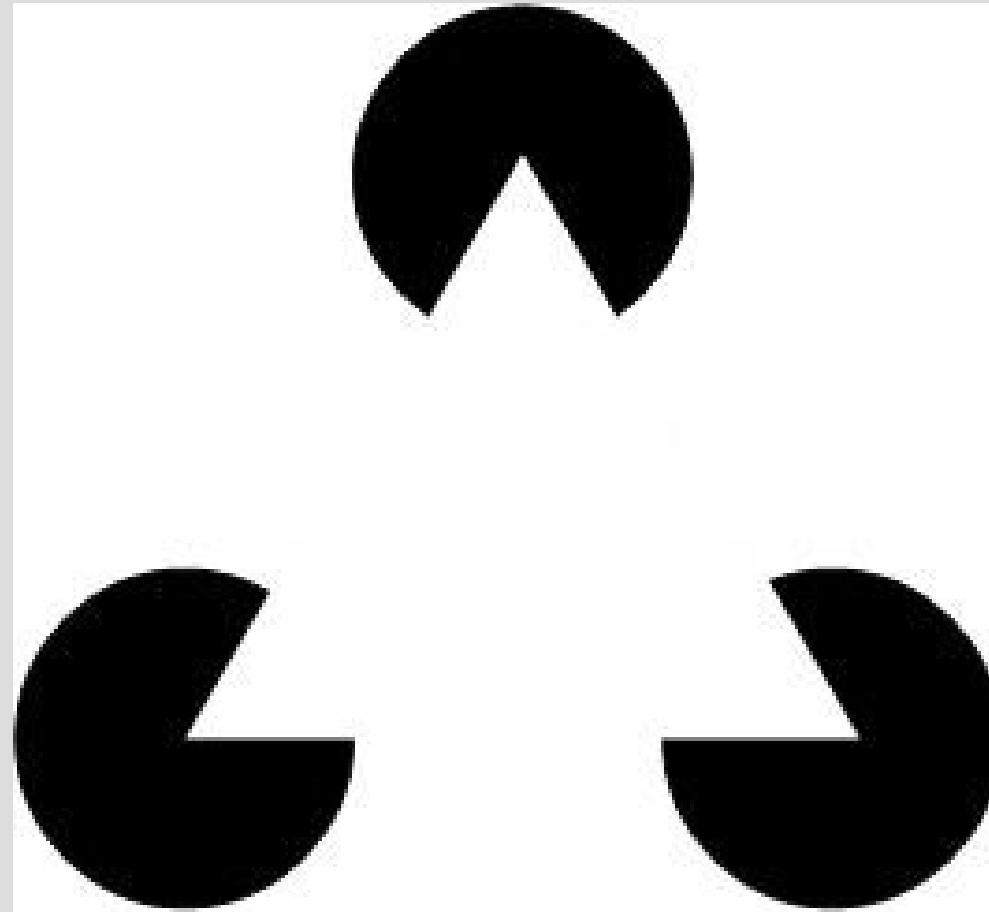
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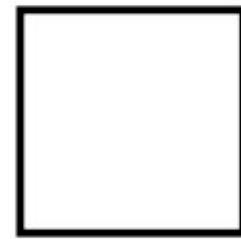
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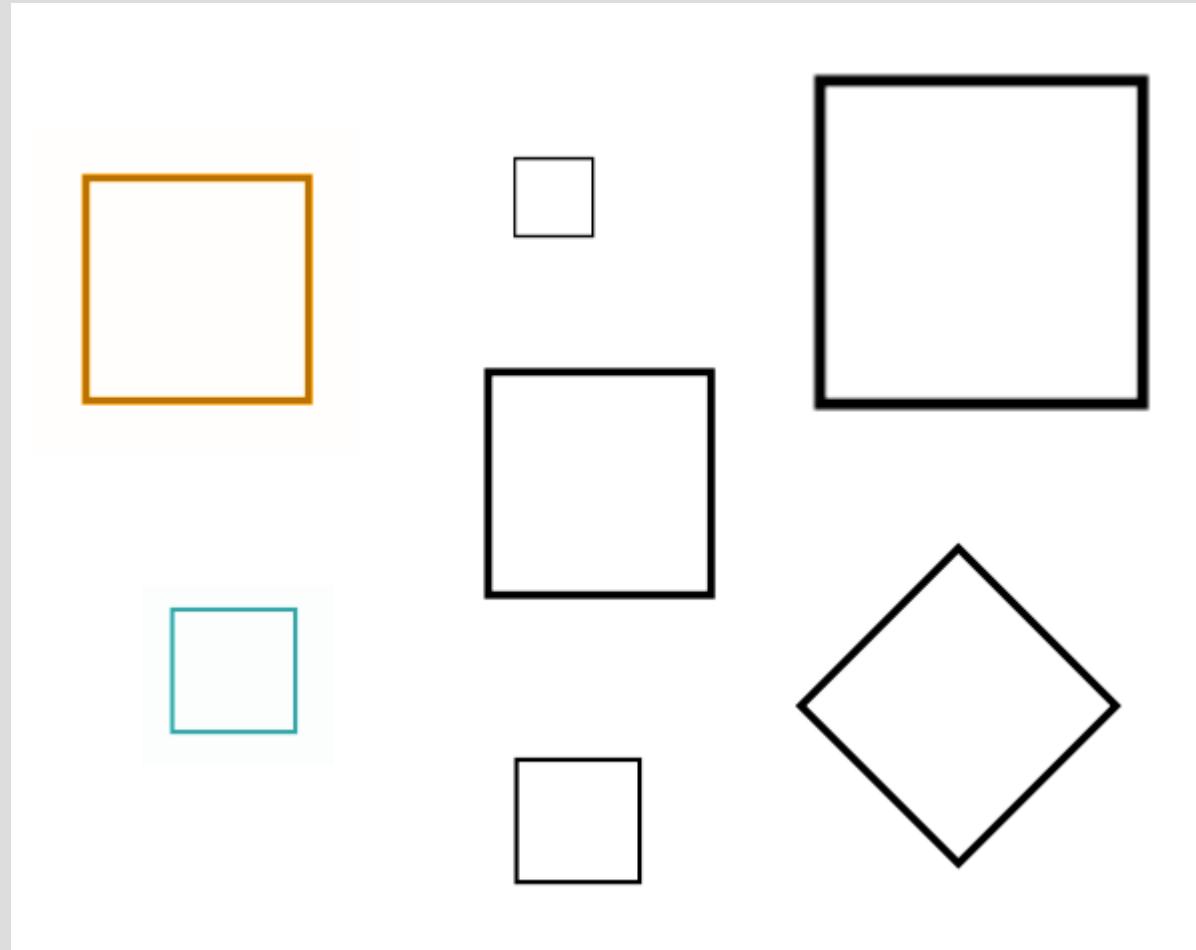
theory

The word "GESTALT" is written in a bold, black, sans-serif font. The letter "S" is unique, composed of a solid black circle on the left and a vertical bar with diagonal hatching on the right. Below it, the word "theory" is written in a smaller, italicized, black serif font.

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GESTALT

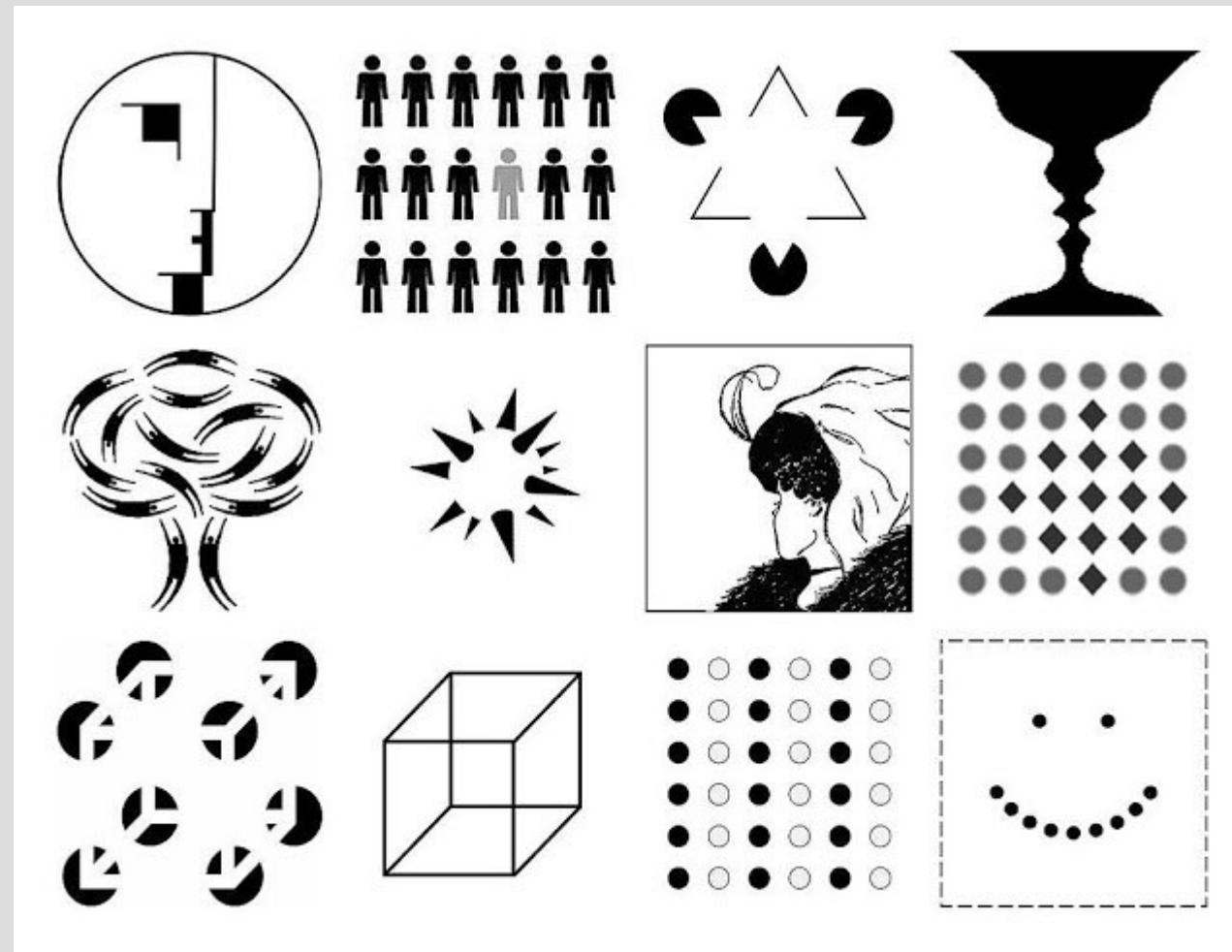
theory

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Gestalt Principles (of Grouping)



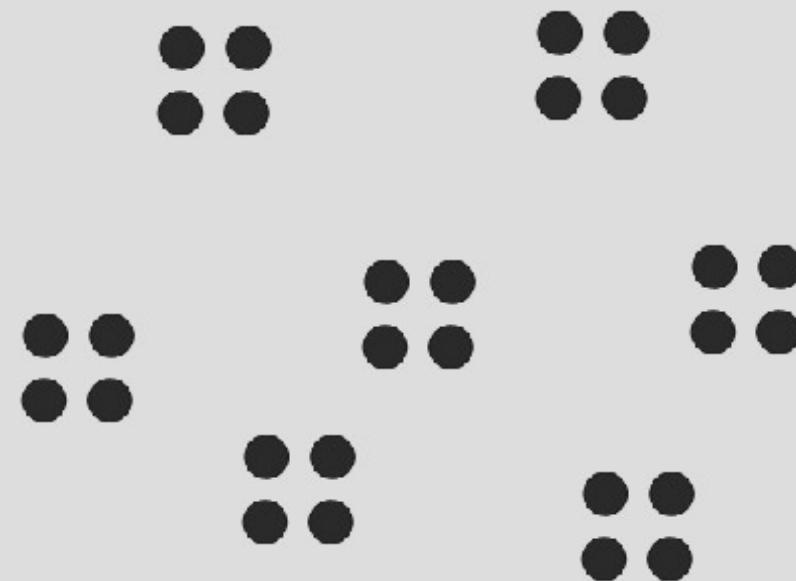
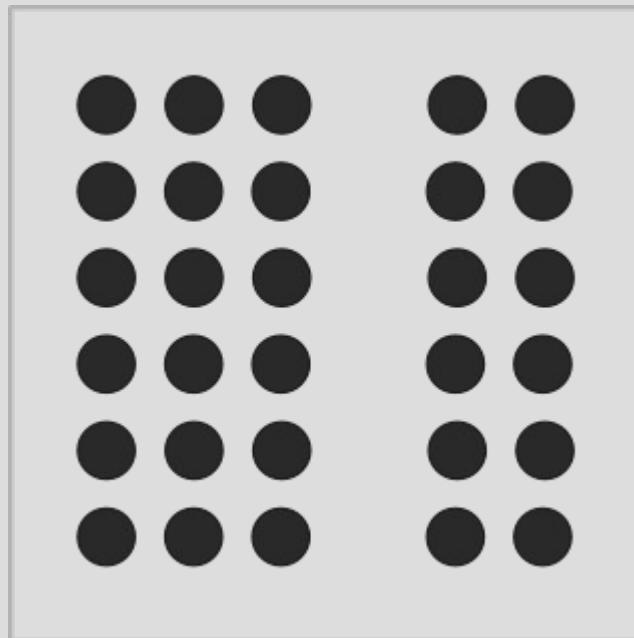
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The Gestalt Principle of ... ?



The Gestalt Principle of Proximity

„We perceive objects that are located near one another as belonging to the same group.“

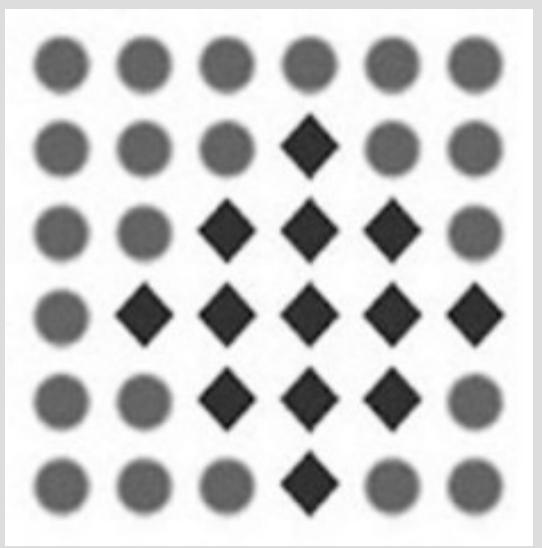
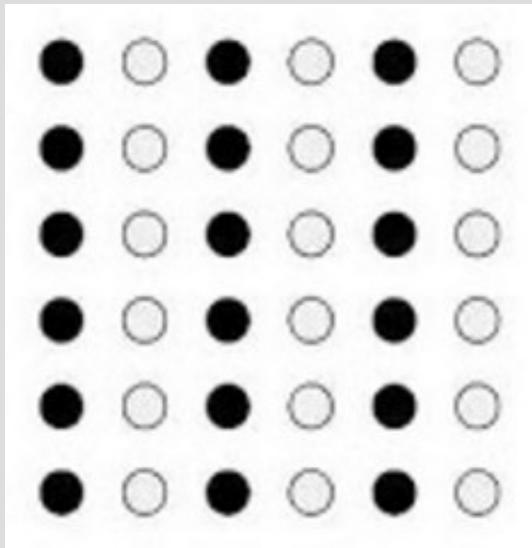


The Gestalt Principle of ... ?



The Gestalt Principle of Similarity

„We tend to group together objects that are similar
in color, size, shape, and orientation.“



The Gestalt Principle of ... ?



The Gestalt Principle of ... ?



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<http://www.flickr.com/photos/fatguyinalittlecoat/2909850055/>

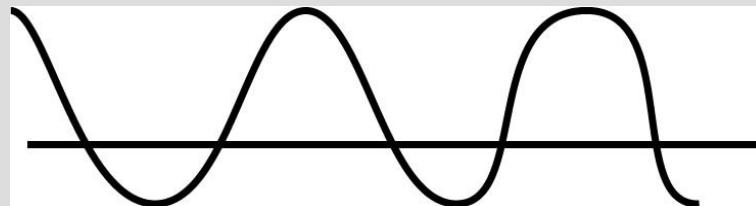
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The Gestalt Principle of Continuity

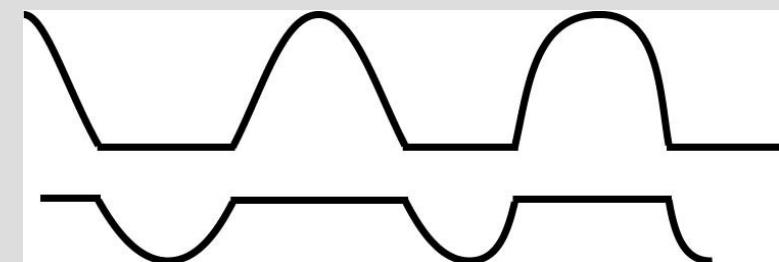
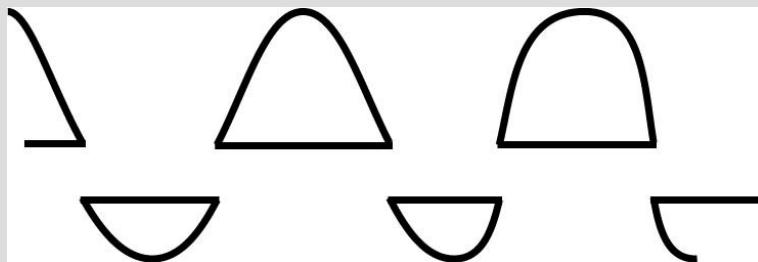
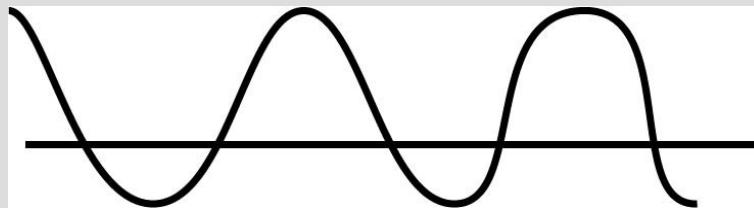
„We perceive objects as belonging together, if they are aligned with one another or appear to form a continuation of one another.“



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The Gestalt Principle of Continuity

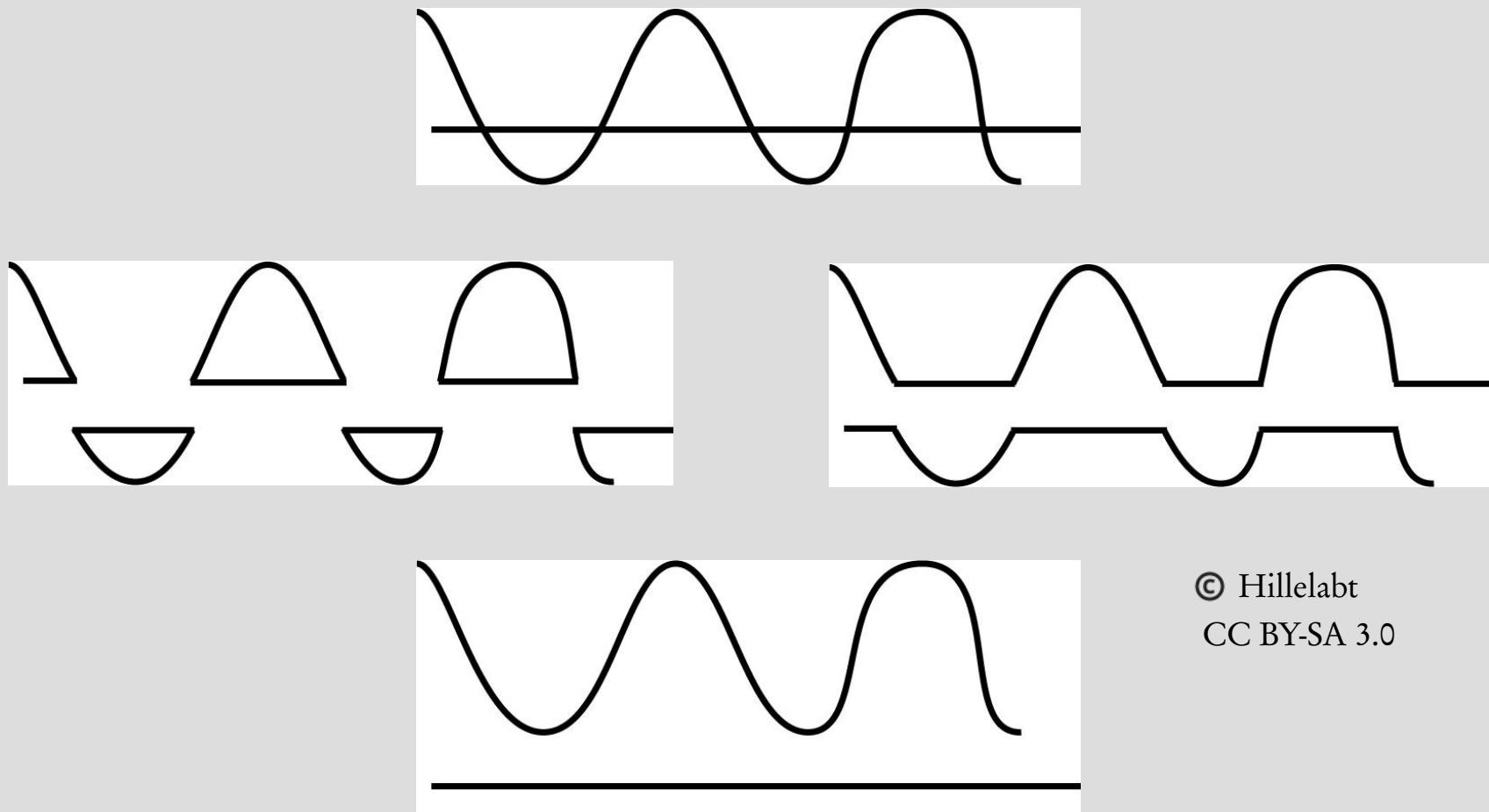
„We perceive objects as belonging together, if they are aligned with one another or appear to form a continuation of one another.“



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The Gestalt Principle of ... ?

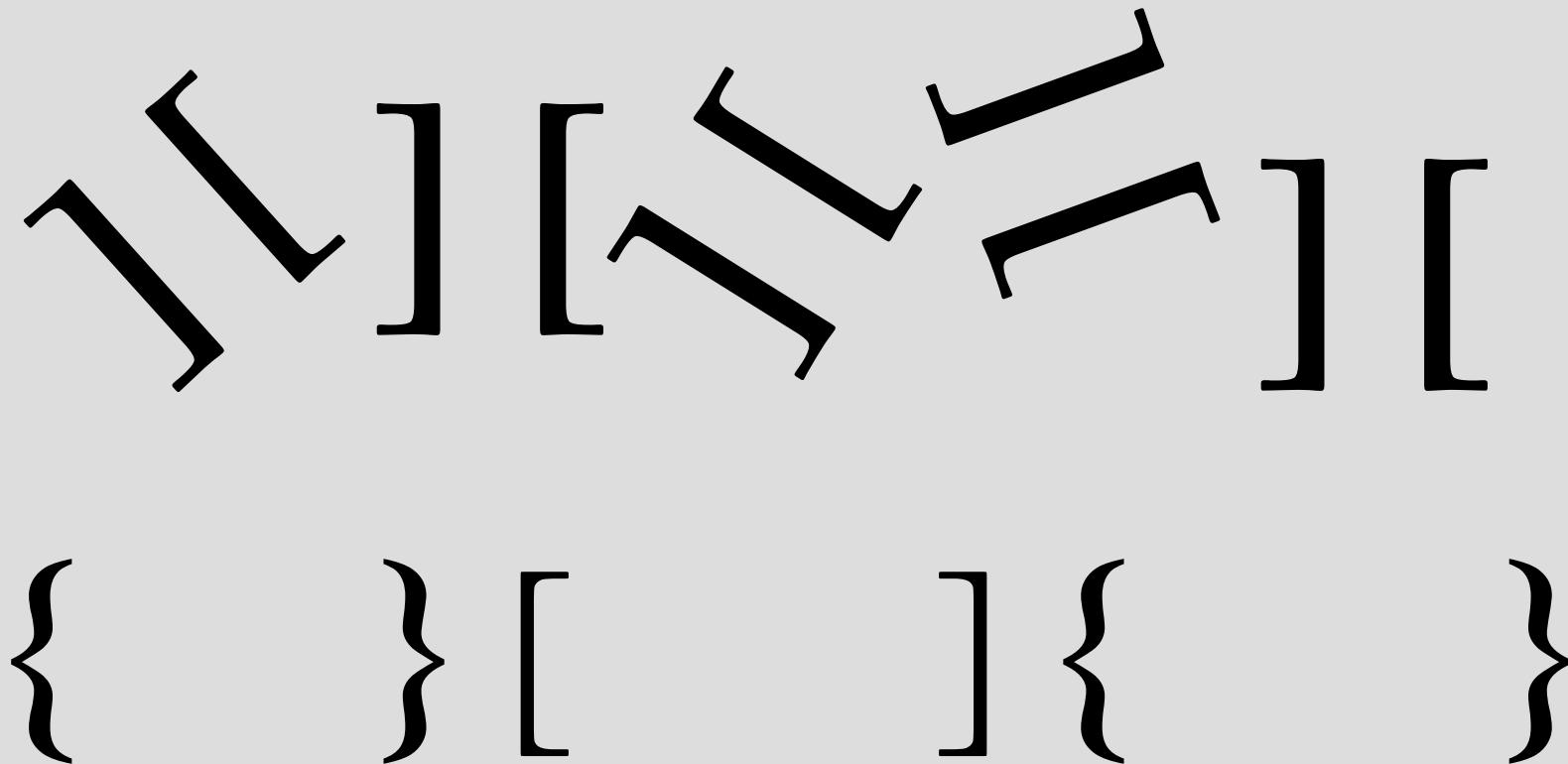


The Gestalt Principle of ... ?



The Gestalt Principle of Symmetry

„People prefer shapes that have some symmetry; we perceive elements that are symmetrical to each other as a unified group.“

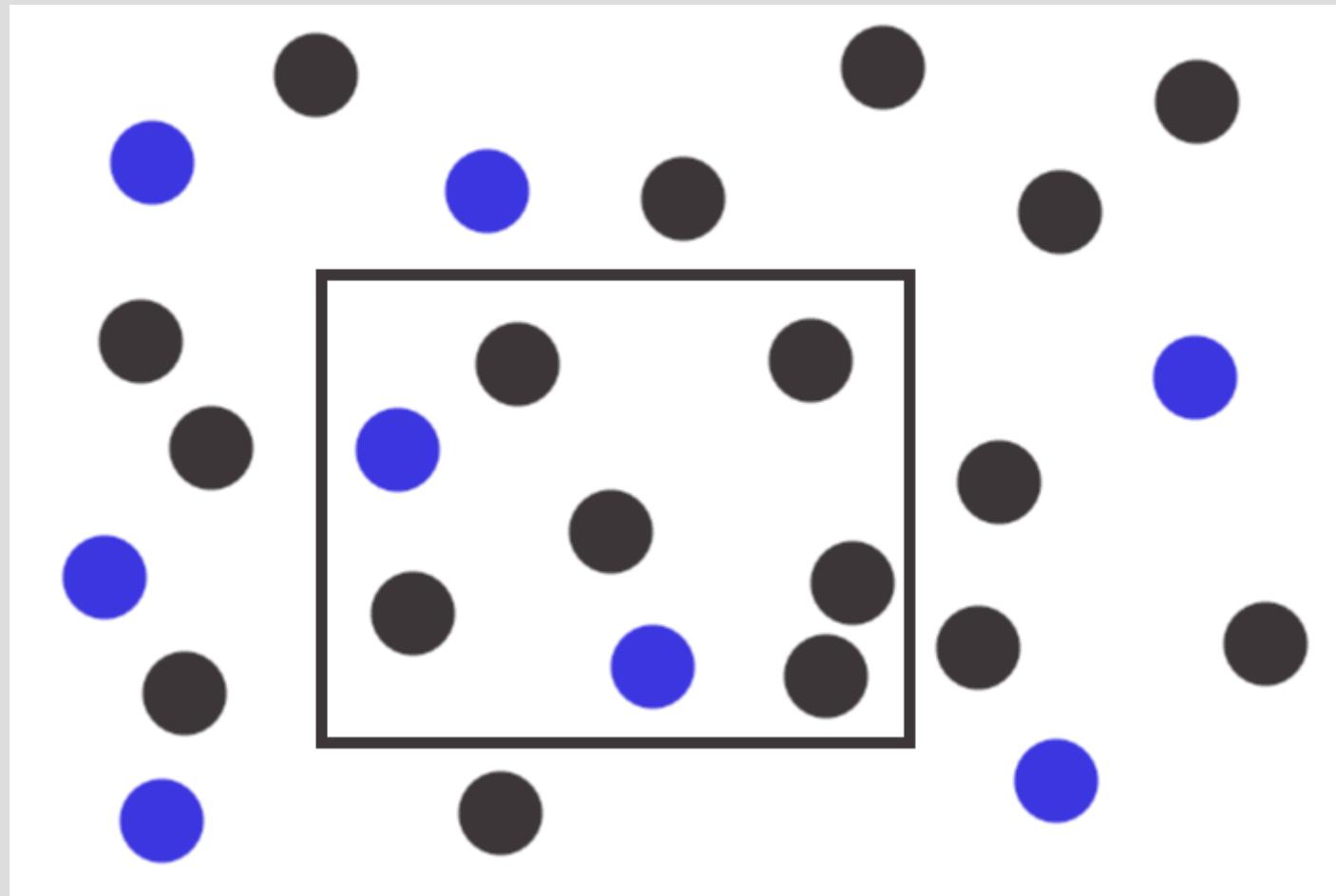


The Gestalt Principle of ... ?



The Gestalt Principle of Enclosure

„We perceive objects as belonging together when they are enclosed by anything that forms a visual border around them.“



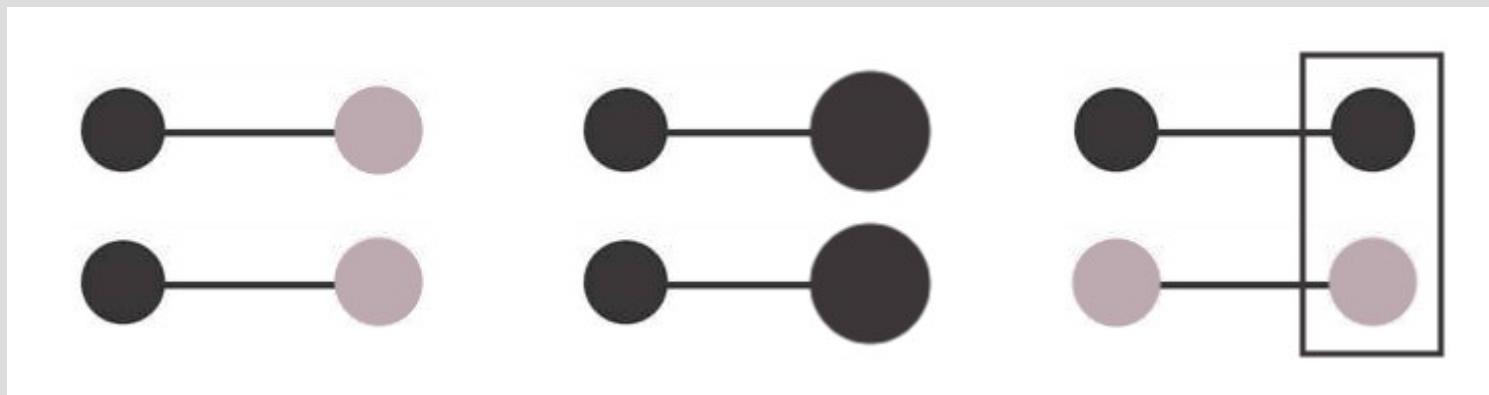
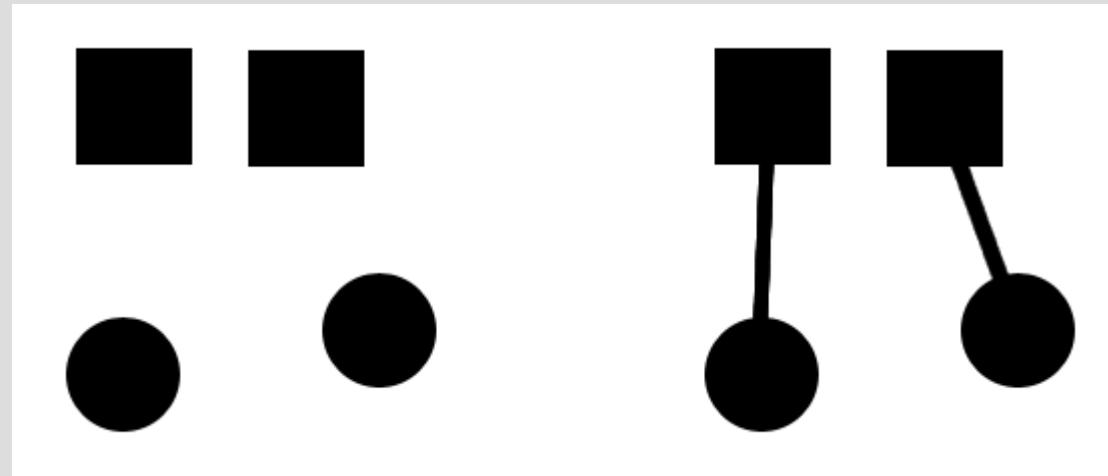
The Gestalt Principle of ... ?



© RIA Novosti archive, image #881647 / Yuryi Abramochkin / CC-BY-SA 3.0

The Gestalt Principle of Connectedness

„We perceive objects that are connected in some way, such as by a line, as part of the same group.“



More Gestalt Principles

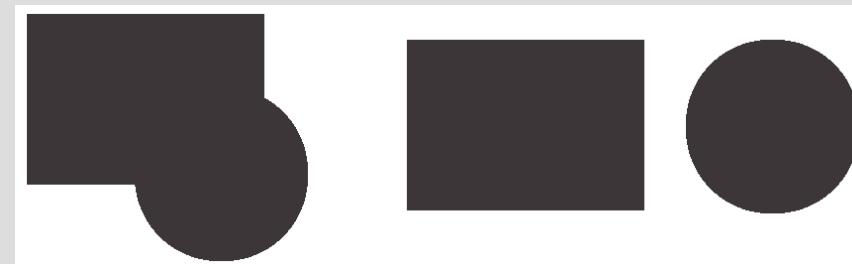
Closure



Figure/Ground

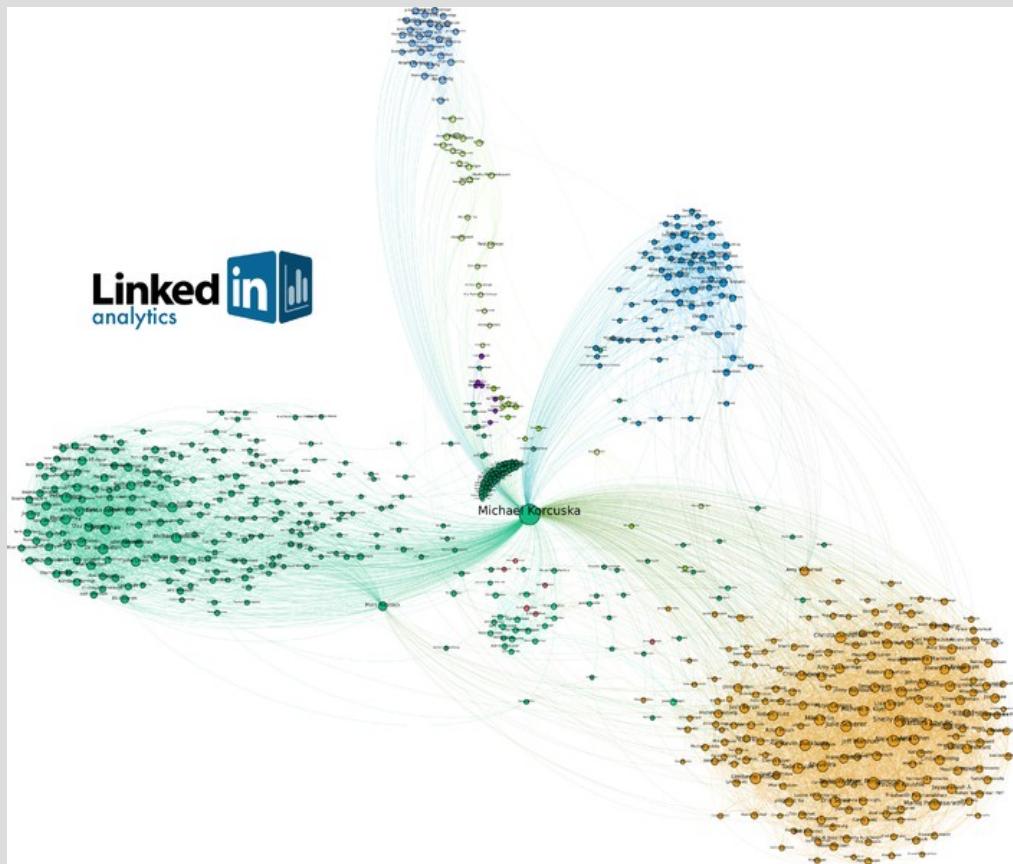


Prägnanz



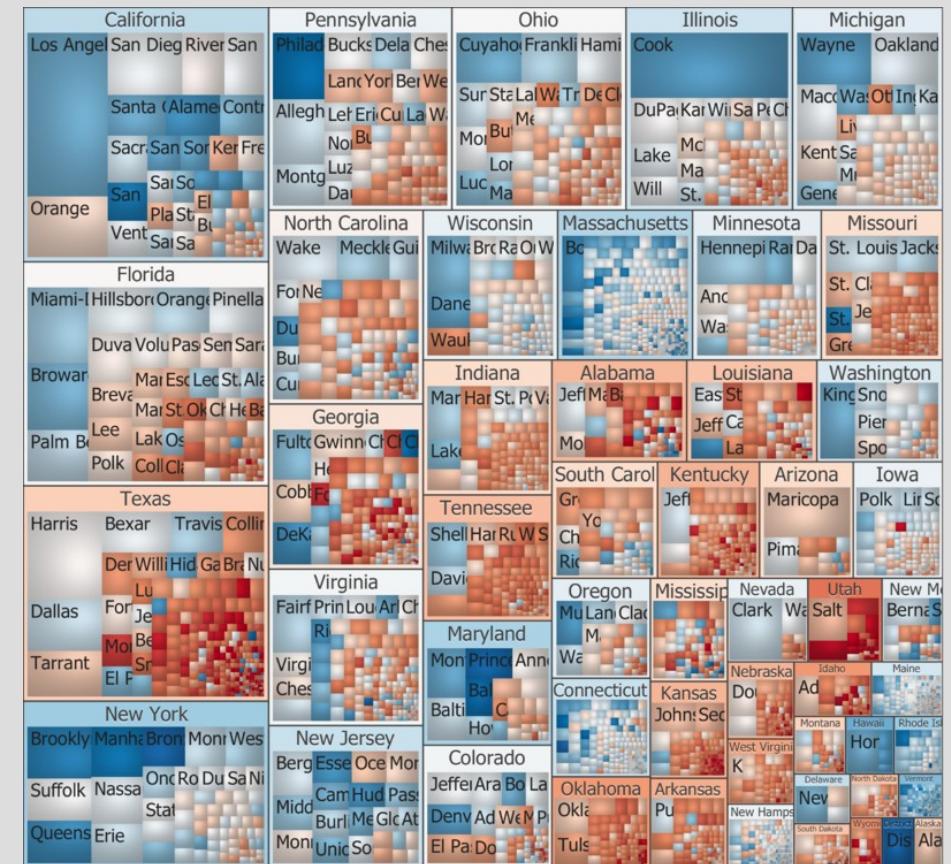
Gestalt Principles in Visualization

social network graph



© Michael Korcuska

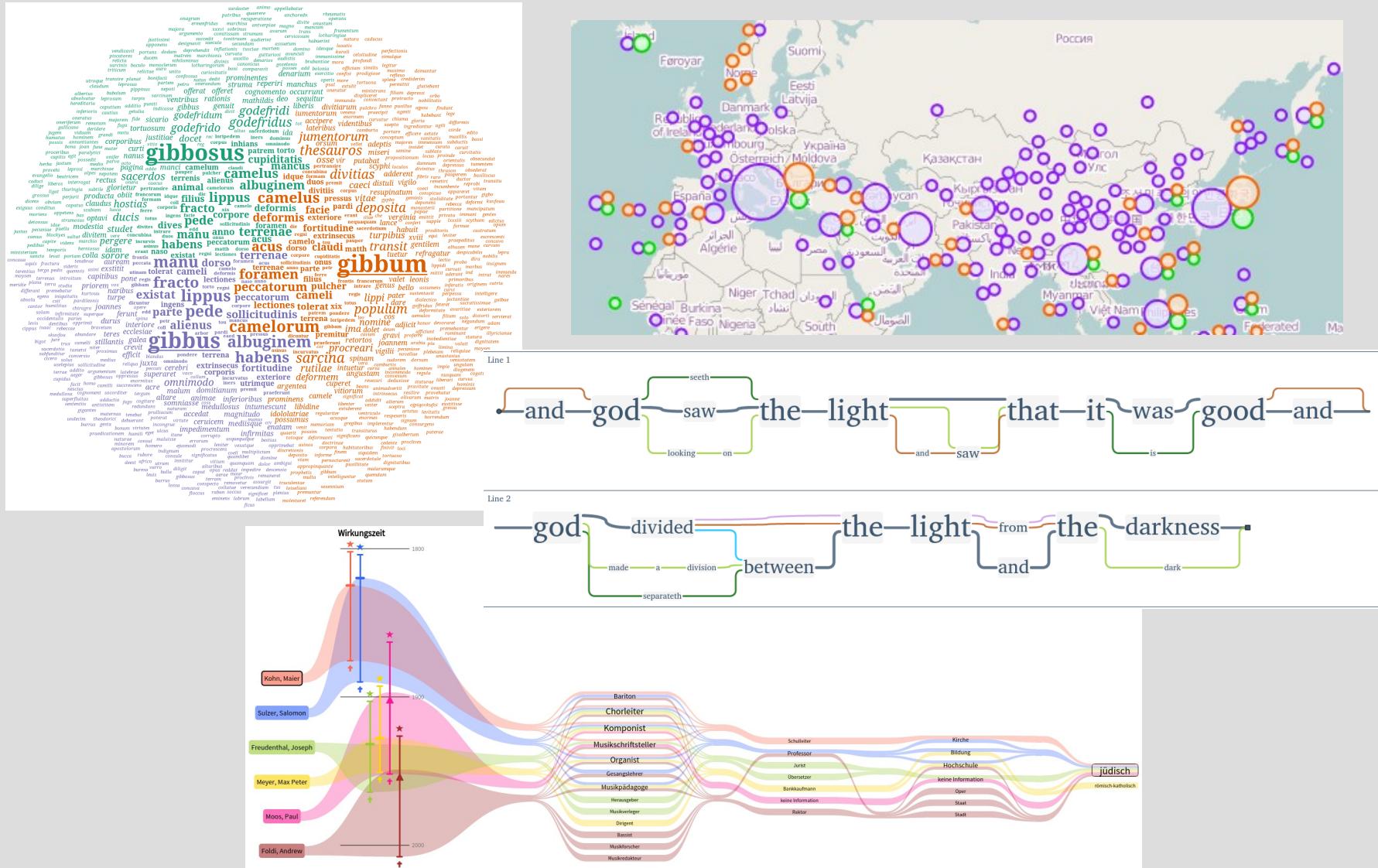
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Gestalt Principles in Visualization



GESTALT & GeoTemCo

Applied Gestalt principles: similarity & proximity



GESALT & GeoTemCo

Applied Gestalt principles: similarity & proximity



+ enclosure

GESLT & GeoTemCo



GESLT & GeoTemCo



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Expert User Review:

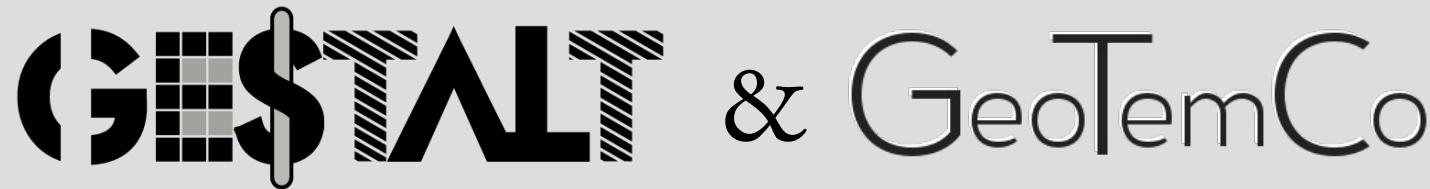
- + visually strengthens geographical similarity
 - + circle groups clearly separate
- + visualizes the region that belongs to a circle group



Expert User Review:

- + visually strengthens geographical similarity
 - + circle groups clearly separate
- + visualizes the region that belongs to a circle group
 - increases visual load
 - additional occlusion of geographical information





Expert User Review:

- + visually strengthens geographical similarity
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rating on a scale from -3 (much worse) to +3 (much better):

+1



Expert User Review:

- + visually strengthens geographical similarity
 - + circle groups clearly separate
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 - increases visual load
- additional occlusion of geographical information

rating on a scale from –3 (much worse) to +3 (much better):

+1

→ will be added as a configurable option in GeoTemCo

GESTALT & TagPies

basic

debuerant naturam theodoricu
rebecca sollicitudine aeger innitur quamlibet
peccati terrenus nummo cibus opere reliquo ejusmodi
ambigui sacerdotio coeli adductio enormitas
superque conversio humilitas bonum antistitem
maternas terram collum quamquam pardileonis bulla eget
barris vulnera chiragra vextaque incongrue
diligit braveum flocus niter studia usquequaque
impedire progresca nescius consule pondere errorum ead humili xxxvii
aselepius domine servitur stillantis fractura impedimentum opprimebat paries caput infirmitate
peccata occidentalis superaret naribus addito verecundiam camilli remaneret
proximus virtute deest omnimodo animae opus burrus latebrae
tenebat tametsi leinter joannes asini reddat solus bucca utinam homo aemulos
pressus argumentum frontis teres infirmitas virtutes corrupto tenebrae math arabia
pedis jugo dubio praeferrunt gibbus sollicitudinis indignum medius acusue
cippus introitum assurit mediisque aerae peccatorum vaco existat crevit accedat vitium coleret pecuniosus ventriculo
laebrum scorditer solam ecclesiae priorum lectiones poterat trux corporis resupinatum animal permittit
scribi proclivis sideris maluisse fortitudine cameli habens deformis turpe parte querit insignem prophetis
kurtoum multiplicium malum tergum corpore iners torto terra foramen camele leuiter petr legitur
bestias dentibus quevis magnitudo ingens ed albuginem alienus ima venit idque accipere negandum
gibbosus premis redundans uelus exstitit terrena lippus manu jumentorum insidet
descensio skuviou altare efficit fracto pauper ferre habendum afficiunt
blandus jure spina terrena lippus manu jumentorum inhians foramen prominens habent
consul manus incurvatus acre terga galea fractorum rutilae camburta habent
plana pardi dolor durus regis dorso pede camelus cauum joannem sexenium
motu erigitur divitem pauper iners camelo tolerat joannem sexenium
petro subtile facie studet acus alienus pede regni anno anno referendam
canonicus gallicano videns dives dominus filius manu lippus camelo dorso erige
totus surdaster denarios rec patrem regni regni patrem jo annem sexenium
dedit surdaster operans ducis inhians existat albuginem thesauros exteriore tolerans crediderim
incurvis boni operans onerandum interrogat obiit corporis habens fractorum extresecus regulariter
hernious concubina hostias die mancus terrena camelorum concavo sustentavit gentes
sancto sarcinam fuga die mancus orsum conferit
scabiem caecus baculo pagina gibbosus camelus populum praecepit loculos propositionum
avaram animo reg portam docet corpore deformis terrenis lateribus vigiliu
add incurvus reg portam doce corporis deinceps value deponeb
dicens auditis capatus curiositat puniti sicario sacerdos lectiones egit intuetur libidine
auro alpes auditis capatus curiositat puniti sicario sacerdos lectiones egit intuetur libidine
asinus curiositat puniti sicario sacerdos lectiones trans spinam strumosum addidit ojipiqokufoi
provehi intrare wituni offerat pergere godefridus iumentorum possumus monasterii
godefredi natus sanatur offeret nanus cupiditatis manchus scyphi scytham memoriam
immanissime grossus unito claudus deo sequitur goffridus resecari proditoris
portans caecus romanus bona rectus glorietur goffridus intrinsecus assumens
succedit dicit onus meritio divinis auxilio occurunt idolatriae portare dicuntur
designavit exercitio proceribus parvo argumento godefrido pulcher francorum episcopi animadverit
ermenfridi marchio jugem justus saltat operis indicasse comparavit protracto
sacerdotium capitio detonsus vere pippinus indicasse comparavit protracto
struma odo mater evangeli pecunias pedibus strumosus
piscatores getulia altus rheumatias sobrinus
cognomento appetens appellabatur justissimi

Applied
Gestalt principle:

similarity (color)
(for category)

GESTALT & TagPies

bars

The word cloud displays numerous Latin words, each colored according to its category. The most prominent word, 'gibbus', is highlighted in red. Other frequently used words like 'terrena', 'manu', 'albus', 'lippus', 'cameli', 'fracto', 'albuginem', 'habens', 'lippus', 'camelorum', 'existat', 'pede', 'camelo', 'gibbum', 'jumentorum', 'gibbosus', 'terrenae', 'populum', and 'sacerdos' are also clearly visible in various colors.

Applied
Gestalt principles:

similarity (color)
(for category)

similarity (design)
(for multiplicity)

GESTALT & TagPies

italics

labrum usquequaque aslepius debuerant
bestias antistitem reliquo terrenus quamlibet
ejusmodi proximus dentibus altaribus bulla innititur
sollicitudine peccata caput gibbosas virtute adductio diligit
maternas conversio pardilonis flocus braveum humilitas impedit ambigi
kurtouu pardi progrescens sideris incurvatus redundans dominic proclivis consul
latebrae enormitas tameti opprimit frontis succrescens quemvis paries prolixis consul
scribi terram iniuitatis occidentalis premebat consule verecundiam ead bonum coeli
infirmitate argumentum assurgit impedimentum indignum chiragra introitum theodoricu
aeger descensio medius addito stillantis skuyfou vexatque studia cibus
nummo blandus solam regis superaret priorem trux acre medullosus vulnera superque
camelli itane opprimebat barrus dubio opus teres terra omnimodo naribus fractura solus servitor sacerdotio habebant
tenebat poterat lenter errorum mediisque gibbus sollicitudinis
pressus solum regis superaret priorem trux acre medullosus vulnera superque
succus camilli niter cognomentum juxta corporis deformis dolor efficit animae adderent permittr
socrideri corrupto virtutes galea ecclesiae inter cameli foramen
remaneret abundare praferunt infirmitas lectiones fracto existat fortitudine
significatus burrus malum peccatorum ed terrenae vox tolerat petr accipere portare proditoris
quamquam spina manum albuginem corpore ima idque habuit camburis
xxxviii nescius terrena crevit manu albuginem
peccati homo deest aeræ exstitit habens lippus dorso jumentorum
rebecca utinam pondere altare durus habens lippus dorso jumentorum
pedis iuglo prulliacum accedit ingens manu camelorum camele
opere iuglo oppressus acutus regni anno dorso dominus mane cavum extrinsecus consurgens
egit manus bucca vitium ulcus turpe coss acutus regni anno dorso dominus mane cavum extrinsecus consurgens
cipus collum terga deo joannes alienus pede camelus concavo dare tuetur tolerans scyham curvatur
justissimi avarum dedit indicasse videns ducis existat pede regni anno camelo anno
alitus gallicano dominus lectiones ingens lippus cameli jo gibbum dare tuetur tolerans scyham curvatur
altus proceribus pergere pauper terrenae lippus patrem terrenis
dicens sanatur capatus rec patrem
natus vito divinis hostias camelus albuginem foramen
sancto onus denarios caecus reg mancus fracto manu thesauros prominens animadvertis
piscatores jugem trans fuga docet inhians egit alienus habens intuetur beans coleret vigiliu sustentavit sexennium
parvo audisti obiit bona iners gibbosus die filius rutilae parte animal habendum
divite boni concubina facie spinam joannem supple referendam
marchio causus offerat divers baculo terrenis deformis lateribus spinam joannem supple referendam
incuvus erigitur portam deinceps libidine goffridus ojipiqovkufoi
petro curiositas animo pagina godefridus sacerdos iumentorum possumus geminis
capitis wituni offeret episcopi pulcher claudus originem pecuniose orientalis
oddo pippinus sarcina interrogat studet cupiditatis resupinatum praecepit deponens negandum
motu subtile meritis sequitur manchus nanus rectus virginia vellet intrinsecus significat
getulia vere exercitio mater auxilio operans portabat diogenem actate
mater leprosus exiguis glorietur sicario occurrant auxilio operans portabat diogenem actate
asinus dicit auro pulcher claudus originem pecuniose orientalis
portans pecunias justus grossus incurvus romanus argumento leviter assumens afficiunt
appellabatur herniosus surdaster oneratus saltat operis immanissime resecari aemulos
ermenfridus pedibus detonans intrare onerandum godefridi totus comparavit designavit evangelio recuperatione propositionum
godefridi strumosus comparavit struma struma
sacerdotium appetens sobrinus rheumatis succedit cognomento
canonicus provehi

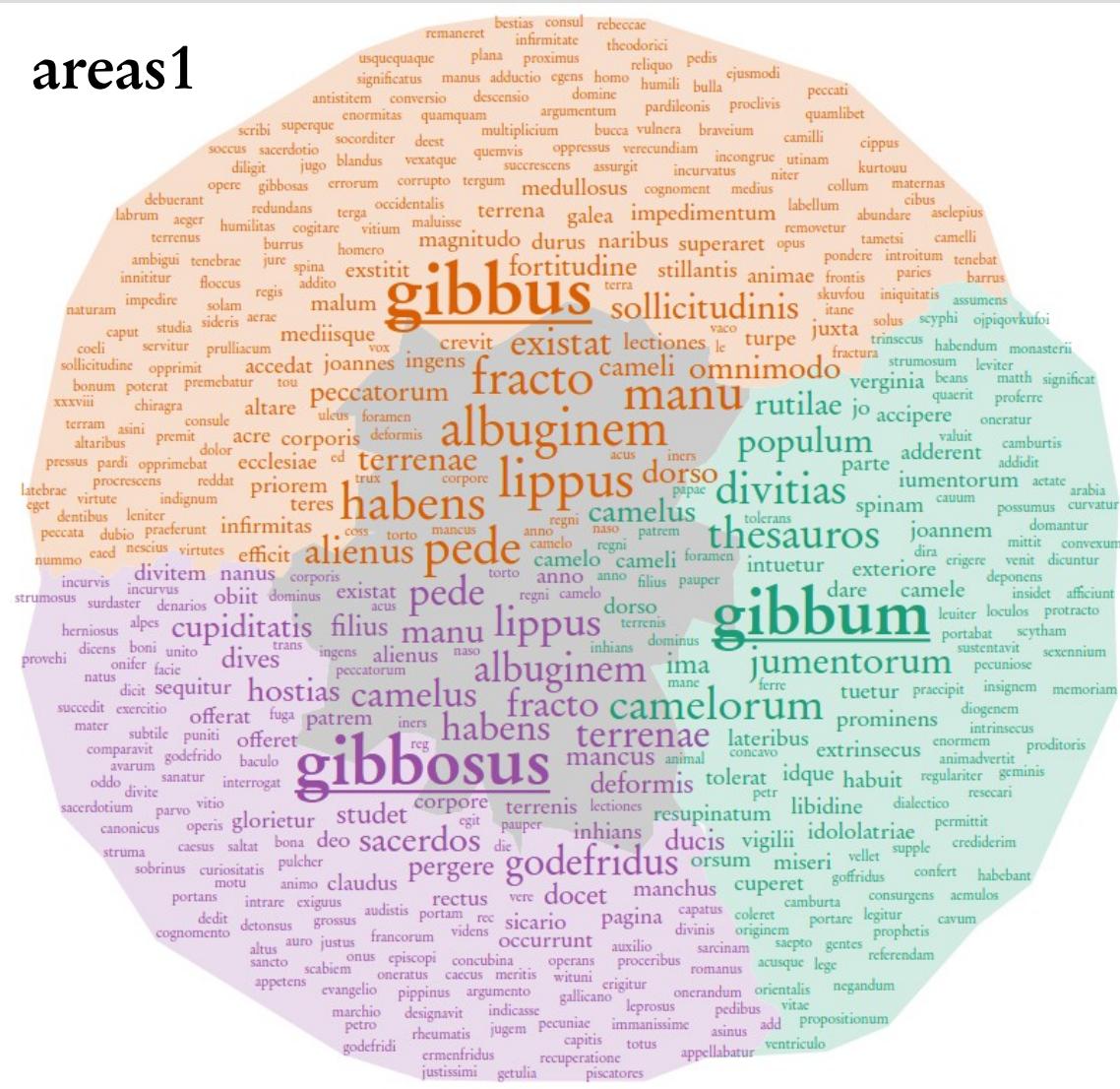
Applied
Gestalt principles:

similarity (color)
(for category)

similarity (font style)
(for multiplicity)

GESTALT & TagPies

areas1



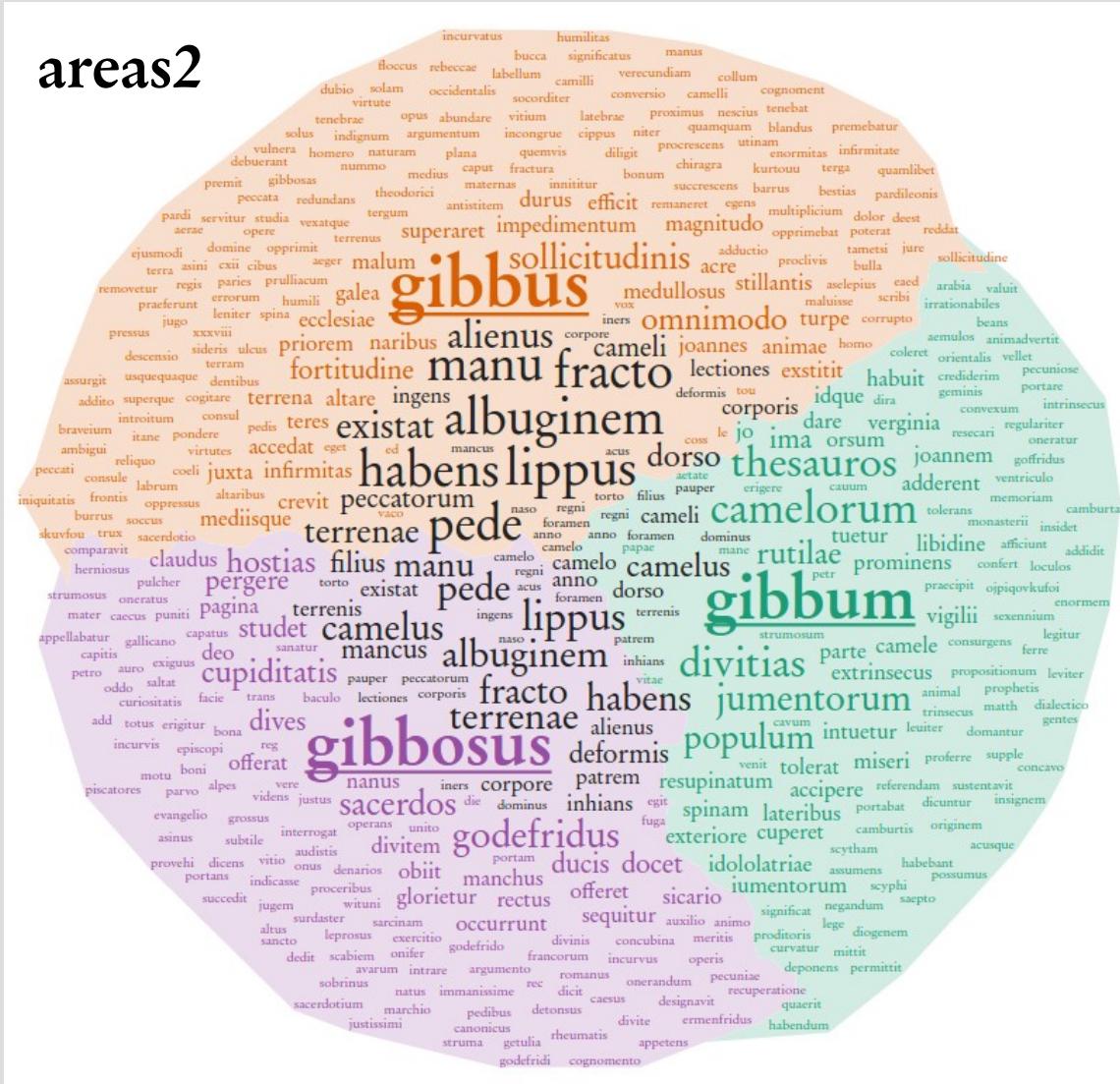
Applied
Gestalt principles:

similarity (color)
(for category)

enclosure
(for multiplicity & category)

GESTALT & TagPies

areas2



Stefan Jänicke

@vizcovery

<http://www.vizcovery.org>

Applied
Gestalt principles:

enclosure
(for category)

similarity (color)
(for category & multiplicity)

GESTALT & TagPies

Expert User Review:

- comparative evaluation of design variants
- ratings from -3 (very bad) to +3 (very good)

GESTALT & TagPies

Expert User Review:

→ comparative evaluation of design variants

→ ratings from -3 (very bad) to +3 (very good)

#1: All tags of a single category form a visual unity!

basic

+ 3

bars

- 1

italics

+ 1

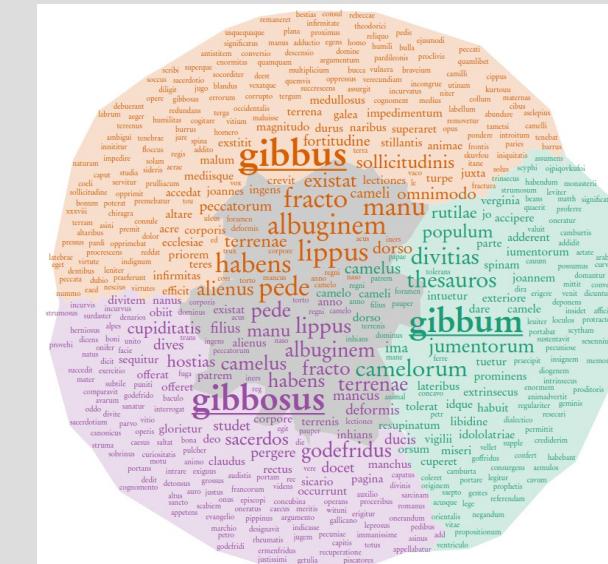
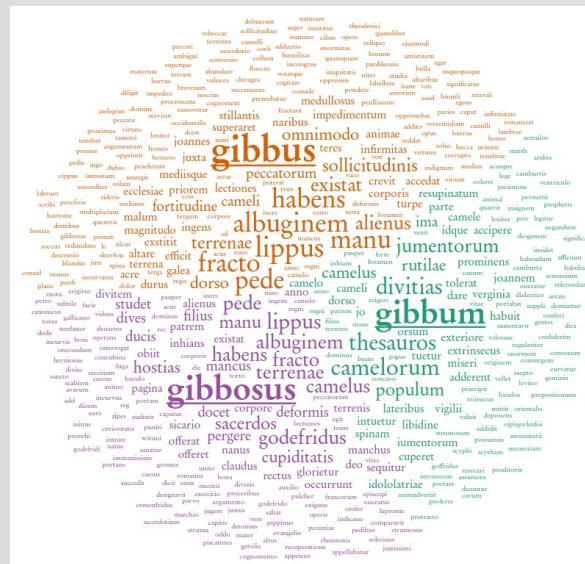
areas1

+ 3

areas2

+ 2

basic



areas1

GESTALT & TagPies

Expert User Review:

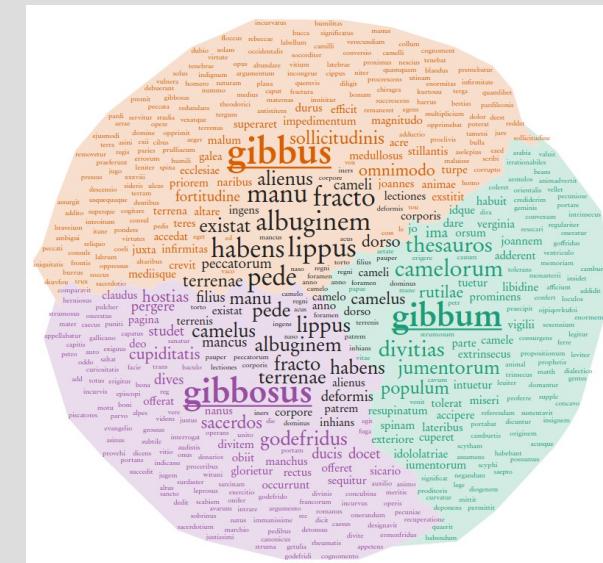
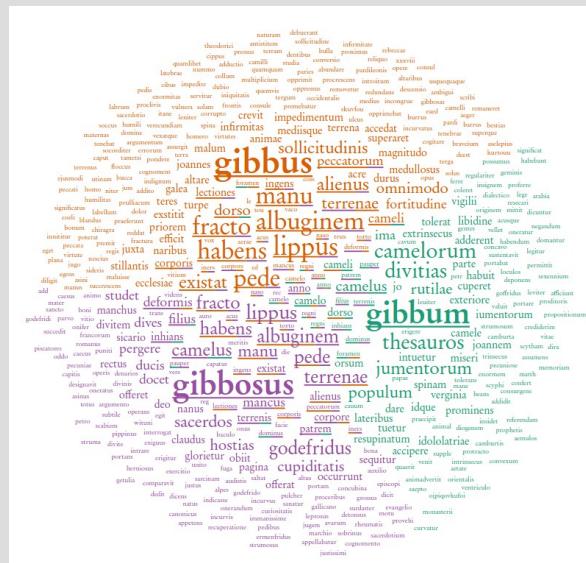
→ comparative evaluation of design variants

→ ratings from -3 (very bad) to +3 (very good)

#2: All shared tags form a visual unity!

basic	bars	italics	areas1	areas2
-3	-2	-1	+1	+3

bars



areas2

GESTALT & TagPies

Expert User Review:

→ comparative evaluation of design variants

→ ratings from -3 (very bad) to +3 (very good)

#3: Shared tags and unique tags visually separate!

basic

-3

bars

-1

italics

-2

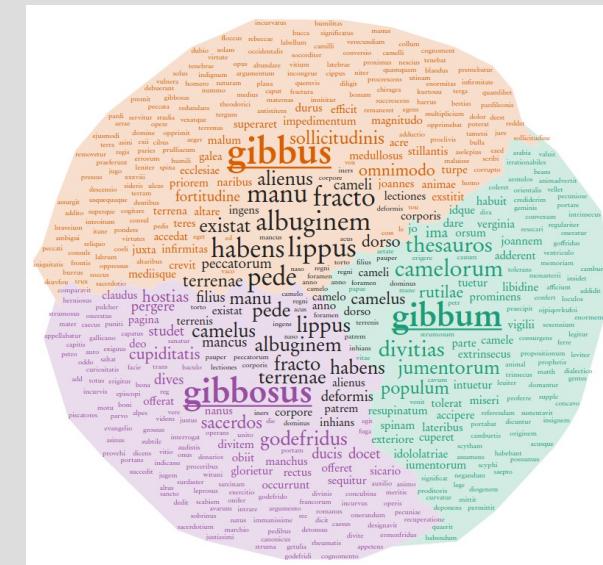
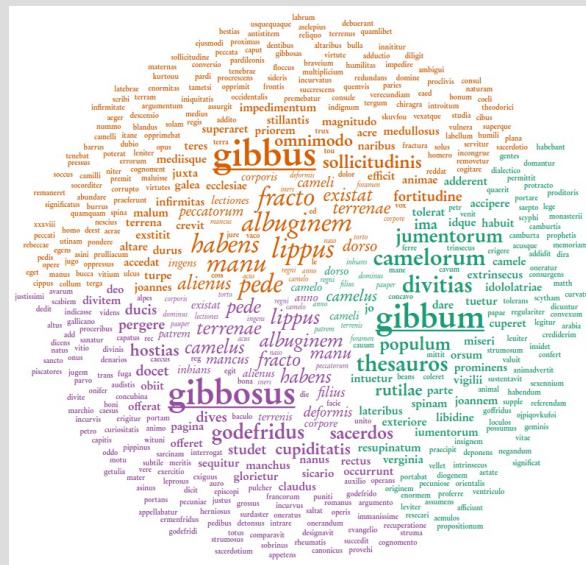
areas1

+2

areas2

+3

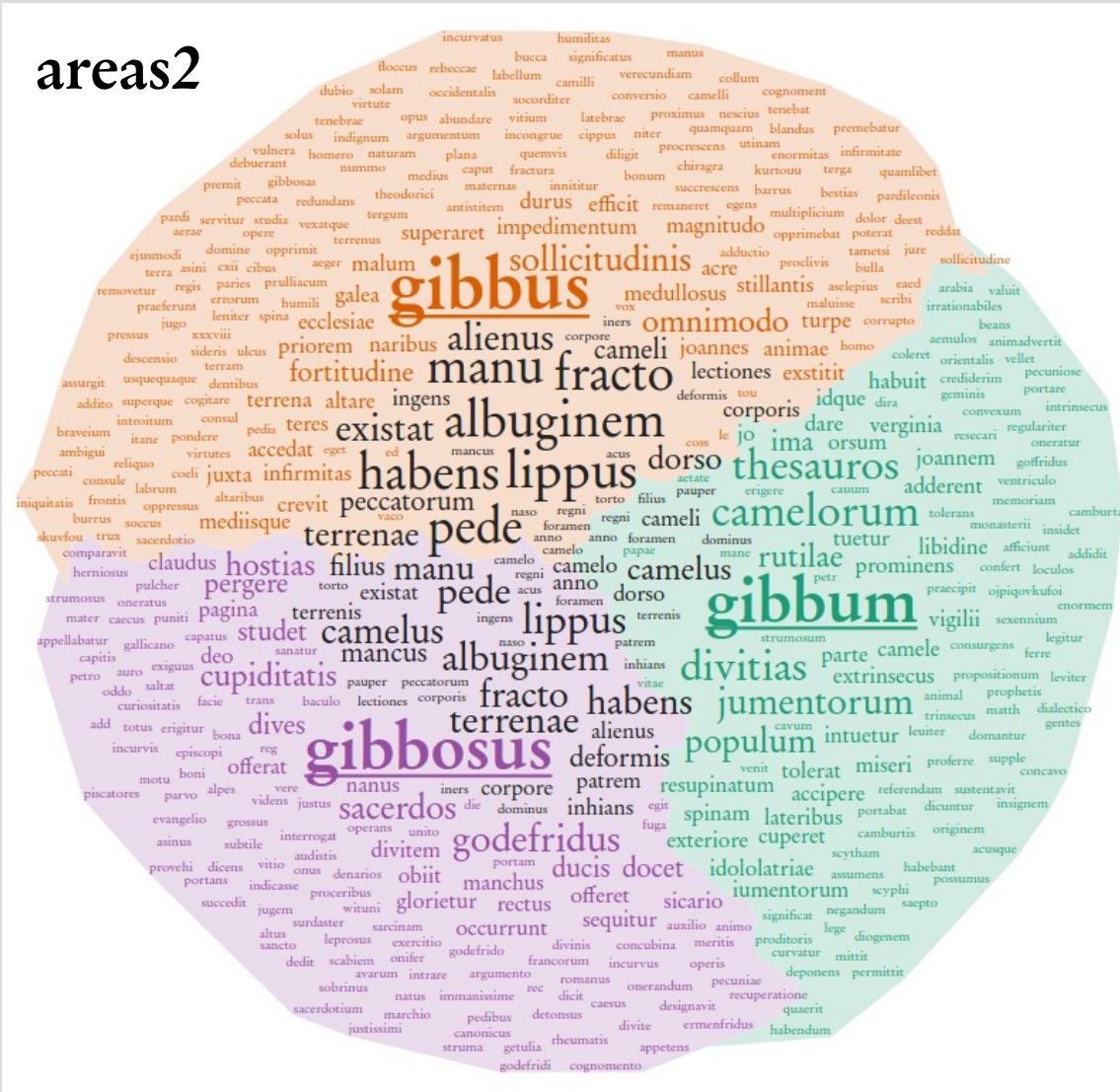
italics



areas2

GESTALT & TagPies

areas2



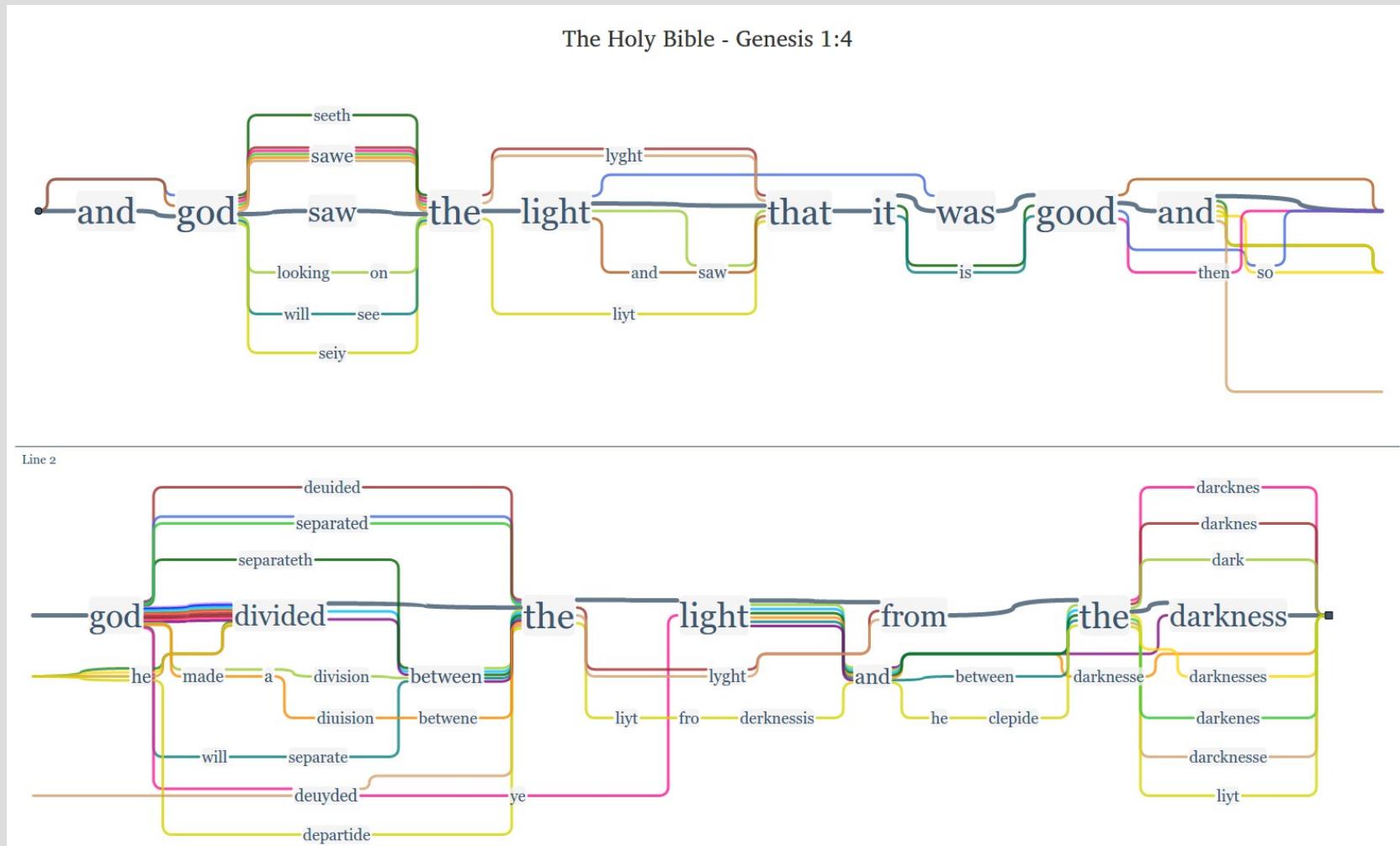
Applied
Gestalt principles:

enclosure
(for category)

similarity (color)
(for category & multiplicity)

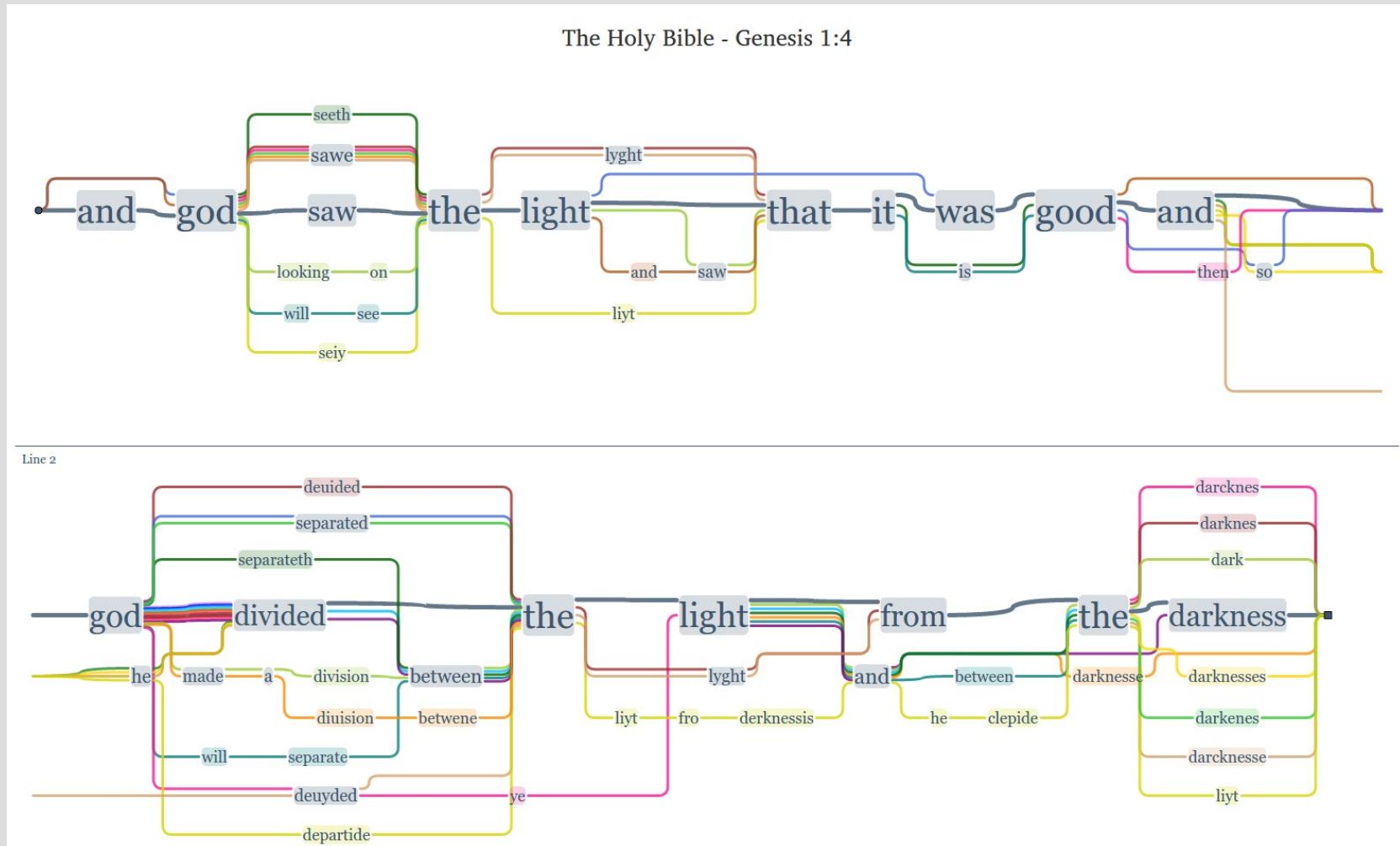
GESTALT & TRAViz

Applied Gestalt principle: connectedness



GESALT & TRAViz

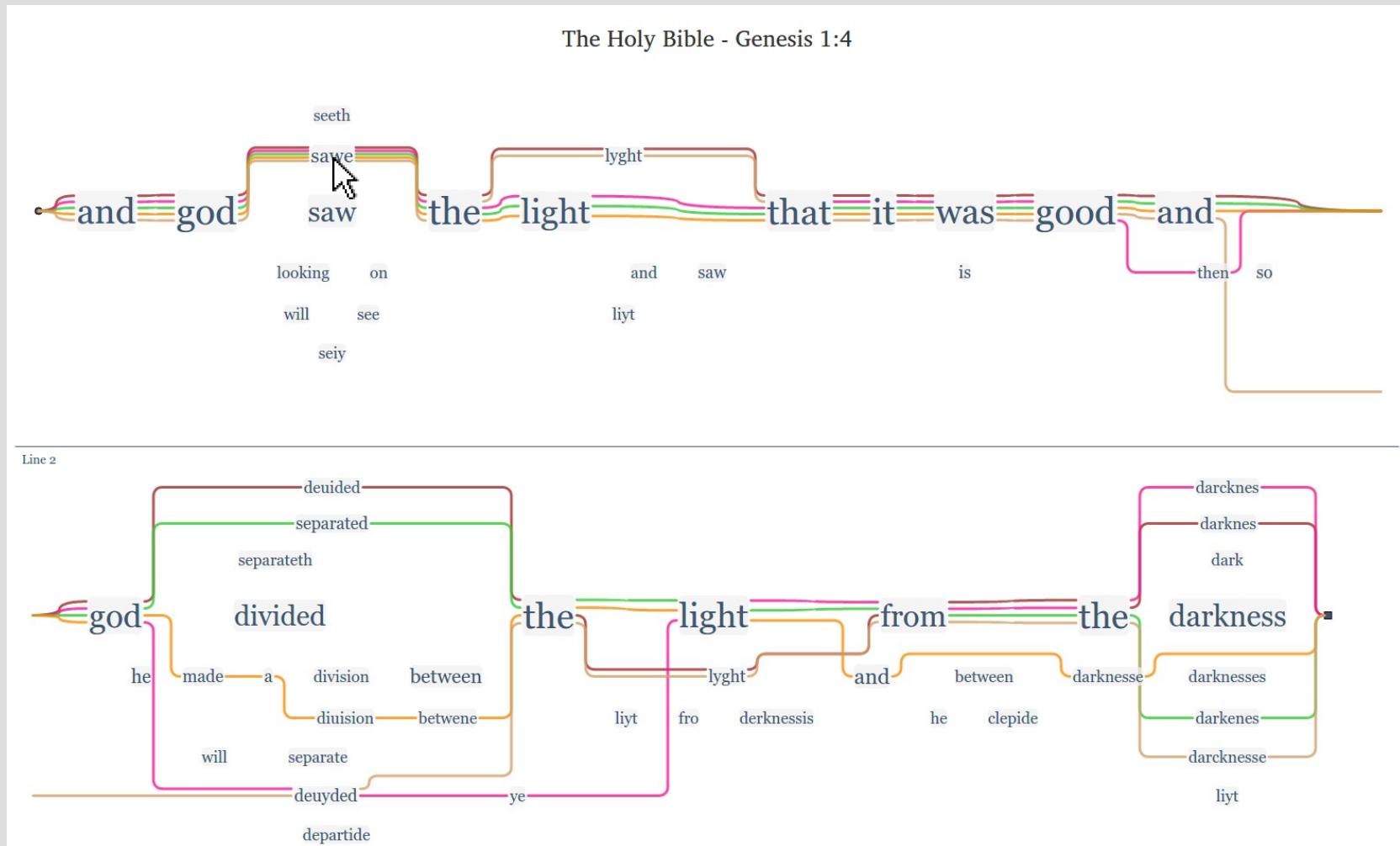
Applied Gestalt principle: connectedness



+ similarity

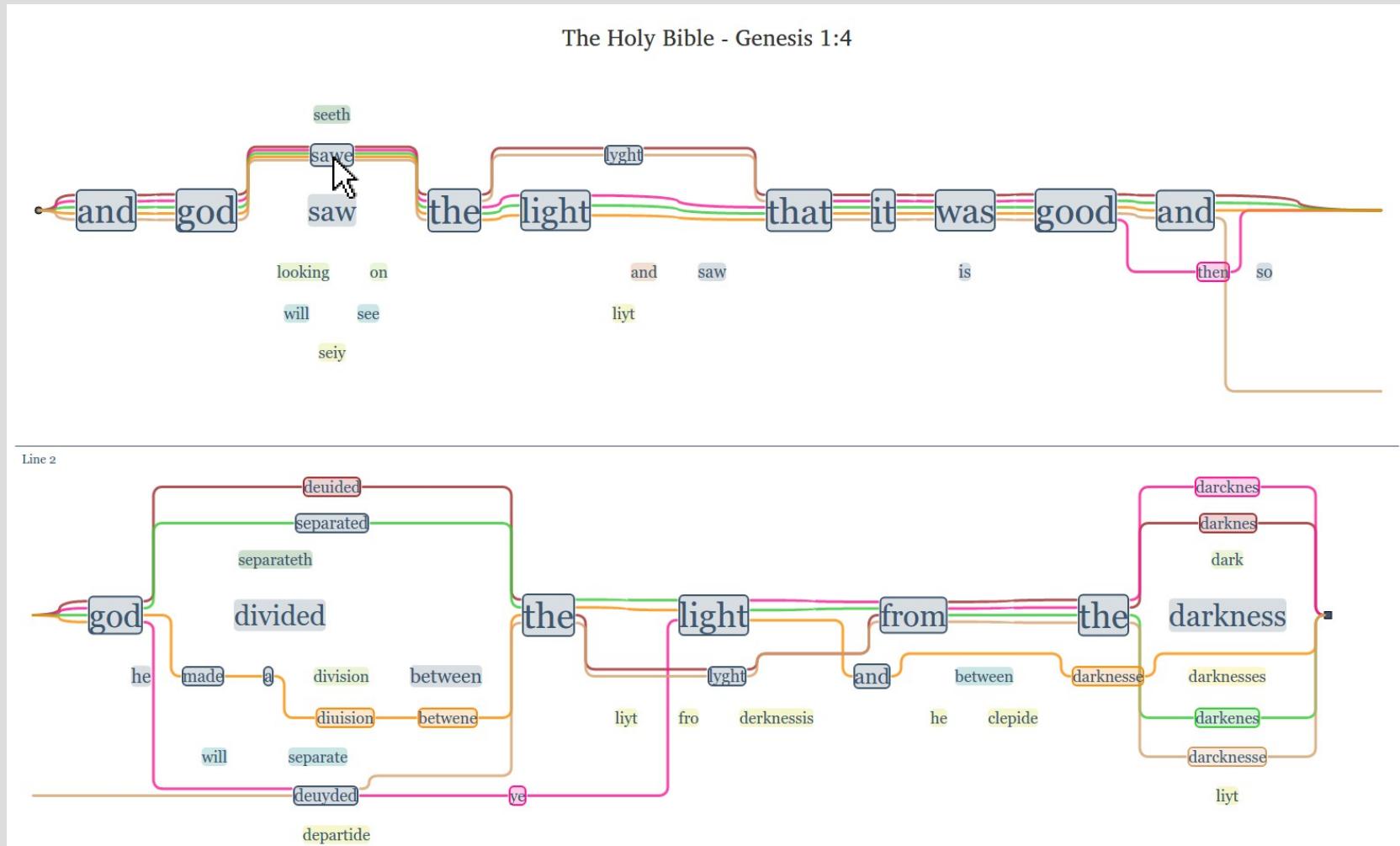
GESTALT & TRAViz

Applied Gestalt principle: connectedness



GESTALT & TRAViz

Applied Gestalt principle: connectedness

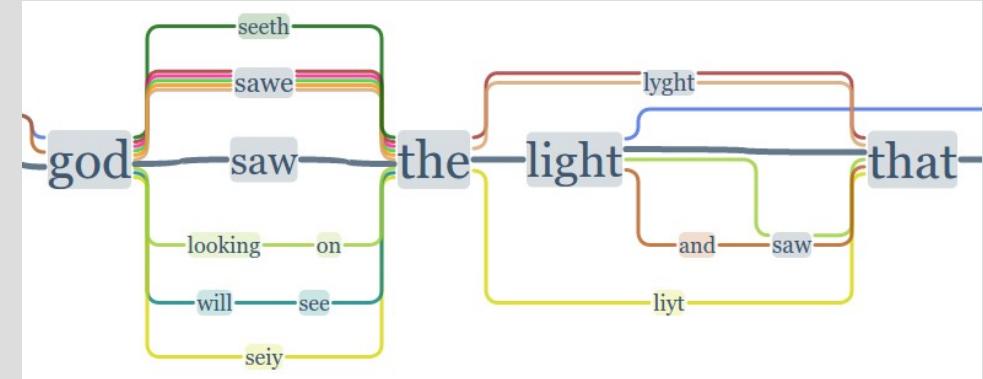
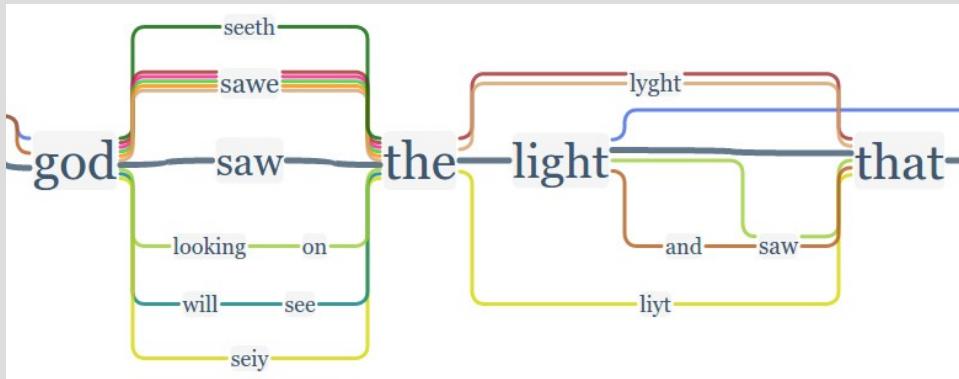


+ similarity

Expert User Review:

- evaluation of new design compared to old design
- ratings from -3 (much worse) to $+3$ (much better)

#1: The words form visual unities!

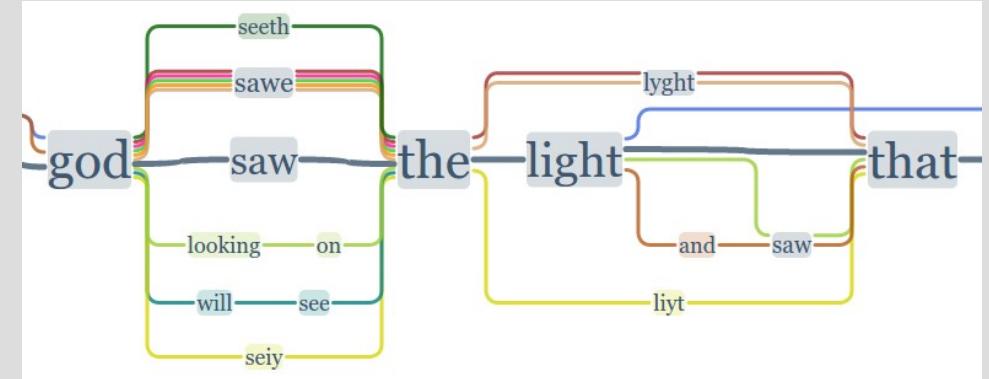
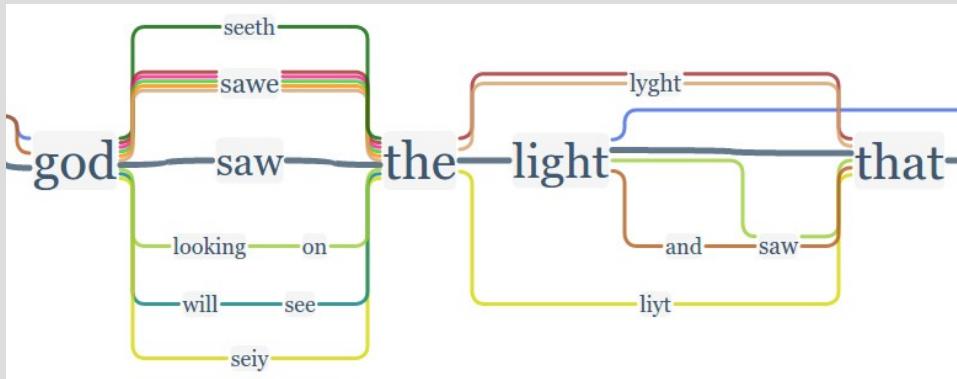


Expert User Review:

- evaluation of new design compared to old design
- ratings from -3 (much worse) to $+3$ (much better)

#1: The words form visual unities!

$+3$

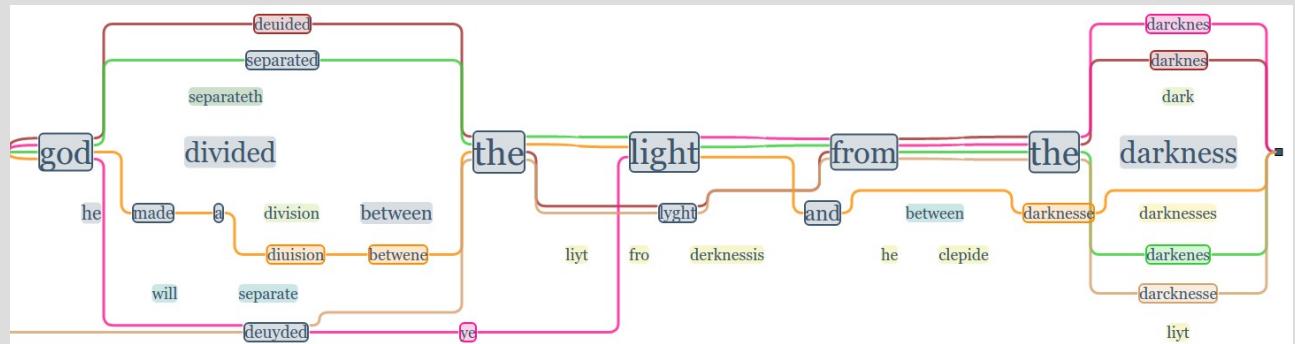
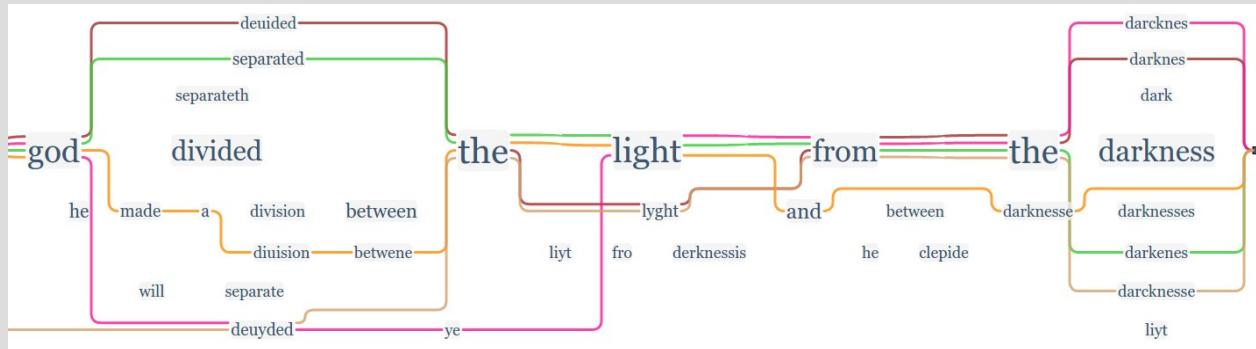


GESSTALT & TRAViz

Expert User Review:

- evaluation of new design compared to old design
- ratings from -3 (much worse) to +3 (much better)

#2: The words form visual unities on highlight!

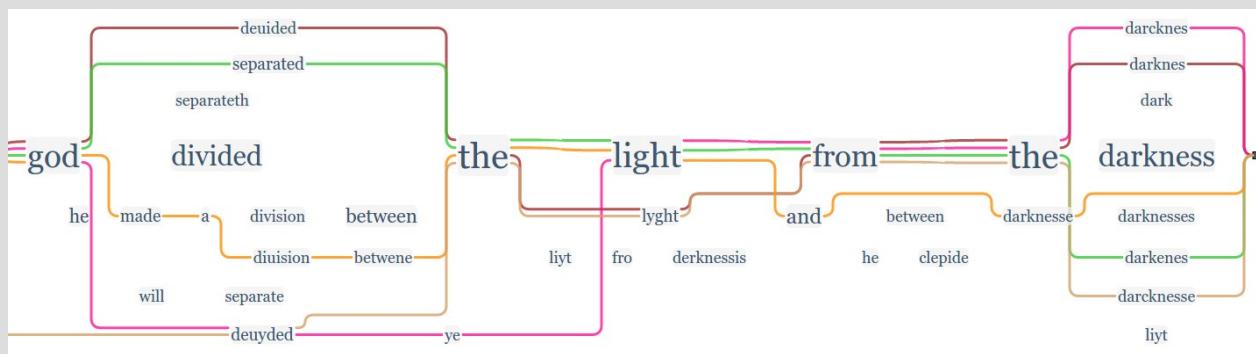


GESSTALT & TRAViz

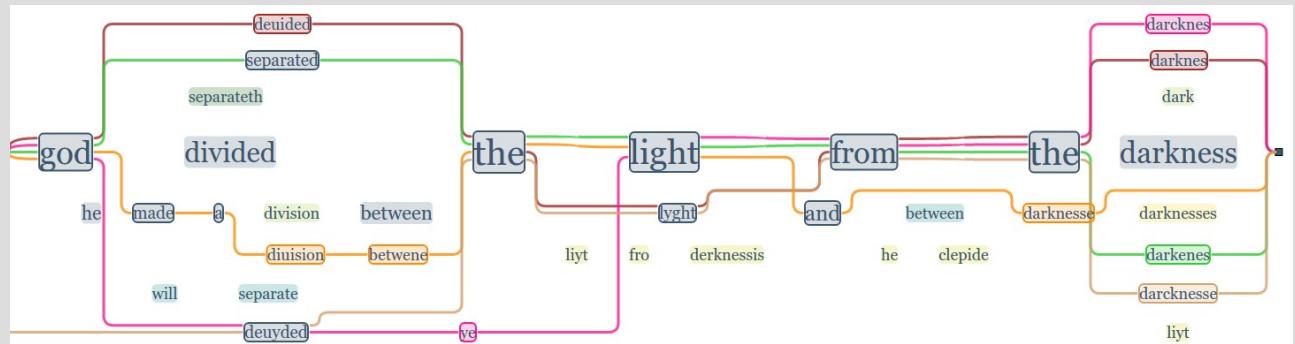
Expert User Review:

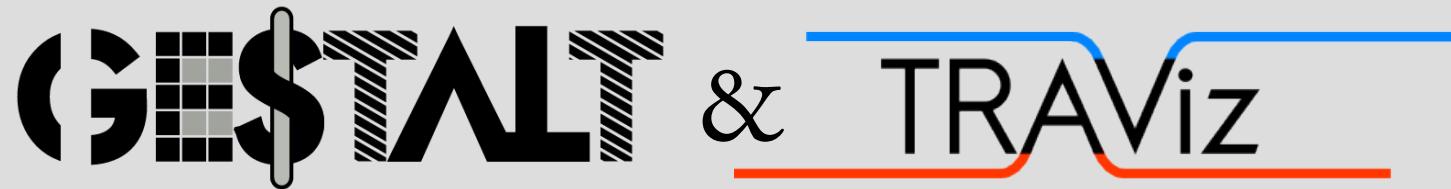
- evaluation of new design compared to old design
- ratings from -3 (much worse) to +3 (much better)

#2: The words form visual unities on highlight!



+2

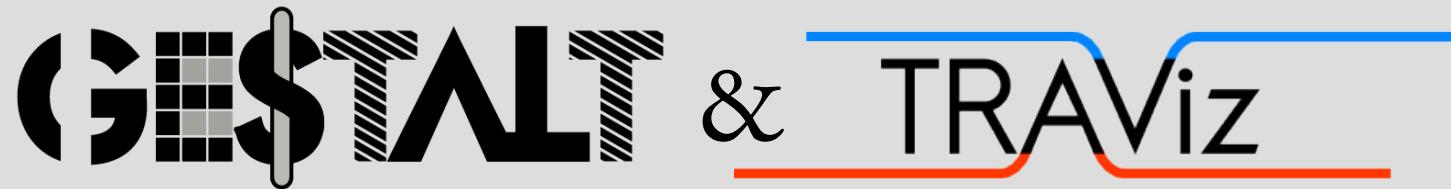




Expert User Review:

- evaluation of new design compared to old design
- ratings from -3 (much worse) to +3 (much better)

#3: Rate the readability of the Variant Graph!



Expert User Review:

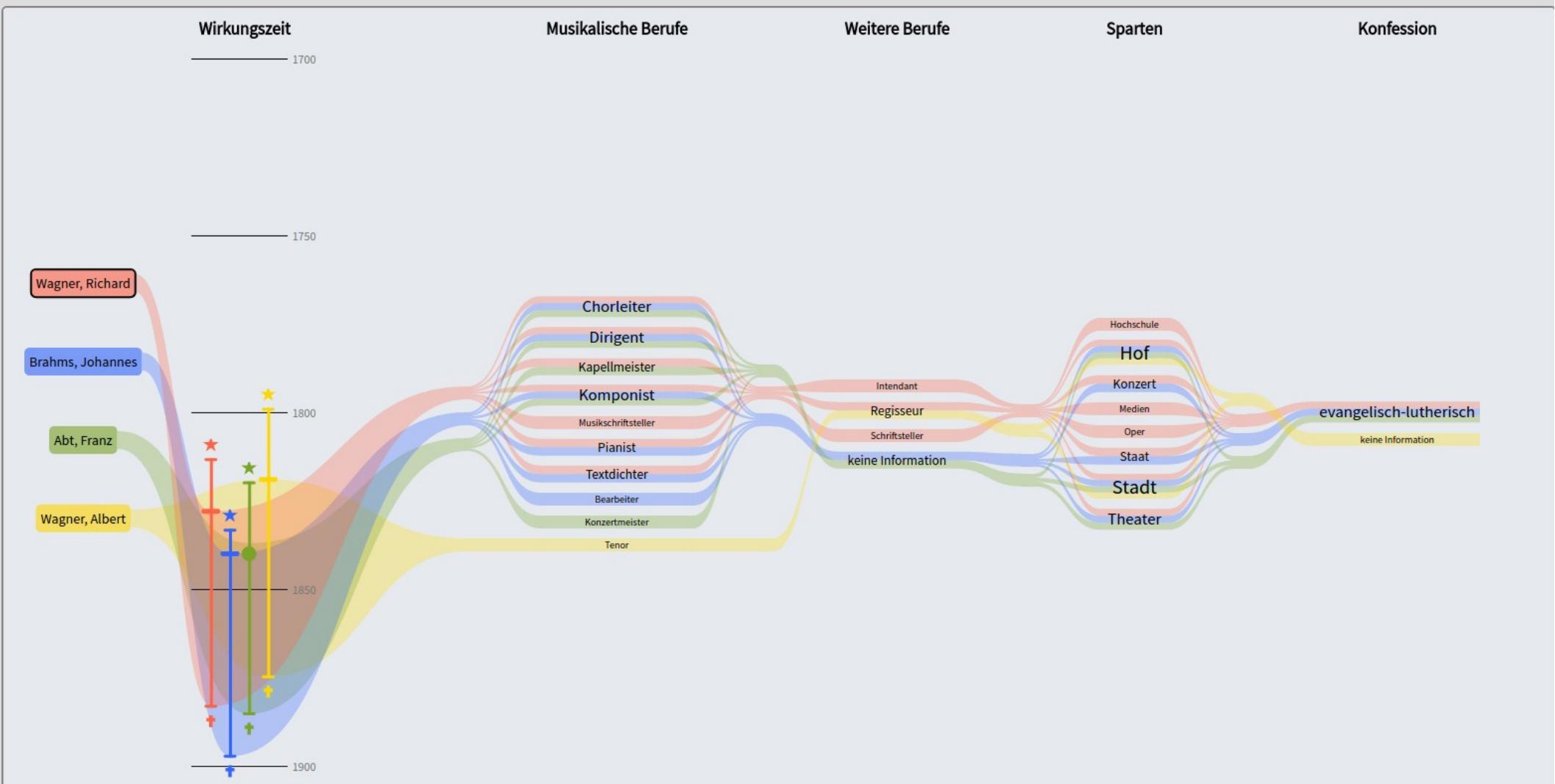
- evaluation of new design compared to old design
- ratings from -3 (much worse) to +3 (much better)

#3: Rate the readability of the Variant Graph!

+ 3

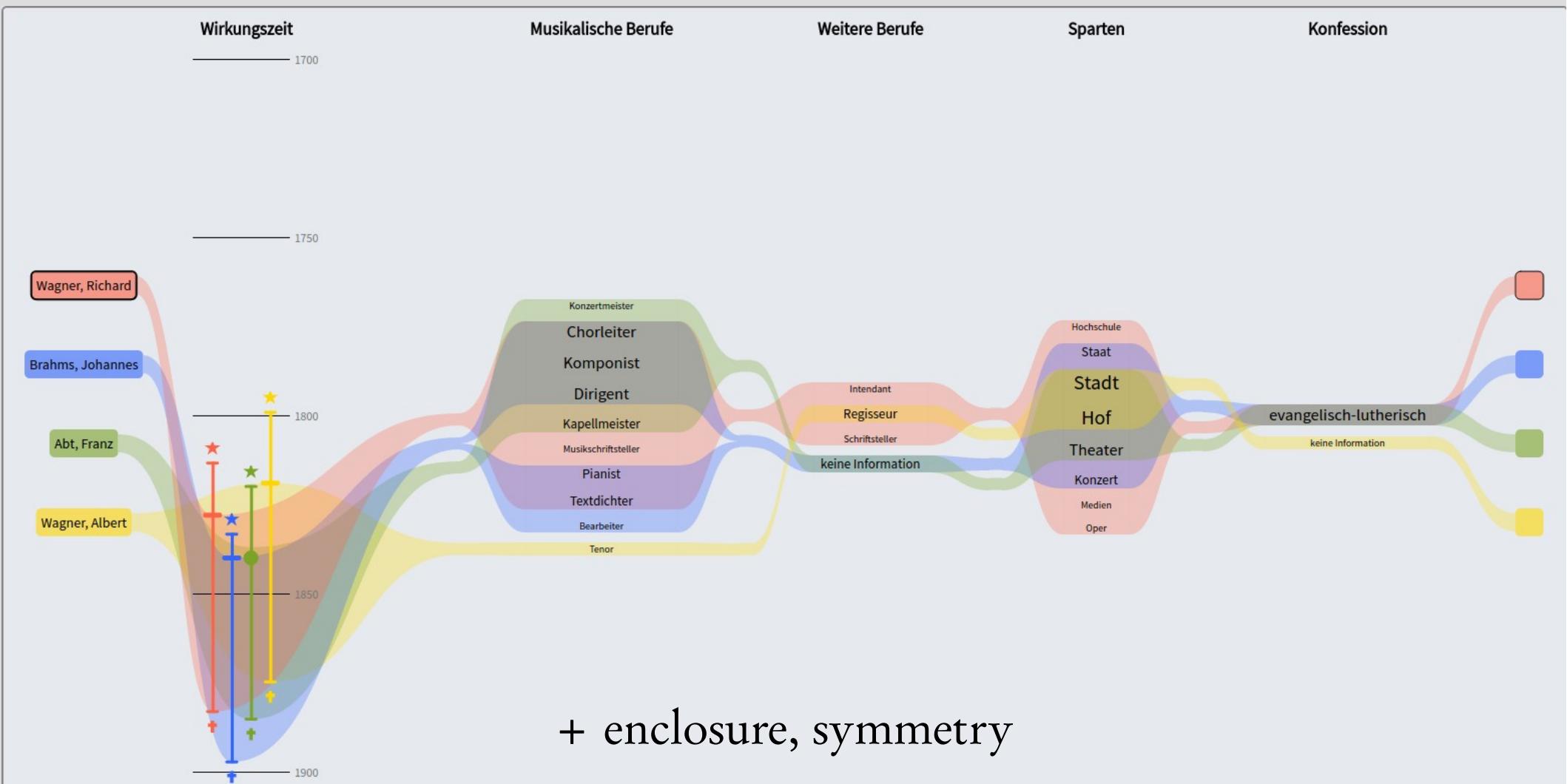
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity, (similarity)



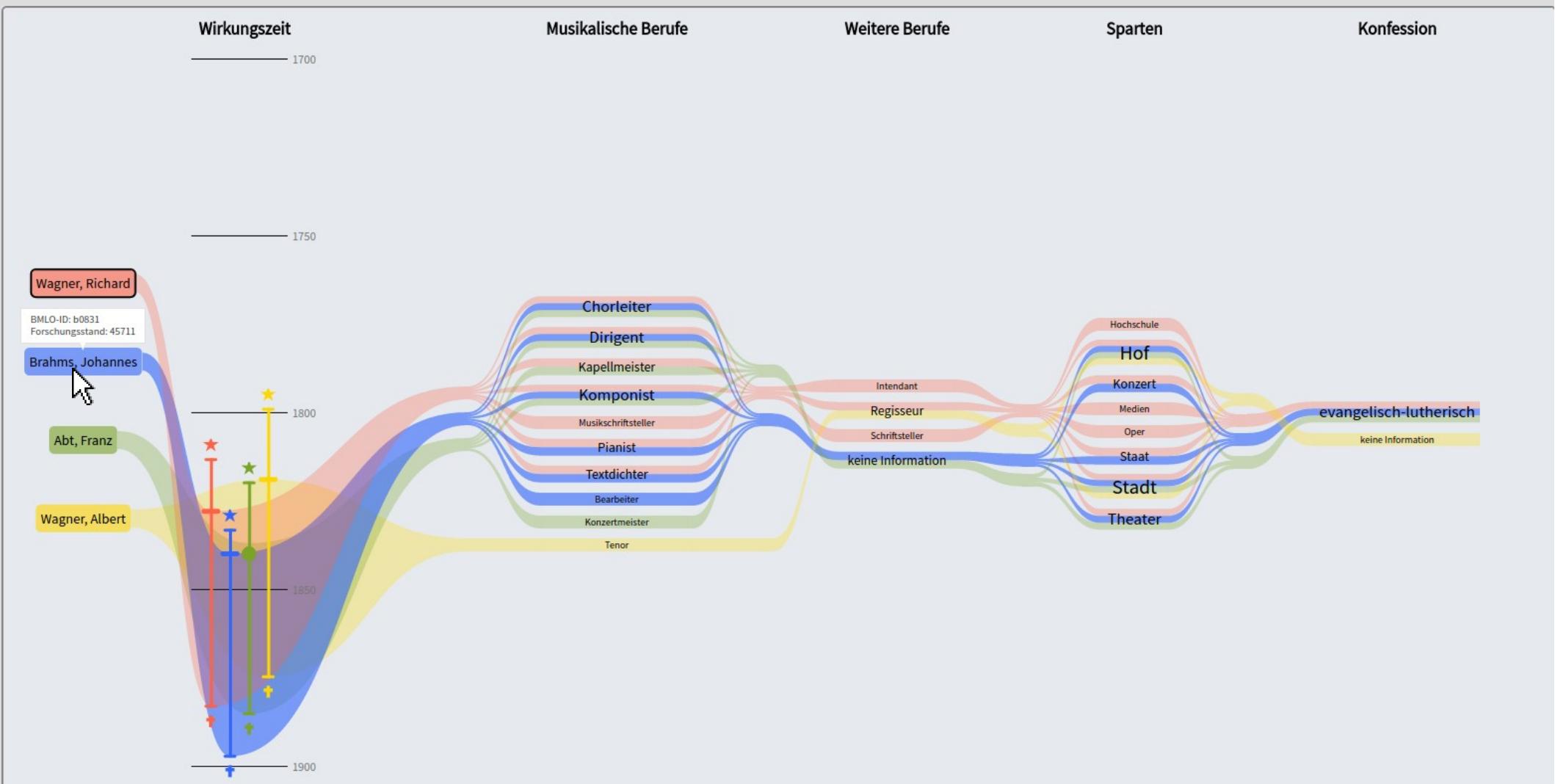
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity



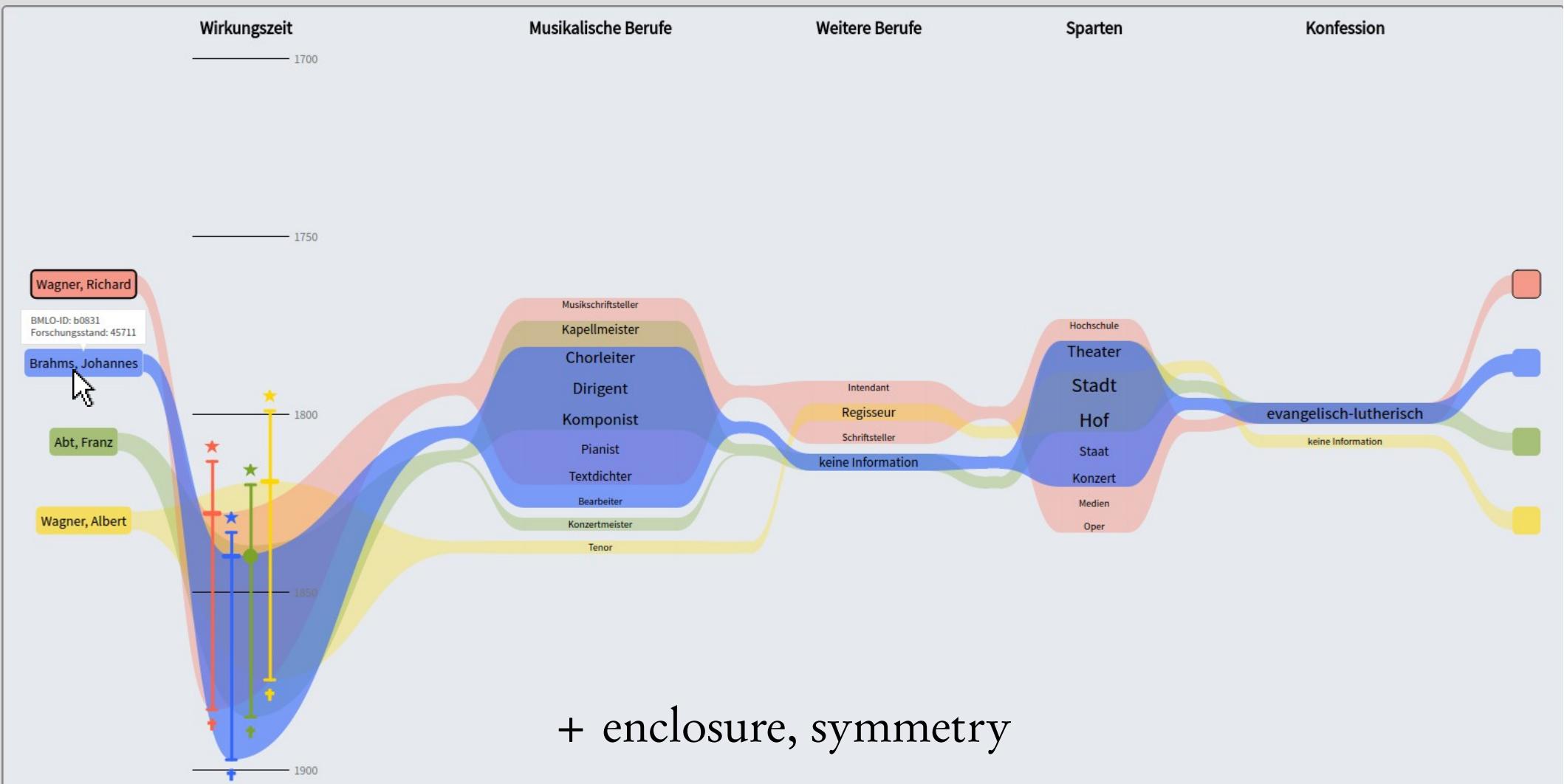
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity, (similarity)



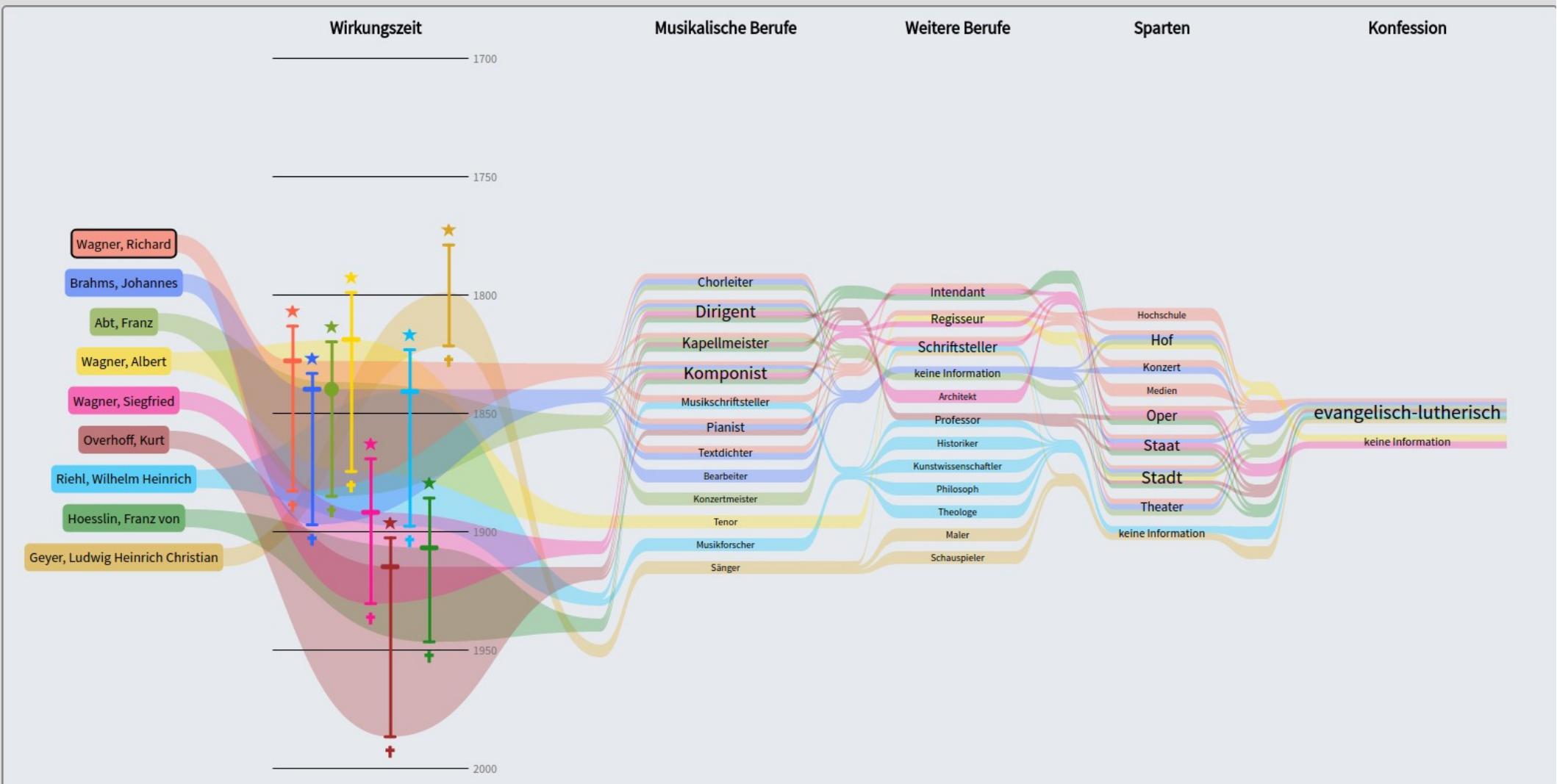
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity



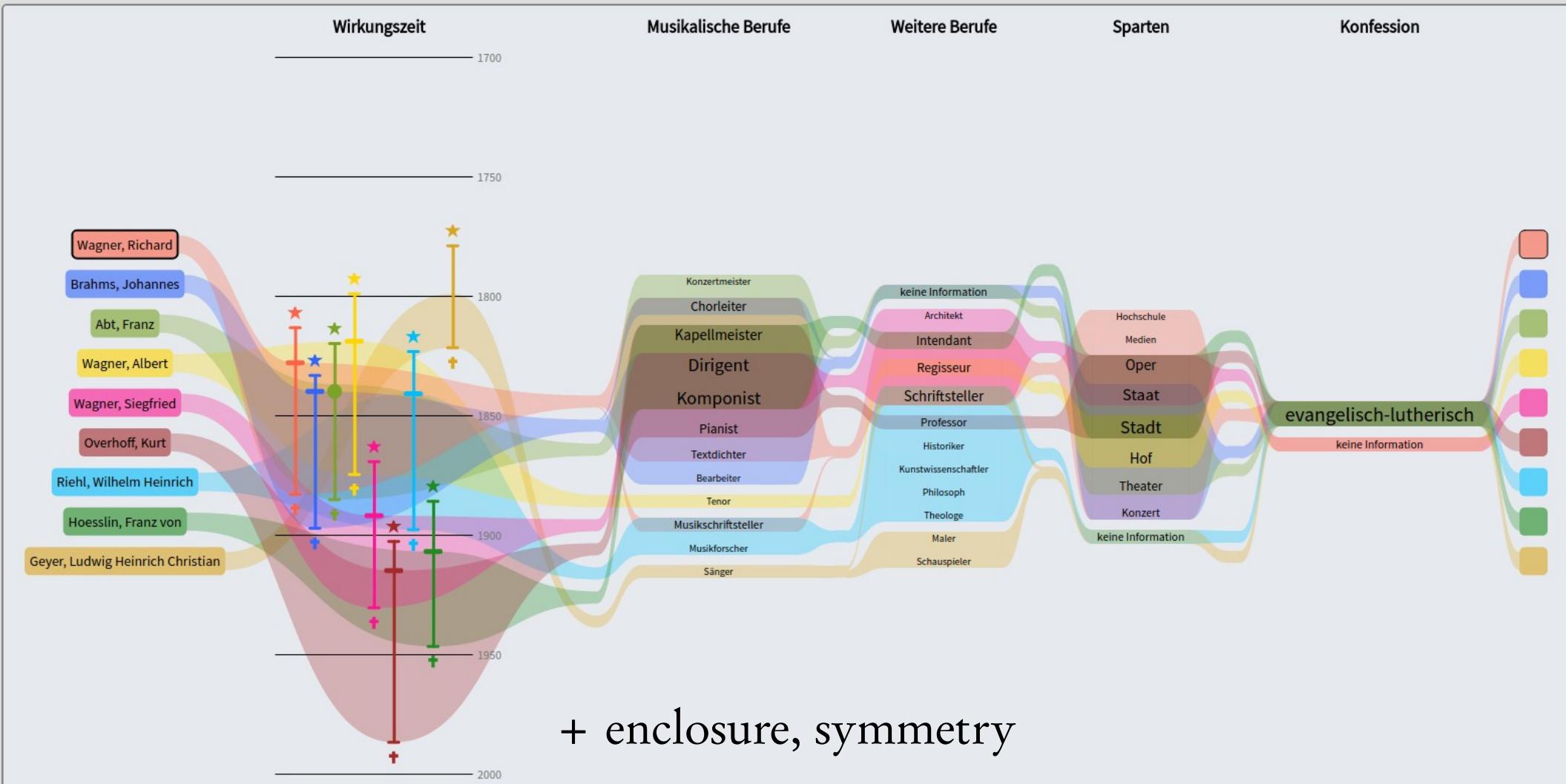
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity, (similarity)



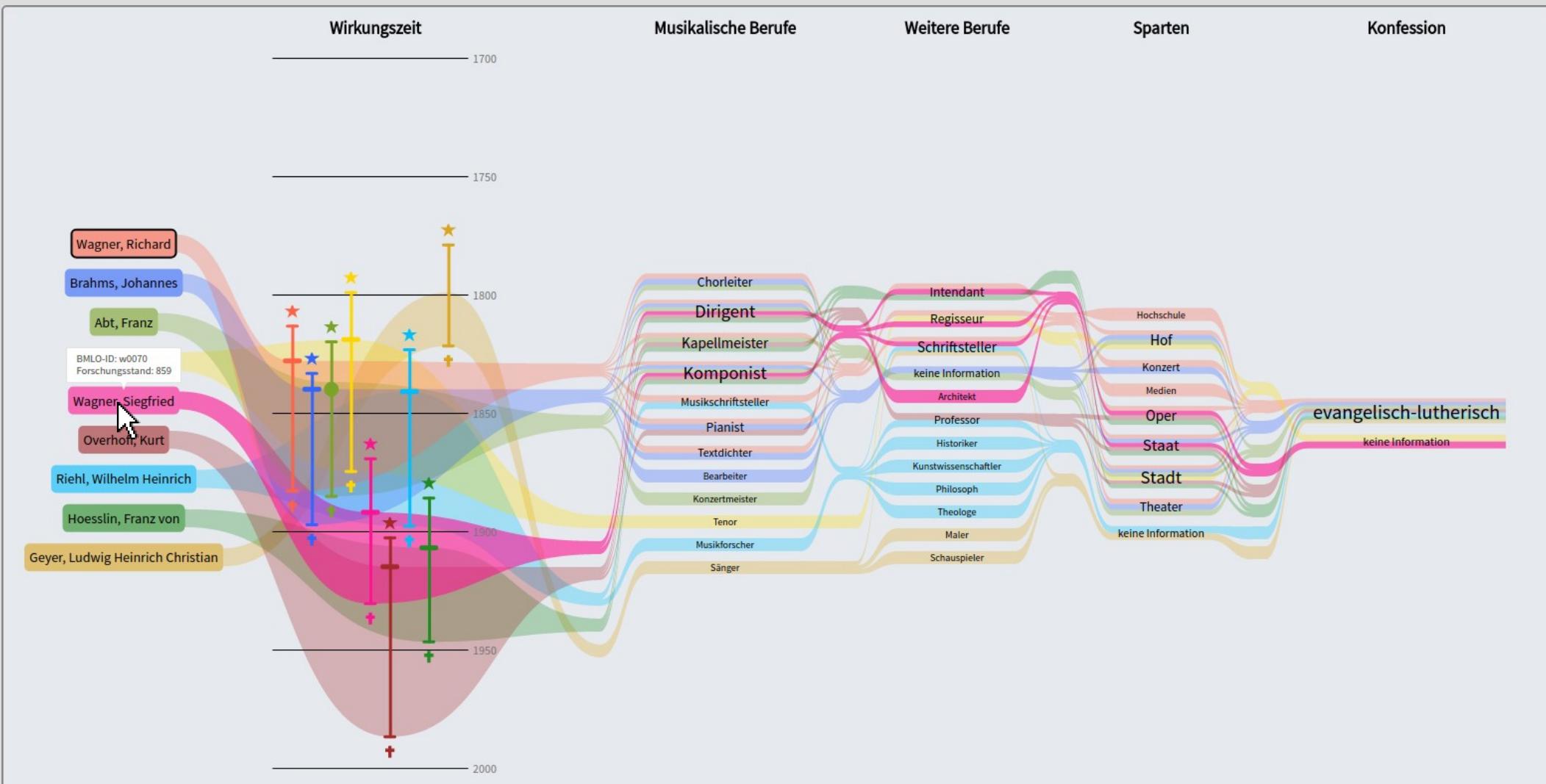
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity



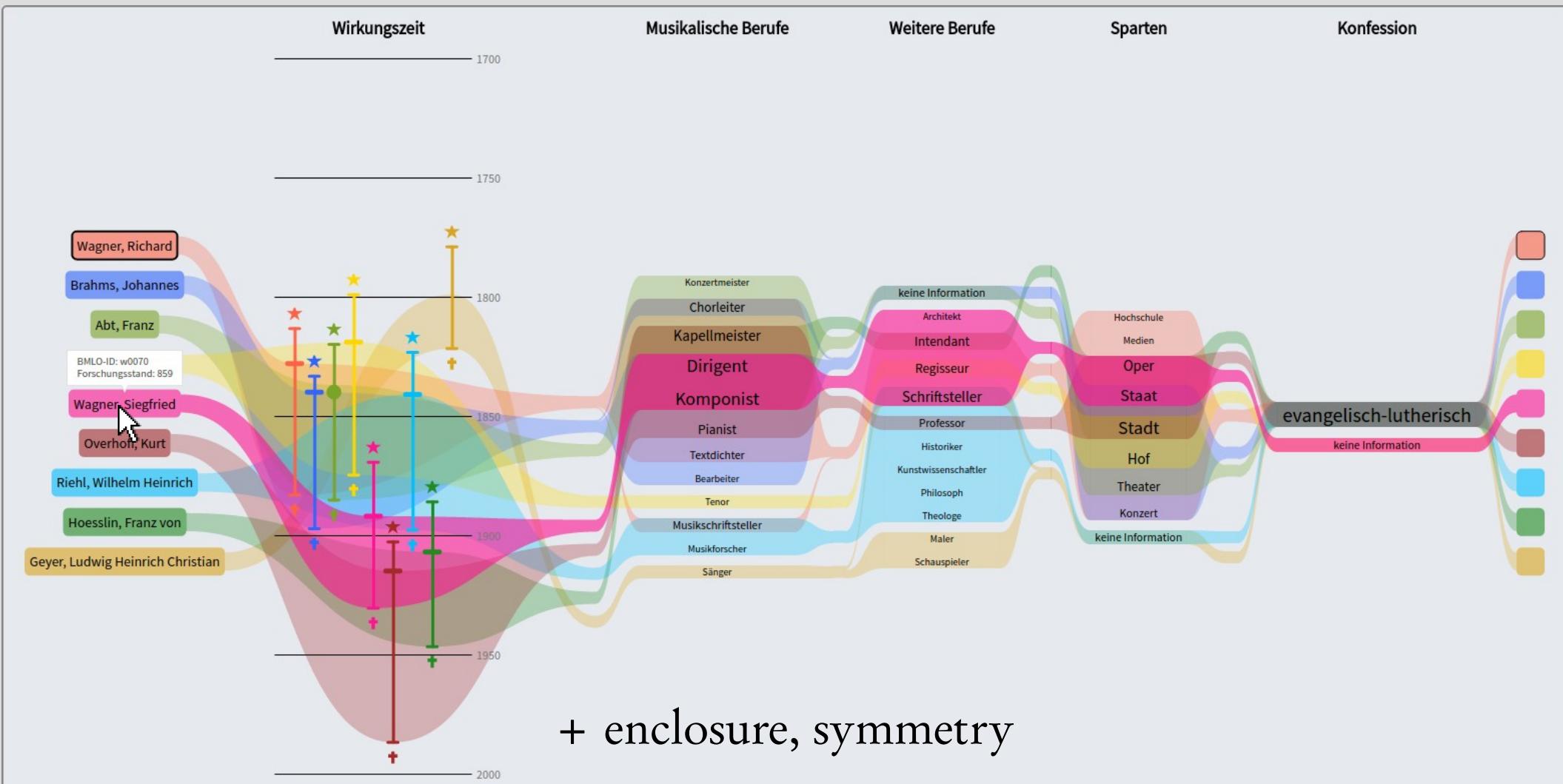
GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity, (similarity)



GES\$TALT & Musiker Profiling

Applied Gestalt principles: connectedness, continuity



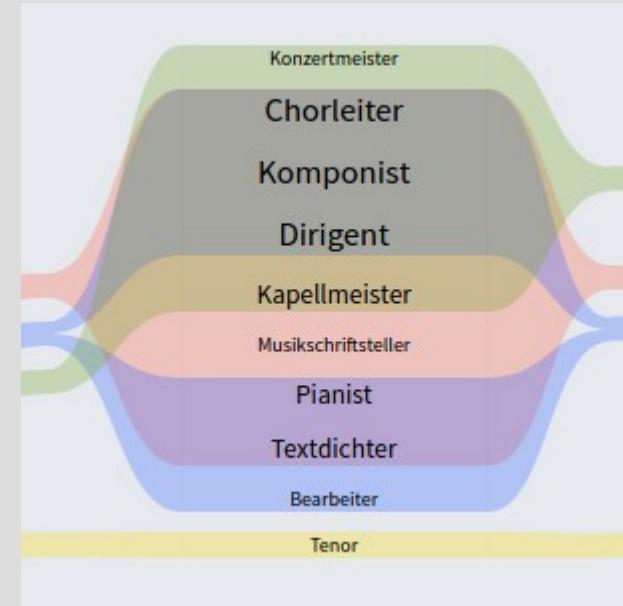
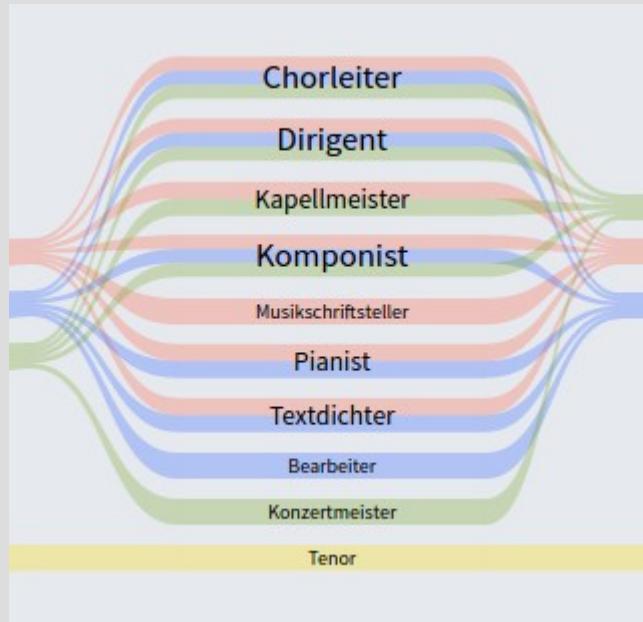
GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#1: Find out, if an attribute belongs to a certain musician!

– 1.5

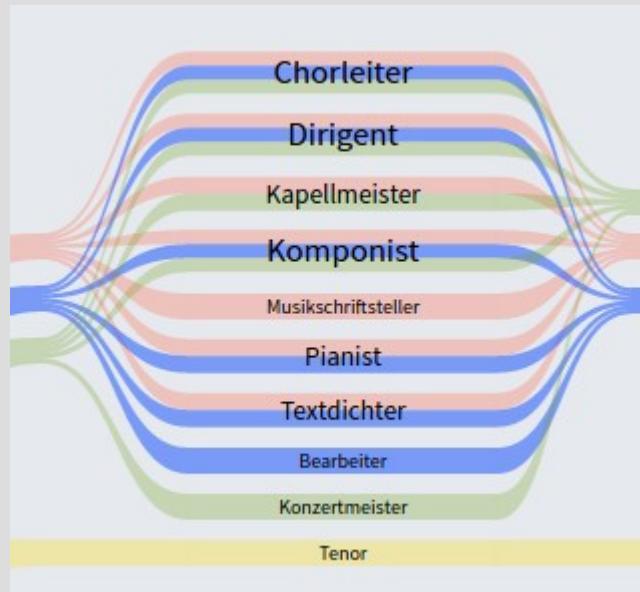


GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#2: Find out, if an attribute belongs to a certain musician!
(using highlight functionality)



+2



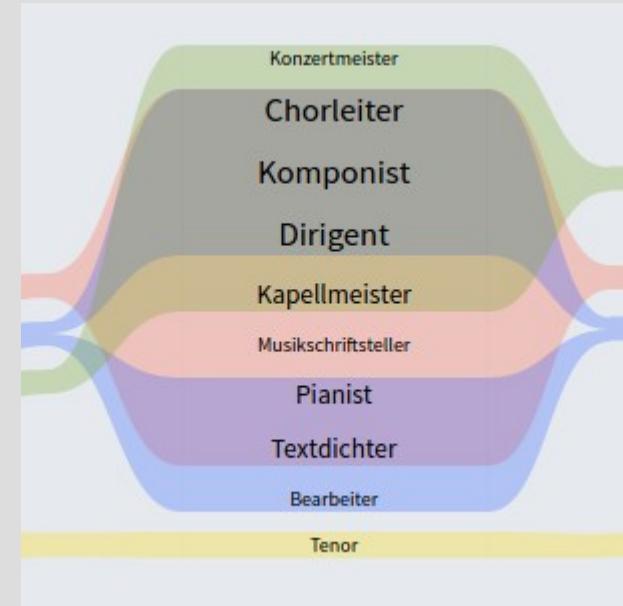
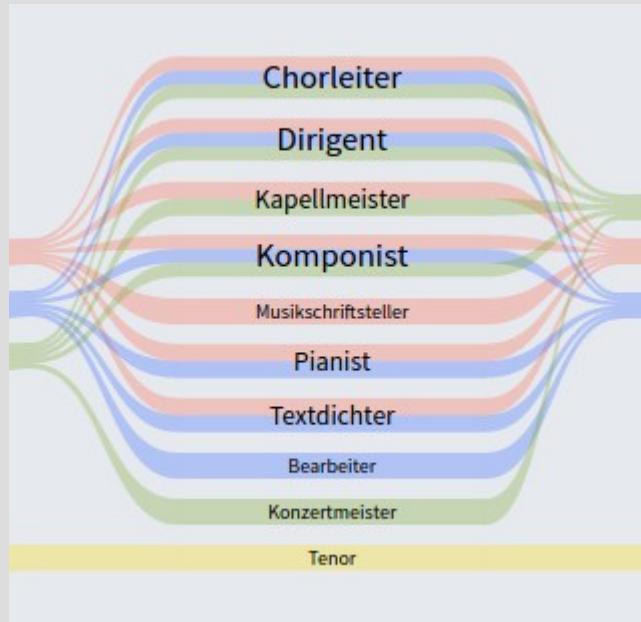
GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#3: Attributes of a musician in a single column form a visual unity!

+0.5



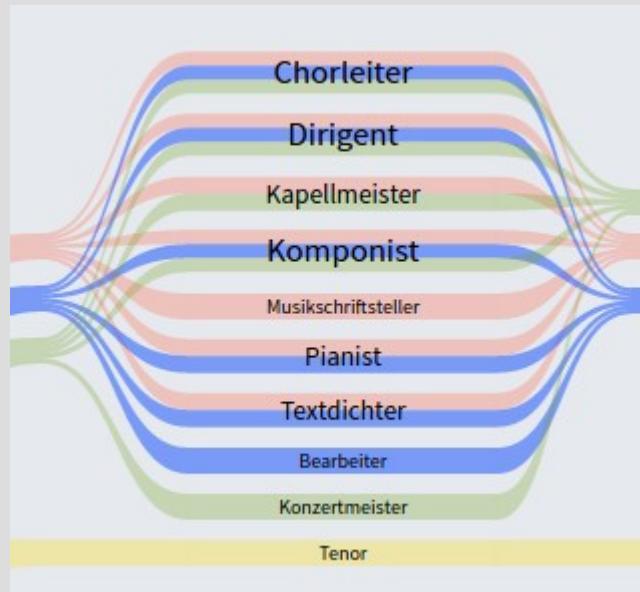
GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#3: Attributes of a musician in a single column form a visual unity!

+0.5



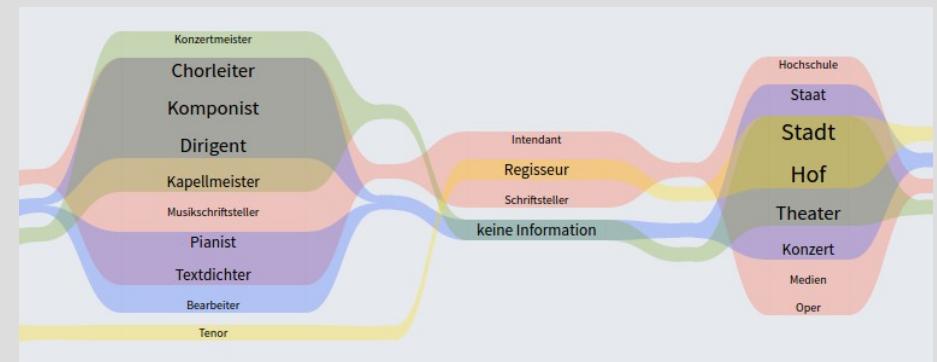
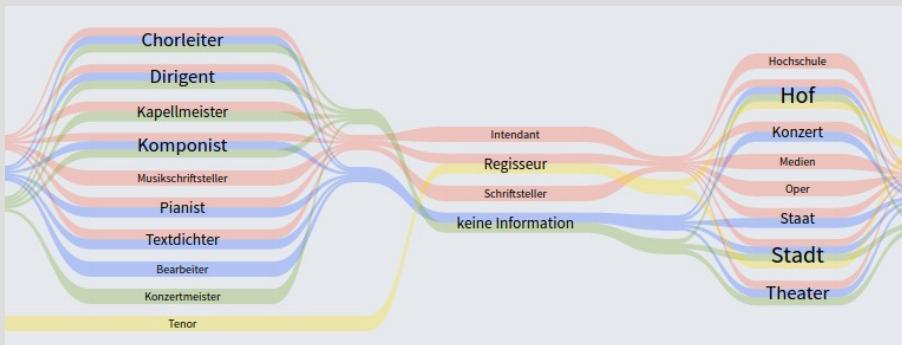
GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from -3 (much worse) to $+3$ (much better)

#4: Attributes of a musician in over all columns form a visual unity!

-1 (static) $+2$ (highlight)



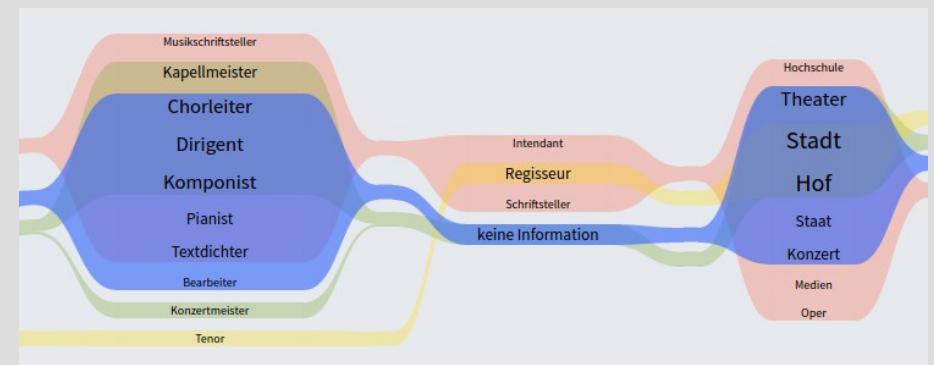
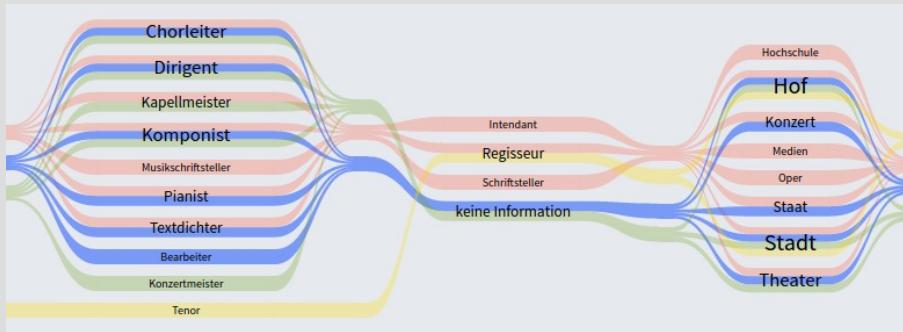
GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#4: Attributes of a musician in over all columns form a visual unity!

– 1 (static) +2 (highlight)



GES\$TALT & Musiker Profiling

Expert User Review:

- evaluation of new design compared to old design
- ratings from –3 (much worse) to +3 (much better)

#5: Is there an overall improvement?

+ 1



Summary

User Ratings: Improvements with Gestalt principles?

+ 1

+ 2.7

+ 2.7

+ 1

1. Considering Gestalt theory makes sense



2. Can also lead to new kinds of “visual challenges”

3. Use different Gestalt principles for different data facets

4. (New) Gestalt principle of *Enclosure* very effective

Rock, I., & Palmer, S. (1990). Gestalt psychology. Sci Am, 263, 84-90.



Next Steps

#1: (digital humanities) literature research

#2: group visualizations dependent on data types
(geographical, textual, ...)

→ #3: developing a design space according to
applicable Gestalt principles

#4: user study to evaluate design space

#5: write a paper

Why do we see one thing as foreground and the other thing as background?

How does the impression of *form* emerge?

What are the reasons for recognizing a *form* easily and quickly?

What is a “good” *form*?

How and why do we see relationships between things?

What makes the detection relationships or differences easier or harder?

What features let us perceive a thing as a *form* that differs from other *forms*?

How do we perceive complex sceneries?



That's it!

↗ closure

Thank you for listening!

↗ just boring proximity

Are there any questions?

similarity ↗