

2d and 3d Figurs and their Perception

A presentation on Kopfermann(1930)

Andrej Schoeke^{1 2}
aschoeke@uos.de

¹Institute of Cognitive Science
University of Osnabrueck

²Faculty of Applied Psychology
University of Trento

December 10, 2007

Organisationals

- This talk will be in english
 - If you do not understand something...
 - Please raise your hand!
 - and I will explain it :)
-
- This presentation will be available on
[http://data.andrej-schoeke.de/coxi/
Presentation_on_Kopfermann.pdf](http://data.andrej-schoeke.de/coxi/Presentation_on_Kopfermann.pdf)

Organisationals

- This talk will be in english
 - If you do not understand something...
 - Please raise your hand!
 - and I will explain it :)
-
- This presentation will be available on
[http://data.andrej-schoeke.de/coxi/
Presentation_on_Kopfermann.pdf](http://data.andrej-schoeke.de/coxi/Presentation_on_Kopfermann.pdf)

Organisationals

- This talk will be in english
 - If you do not understand something...
 - Please raise your hand!
 - and I will explain it :)
-
- This presentation will be available on
[http://data.andrej-schoeke.de/coxi/
Presentation_on_Kopfermann.pdf](http://data.andrej-schoeke.de/coxi/Presentation_on_Kopfermann.pdf)

Organisationals

- This talk will be in english
 - If you do not understand something...
 - Please raise your hand!
 - and I will explain it :)
-
- This presentation will be available on
[http://data.andrej-schoeke.de/coxi/
Presentation_on_Kopfermann.pdf](http://data.andrej-schoeke.de/coxi/Presentation_on_Kopfermann.pdf)

Organisationals

- This talk will be in english
 - If you do not understand something...
 - Please raise your hand!
 - and I will explain it :)
-
- This presentation will be available on
[http://data.andrej-schoeke.de/coxi/
Presentation_on_Kopfermann.pdf](http://data.andrej-schoeke.de/coxi/Presentation_on_Kopfermann.pdf)

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Outline

1 Motivation

- Why is it 2d or 3d?
- Previous Work
- How they approached the problem

2 3 Factors and Experiment

- Binding
- Delimiting Function
- Role
- Experiment

3 Criticism and Summary

- Criticism
- Summary

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Why is it interesting?

- Every figur can be perceived in 2d or 3d.
- Yet, we seem to be biased towards one of them.
- The Question is: What are the factors, that let us perceive a shape in one way or the other?

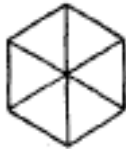
Why is it interesting?

- Every figur can be perceived in 2d or 3d.
- Yet, we seem to be biased towards one of them.
- The Question is: What are the factors, that let us perceive a shape in one way or the other?

Why is it interesting?

- Every figur can be perceived in 2d or 3d.
- Yet, we seem to be biased towards one of them.
- The Question is: What are the factors, that let us perceive a shape in one way or the other?

Why is it interesting? Example



Are you sure?

Why is it interesting? Example



Are you sure?

Why is it interesting? Example



Outline

- 1 **Motivation**
 - Why is it 2d or 3d?
 - **Previous Work**
 - How they approached the problem
- 2 **3 Factors and Experiment**
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 **Criticism and Summary**
 - Criticism
 - Summary

Approaches by different Authors

Experience If the figure resembles an previously seen 3d object, the depth value of the object are applied on the figure. *Hillebrand (1929)*

Attentional Focus We perceive the figures different, depending on how our view is focused and our attention distributed along its part. *Schumann (1910)*

Gestaltproduction The connection between a figure and the corresponding 3d body is a associativ process, in which the 2d image is proceeded or arranged in such a way, that a inner Gestalt is produced that resembles a 3d body. *Benussi (1911)*

Approaches by different Authors

Experience If the figure resembles an previously seen 3d object, the depth value of the object are applied on the figure. *Hillebrand (1929)*

Attentional Focus We perceive the figures different, depending on how our view is focused and our attention distributed along its part. *Schumann (1910)*

Gestaltproduction The connection between a figure and the corresponding 3d body is a associativ process, in which the 2d image is proceeded or arranged in such a way, that a inner Gestalt is produced that resembles a 3d body. *Benussi (1911)*

Approaches by different Authors

Experience If the figure resembles an previously seen 3d object, the depth value of the object are applied on the figure. *Hillebrand (1929)*

Attentional Focus We perceive the figures different, depending on how our view is focused and our attention distributed along its part. *Schumann (1910)*

Gestaltproduction The connection between a figure and the corresponding 3d body is a associativ process, in which the 2d image is proceeded or arranged in such a way, that a inner Gestalt is produced that resembles a 3d body. *Benussi (1911)*

Outline

1

Motivation

- Why is it 2d or 3d?
- Previous Work
- How they approached the problem

2

3 Factors and Experiment

- Binding
- Delimiting Function
- Role
- Experiment

3

Criticism and Summary

- Criticism
- Summary

Quotes from the paper...

“The spacious perception is not just the plane perception + depthness values or + special attentional distribution; (...) psychological, more and different happens.”

*“We studied the psychological processes on such **transformations** with rich material. In the process, typical moments of a strong manner appear: characteristic structural changes, changes in grouping of the figure, changes in the manner, how the parts of the figures are fused together, (...).”*

Quotes from the paper...

“The spacious perception is not just the plane perception + depthness values or + special attentional distribution; (...) psychological, more and different happens.”

*“We studied the psychological processes on such **transformations** with rich material. In the process, typical moments of a strong manner appear: characteristic structural changes, changes in grouping of the figure, changes in the manner, how the parts of the figures are fused together, (...).”*

Examples of the Material

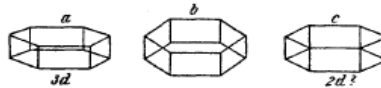


Fig. 2.

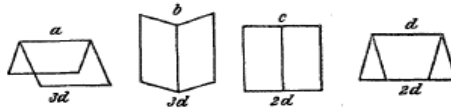


Fig. 3.

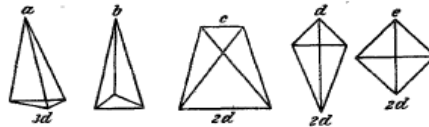


Fig. 4.

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 **3 Factors and Experiment**
 - **Binding**
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Binding - Zusammengefasstheit

- “Binding” means the way certain elements of an object relate to each other.
- But not merely in a functional-geometrical way, but more in psychological.
- The Idea: Changes in 2d and 3d perception go along in changes of the “Binding“, in the grouping of their parts.

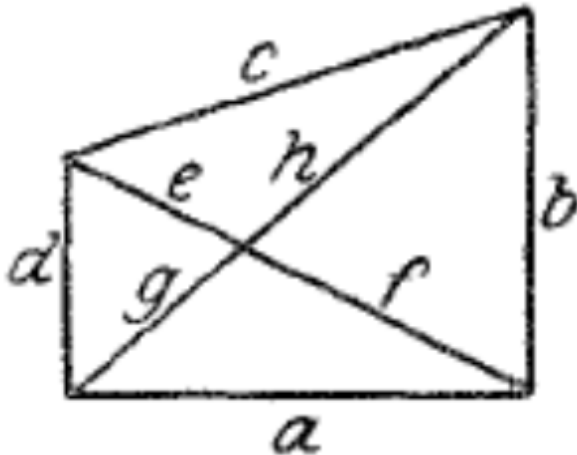
Binding - Zusammengefasstheit

- “Binding” means the way certain elements of an object relate to each other.
- But not merely in a functional-geometrical way, but more in psychological.
- The Idea: Changes in 2d and 3d perception go along in changes of the “Binding“, in the grouping of their parts.

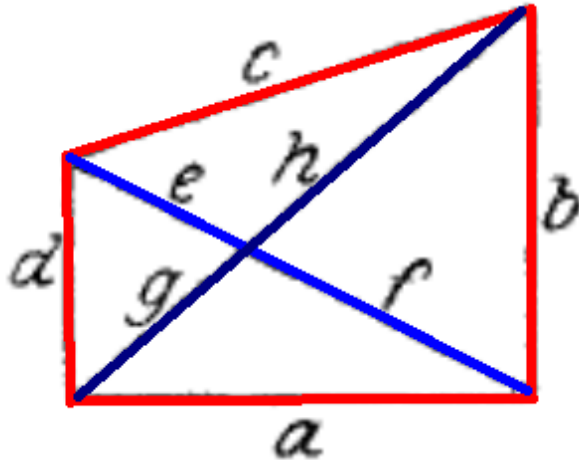
Binding - Zusammengefasstheit

- “Binding” means the way certain elements of an object relate to each other.
- But not merely in a functional-geometrical way, but more in psychological.
- The Idea: Changes in 2d and 3d perception go along in changes of the “Binding“, in the grouping of their parts.

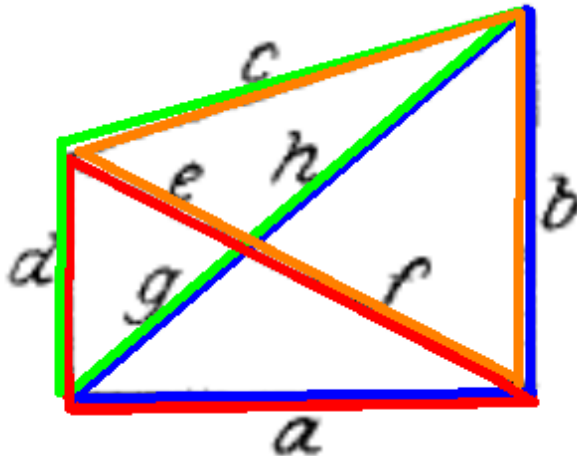
Binding - Examples



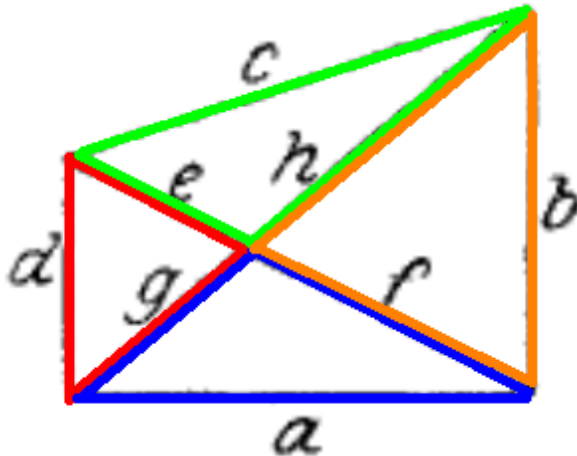
Binding - Examples cont.



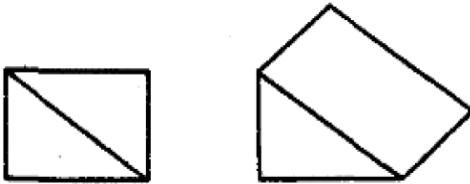
Binding - Examples cont.



Binding - Examples cont.

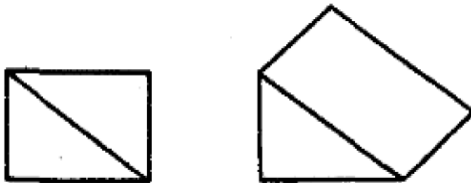


Binding - Surrounding Contours



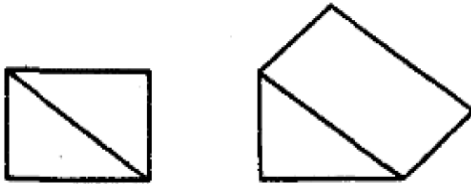
- The first figure is most commonly perceived as a plane, the second one hardly.
- In the second figure, the surrounding contour is unregular. A better Gestalt is perceived, if you split it into subparts.
- Therefore the object is more likely to be perceived 3d.
- There seems a tendency to perceive a surrounding contour as one area. This tendency is stronger, if the contour is a "good" Gestalt.

Binding - Surrounding Contours



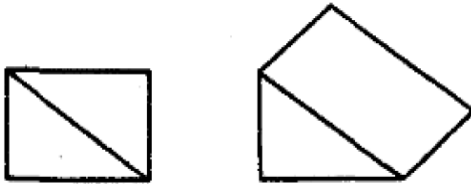
- The first figure is most commonly perceived as a plane, the second one hardly.
- In the second figure, the surrounding contour is unregular. A better Gestalt is perceived, if you split it into subparts.
- Therefore the object is more likely to be perceived 3d.
- There seems a tendency to perceive a surrounding contour as one area. This tendency is stronger, if the contour is a "good" Gestalt.

Binding - Surrounding Contours



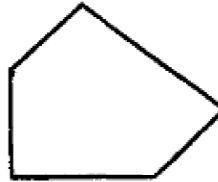
- The first figure is most commonly perceived as a plane, the second one hardly.
- In the second figure, the surrounding contour is unregular. A better Gestalt is perceived, if you split it into subparts.
- Therefore the object is more likely to be perceived 3d.
- There seems a tendency to perceive a surrounding contour as one area. This tendency is stronger, if the contour is a "good" Gestalt.

Binding - Surrounding Contours

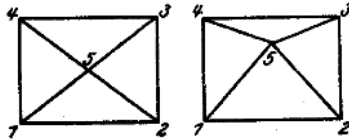


- The first figure is most commonly perceived as a plane, the second one hardly.
- In the second figure, the surrounding contour is unregular. A better Gestalt is perceived, if you split it into subparts.
- Therefore the object is more likely to be perceived 3d.
- There seems a tendency to perceive a surrounding contour as one area. This tendency is stronger, if the contour is a "good" Gestalt.

Short Own Experiment

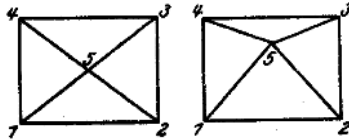


Binding - Straight Lines



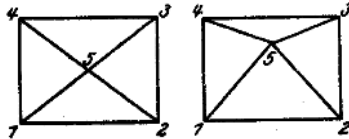
- Several straights in a continuous row are often perceived as one straight line.
- A straight is the most simple way of creating a "good" Gestalt.
- Therefore, disrupting a straight is also disrupting a Gestalt.
- By this, disrupting the straights commonly creates a new binding.

Binding - Straight Lines



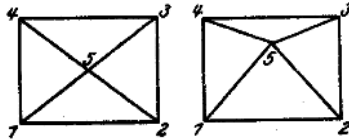
- Several straights in a continuous row are often perceived as one straight line.
- A straight is the most simple way of creating a "good" Gestalt.
- Therefore, disrupting a straight is also disrupting a Gestalt.
- By this, disrupting the straights commonly creates a new binding.

Binding - Straight Lines



- Several straights in a continuous row are often perceived as one straight line.
- A straight is the most simple way of creating a "good" Gestalt.
- Therefore, disrupting a straight is also disrupting a Gestalt.
- By this, disrupting the straights commonly creates a new binding.

Binding - Straight Lines



- Several straights in a continuous row are often perceived as one straight line.
- A straight is the most simple way of creating a "good" Gestalt.
- Therefore, disrupting a straight is also disrupting a Gestalt.
- By this, disrupting the straights commonly creates a new binding.

Binding - Conclusion

Conclusion: Binding

- 1 The plane and bodily perception of a figure are typically different in their bindings.
- 2 In general, the preferred binding is caused purely by figurale and Gestalt factors
- 3 Changing the figure on these factors changes the binding and therefore can "switch" the perception.
- 4 Therefore, binding alone is already likley to cause preferences on 2d or 3d perception.

Binding - Conclusion

Conclusion: Binding

- 1 The plane and bodily perception of a figure are typically different in their bindings.
- 2 In general, the preferred binding is caused purely by figurale and Gestalt factors
- 3 Changing the figure on these factors changes the binding and therefore can "switch" the perception.
- 4 Therefore, binding alone is already likley to cause preferences on 2d or 3d perception.

Binding - Conclusion

Conclusion: Binding

- 1 The plane and bodily perception of a figure are typically different in their bindings.
- 2 In general, the preferred binding is caused purely by figurale and Gestalt factors
- 3 Changing the figure on these factors changes the binding and therefore can "switch" the perception.
- 4 Therefore, binding alone is already likley to cause preferences on 2d or 3d perception.

Binding - Conclusion

Conclusion: Binding

- 1 The plane and bodily perception of a figure are typically different in their bindings.
- 2 In general, the preferred binding is caused purely by figurale and Gestalt factors
- 3 Changing the figure on these factors changes the binding and therefore can "switch" the perception.
- 4 Therefore, binding alone is already likley to cause preferences on 2d or 3d perception.

Binding - Conclusion

Conclusion: Binding

- 1 The plane and bodily perception of a figure are typically different in their bindings.
- 2 In general, the preferred binding is caused purely by figurale and Gestalt factors
- 3 Changing the figure on these factors changes the binding and therefore can "switch" the perception.
- 4 Therefore, binding alone is already likley to cause preferences on 2d or 3d perception.

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 **3 Factors and Experiment**
 - Binding
 - **Delimiting Function**
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Delimiting Function - Grenzfunktion

- A line can have a special function in a figure. It can cut the object in two subparts.
- If it does that, it is called Delimiting Function, as it serves as a delimiter to the subfigure(s).
- A line can change or loose its Delimiter Function by structural changes of the figure.
- Idea: The changing Delimiter Function plays a vital role in 2d/3d preception of objects.

Delimiting Function - Grenzfunktion

- A line can have a special function in a figure. It can cut the object in two subparts.
- If it does that, it is called Delimiting Function, as it serves as a delimiter to the subfigure(s).
- A line can change or loose its Delimiter Function by structural changes of the figure.
- Idea: The changing Delimiter Function plays a vital role in 2d/3d preception of objects.

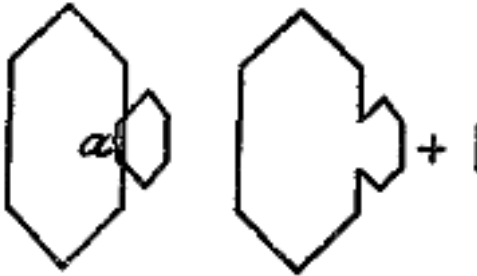
Delimiting Function - Grenzfunktion

- A line can have a special function in a figure. It can cut the object in two subparts.
- If it does that, it is called Delimiting Function, as it serves as a delimiter to the subfigure(s).
- A line can change or loose its Delimiter Function by structural changes of the figure.
- Idea: The changing Delimiter Function plays a vital role in 2d/3d preception of objects.

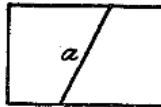
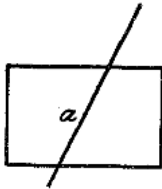
Delimiting Function - Grenzfunktion

- A line can have a special function in a figure. It can cut the object in two subparts.
- If it does that, it is called Delimiting Function, as it serves as a delimiter to the subfigure(s).
- A line can change or loose its Delimiter Function by structural changes of the figure.
- Idea: The changing Delimiter Function plays a vital role in 2d/3d preception of objects.

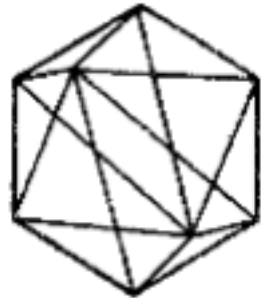
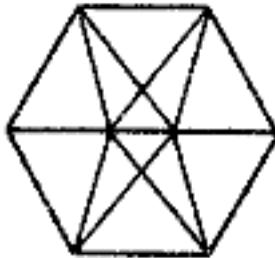
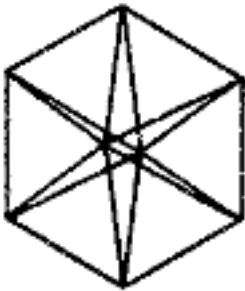
Delimiting Function - Example



Delimiting Function - Example cont.



Delimiting Function - Example cont.



Delimiting Function - Example cont. (3d)



Delimiter Function - Conclusion

Conclusion: Delimiter Function

- 1 In the plane or bodily perception of a figure, the delimiting function is typically different concerning certain lines.
- 2 For bodily objects, this also applies for certain areas, which then delimit to the "back" or the "front".

Delimiter Function - Conclusion

Conclusion: Delimiter Function

- 1 In the plane or bodily perception of a figure, the delimiting function is typically different concerning certain lines.
- 2 For bodily objects, this also applies for certain areas, which then delimit to the "back" or the "front".

Delimiter Function - Conclusion

Conclusion: Delimiter Function

- 1 In the plane or bodily perception of a figure, the delimiting function is typically different concerning certain lines.
- 2 For bodily objects, this also applies for certain areas, which then delimit to the "back" or the "front".

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 **3 Factors and Experiment**
 - Binding
 - Delimiting Function
 - **Role**
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Role - Rolle

- In figures, points and lines serve a certain role such as edge, corner or connecting line and crossing point.
- These roles include also the factors delimiting function and surrounding contour.
- The idea: Changes in the understanding of a role are also important in the overall perception of an object.

Role - Rolle

- In figures, points and lines serve a certain role such as edge, corner or connecting line and crossing point.
- These roles include also the factors delimiting function and surrounding contour.
- The idea: Changes in the understanding of a role are also important in the overall perception of an object.

Role - Rolle

- In figures, points and lines serve a certain role such as edge, corner or connecting line and crossing point.
- These roles include also the factors delimiting function and surrounding contour.
- The idea: Changes in the understanding of a role are also important in the overall perception of an object.

Role - Example



- The role of the central point is in 2d the crossing point of the diagonals.
- If you see it as a cube, this role changes to a corner immediatly.

Role - Example



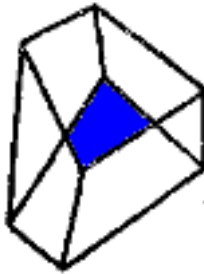
- The role of the central point is in 2d the crossing point of the diagonals.
- If you see it as a cube, this role changes to a corner immediatly.

Role - Example cont.



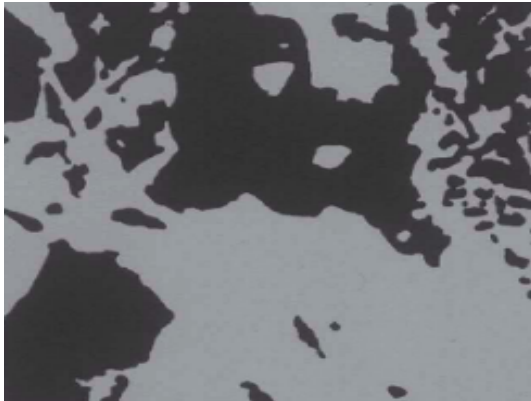
- What do you see?

Role - Example cont.



- What do you see?

Role - Not really an Example



- A role can be many things!

Role - Conclusion

Conclusion: Role

- 1 Changing the structure in such a way, that the psychological role of a small part or area also changes, alters the overall perception dramatically.
- 2 Whether this changing is likely depends on the before mentioned figural properties.

Role - Conclusion

Conclusion: Role

- 1 Changing the structure in such a way, that the psychological role of a small part or area also changes, alters the overall perception dramatically.
- 2 Whether this changing is likely depends on the before mentioned figural properties.

Role - Conclusion

Conclusion: Role

- 1 Changing the structure in such a way, that the psychological role of a small part or area also changes, alters the overall perception dramatically.
- 2 Whether this changing is likely depends on the before mentioned figural properties.

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - **Experiment**
- 3 Criticism and Summary
 - Criticism
 - Summary

Putting the factors on a test

- To test these hypothesis, the researchers builded a device to create depth vision.
- They tested several figures in configurations which are very unlikely to occure in reality.

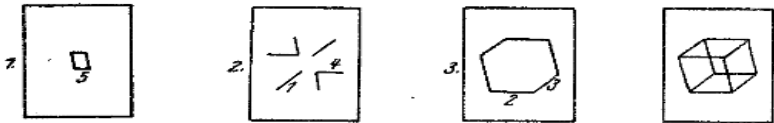


Putting the factors on a test

- To test these hypothesis, the researchers builded a device to create depth vision.
- They tested several figures in configurations which are very unlikely to occure in reality.

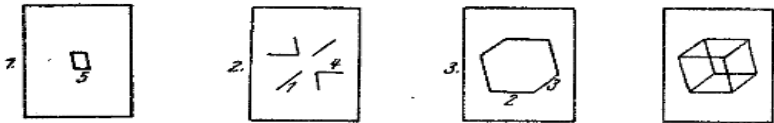


Experiment - Bad 3d to Good 3d



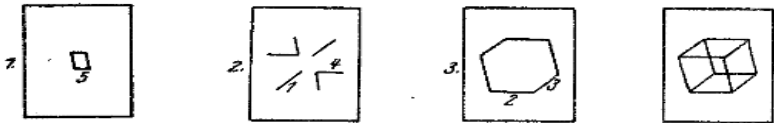
- Clearly, the depth values should suggest a very unlikely 3d figure.
- Yet, all participants saw a cube with no irregularities.
- The overall signals from the screens were transformed in a "good" Gestalt.

Experiment - Bad 3d to Good 3d



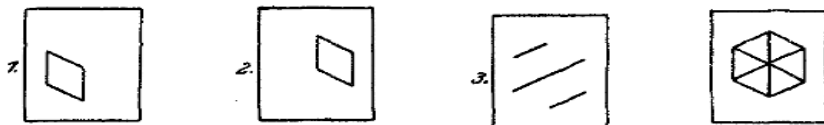
- Clearly, the depth values should suggest a very unlikely 3d figure.
- Yet, all participants saw a cube with no irregularities.
- The overall signals from the screens were transformed in a "good" Gestalt.

Experiment - Bad 3d to Good 3d



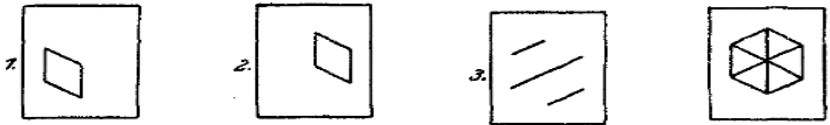
- Clearly, the depth values should suggest a very unlikely 3d figure.
- Yet, all participants saw a cube with no irregularities.
- The overall signals from the screens were transformed in a "good" Gestalt.

Experiment - 3d to 2d



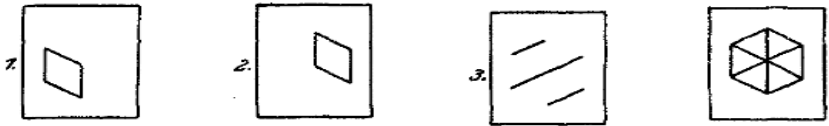
- The shown body is objectively a 3d figure.
- Yet, all participants saw a clear 2d object.
- The overall factors are the preferred perception of surrounding contour and straight lines.

Experiment - 3d to 2d



- The shown body is objectively a 3d figure.
- Yet, all participants saw a clear 2d object.
- The overall factors are the preferred perception of surrounding contour and straight lines.

Experiment - 3d to 2d



- The shown body is objectively a 3d figure.
- Yet, all participants saw a clear 2d object.
- The overall factors are the preferred perception of surrounding contour and straight lines.

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Criticism

Kanizsa stated 3 criticisms on this or equivalent research:

- Surrounding Contours are not always there, but we perceive a "contour while absent".
- The Supremacy of the Straight Line is very much doubtable.
- The experiments are mostly done with regular shaped objects and are not that convincing in unregular shapes.

Criticism

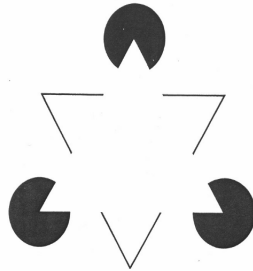
Kanizsa stated 3 criticisms on this or equivalent research:

- Surrounding Contours are not always there, but we perceive a "contour while absent".
- The Supremacy of the Straight Line is very much doubtable.
- The experiments are mostly done with regular shaped objects and are not that convincing in unregular shapes.

Criticism

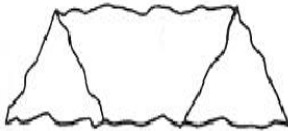
Kanizsa stated 3 criticisms on this or equivalent research:

- Surrounding Contours are not always there, but we perceive a "contour while absent".
- The Supremacy of the Straight Line is very much doubtable.
- The experiments are mostly done with regular shaped objects and are not that convincing in unregular shapes.



- We perceive clearly a triangle, while the contours do **not** suggest it.
- Applying the factors of this article, we are not supposed to see anything.

Criticism - Straight Lines



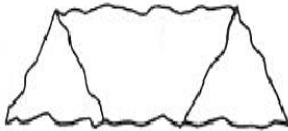
a



b

- We see the objects in 2d or 3d.
- Yet, we can not apply the rules on straight lines here.

Criticism - Straight Lines



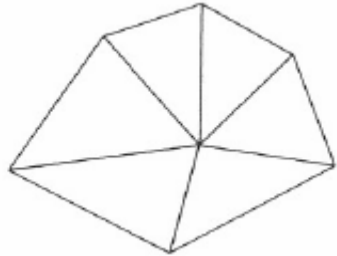
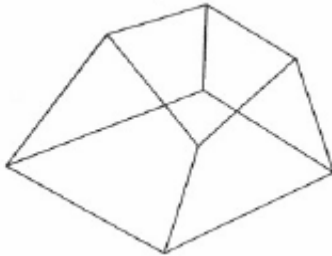
a



b

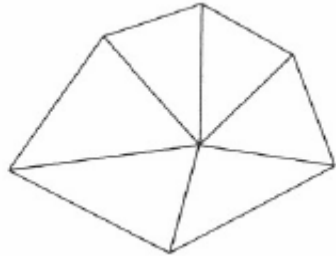
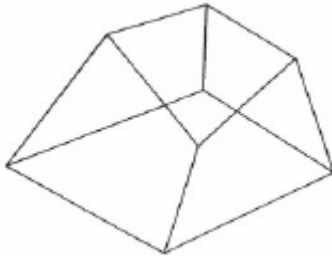
- We see the objects in 2d or 3d.
- Yet, we can not apply the rules on straight lines here.

Criticism - Regularity



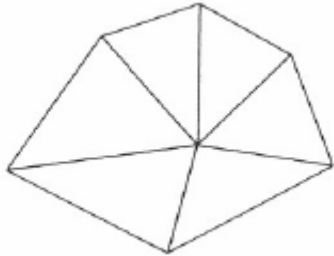
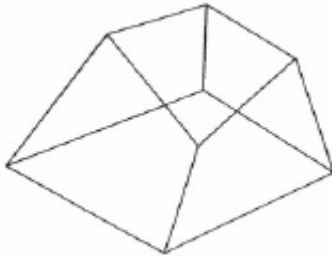
- The shapes in these experiments are mostly regular.
- The benefit of the "good" Gestalt can not apply on such unregular shapes.
- Yet, we are prone to accept the figure a) as 3d.

Criticism - Regularity



- The shapes in these experiments are mostly regular.
- The benefit of the "good" Gestalt can not apply on such unregular shapes.
- Yet, we are prone to accept the figure a) as 3d.

Criticism - Regularity



- The shapes in these experiments are mostly regular.
- The benefit of the "good" Gestalt can not apply on such unregular shapes.
- Yet, we are prone to accept the figure a) as 3d.

Outline

- 1 Motivation
 - Why is it 2d or 3d?
 - Previous Work
 - How they approached the problem
- 2 3 Factors and Experiment
 - Binding
 - Delimiting Function
 - Role
 - Experiment
- 3 Criticism and Summary
 - Criticism
 - Summary

Summary

- 1 The described factors of **Bindings, Delimiting Functions and Roles** seem to be important for our understanding of Gestalt perception, both 2d and 3d as well as the changing between them.
- 2 These factors are determined by overall principles such as "good" **Gestalt and supremacy of straight lines**.
- 3 Yet, there are objections, made especially by Kanizsa, on **surrounding contours, supremacy of straight lines** and **regularity**.

Summary

- 1 The described factors of **Bindings, Delimiting Functions and Roles** seem to be important for our understanding of Gestalt perception, both 2d and 3d as well as the changing between them.
- 2 These factors are determined by overall principles such as **"good" Gestalt and supremacy of straight lines**.
- 3 Yet, there are objections, made especially by Kanizsa, on **surrounding contours, supremacy of straight lines and regularity**.

Summary

- 1 The described factors of **Bindings, Delimiting Functions and Roles** seem to be important for our understanding of Gestalt perception, both 2d and 3d as well as the changing between them.
- 2 These factors are determined by overall principles such as **"good" Gestalt and supremacy of straight lines**.
- 3 Yet, there are objections, made especially by Kanizsa, on **surrounding contours, supremacy of straight lines and regularity**.

For Further Reading



G. Kanizsa

Organization in Vision(1979)

Chapter 5 and 12



H. Kaufmann

Psychologische Untersuchung ueber die Wirkung
zweidimensionaler Darstellung koerperlicher Gebilde

Psychologische Forschung, Vol. 13: 293–365