

# AQUAD 7

## – Analysis of Qualitative Data and Exploratory Statistics –

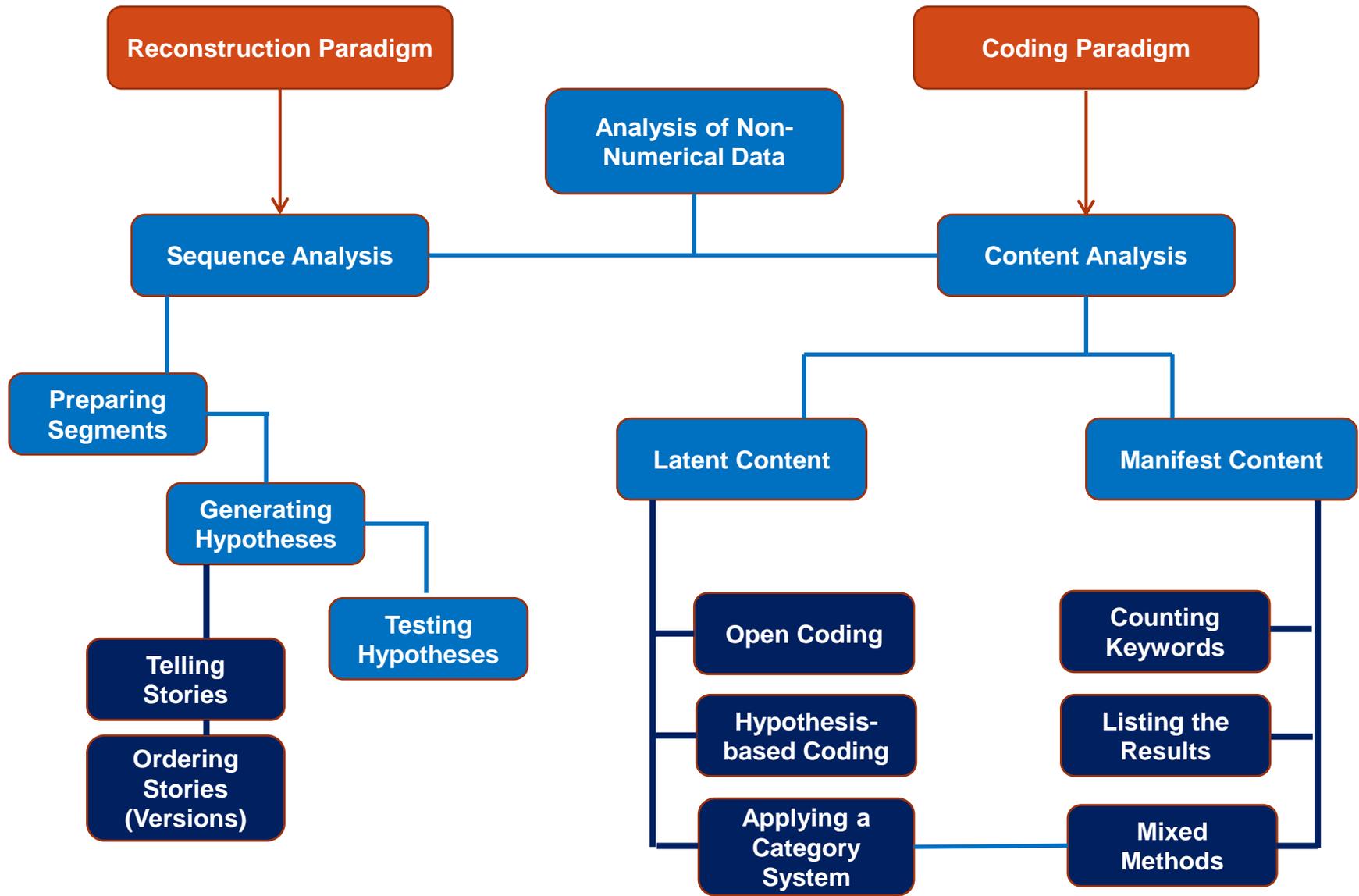
International Research Workshop, Flensburg,  
29/09/15 (14:30 – 18:00) – Wednesday, 30/09/15 (09:00 – 18:00)

# Data analysis

- ... is always some kind of data reduction
- ... the goal is to tell great stories based on minimal information
- at best:
  - explain the past
  - forecast the future
  - offer intervention in the here-and-now to create a better future
- *This has nothing to do with a possible difference between QUAL and QUAN*

# Overview

- Quantitative Content Analysis
  - Code paradigm
    - Exploratory Data Analysis (EDA) with statistics
  - Sequential analysis
  - Boolean Minimization
- 
- In general: from the obvious/ manifest to the latent level of data ...



# Overview

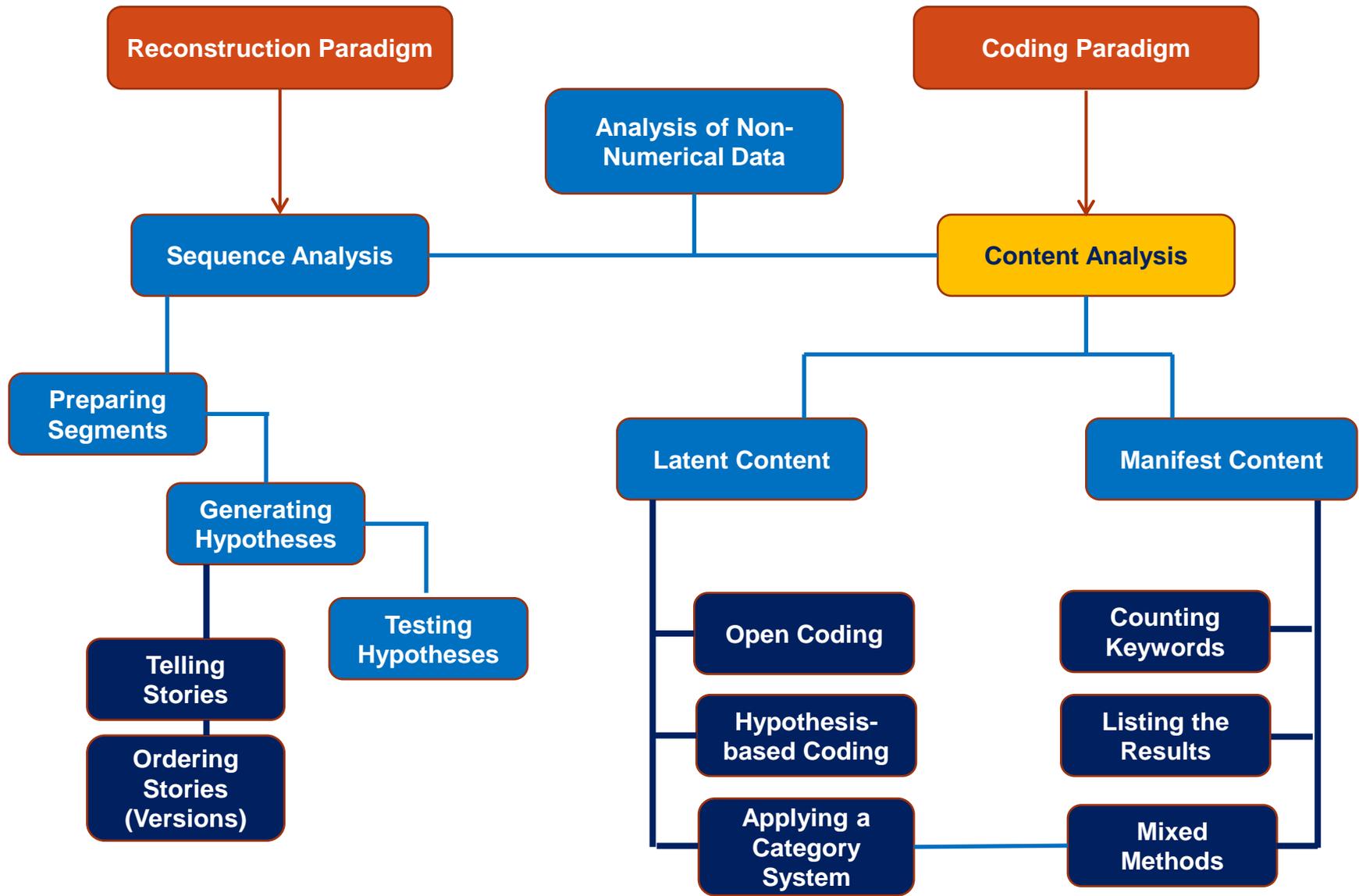
# "Text" as non-numerical data

- If we talk of „text“ here in this workshop, we apply a very broad understanding of what is a „text“.
- As a reference: Oevermann et al. (1979, p. 378) refer here to „protocols of real, symbolic mediated social actions or interactions, may they be available in a written form, audio, visual or combined, and based on different media or archived in any other fixed form“.

(translated by the authors from the original German)

# Research questions

What typical research questions are known in your field of interest with the goal to reconstruct meaning and sense directly from the data?



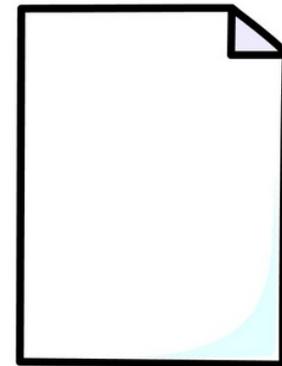
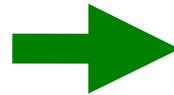
# Content Analysis

# Content analysis

- In the social sciences, *content analysis* can be realized as a quantitative based or a qualitative based method.
- In 1952, Kracauer as well as Berelson published their trend-setting articles.

# Content analysis – actually:

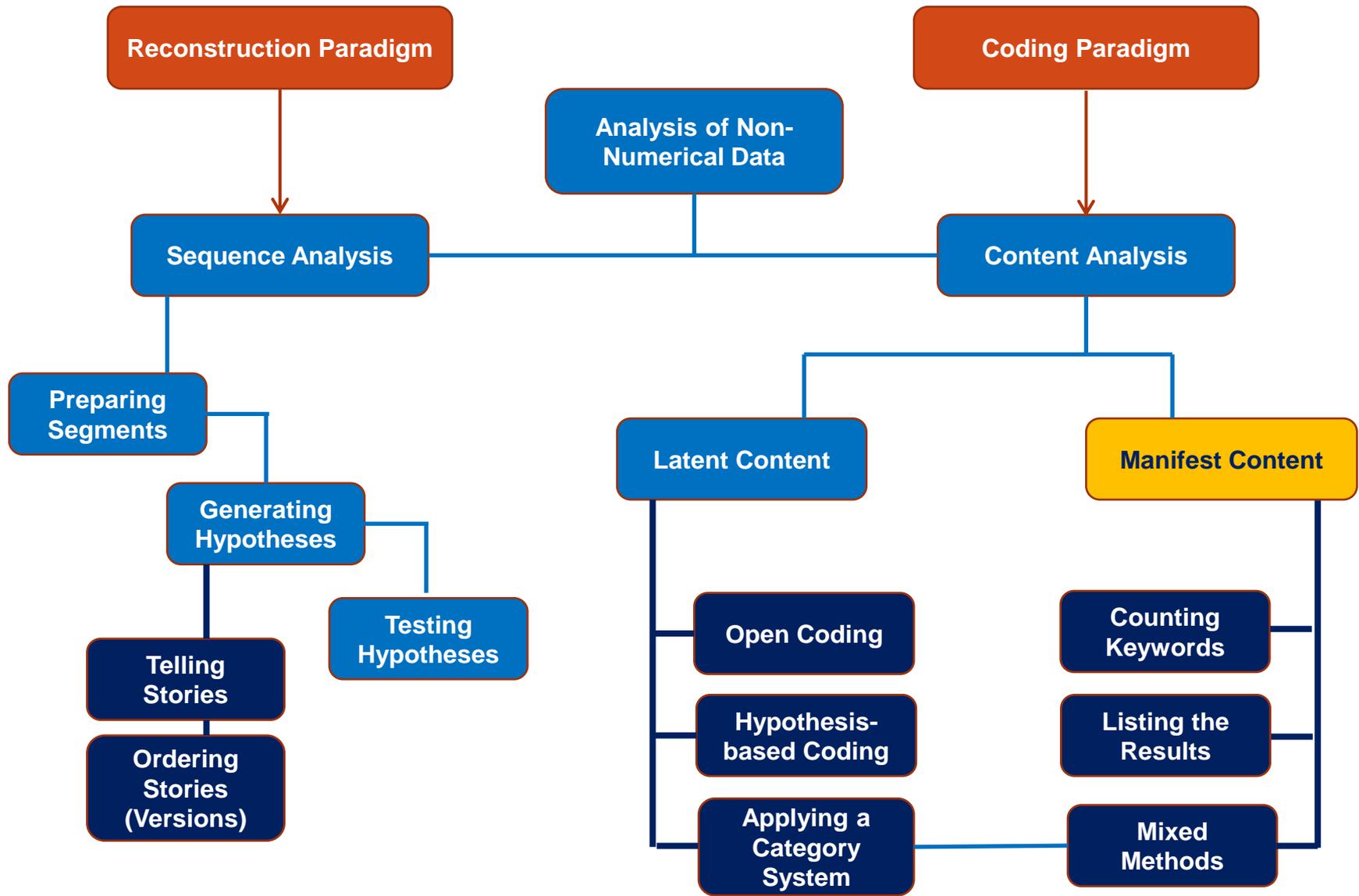
- TEXT reduction



... writing, search & replace, find something, create tables, ...

# Content analysis – The code paradigm

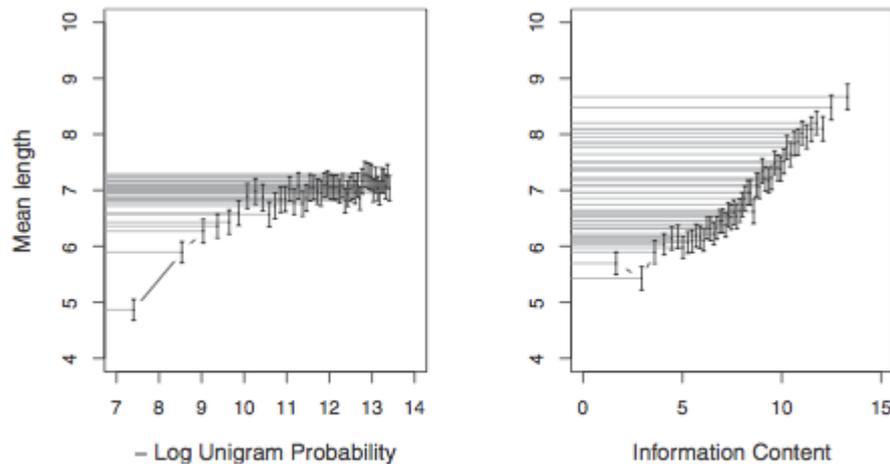
- Qualitative content analysis reduces a huge amount of data (text, audio, video, pictures) by identifying areas that represent a special interpretation and meaning.
- A “code” is a shorthand of this meaning and it is directly related to the part for which a meaning has to be found.
- Codes are representatives of units of meaning.
- It is a process of building and/ or developing a code system.
- Different codes summed up together can result in a new (meta-)code – the same is true for complex sequences of codes -> „chunking“.



## Analysis of Manifest Content ... the obvious

# Quantitative content analysis

- Extrema: Analysis of mere formal characteristics as a source of insight



**Fig. 2.** Relationship between frequency (negative log unigram probability) and length, and information content and length. Error bars represent SEs and each bin represents 2% of the lexicon.

Piantadosi ST, Tily H, & Gibson E (2011). From the Cover: Word lengths are optimized for efficient communication. *Proceedings of the National Academy of Sciences of the United States of America*, 108 (9), 3526-9 PMID: 21278332

# Quantitative content analysis

- After Berelson, the goal of quantitative analysis of texts is to find out the manifest content of communication – in a systematic, objective, and quantitative way.
- E.g. frequency approach: count key words (later: count complex sequences of words/ phrases)
- What are *keywords*? They point out the opposite of the coding process: take a category and create or find a keyword that represents only this specific category. The categories must be definite/ disjunct.

# Application of quantitative content analysis

- What are typical research questions that can be asked in this specific area of research?
- In which ways are these questions different from the typical, already mentioned research questions of the qualitative kind?

# Exploratory data analysis pt1

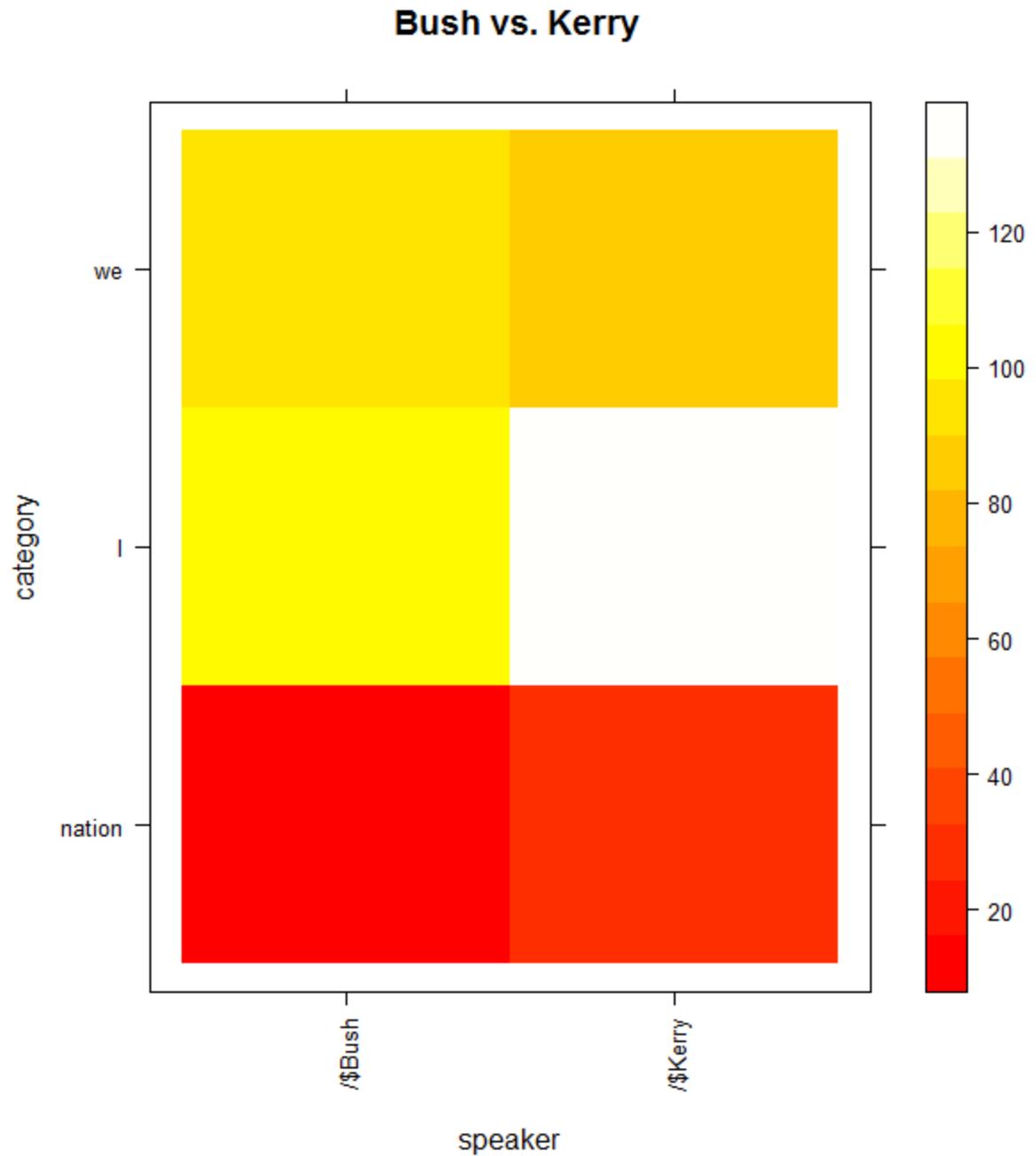
- How does it look like if we visualize quantitative content analyses?
- What can we expect – and what not?
- Exploratory actually means exploratory, we do not talk of deduction, explanation, etc. in the scientific way of understanding. It is not hypothesis testing, it is not the experimental design.

# The functions of EDA (from a seminar announcement)

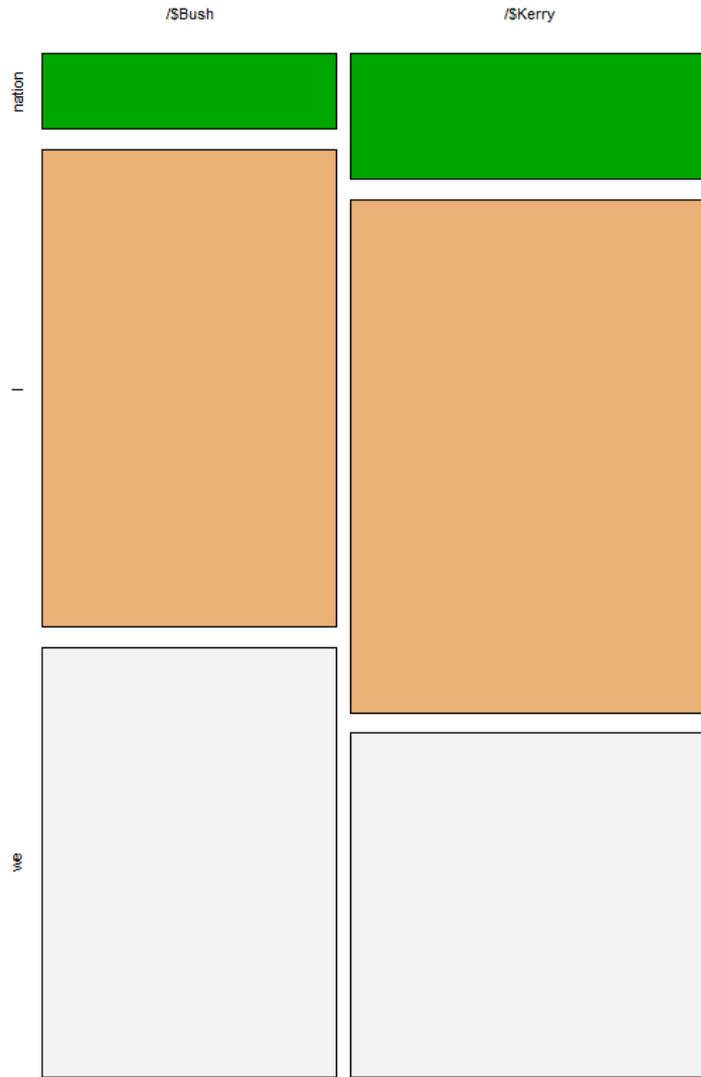
- "The exploratory data analysis is a set of strategies for the analysis of data with the goal to **permit that the data speak and we find patterns in the data.**
- In many situations an exploratory data analysis may precede a situation of formal inference, while in other situations the exploratory analysis may suggest questions and conclusions, which could be confirmed with an additional study. Accordingly the exploratory data analysis may serve as a useful tool for the generation of hypothesis, conjectures and questions regarding the phenomena the data came from."

Research  
example:

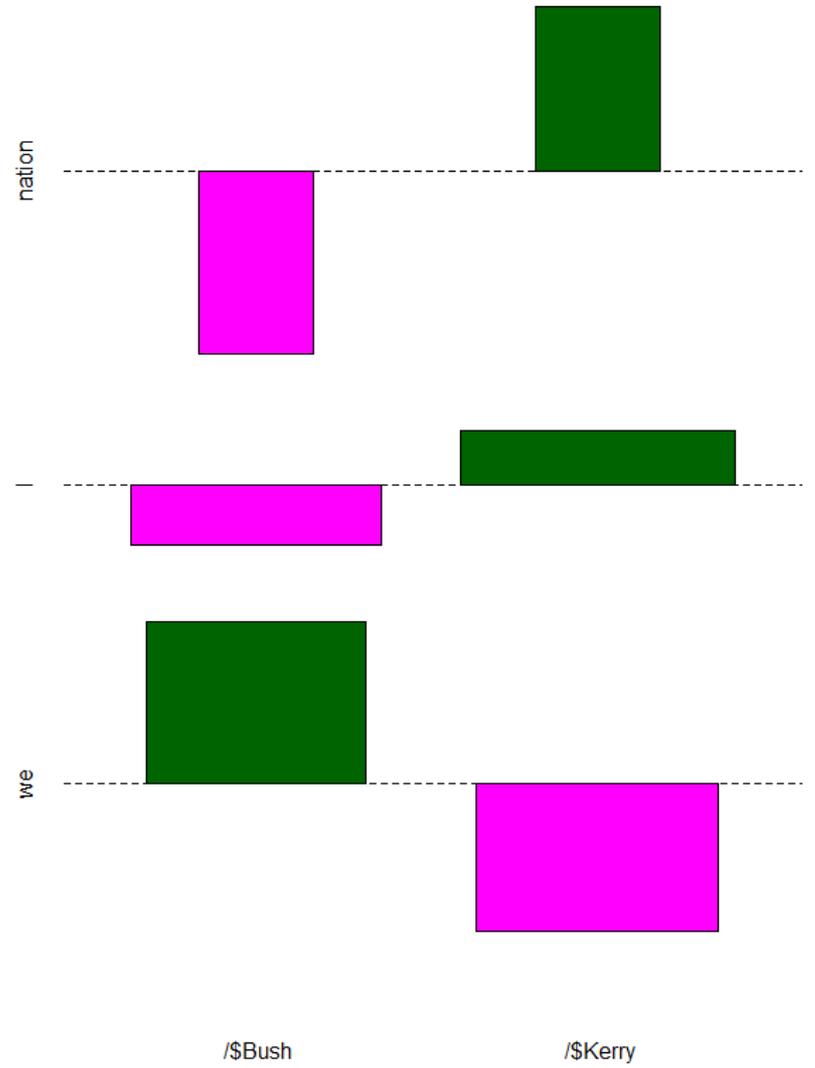
Bush vs. Kerry



# Kerry Bush



# Kerry Bush

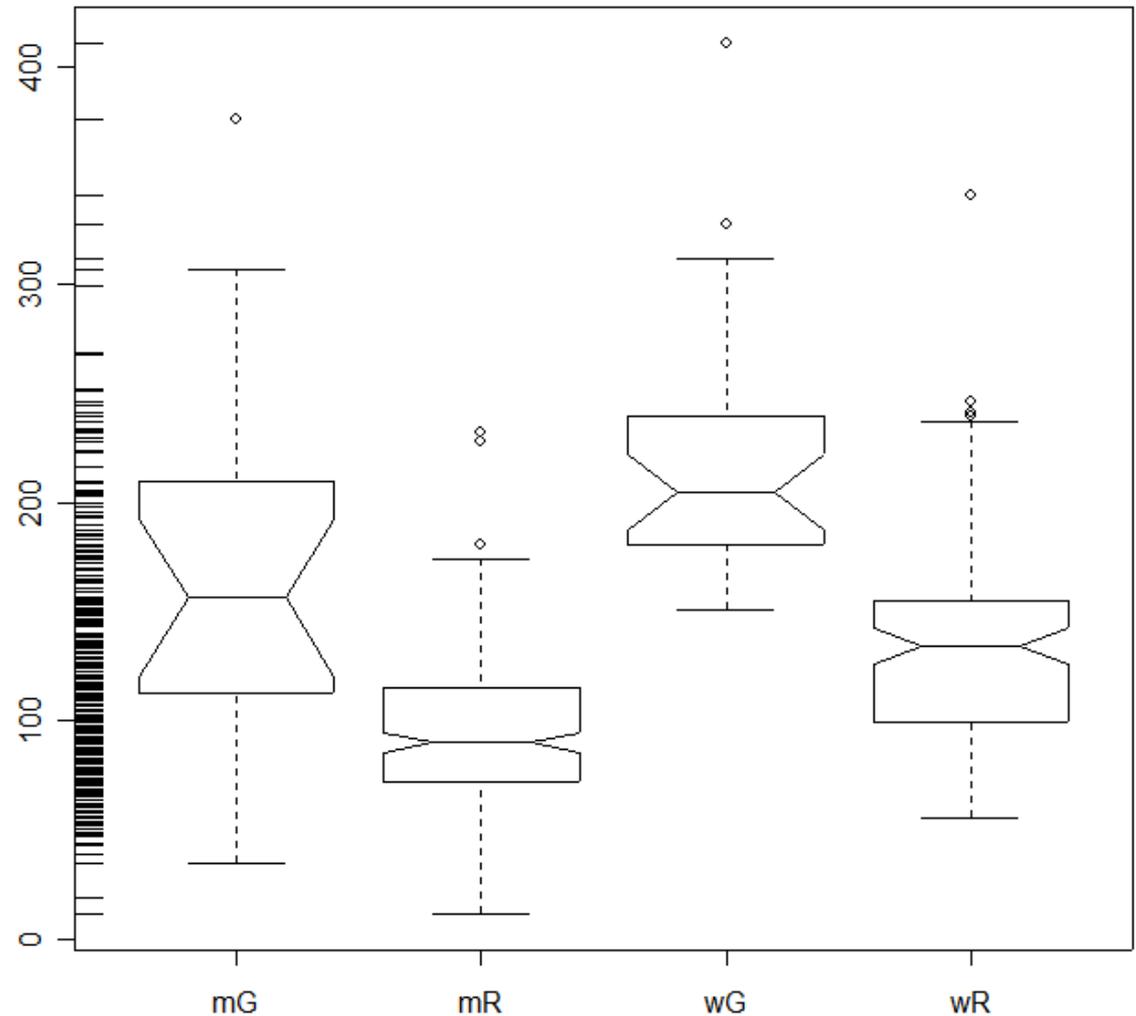


# Research example:

## Word frequencies in questionnaires (school)

groups:

- male/female
- German „Realschule“/“Gymnasium“



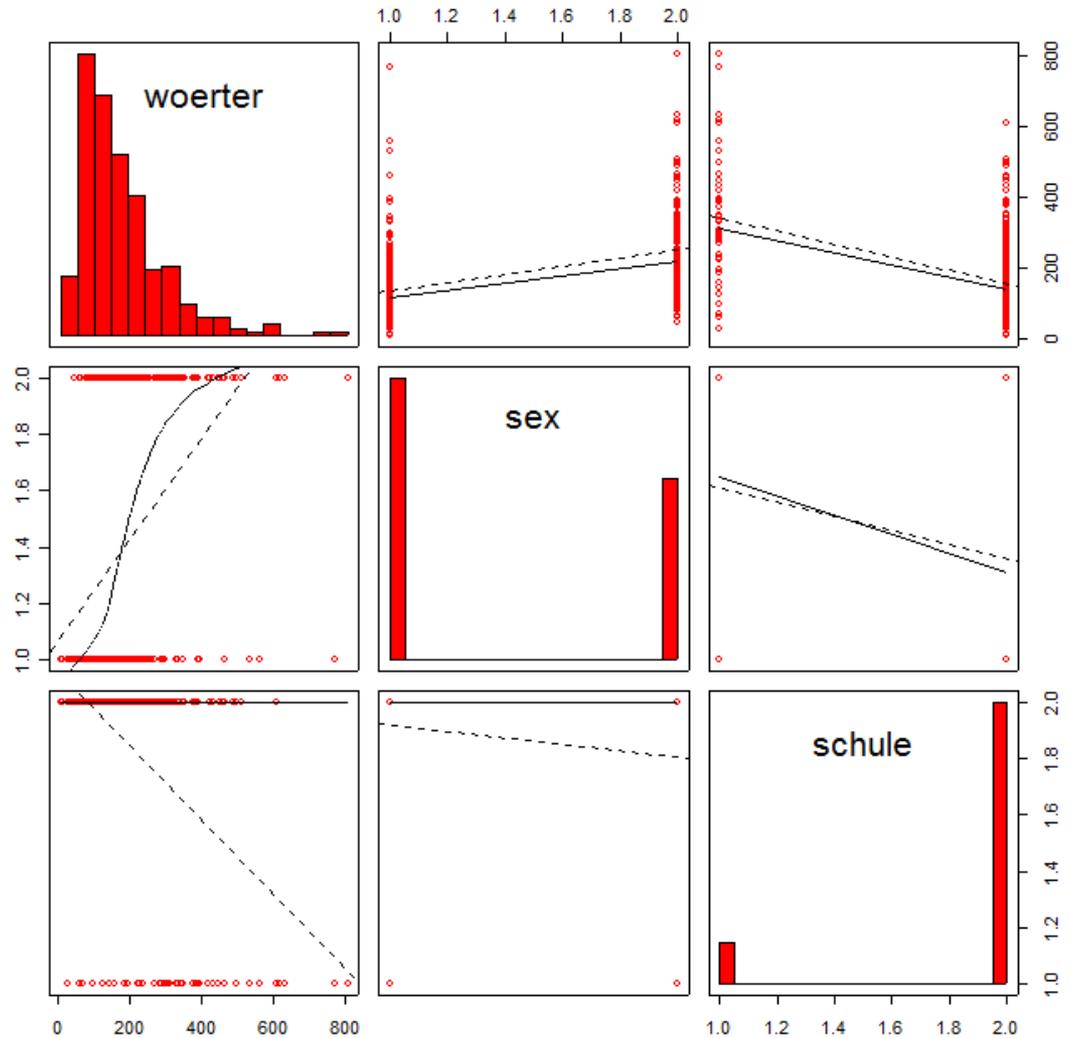
questionnaires word production: non-similar word

# Research example:

## Word frequencies in questionnaires (school)

groups:

- words
- sex
- school type

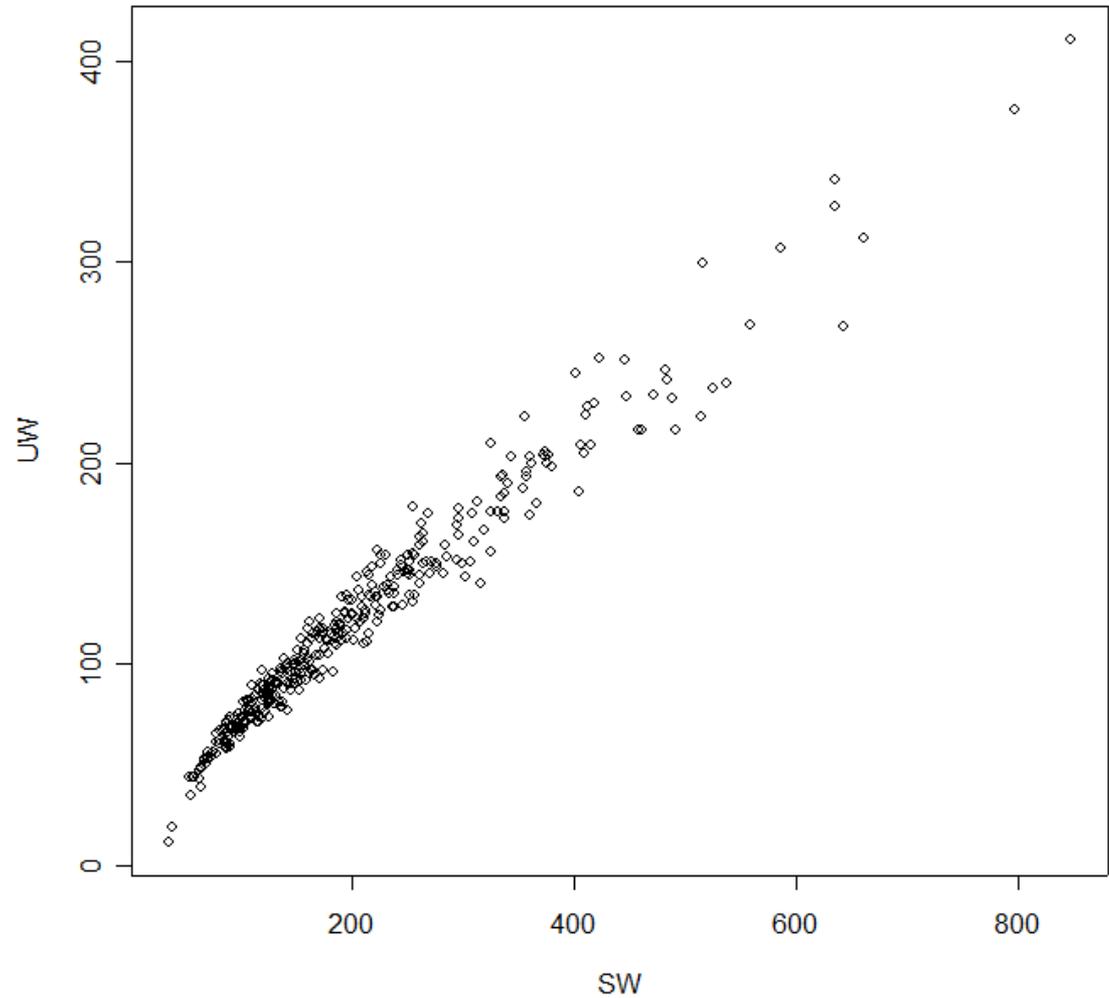


questionnaires word production: non-similar word

Research  
example:

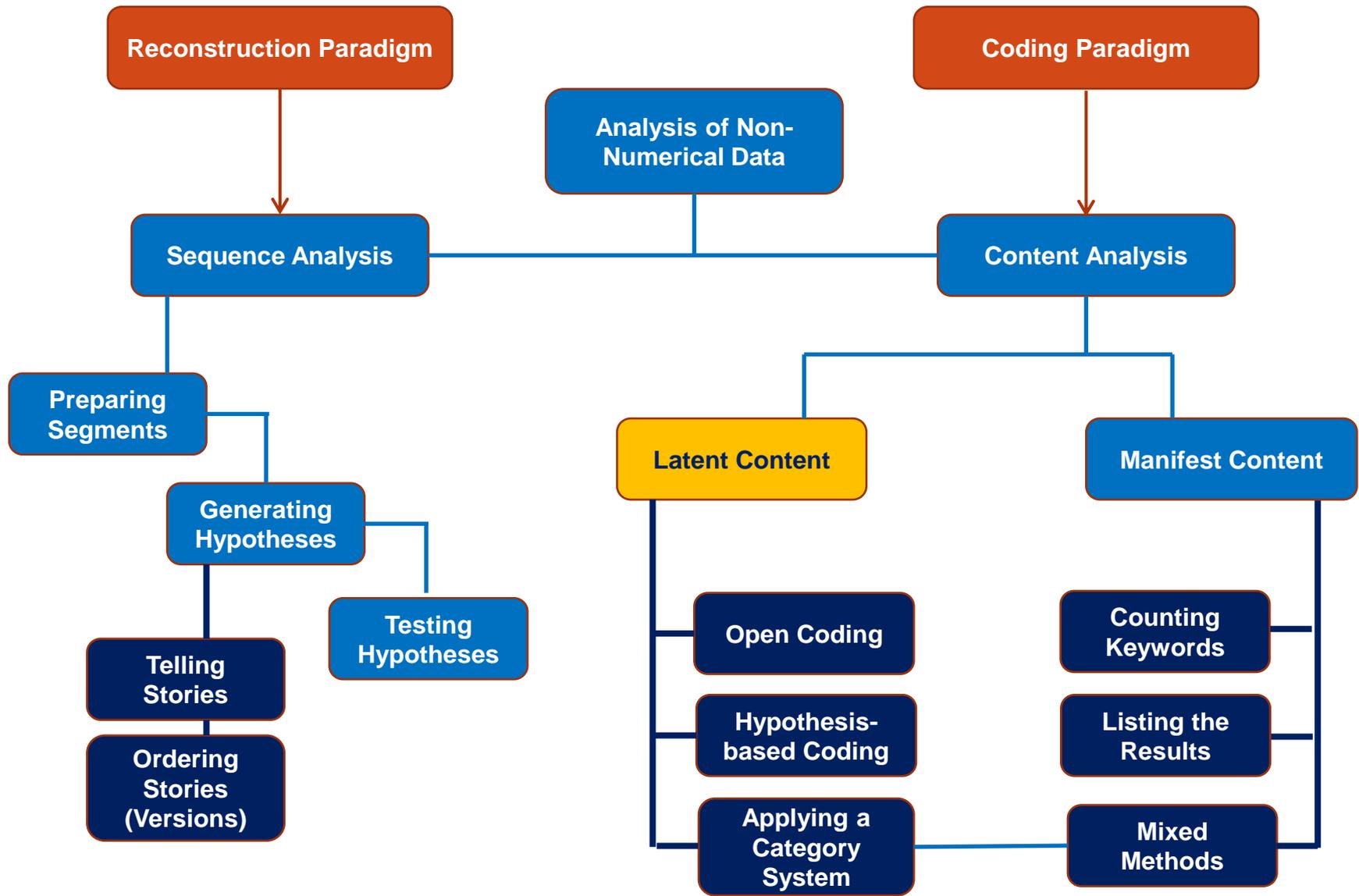
Word  
frequencies in  
questionnaires  
(school)

Fragebögen Korrelation: SW und UW



scatterplot -> exploration of  
correlative relationships

questionnaires word production



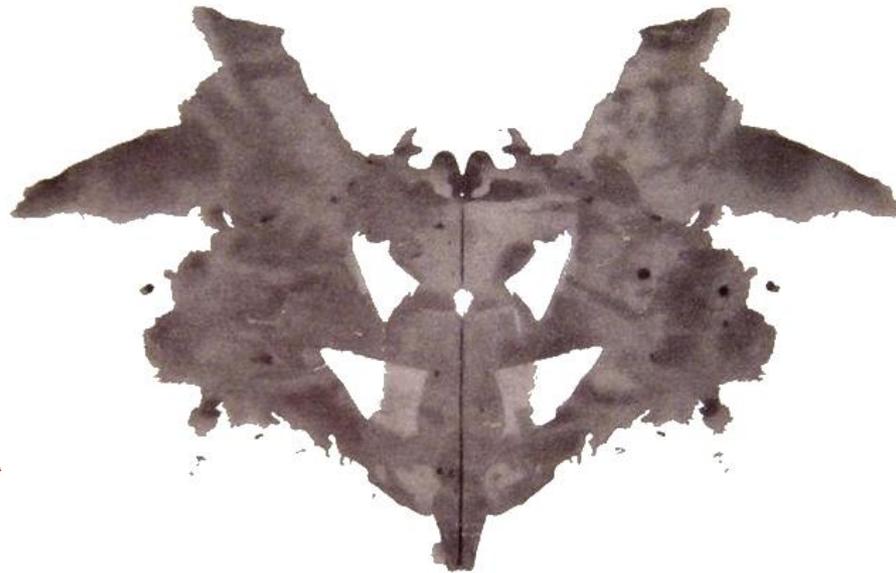
# Analysis of Latent Content

# Qualitative content analysis

- Reconstruct the latent level of meaning

What do you expect?

What do you see here?



# What are latent contents?

- ...and what are typical research questions related to the reconstruction of latent content and hidden meaning?
- ...which questions are not related to latent content?

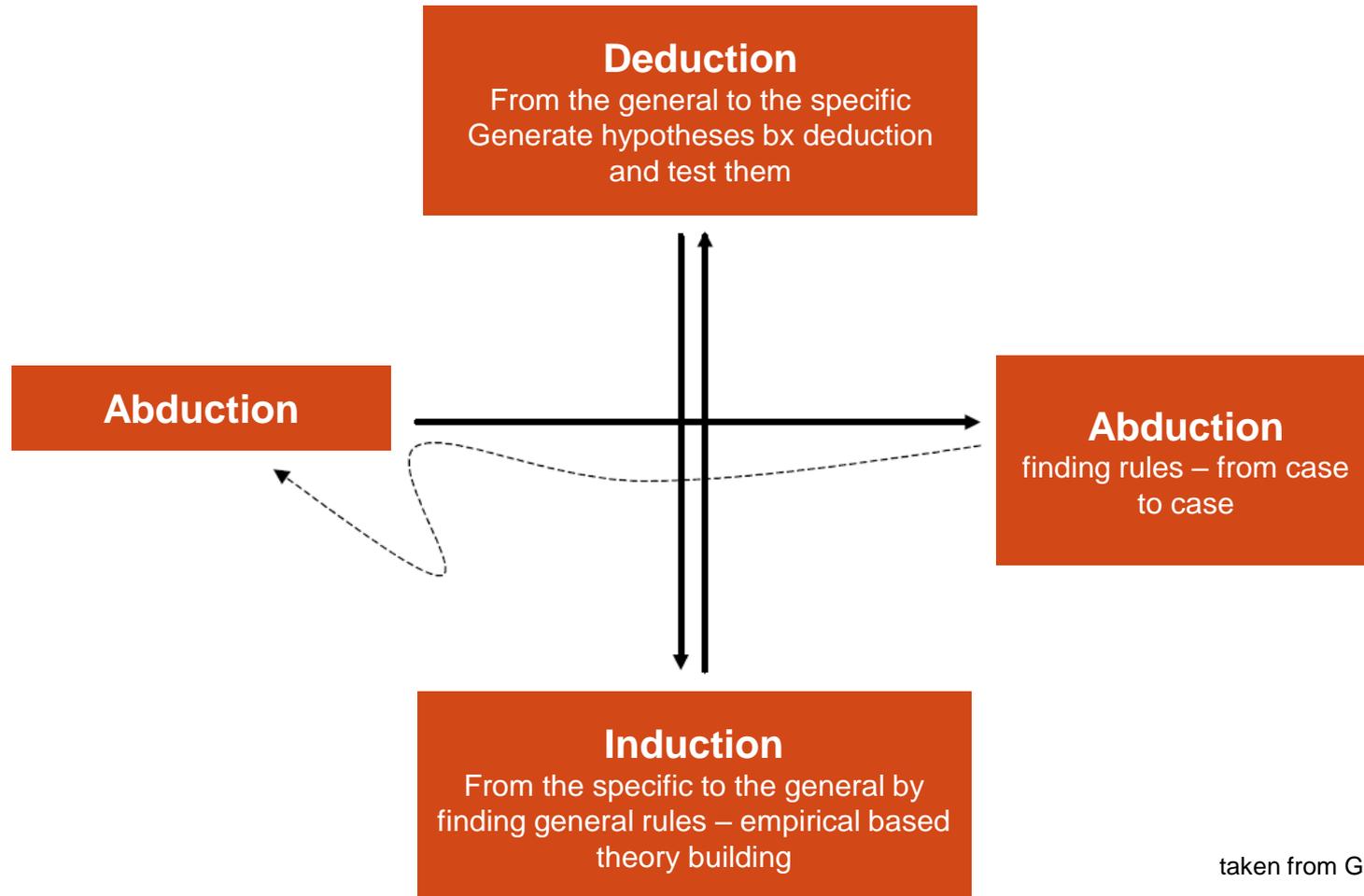
# Qualitative content analysis

- Qualitative content analysis in accordance to Kracauer targets to find out the hidden meaning, ie. the latent meaning, of data
- Different approaches – same instruments: interpretation (but here: thinking and logical reasoning, no number-crunching)

Problem: How to ensure that the process of reconstruction of hidden meaning is realized in a systematic, scientific, and serious way? This leads to the question of objectivity or intersubjectivity and/ or its appropriateness, necessity, etc.

*In short – criteria of scientific working*

# How to find categorial codes



taken from Gürtler (2005).

# How to find categorial codes ...



# How to find categorial codes ...

- Application of available category systems
- Hypothesis-based categorization
- Development of categories by empirical-based "theory-building"

# Example: Category system by Flanders

- Already in 1970, Ned Flanders made the usage of observation protocols popular in the research of teaching. His "Flanders Interaction Analysis Categories" (FIAC) consists of 10 behavioral categories to measure the interaction of teachers and students. Trained observers used the protocol and drew a picture of the various processes that took place in class.
- Within these observations, researchers investigated the typical patterns of social interactions.
- Flanders' work encouraged many scientists to develop their own specific context-based observation protocols.
- see also: <http://education.stateuniversity.com/pages/2488/Teaching-METHODS-STUDYING.html#ixzz28n2LQ6HW>

<b>Teacher Talk</b>	<b>Indirect Influence</b>	1. <i>Accepts feelings:</i> Accepts, clarifies positive or negative feeling tone in a non-threatening way.
		2. <i>Praises or encourages:</i> Praises or encourages student behavior or action.
		3. <i>Accepts or uses ideas of student:</i> Clarifies, builds, or develops student ideas.
		4. <i>Asks questions:</i> Asks content or procedure questions for students to answer.
	<b>Direct Influence</b>	5. <i>Lectures:</i> Dispenses facts or opinions about content or procedure, expresses ideas, asks rhetorical questions.
		6. <i>Gives directions:</i> Gives directions, orders, or commands that students must obey.
		7. <i>Criticizes or justifies authority:</i> Makes statements to change student behavior from non-acceptable to acceptable; explains why something is being done.
<b>Student Talk</b>		8. <i>Student talk-response:</i> Students respond to teacher; teacher initiates contact or solicits student response.
		9. <i>Student talk-initiation:</i> Students initiate talking. Observer decides whether student wanted to talk.
<b>Silence or Confusion</b>		10. <i>Silence or confusion:</i> There are pauses, periods of silence, periods of confusion, or communication not understood by observer.

Adapted from Flanders, 1970, as cited in Aspy & Roebuck (1977), p. 270.

# Hypothesis based coding

- The research questions lead to hypotheses that give a direction while searching for units of meaning within the data. Along with these hypotheses categories and coding rules are worked out.
- However, the decisions about specific categories are made at the time of creating the research design and frequently even before data collection.
- The leading questions of an interview are based on deductive reasoning based on these hypotheses.
- As a result not every bit of the data fits to this deductive based categorical system. Then, inductive reasoning to build new categories is required to prevent a loss of important information.

# Glaser & Strauss (1967; 1979): *Discovery of a "Grounded Theory"*

- The term „discovery“ emphasizes the essential difference to methodological approaches that are dedicated to confirm existent theories. "Grounded Theories" are built during and caused by the process of content analysis & coding.
- This process starts with an observed phenomenon within the data which the researcher tries to understand and to explain – it does not start with a theory with the goal of falsification (Strauss & Corbin, 1990).
- The approach requires a maximum of interpretive skills. Whereas hypothesis based coding can rely on a general orientation in the data, the discovery of a theory is faced by the challenge to get a grip about the story hidden in the data themselves.

# Different kinds of Coding (Strauss & Corbin, 1990)

- Open coding: Search for “emerging” categories
- Axial coding: Work according to general ideas and hypotheses
- Thematic coding: Abstraction of the guiding theme in the data

This will be contrasted (later) by **Sequential analysis...**

# After coding – what now?

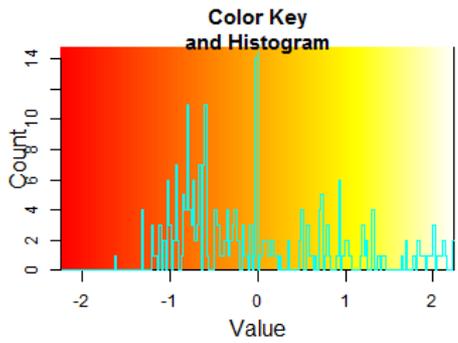
- Summarize codes to meta-codes (= ie. codes on a broader and more abstract/ hierarchical level)
- Matrix analysis (Miles & Huberman), i.e. count codes and create frequency tables (later: visualize and analyze via EDA sensu Tukey)
- Search for structures within codes:
  - Formulate hypotheses about relationships within the codes
  - Test hypotheses on the data (text) and add the (positive) results as new and unique codes
  - Search for complex sequential code sequences, and perform another matrix analysis sensu Miles & Huberman

# Research example

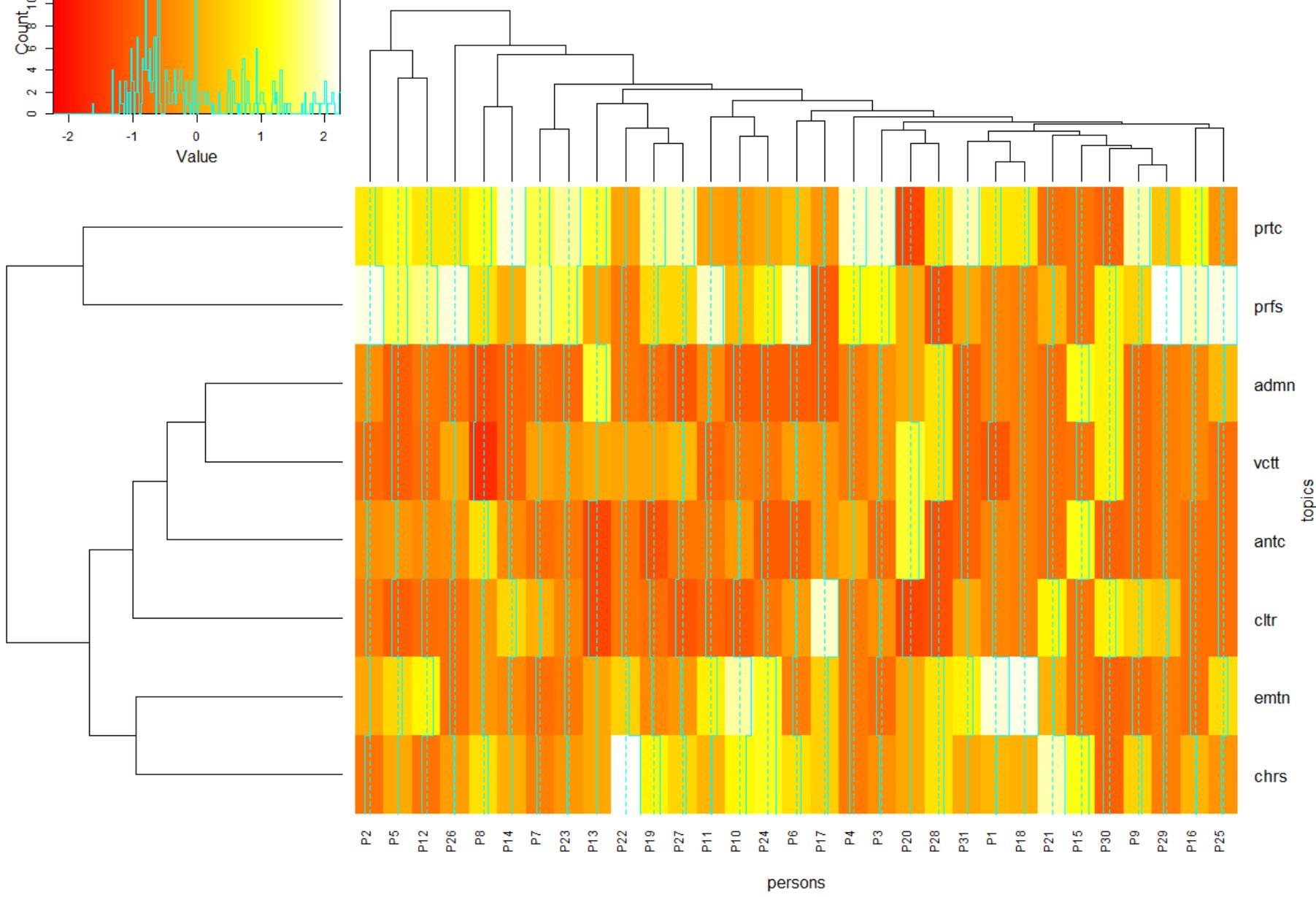
- Research study from Spain about **leadership in school**
- *Base*: n=31 interviews (=cases)
- Coding of the interviews with AQUAD 7
- *Topics* (Meta-Codes): Charisma, Emotion, Anticipation, Professionalism, Participation, Culture, Further Training, Administration
- *Graphical visualization* of data to explore the topics and possible relationships between (meta-)codes and between cases

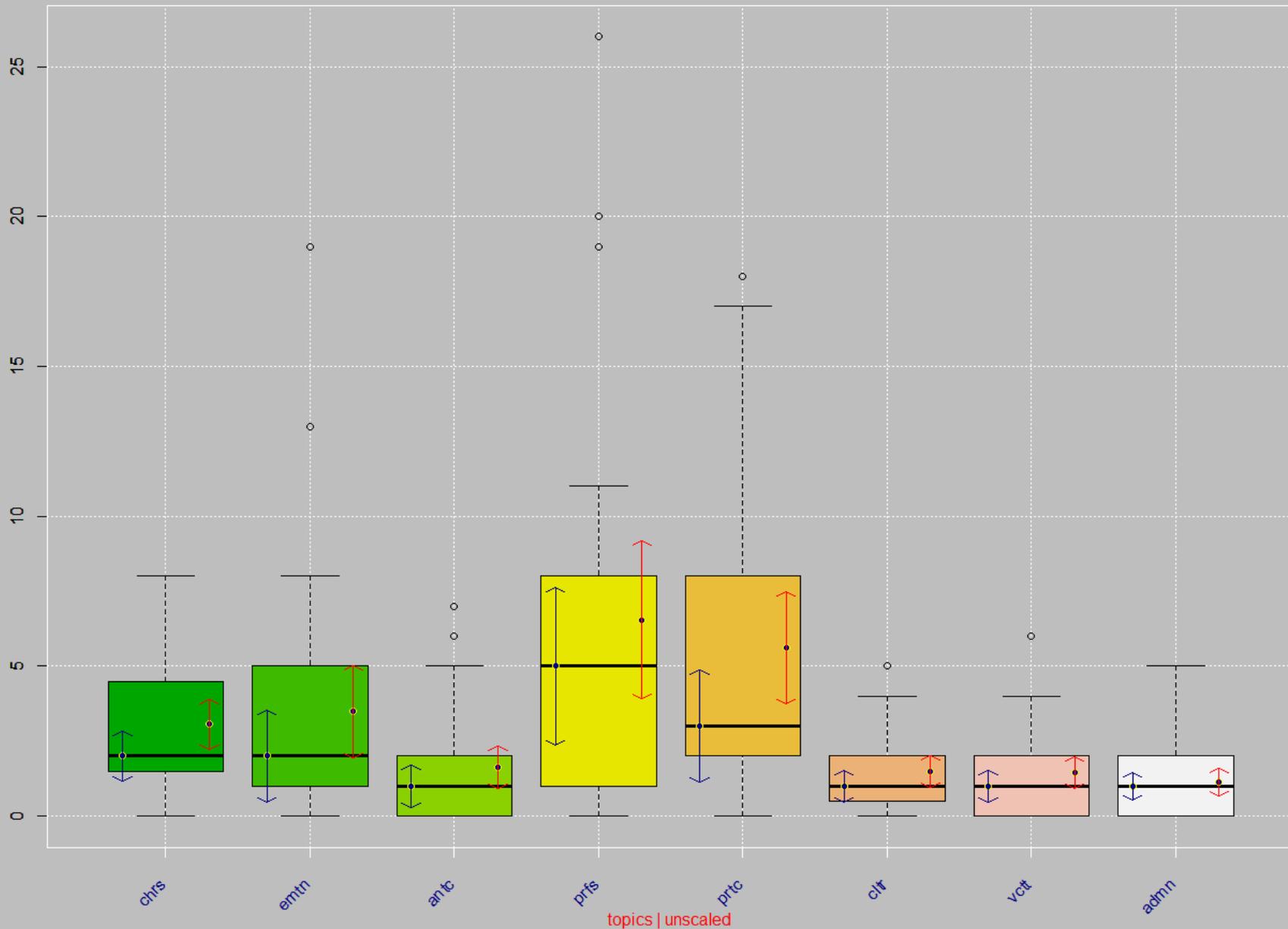
# Questions related to the research example

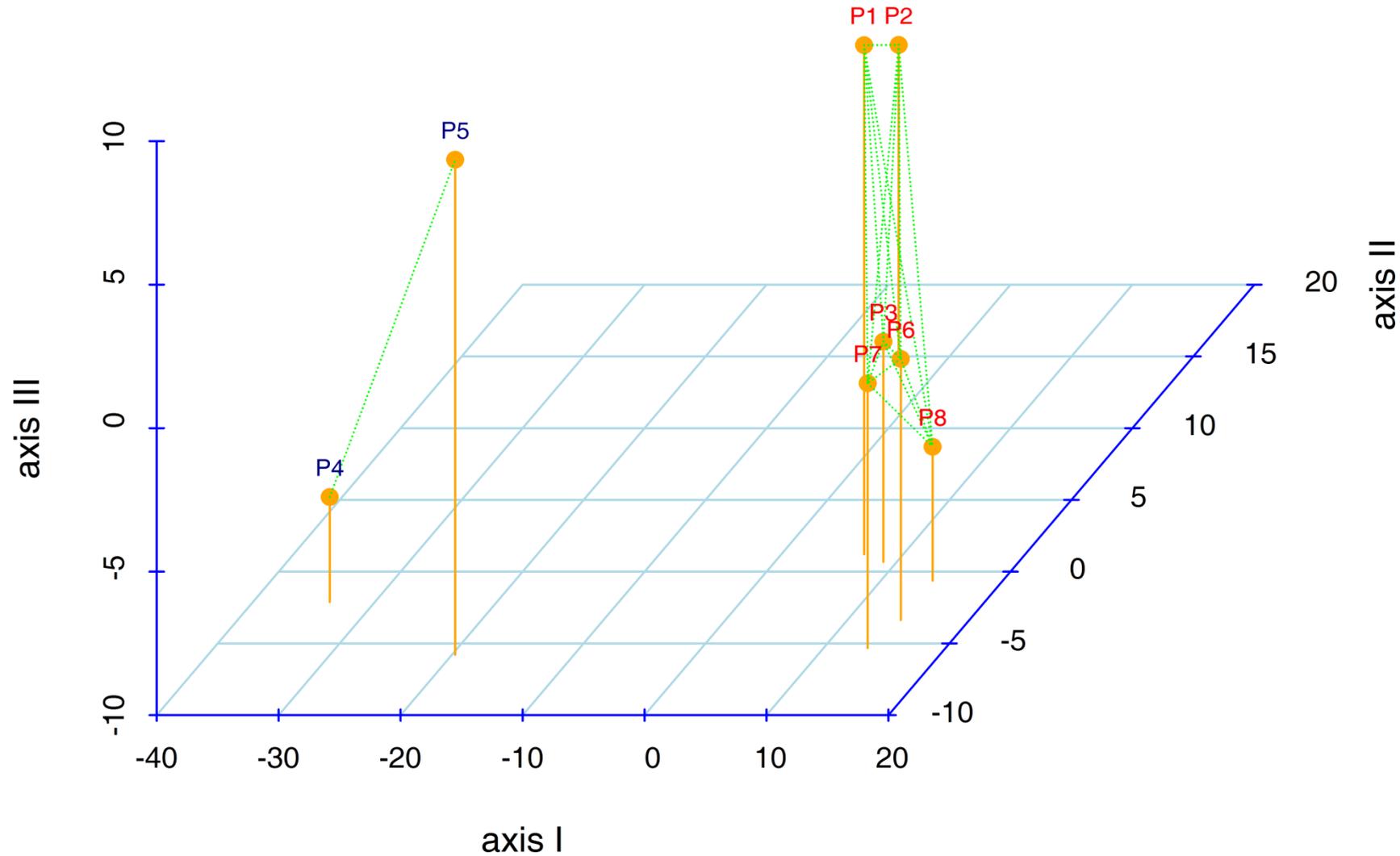
- How can we – hypothetically – answer the research example of leadership in the Spanish school system? Try to imagine ... No reality necessarily involved.
- ... OR – what do you think – which topics are definitely not part of the answer? What do you expect?
- What about the latent meaning – what at all is latent in this context?



euclidean | average







# Conversion designs and exploratory statistics

- **Conversion design 1.0:** In most social studies socio-demographic data include metric data, for instance, age or years of professional experience of respondents of a questionnaire. These data are regularly grouped and converted into nominal data, which structure further analyses.
- **Conversion design 2.0:** A typical example is the method of quantitative content analysis, which is based on critical keywords (qualitative phase). Their frequencies are then (quantitative phase) analyzed statistically.

# Conversion design 3.0

- combines a full qualitative analysis with exploratory data analysis usually in sequential order.
- The first strand represents a fully marked qualitative study with interpretative results based on a well-founded and justified coding system. The conversion of critical codes in frequency data allows statistical analyses that help to reveal additional structures or patterns of meaning within the data.

# EDA in conversion designs 3.0

- EDA assists to explore the data with more depth and to see implicit patterns or data structures, which are not necessarily visible by means of exclusive qualitative, i.e. interpretive analysis.
- EDA invites to play with the available data and reveals expected or unexpected data patterns – or the absence of such patterns.
- “Far better an approximate answer to the right question, which is often vague, than the exact answer to the wrong question, which can always be made precise.” (Tukey, 1962:13)

# Analysis of pictures and graphs

...same procedure ...similar results

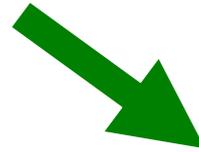
Codieren: Bilder (Projekt: Blüten)

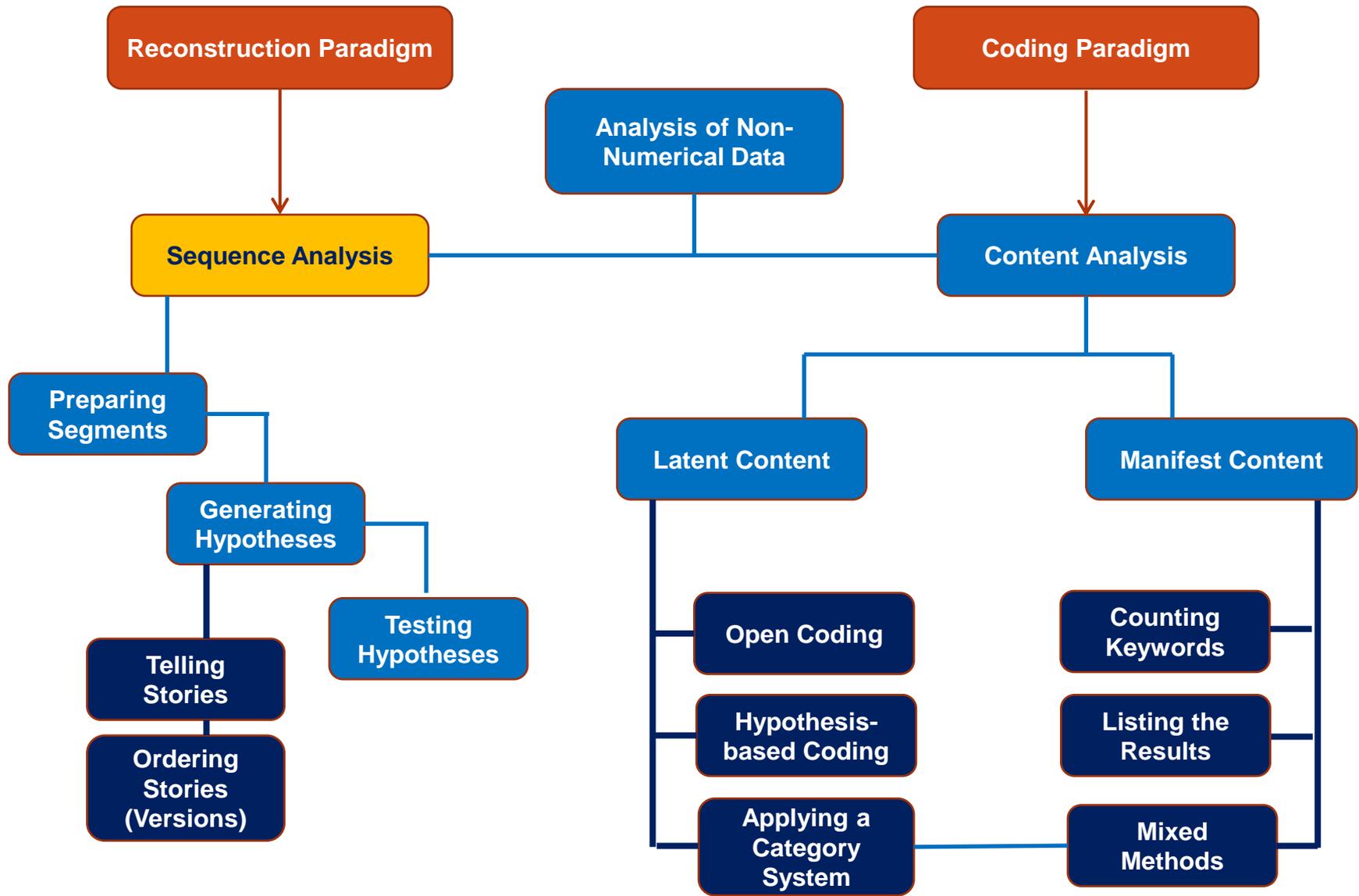
Memo	von	bis	Code:
0	29/99	428/274	Perigon
0	173/41	302/153	Sepal, mittleres
0	30/100	205/205	Sepalen, paarige
0	129/276	185/389	Seitenlappen
0	145/208	193/276	Höcker
0	154/135	317/195	Petalen
0	172/372	216/403	Anhängsel
0	183/167	277/240	Bestäubungsapparat
0	184/217	204/234	Basalschwiele
0	194/231	256/273	Basalfeld
0	231/300	292/402	Seitenlappen
0	251/228	270/243	Basalschwiele
0	258/210	299/301	Höcker
0	278/142	426/275	Sepalen, paarige



Now to something completely different – **sequential analysis** ...

## Craft and Art





# Sequence Analysis

Sequential analysis or „structural hermeneutics“ (German sociology)

*[...], as long as I live*

27.06.2012 (AM)

...or any other well-known citation

*I have a dream ...*

28.08.1963 (MLK)

...What can you derive from a single sentence? Or even a few words?

Is there already some meaning involved?

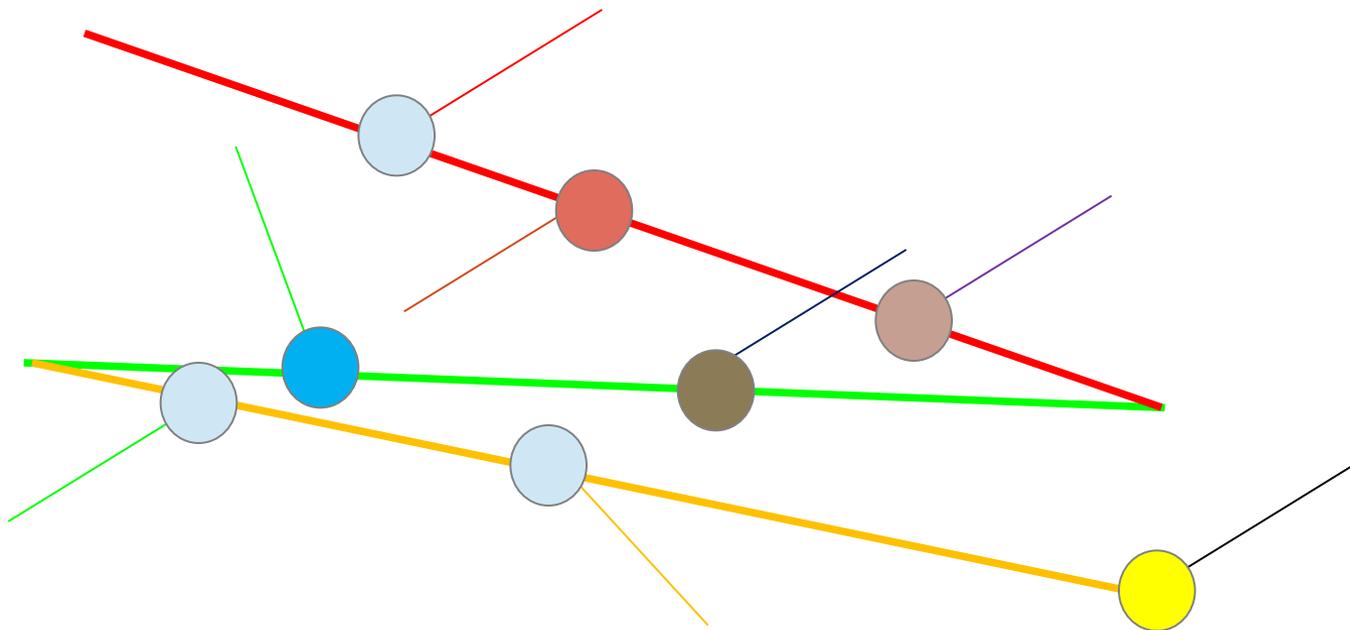
Or is it meaningless?

**Let's try...**

# Strategy

- *Sequential analysis* is not very known in non-German speaking countries. It starts not by gaining an overview of the material, separate it into small bits of information, and apply existent hypotheses on them, etc..
- *Instead* – we start with a single part of the data and proceed step by step in order ie. in strict sequence! Along the way, we make notes of every thinkable and relevant meaning related to the part that is discussed at the moment.
- We create hypotheses about the future of the text – and test these hypotheses on the text while using the next segment of the data.

# Reconstruction of structures



# Objektive structures of meaning

- Goal of sequential analysis according to Oevermann et al. (1979) is to use texts as protocols “of real, symbolic mediated social actions and interactions” (p. 378). The goal is to reconstruct the hidden latent meaning based on objective data and methods and contrast it to the manifest meaning:
- "Interaktionstexte konstituieren aufgrund rekonstruierbarer Regeln objektive Bedeutungsstrukturen und diese *objektiven Bedeutungsstrukturen* stellen die *latenten Sinnstrukturen* der Interaktion selbst dar." [kursiv im Original]

..which can be translated to:

- A text is always based on rules which can be reconstructed.
- A text constitutes itself because of these rules with patterns of objective meaning.
- These patterns of objective meaning themselves are the latent structures of meaning of the text itself.
  
- ... it is a little bit like Münchhausen or bootstrapping. You reconstruct the hidden meaning directly from where the meaning takes place.

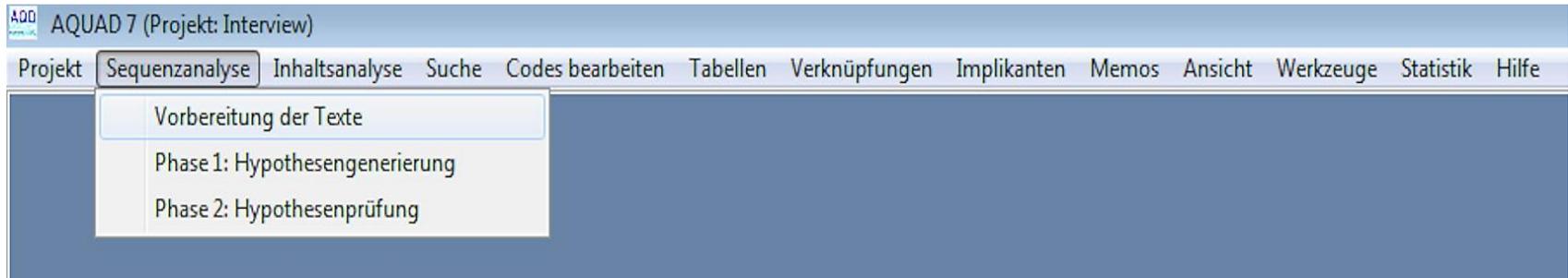
# Sequential analysis

- Sequential analysis starts with a unique and single part of the text, e.g. the introduction. For each segment all thinkable and hypothetical meanings are created. We ask „How can we interpret this part? What story does it tell us – and how does the story goes on?“
- A segment of the text can be anything: full sentences, parts of a sentence, or even words, phrases, a specific amount of words, etc. There is no fixed rule. The segments will be defined before the analysis.
- The generation of hypotheses is a strictly hypothesis based sequential process: the text will be interpreted step by step without neglecting anything nor relying on future, not-yet-seen data. This represents the scientific principles: hypotheses building and testing.

# (preliminary) Case structures

- If we work in this order, step by step many hypotheses are formulated and almost all are falsified. But is left becomes thicker and richer in its meaning and its scope.
- At some point we realize that the „structure“ repeats itself – it does not seem that something new is gained by working further. That is the point a preliminary case structure can be formulated. It answers the following question: „**What is the case?**“
- Then – the preliminary case structure has to be challenged at other critical parts of the text to proof its stability and substance.

# Main menu – AQUAD Seven



# Create data segments

Define units of analysis

## Länge der Sequenzen

- Satzteile (bis zum nächsten Satzzeichen / S-St)
- kompletter Satz (bis zum Satzende / S-kS)
- 5 Wörter (S-5)
- 10 Wörter (S-10)
- 15 Wörter (S-15)
- 30 Wörter (S-30)
- 50 Wörter (S-50)
- 100 Wörter (S-100)

# Generate hypotheses ...



Only risk makes a  
scientific theory  
really scientific –  
why?

***risk... and failure***

# Generate hypotheses (Rule: make notes of everything)

Text: Sequenzanalyse - Phase 1: Hypothesengenerierung

Nr.	Gruppierung	Hypothesen	Anfang	Ende	Sta.	Verw.	Typ
1		P nimmt an, dass Piet für die Lösung relevant ist.	1	1			

1 P:- Steht bei dir, in welcher Gruppe Piet ist?

Schreiben Sie hier eine Hypothese:

Status:  bestätigt  falsifiziert

Verweis:

Typ:

Rückgriffe:

Hypo. speichern

Segment erweitern

{s- kS}kooperationsprotok

Schließen

Hilfe

Hypothesen ordnen

- nach Segment
- nach Status
- nach Typ
- nach Tragfähigkeit
- nach lfd. Nummer

MEMO schreiben

MEMOs suchen

- zu aktueller Datei
- zu anderer Datei
- zu Hypothese Nr.

Make notes of everything that can be imagined – an example:

Segment 1: **"Hallo, hallo!"**

??? What does this mean?  
Tell a story!

# An example

Segment 1: **"Hallo, hallo!"**

- Someone tries to call attention to someone.
- Someone tries to call attention to someone who lost something.
- Someone opens a door and greets a visitor.
- Someone greets someone else while walking fast along.
- Someone expresses anger.
- Someone tries to call unspecific attention.

Next step: categorize stories according to „interpretation“ (German: „Lesart“)

- Three types of interpretation of the segment "Hallo, hallo":
  - (1) call attention
  - (2) greetings
  - (3) express anger

# Structural analysis: Latent structure of meaning

- The latent structure of meaning can be reconstructed by applying the rules that every interaction is bound to. Oevermann et al. (1979, p.370) name „syntactical rules, pragmatical rules, rules of sequencing of interactions, rules how to distribute contributions, etc.". These relationships can be made accessible from the text itself. The interacting groups or people not necessarily have to be aware of the way the text is emerges or even be aware of the underlying latent structure.
- In short: **the case always reveals itself** – you have nothing to do except performing proper analysis.

# Step-wise procedure – sequential!

- Oevermann et al. (1979, p.354) state that this approach is based on simple and almost trivial assumptions that are used for reasoning.
- But – we have to stick to them very thoroughly.
- However, these assumptions lead to very strict methodological consequences. It must be noted that **no infos of later incidents must be used to interpret previous incidents** (Oevermann et al., 1979, p.414).
- Or – as Wernet (2009, p.28) emphasizes: “We do not search along the text to find something usable, instead, we follow the protocol/ text step by step along its natural development.”

# Five rules to generate hypotheses

- (1) ignore the context (Kontextfreiheit)
- (2) strict formal interpretation (Wörtlichkeit)
- (3) sequence order (Sequentialität)
- (4) everything is equally important (Extensivität)
- (5) economy (Sparsamkeit)

## ***(1) Ignore the context (German: Kontextfreiheit)***

- Of course we must consider the context of the origins of the text while interpreting. But only afterwards at a stage when we have already reconstructed the meaning underlying a text segment.
- At first, we invent stories in which the text segment in question makes sense. We imagine how it can be so it does make sense – and for that we have to broaden our view far beyond the „real“ context. Otherwise we stick too fast to selffulfilling prophecies.
- Instead, we have to explore the whole area of possible meaning – to contrast with the real text and its natural course.

## ***(2) Strict formal interpretation (German: Wörtlichkeit)***

- If we interpret anything, only the text itself – as being a manifestation of reality – is important. Only there we can perform analysis as well as hypothesis testing. We do not imagine and test against something that is not part of the text ie. which is not real in its nature. The text itself is operationalized as some part of reality and that's the „objective“ part. We use only objective information accessible by the text itself.

### *Consequences:*

- (1) This working procedure requires the text in its original form without changing it in any way – e.g. a true-to-audio transcript is valid, but no paraphrases are allowed!
- (2) Interpretation is done rather finical. It is not allowed to ignore hazy or inappropriate looking details as we do in everyday life. Wernet states that we „have to weigh one's words“ very thoroughly which would sound very pedantic in normal life.
- ***Rule: We interpret what is really part of the text.***

### *(3) Sequential order (German: Sequentialität)*

- This principle represents the core of the analysis. We work step by step along the natural order of the text without doing this jump or that one. The procedure is logic in its nature and stepwise. This means we perform a constant dance between „generating hypotheses“ and „testing hypotheses“ **directly** on the text.
- The first place to start the analysis is not fixed. It can be the first sentence, but this is not essential. But as soon as one starts the work, the sequential order is essential. Everything which follows later in the text is ignored as long as it is not the time to analyze this segment, too.

## ***(4) Everything is equal important (German: Extensivität)***

- Everything is equal important points to a **balanced principle**. Its meaning is to avoid subjective, impulsive, and arbitrary interpretations. What seems to be an unimportant detail is equal important to everything else. There is no reason to focus on “obviously” important parts of the text or ignore other information. Importance or non-importance is a product of subjectivity, not of science per se. If we handle each text segment and every detail the same way, this leads to a situation where our imagination about possible meanings and latent structures covers the whole spectrum of possible outcomes.
- ***Rule: Do not neglect anything, do not give importance to your own subjectivity if you ignore the data as a consequence.***

# Economy...



Occam's razor

## ***(5) Economy (German: Sparsamkeit)***

- This principle requires, that we expect everything to be normal while generating hypotheses and possible meanings. We include only those hypotheses which can be falsified by the text itself.
- This narrows down the possible hypothesis space („story telling“) to those variants that are in line with the text.
- We do not create science fiction here nor does we allow esoteric stories or pathologies not based in the text.
- ***Rule:* Everything is handled as normal unless the text proofs that it is not.**

# Testing hypotheses



# Part 2 – critical testing of hypotheses

- On the methodological level, we follow the principle of **falsification** as laid down by Popper (1934). We drop a hypothesis after falsification and we maintain it unless it is falsified. In this sense there is no verification of hypotheses. Proving a hypothesis wrong just means that the hypothesis in question is not in line with the text.
- In this phase we do not work in sequence order anymore. Instead, we search for those parts of the text that have the biggest impact to bring down (“falsification”) the preliminary case-structure (= hypothesis construct).
- We explicitly search for counter-evidence to falsify our preliminary case-structure.

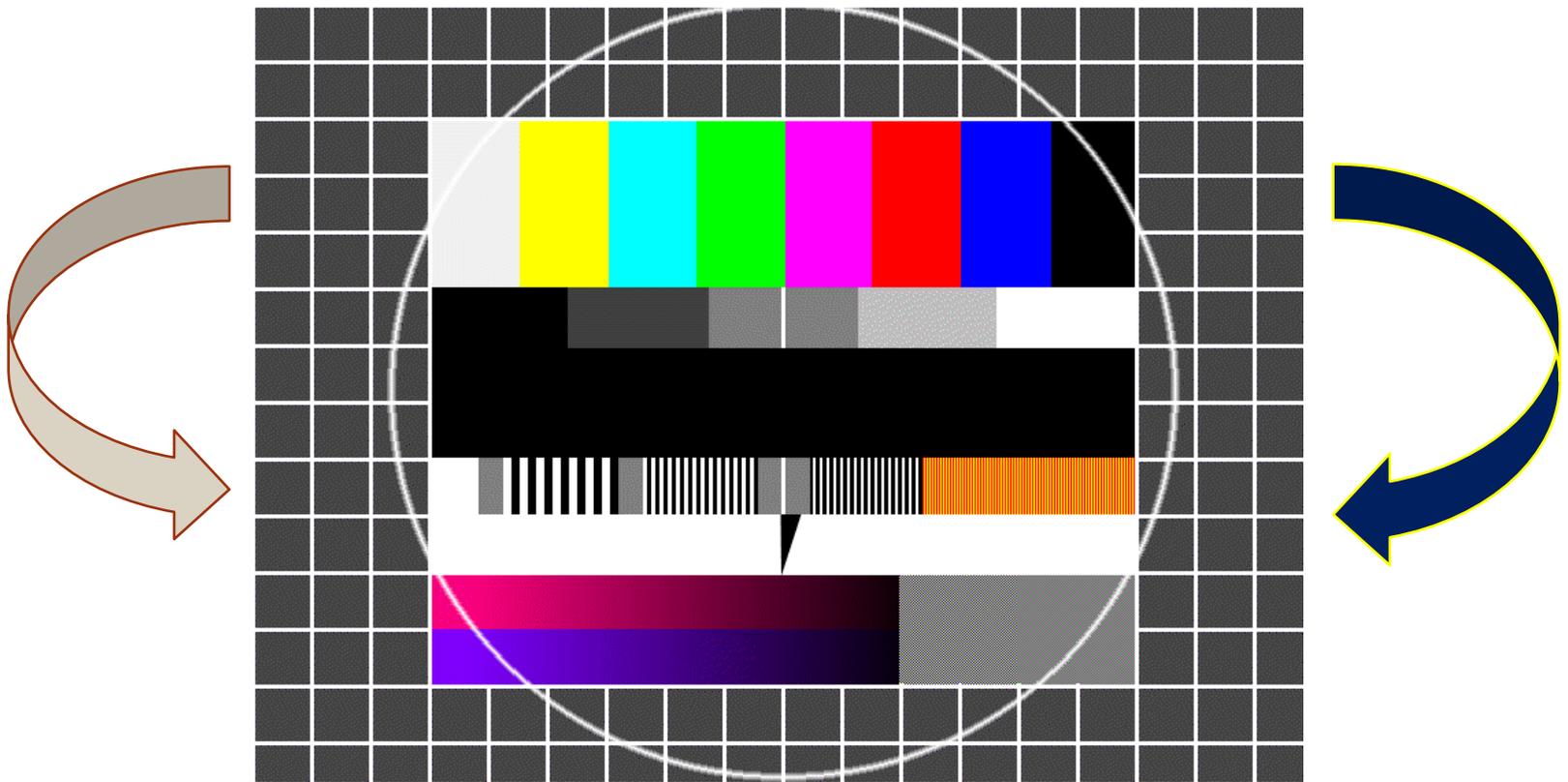
# General attitude while interpreting

- The process of sequence analysis follows the text (and all incidents) in its natural order as it is the case.
- Wernet (2009, p.27) emphasizes the importance of our “interpretative attitude” which means we have to take the text really serious. It is not a market of information we can use to put in some meaning that suits us. We should not make use of meanings in an inflationary manner.

# Objektive vs. subjective meaning

- The objective structure of meaning or the latent pattern of significance has to be analyzed before we consider the subjective perspective of those who are involved – and that can be a different source of data of course.
- Oevermann et al. (1979, p.380) are very precise when they use the term “objective meaning” which means an interpretation is based on objective data / social structure – not on subjective data. These data are the pre-requisites of subjective intentions.

# Cut-off of sequential analysis – when does it end?



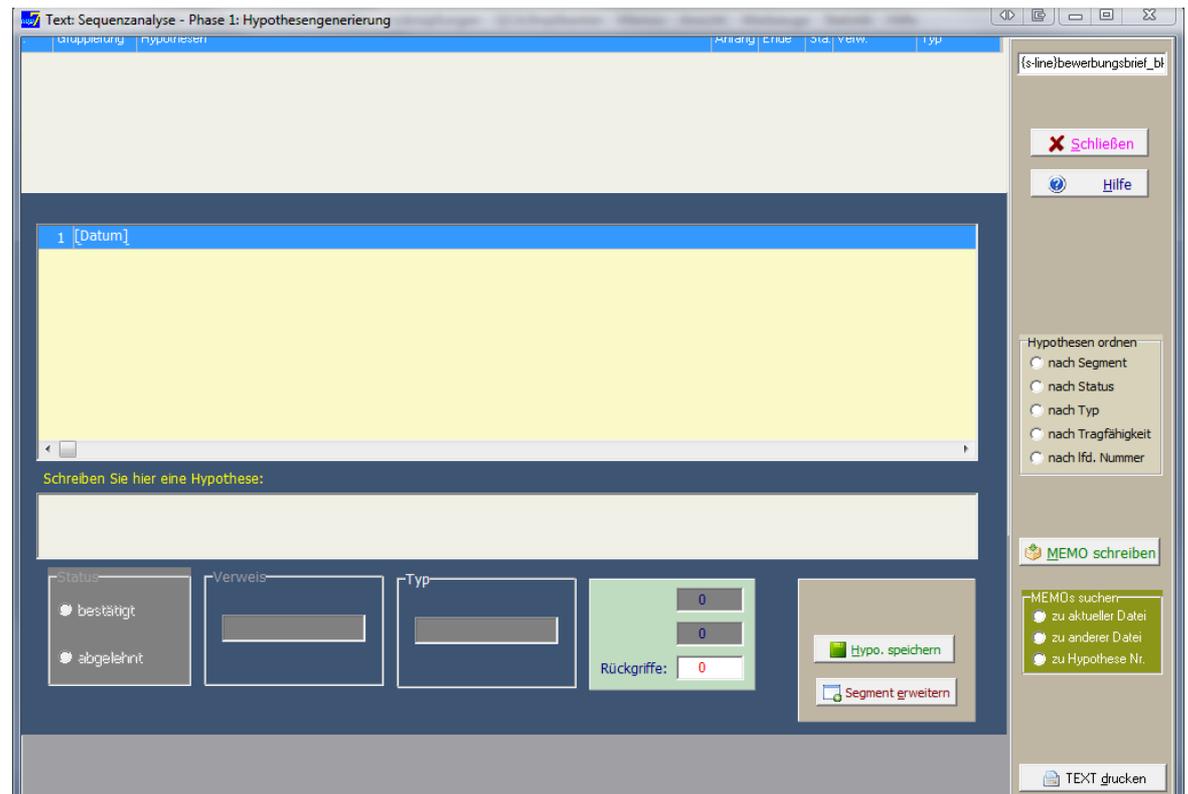
# When does a sequential analysis end?

There are two phases:

- (1) We analyze in sequence order unless the underlying case structure is reproduced once – but fully (Oevermann, 1996). The assumption is that this structure recreates itself continuously. Therefore there is no need to analyze all data, but rather analyze some data but very thoroughly. This ensures not to neglect anything. In sum, this leads to a preliminary case-structure.
- (2) We search for counter-evidence to falsify our preliminary case structure. If it proves to be stable, this is our result. Otherwise, we have to start again (from scratch).

# Research example

- Application letter from detox (stationary psychiatry, fax) sent to a drug-addict center



# Research example

*Application for an interview  
[...]*

anonymous client

# Reflections about sequence analysis

- What are the differences between coding paradigm (ie. content analysis) and sequential analysis
- Are there any similarities between them?
- How does it work in research practice?
- Is it possible to combine these approaches?

# Search and find configurations ...

- *Base*: Boolean minimization (pure logic)
- *Goal*: Find code configurations for subgroups/ cases
- *Application*: type building, meta-analysis, find minimal sets of codes (categories) that are sufficient for an outcome to become true or false
- *Criteria*: positive or negative (both required)
- There are no objective criteria. This is pure exploratory data analysis, but based on logic, not on statistics. It does not handle causality in reality.
- Introduced by C.Ragin (1987) into the social sciences

# Research example Boolean minimization

- Research study (Spain, interviews with teachers) (Marcelo, 1991). Starting point was the observation that young teachers talked a lot about disciplinary problems, but not all mentioned this topic.
- Research question:
  - Critical differences between teachers who mention disciplinary problems (yes/ no)

# Units of analysis

- Important topics based on interview analysis (codes):
  - A = teachers themselves
  - B = teacher-student relationship
  - C = teaching method
  - D = disciplinary problems (=criterium)
  - E = student's motivation
  - F = general class climate
- Questions:
  - Which code configurations are typical, if disciplinary problems = TRUE?
  - Which cases are covered by these configurations?

# Method and truth values

- The method works absolutely logical based on Boolean minimization – there is no number-crunching.
- All configurations (TRUE/ FALSE) will be compared with each other. There is not shortcut.
- Procedure: **If two configurations differ only on one condition but lead to the same output (TRUE/ FALSE), then this one condition can be dropped**, because it is not relevant to reach the output criterion.
- This reduces all configurations till no further reduction of configurations is possible.

# Results

- Marcelo (1991) found the following solutions:
  - $D = ABC + ACEF + abcef$
- This means there are three different groups of teachers (beginners) and each group encountered different disciplinary problems. The exact interpretation of these types is therefore important for further procedures like supervision, peer-coaching, teacher education, etc. It must be put back to the practical level.
- The method shows not only the configurations, but also the cases related to the results on the level of original data material.

# Results

- $D = ABC + ACEF + abcef$
- ...with the categories:
  - A = teachers themselves
  - B = teacher-student relationship
  - C = teaching method
  - D = disciplinary problems
  - E = student's motivation
  - F = general class climate
- Question: What does this means on a concrete level?

# Interpretation und application

- Boolean minimization requires:
  - data material is already coded
  - in case of meta-analysis -> data of research studies
  - choose a criterion (true/ false)
- The procedure gives the following output:
  - Which sets of minimal configurations related to the criterion in question (true/ false) can be identified – and which cases are covered by these minimal configurations?
- Therefor we can perform type building or do research on complex influences
- Thus, the method is fit to be used for theory building as well as post-hoc meta-analysis.

# Reprise – qualitative approaches

- What important differences and similarities can you find for the following research approaches?
  - Quantitative Content Analysis
  - Qualitative Content Analysis
  - Sequential Analysis
  - Boolean Minimization
  - Exploratory Data Analysis (i.e.. graphs of frequency tables)
- How can you apply it in your own research? What questions follow – what makes sense, what does not make sense?
- Which methods do you like and why?

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# ???

## Questions

