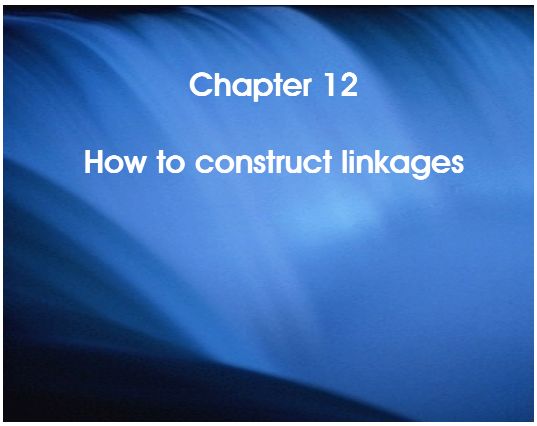


Since the hypotheses pre-formulated in AQUAD cover only a small number of possible options, the program provides you with the opportunity to formulate your own. You have to learn a few special mouse clicks, but they are quite easy to understand and to use. As already described in the previous chapter, AQUAD allows you to analyze complex relations between data. For this purpose,

- you have to draw conclusions including several different codes;
- you have to *state* that those relations do exist within your data, and then,
- you have to test whether the hypothetical statement is true or false. This is done for your own hypotheses within the module "*Linkages*", using "*Construct linkages*" from the sub-menu.

Unlike usual database programs, AQUAD compares all the elements of its database with each other on its own, applying a principle of deduction. You only need to formulate a statement, and then you can be sure that AQUAD will not forget any combination of code entries when it tests the specific conclusion. The only problem is that you need to translate your hypothesis from everyday language into a particular sequence of code names when you want to test your own hypotheses. To this end, however, you only need to be familiar with one of the windows in AQUAD and how to make use of its possibilities.

12.1 How to construct a linkage hypothesis

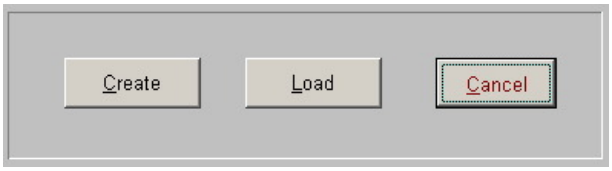
How do you translate your own hypotheses into a language which AQUAD is able to understand? To make understanding as easy as possible, we are going to construct ourselves what is already implemented in AQUAD as preconstructed linkage #1 (see chap. 11).

Let us look at the procedure with the help of a simple example, for which we will use the data of the interviews with beginners in the teaching profession we referred to in earlier chapters (see files "interview_1" ... "interview_4" on your program CD). We suppose there is a (sequential and/or causal) relation between descriptions of dilemmas and typical controversies particularly novice teachers experience in their classroom: How to maintain a balance between order and spontaneity or between discipline and positive social relations to students? Consequ ently we claim that we can find linkages between three codes: "*dilemma*", "*order/spontaneity*", and "*discipline/good relations*." Let us first formulate the hypothesis in everyday language:

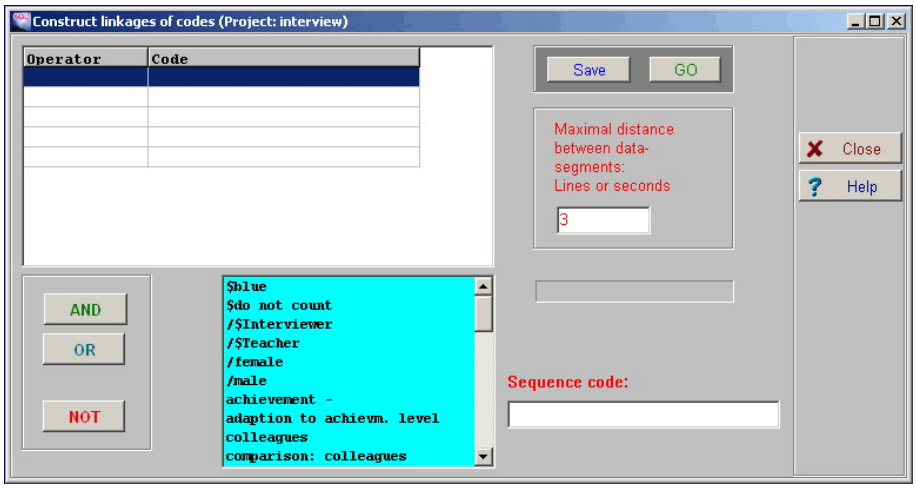
> The hypothesis is true, if
> among the codes attached to an interview transcription
> a code "*dilemma*" can be found,
> and shortly afterwards a code "*order/spontaneity*" or a code "*discipline/good relations*" will show up.

Often, the problems with constructing specific hypotheses have less to do with the principles of AQUAD, which are rather simple, than with unclear conceptions of the critical relations between the coded segments in the texts. Or to say it more directly: only if a hypothesis is formulated clearly and well structured in regular English, can it be translated into a logically connected sequence of codes!

To start we click in the menu "*Linkages*" on the option "*Construct linkages*" and select the alternative "*Create*" in the window occurring afterwards:



Here is the window for the construction of your own hypotheses. You can manage it almost intuitively, nevertheless we will describe the necessary procedures step by step:



What we see in the lower part on the left are three buttons for entering the logical connections or operators "AND", "OR", and "NOT" as well as (in the middle) the familiar blue window containing the master

code list of our project. Each linkage construction has to begin with a code that is included by "AND." The notation of linkages demands that an operator always precedes a code included in the construction. In the upper part we see on the left a box containing the real construction table (two columns: operator and code), on the right a box, where we determine the maximal distance between coded data segments (as described in section 10.3). On top of the right side are two buttons to "*Save*" our construction for later application and/or edition, and to "*GO*", that is to start the analysis. At the bottom we find the meanwhile familiar entry slot for sequence codes (see section 11.6).

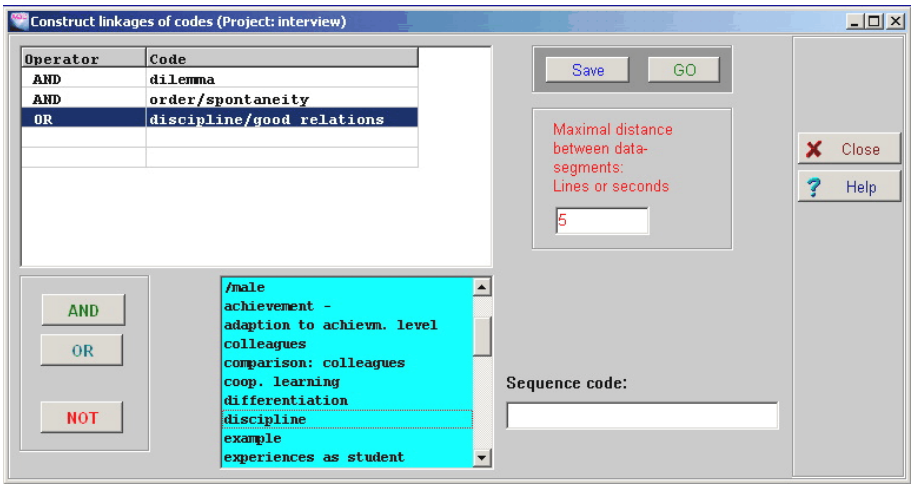
Just to make sure there are no doubts as regards the functions of the operators: If we link two or more codes by "AND", the resulting linkage hypotheses will be confirmed as true only if all of its components appear in your data within the defined maximal distance of each other. If you attach a code together with the operator "NO" the resulting linkage hypotheses will be confirmed as true only if this particular code does not occur at all in a data file.

Besides entering operators and codes we have to decide which maximal distance (see section 10.3) should be accepted between codes, or better their data segments, under the conditions of our hypothesis – except "NO"-operated codes (see above). Distances are expressed in the amount of lines between end of a preceeding and begin of a succeeding data segment in case of text documents. If we work with audio or video documents, the number you enter is automatically converted into the appropriate unit: seconds in case of audio files (1 unit -> 1 second -> 10 units of segment limitations in your code files, where positions are counted in $1/10^{th}$ of seconds), frames in case of video files (1 unit -> 1 second -> 25 frames).

Now back to the linkage hypothesis we suggested in the beginning: Our hypothesis will be confirmed, whenever the program can find in a text file of the project a code "*dilemma*" AND within a distance maximally five lines from the corresponding data segments another segment coded "*order/spontaneity*" OR "*discipline/good relations*." How do we enter operators and codes? Let us proceed step by step:

We click into the first empty cell for operators and "activate" it for an entry. At the beginning of a linkage construction, AQUAD fills the cell in this moment automatically with an "AND," whereas in the following operator cells you have to click – after activating the cell – on the appropriate operator (AND, OR, NOT). The you go to the second cell in this row, the code cell: click somewhere into the cell to activate it, then select a code from the master code list (by clicking, as usual).

In our example we select "*dilemma*" to fill the uppermost code cell. The next steps are just repetitions with variations: Clicking on the second operator cell activates it, then we fill it with "AND." We move the cursor into the neighboring code cell, click on it and select then "*order/spontaneity*" from the master code list. And a third time: We activate the next empty operator cell and fill it with "OR", activate the code cell to the right and fill it with "*discipline/good relations*." Here is what we produced:



Concluding from the number of rows in the construction table we can compose linkage hypotheses from up to five codes. Principally, we have to follow these **rules**:

- If we want to differentiate a linkage hypothesis by speakers, only one speaker code at a time must be placed into a linkage construction **and** this speaker code must be the first of all linked codes.

- A linkage construction may contain maximally two profile codes; they must be placed either as first codes or following a speaker code.

- A linkage construction may contain maximally two "NOT" operators. They function like general retrieval conditions, that is, AQUAD starts a linkage analysis by checking for codes that are expected NOT to occur in a file and does not proceed (in the actual file), if one if these codes is unexpectedly found anywhere in the file.

The sequence of codes (and connected operators) within a linkage construction may be easily modified by "drag-and-drop" movements within the construction table. Of course, this modifies also the meaning of a linkage hypothesis. Supposing we would exchange the positions of the first two elements in our example construction, we would formulate the expectation that novice teachers talking about experiences with order vs. spontaneity in their classrooms will continue by describing this situation as dilemma OR refer to a related problem of balancing discipline and positive social relations. Of course, we may also modify the critical distance between data segments. A double click into a cell or entry slot erases its content.

Finally, we have AQUAD test our linkage and click on the green "*GO*" button. Maybe yu would like to save your construction first – to apply it again later, maybe with some modifications. Just click on the button "*Save*," enter a file name afterwards, and start the storage routine.

12.2 Linkage construction step by step

In this section we will deal with a specific application of AQUAD during the analysis of qualitative data. It is taken from a study by Carlos Marcelo Garcia, University of Seville (see Huber and Marcelo Garcia, 1990). The data presented here are only a small portion of the huge amount of qualitative and quantitative data combined in this study. Originally, version 3 of AQUAD was used for this analysis, so we have no screen shots for the last step of applying the final linkage construction.

12.2.1 Theoretical background

The goal of this study was to develop a more practice-oriented program for teacher education by means of analyzing the subjective experiences, especially expectations, convictions, sorrows, emotions, implicit theories, etc., of novice teachers. The first months at school are usually considered very important in the professional socialization of teachers. A series of studies have tried to identify the essential influences on novice teachers, i.e., the personal and situational factors in their professional socialization.

Jordell (1987) has developed a well structured model. He defines a first level of influence as personal. It includes the former experiences of novice teachers as students (biographical data), and also their experiences during their university education. On a second level, Jordell differentiates the influences of the teaching situation. Empirical data show that especially the students and some characteristics of classroom interaction (for instance, multi-dimensionality, simultaneity, immediacy, unpredictability) socialize the novice teachers. The third level of influence is institutional. Here, colleagues, parents and the administrative officials play important roles. In addition, the curriculum and the formal, as well as the informal rules influence the novice teachers' professional development. According to further sources in the literature, answers to the following questions might shed some light on the discrepancy between teacher training and the demands of school practice:

(1) What are the main troubles and problems of teachers during their first year in school?
(2) On which levels of professional socialization do novice teachers experience influences during their first year in school?
(3) How do novice teachers evaluate the different forms and methods of teacher training?

12.2.2 Data collection and analysis

In this study, 105 novice teachers participated, 46 men and 59 women. They were teaching at primary and secondary schools in the south of Spain. All subjects were asked to answer the following questions during an interview several months after the beginning of their teaching activities:

- Please describe your teaching experiences, after the first few months in school.
- What kind of difficulties have been important for you during this time?
- How do you like your school?
- How do you get along with your colleagues?
- Please describe an ordinary day in your classroom.
- What kind of problems do you have to deal with in your classroom?
- How do you feel as a teacher?
- How do you get along with your students?
- What do you think about teacher education?

Additionally, all subjects had to fill in a "teachers' conviction inventory" and a "teachers' problem inventory." The results of these quantitative instruments are not considered here. The interviews were audio-taped, transcribed with the help of a word processor, and saved on disks. According to recommendations by Miles and Huberman (1994) we defined codes for the interpretation of the transcripts. In this process we combined a deductive and an inductive strategy.

First, we chose a theoretical model appropriate for our questions. We took the model of the different levels of influence by Jordell (1987). In order to generate a provisional code repertory, we simply used the concepts of his model. With increasing understanding of our subjects' world view, we elaborated this coding system, included new features for our interpretation, and eliminated others. As the result of this first process of interpretation, we created the codes listed in the box below:

1. Personal dimension
   - ECA Experiences as student
   - EFP Experiences in teacher education
   - EDP Former teaching experiences
   - SIM Self
   - PRE Sorrows
   - APR Learning
   - CRE Convictions
   - NEF Needs for training
   - CDO Burden of teaching

2. Teaching dimension
   - 2.1 Classroom
     - RPA Ratio teachers/students
     - EFC Size (of the room)
     - EQU Equipment
     - AMB Social climate
   - 2.2 Students
     - CON Behavior
     - REN Achievement
     - COM Understanding
     - CNP Previous knowledge
     - REL Teacher-student relations
     - PAR Contribution to lessons
     - EXP Expectations
     - PRO Family
   - 2.3 Planning
     - PLA
   - 2.4 Subject matter
     - COA
   - 2.5 Interactive teaching
     - MET Methods
     - ACT Activities
     - DIS Discipline
     - MOT Motivation
     - GES Classroom management
   - 2.6 Evaluation
     - EVA

3. Institutional dimension
   - 3.1 School
     - COL Colleagues
     - MAT Materials and media
     - AMC School atmosphere
     - CUR Curriculum
     - IDE Rules
     - ORG Organization/administration
   - 3.2 Context
     - PAD Parents
     - ENT Relations to context
   - 3.3 School system
     - ADM Administration
     - LIM Limitations/rules

(Originally, the codes were defined in Spanish. In this language, the abbreviations are meaningful, of course; for instance, the first code *ECA* signifies *experiencias como alumno.*)

First, we tried then to get an overview of the most and the least frequent topics in the interviews. With a function in the module *"Retrieval"* we counted code-frequencies. As you can see in the table below, the novice teachers talked most of the time about teaching methods (MET), followed by statements about themselves (SIM), and their troubles (PRE).

EDP:	14	EFP:	10	ECE:	12	**SIM:**	**25**	**PRE:**	**23**
APR:	0	CRE:	4	NEF:	8	CDO:	4	RPA:	5
EFC:	2	EQU:	3	AMB:	2	CND:	2	REN:	4
COM:	2	CNP:	9	REL:	17	PAR:	4	EXP:	3
PRO:	1	PLA:	8	CON:	7	**MET:**	**29**	ACT:	7
DIS:	6	MOT:	12	EVA:	9	COL:	18	MAT:	15
AMC:	6	CUR:	2	IDE:	0	ORG:	2	PAD:	14
ENT:	0	ADM:	1	LIM:	4				

In the next step, we used the module *"Retrieval"* to analyze the "profile" of the codes under particular perspectives. We reasoned that we would get important information for further steps of the analysis if we would find out which other units of meaning appear within a certain maximal distance (text lines) of the segments we were interested in. In AQUAD Six we would apply the option "*Sequence of codes*" in the sub-menu "*Coding structures*" of "*Retrieval*". In this way, we would get access to hypothetical patterns of meaning in the statements of our interview participants. We decided to define five lines as the maximum distance for the search of sequences focused around the most frequent code MET, then around PRE.

During our third step, we took a closer look at the interview transcriptions on the basis of these results. We tried to make sure that there were meaningful relationships between those text segments coded with MET and PRE, and the segments in close proximity to them. If this was not the case, we could change the criterion for the sequence (in this case: decreasing it), or eliminate unrelated codes from more refined further analyses (i.e., exclude these codes from the formulation and testing of specific linkage hypotheses).

In our case, one hypothesis could state that some of the novice teachers think a lot about teaching methods, however, they do so within a narrow perspective: segments that concern methods of teaching in their interviews are mostly related to passages in which they talk about other aspects of interactional teaching or about general dimensions of teaching; methodological topics are only rarely related to statements about the personal or institutional dimension. Another hypothesis could emphasize the relation between PRE (troubles) and EVA (evaluation), and state that some of the novice teachers think primarily about how to evaluate their students.

If the search for novice teachers with a narrow perspective concerning methodological questions should be successful, we could distinguish two types of teachers. Their narrow or wide perspective could be related to their convictions, to their problems in the classroom (for this purpose, we have data from quantitative instruments), and --perhaps after a specific new interpretation (coding) of relevant parts of the interviews -- to their relations to students and colleagues. If the hypothesis cannot be affirmed, not much was lost, since we get this result after only few minutes of work. Due to AQUAD we can save a lot of time, as well as the boring and error-prone work of looking through pages of interview transcriptions (105 interviews!) in order to search for the joint appearance of particular segments. Consider the fact that any one of the related segments could be represented by any of 19 codes (i.e., by the codes that represent the "teaching dimension").

Let us use this example to demonstrate how to translate a statement formulated in everyday language:

There are teachers in our sample whose reflections about teaching methods are connected to thoughts about other aspects of the teaching situation, but not to considerations about their own person or about school in general.

Of course, it would make sense to formulate immediately the alternative statement, i.e., that there are teachers who connect thoughts about teaching methods to personal and institutional considerations. For spatial reasons, and in order to avoid a too complex, confusing structure of the hypothesis, we will limit our efforts to the more "narrow" hypothesis. In order to avoid superfluous discriminations between numerous codes, and also to save processing time, we used the function *"Meta-codes"* within the module "*Coding*" first. We transformed all

- codes belonging to the personal dimension into PDI;
- codes belonging to the institutional dimension into IDI;
- codes belonging to the dimension of the teaching situation (MET excluded) into TDI.

In this way we get new (meta-) code files containing only four different codes. The next step is to reformulate our hypothesis according to the syntactical demands of constructing a linkage hypothesis in AQUAD, in agreement with its deductive procedures:

There is an entry MET in the data,
AND another segment which refers to TDI,
but we do NOT find entries that refer to PDI and
NOT to IDI;
only those segments are relevant that follow a segment coded MET within a distance of five lines.

12.3 How to apply and create sequence codes

AQUAD offers the opportunity to mark linked data segments, which were found as result of a linkage test, by a sequence code. In the construction window (right side, lower part) you find an entry slot labeled "Sequence code:" (see sections 11.6 and 12.1). In this section, Leo Gürtler will share experiences from the work on his doctoral thesis with you and describe some possibilities how to analyze more complex problems and research questions by creating sequence codes.

Applying the operator NOT in comparisons of speakers

In section 11.6 wie learned how to apply preconstructed linkages to compare speakers. You apply this option in "*Linkages*" -> "*Apply preconstructed linkages*" -> "*Comparison of 2 speakers*." These constructions link the speaker codes per default by the logical "AND." Normally this will serve well for the purpose of speaker comparisons. However there may be hypotheses that one speaker will address a particular topic, which the other speaker does exactly avoid or neglect. In this case, we have to construct linkage hypotheses on our own and apply the logical operator "NOT." We want to demonstrate a construction of this type and the usefulness of corresponding sequence codes in the following.

In a study on implicit theories of humor a relation between answers to two particular questions was assumed (Gürtler, 2004, coded open answers of students in questionnaires):

Question 7 – "*Do you think there is enough humor in your classes*?" and
Question 8 – "*If you were allowed to modify the classes, what would you do to promote humor*?"

It was interesting to find out whether students, who expressed dissatisfaction in question7, that is, who were not content with quality and/or quantity of humor in their classes, nevertheless did not suggest possible improvements as answers to question 8. This finding would indicate a difference between students, who combine dissatisfaction and tendentious passivity, and students, who see possibilities of improvement (for instance, changes of classroom climate, teaching style, teaching methods, etc.) although they are not contentas regards humor in their classes. The following sequence codes were defined and added to the code files with the goal to differentiate between these two groups of students:

```
SeqCode 1: "Q7_dissatisfaction"
        AND   speaker code:   /$question7
        AND   code:           StatusQuo: lack of humor
        NOT   code:           StatusQuo: enough humor

SeqCode 2: "Q7_satisfaction"
        AND   speaker code:   /$question7
        AND   code:           StatusQuo: enough humor
        NOT   code:           StatusQuo: lack of humor

SeqCode 2: Q8_no answer"
        AND   speaker code:   /$question8
        AND   code:           Missing Data
        OR    code:           Don't know/irrelevant

SeqCode 4: "Q8_suggestions"
        AND   speaker code:   /$question8
        AND   code:           Modifications (classes/methods)
        OR    code:           Promote climate/relations
        OR    code:           Institutional changes
```

We see, each of these sequence codes is attached unambiguously to one of the questions, and positive results of a linkage analysis therefore are linked exclusively to this question (= "speaker"). In a second step additional sequence codes were created:

SeqCode 5: "Comp_Q7<->Q8_inconsistent1"
AND code: Q7_dissatisfaction
AND code: Q8_no answer

SeqCode 6: "Comp_Q7<->Q8_inconsistent2"
AND code: Q7_dissatisfaction
NOT code: Q8_suggestions

SeqCode 7:"Comp_Q7<->Q8_inconsistent3"
AND code: Q7_satisfaction
AND code: Q8_suggestions

SeqCode 8: "Comp_Q7<->Q8_consistent1"
AND code: Q7_dissatisfaction
AND code: Q8_suggestions

Based on this system of codes, we are able to distinguish four groups of students according to their configurations of answers. Instead of comparing two speakers within a data file we compare two particular questions within a data file. There are students, who are

- dissatisfied with their situation, but do not answer (= "missing data") the question asking for possible desirable changes. This behavior is inconsistent and may indicate problems of individual competence or readiness to consider or to express any school-centered modifications.
- dissatisfied, but do not suggest any changes. This is also inconsistent, however, as distinguished from the first mentioned group, these students give answers to question 8 although not suggesting positive modifications.
- satisfied with their situation, but nevertheless present suggestions how to improve the situation. (This leads to an additional question: Are these students really satisfied? Or are these students socially highly motivated and creative?)
- dissatisfied, but able to present suggestions how to improve their school situation.

Combining sequence codes is a means to answer even complicated research questions without too much effort. Above all the possibility to have data segments retrieved together with linked codes gives perfect access to the meaning of all findings. Additionally, this example can demonstrate how to apply "speaker codes" creatively: Data segments cannot only be analyzed separately for real speakers, but also for different questions in a questionnaire or for various content domains like emotions, cognitions, actions, etc. found in a data file. This in turn may serve as perfect base of a logical minimization (see chapter 13) or discrimination of types of cases. It is a big advantage in an analysis of implicants (see chapter 13), if you are not limited to relate isolated conceptual codes to each other in your code configurations, but are able to apply propositions (for instance, subject-predicate-object), which were operationalized by sequence coding. Usually sequence based conclusions are much more meaningful than only frequency based conclusions. We would like to refer here to Fühlau (1978; 1982), who explained meticulously the advantages and disadvantages of content analysis in de-contextualized domains.