# DDI: Metadata to support collection processes, discovery, and comparability

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NADDI 2012

University of Kansas

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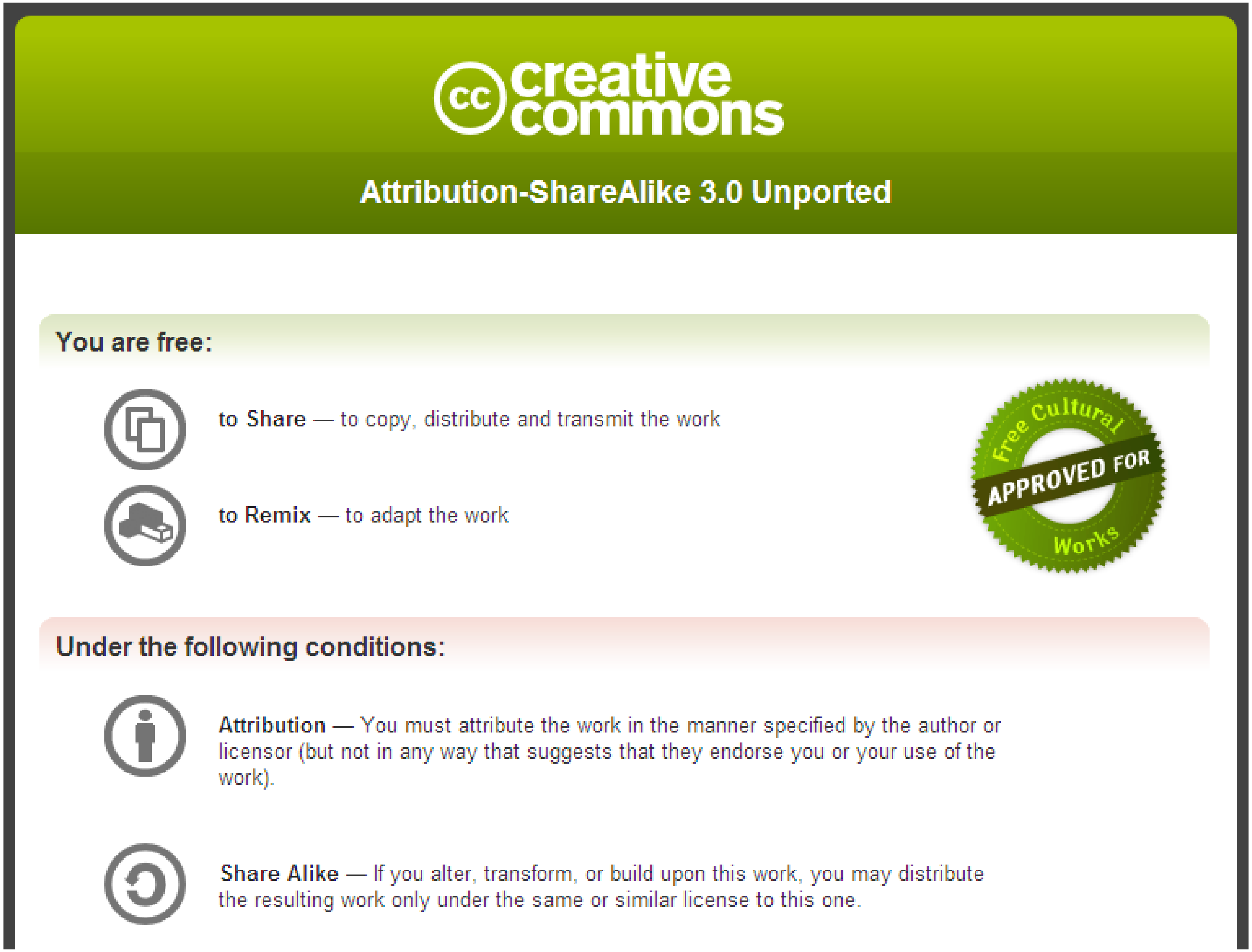

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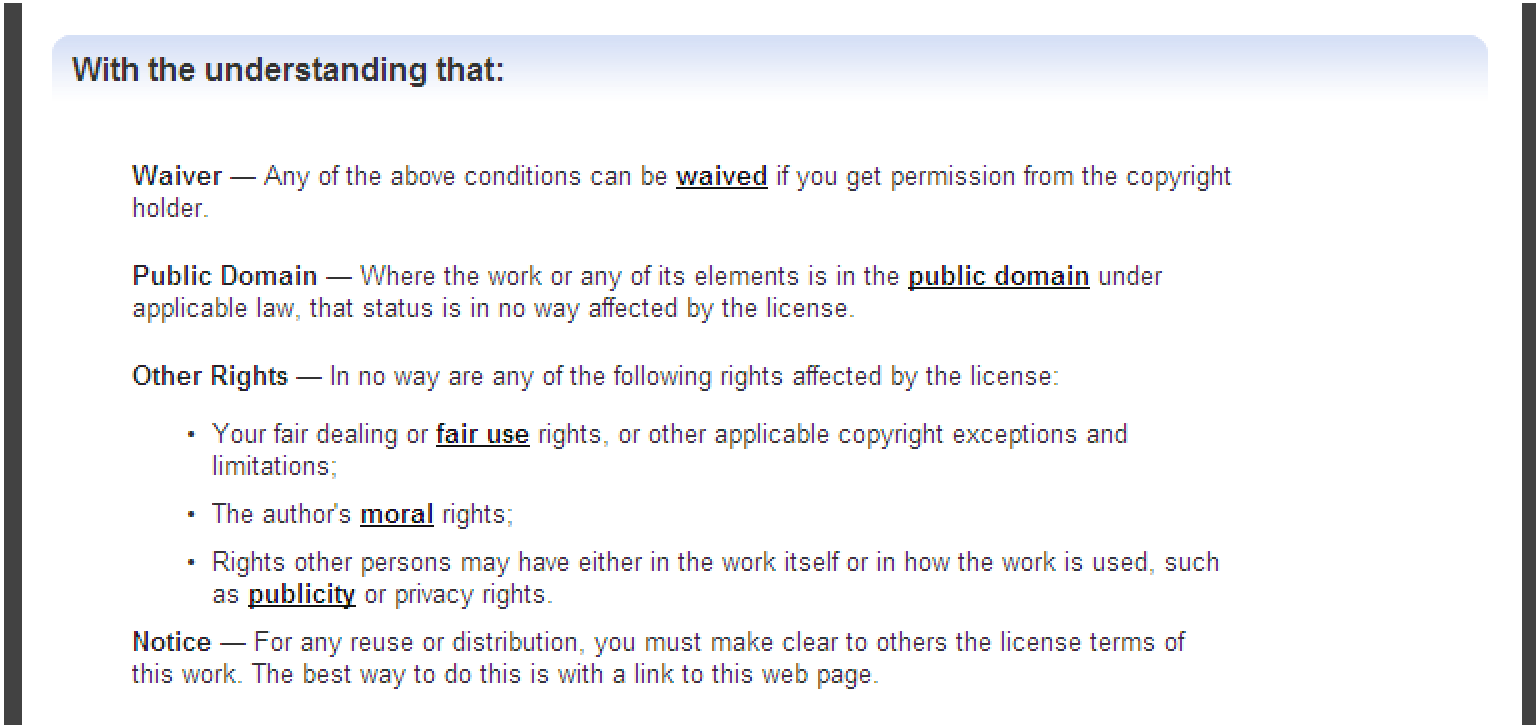

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# Credits

- Some of these slides were developed for DDI workshops at IASSIST conferences and at GESIS training in Dagstuhl/Germany
- Major contributors
  - Wendy Thomas, Minnesota Population Center
  - Arofan Gregory, Open Data Foundation
- Further contributors
  - Joachim Wackerow, GESIS – Leibniz Institute for the Social Sciences
  - Pascal Heus, Open Data Foundation

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for the Social Sciences

Open Data Foundation

# Outline

- Intros
- Study Units, Groups, and Resource Packages
- Modules vs. Schemes
- Questions, data collection instruments, variables, concepts, geography, grouping and comparison
- Process control
- Discovery tools and "reusable" metadata
- Support for comparability within and between data sets

# Introductions

- Who are you?
- What does your organization do?
  - Data collection
  - Data production
  - User access
  - Preservation
- What is the scale of your operations?

# Reuse Across the Lifecycle

- This basic metadata is reused across the lifecycle
  - Responses may use the same categories and codes which the variables use
  - Multiple waves of a study may re-use concepts, questions, responses, variables, categories, codes, survey instruments, etc. from earlier waves

# Reuse by Reference

- When a piece of metadata is re-used, a *reference* can be made to the original
- In order to reference the original, you must be able to *identify* it
- You also must be able to *publish* it, so it is visible (and can be referenced)
  - It is published to the user community – those users who are allowed access

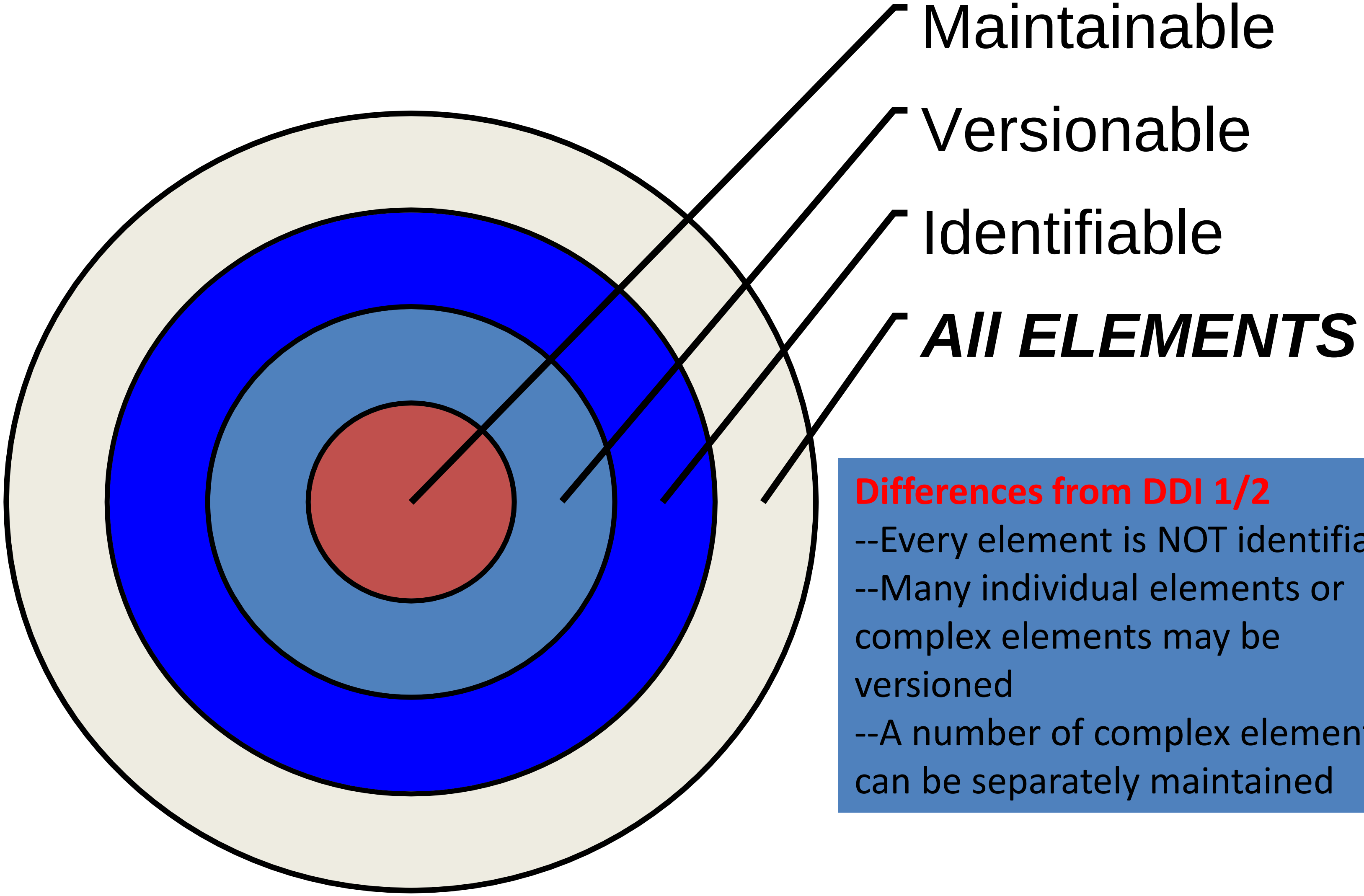
# Change over Time

- Metadata items change over time, as they move through the data lifecycle
  - This is especially true of longitudinal/repeat cross-sectional studies
- This produces different *versions* of the metadata
- The metadata versions have to be *maintained* as they change over time
  - If you reference an item, it should not change: you reference a specific version of the metadata item

# DDI Support for Metadata Reuse

- DDI allows for metadata items to be *identifiable*
  - They have unique IDs
  - They can be re-used by *referencing* those IDs
- DDI allows for metadata items to be *published*
  - The items are published in *resource packages*
- Metadata items are *maintainable*
  - They live in “schemes” (lists of items of a single type) or in “modules” (metadata for a specific purpose or stage of the lifecycle)
  - All maintainable metadata has a known owner or *agency*
- Maintainable metadata can be *versionable*
  - This reflects changes over time
  - The versionable metadata has a version number

# Basic Element Types



Maintainable

Versionable

Identifiable

***All ELEMENTS***

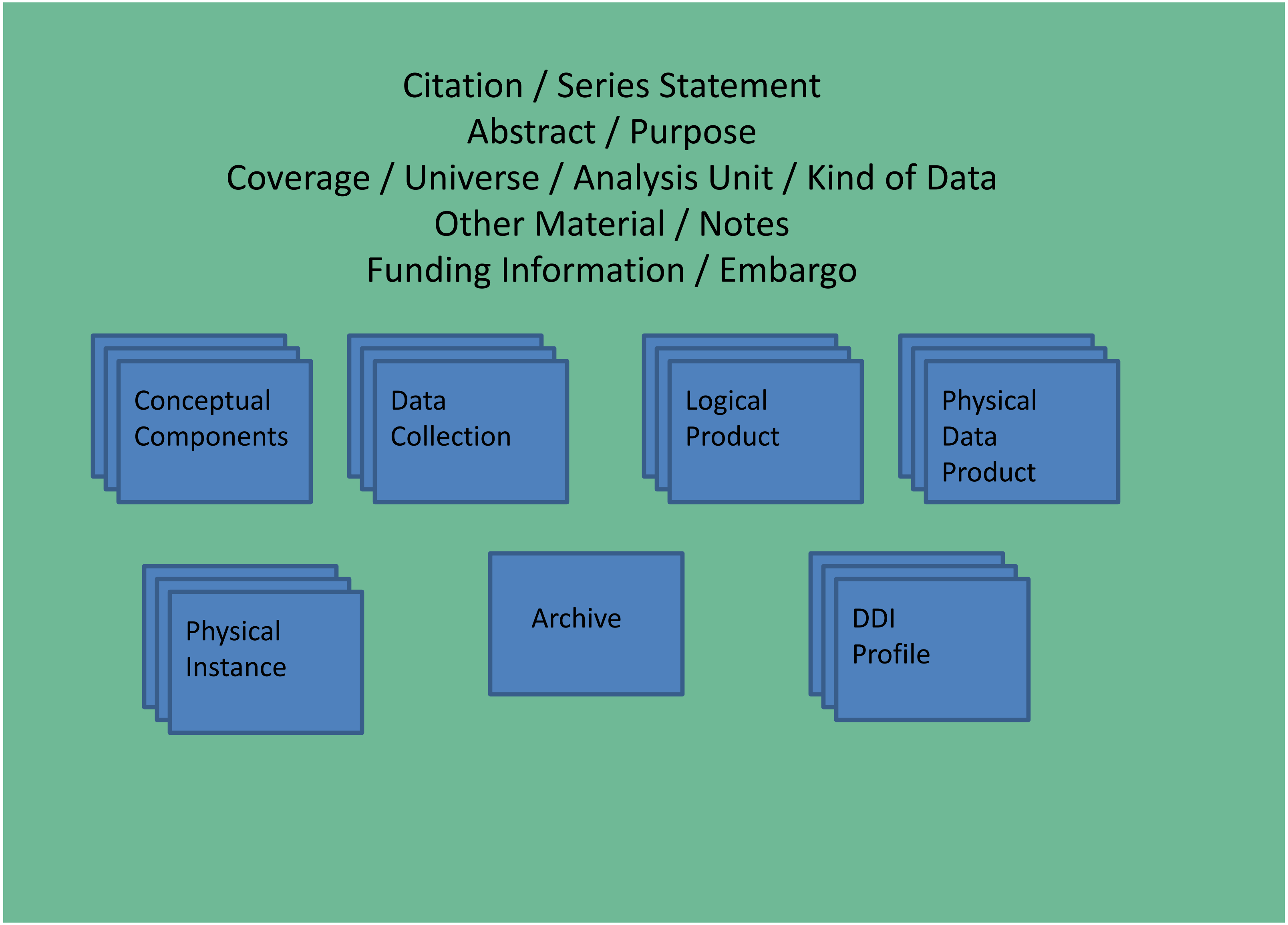
**Differences from DDI 1/2**

--Every element is NOT identifiable

--Many individual elements or complex elements may be versioned

--A number of complex elements can be separately maintained

# Study Unit



Citation / Series Statement
Abstract / Purpose
Coverage / Universe / Analysis Unit / Kind of Data
Other Material / Notes
Funding Information / Embargo

Conceptual Components

Data Collection

Logical Product

Physical Data Product

Physical Instance

Archive

DDI Profile

# Questions and Instruments

- DDI 3 separates the questions which make up a survey instrument from the survey instrument itself
  - Questions can be re-used!
- There are several different types of question text
  - Many of these are the normal string types found throughout DDI 3

# Questions and Instruments

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- There are several different types of question text
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# Questionnaires

- Questions
  - Question Text
  - Response Domains
- Statements
  - Pre- Post-question text
- Instructions
  - Routing information
  - Explanatory materials
- Question Flow

# Simple Questionnaire

Please answer the following:

1. Sex
   (1) Male
   (2) Female
2. Are you 18 years or older?
   (0) Yes
   (1) No (Go to Question 4)
3. How old are you? ______
4. Who do you live with?
   __________________
5. What type of school do you attend?
   (1) Public school
   (2) Private school
   (3) Do not attend school

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- Questions

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   ______________________

5. What type of school do you attend?

   (1) Public school

   (2) Private school

   (3) Do not attend school

- Questions
- Response Domains
  - Code
  - Numeric
  - Text

# Representing Response Domains

- There are many types of response domains
  - Many questions have categories/codes as answers
  - Textual responses are common
  - Numeric responses are common
  - Other response domains are also available in DDI 3 (time, mixed responses)

# Category and Code Domains

- Use CategoryDomain when NO codes are provided for the category response

  [ ] Yes

  [ ] No

- Use CodeDomain when codes are provided on the questionnaire itself

  1. Yes
  2. No

# Category Schemes and Code Schemes

- Use the same structure as variables
- Create the category scheme or schemes first (do not duplicate categories)
- Create the code schemes using the categories
  - A category can be in more than one code scheme
  - A category can have different codes in each code scheme

# Numeric and Text Domains

- Numeric Domain provides information on the range of acceptable numbers that can be entered as a response
- Text domains generally indicate the maximum length of the response and can limit allowed content using a regular expression
- Additional specialized domains such as DateTime are also available
- Structured Mixed Response domain allows for multiple response domains and statements within a single question, when multiple response types are required

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- Questions
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  - Code
  - Numeric
  - Text
- Statements

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- Questions
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- Instructions

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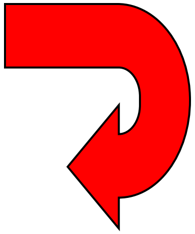
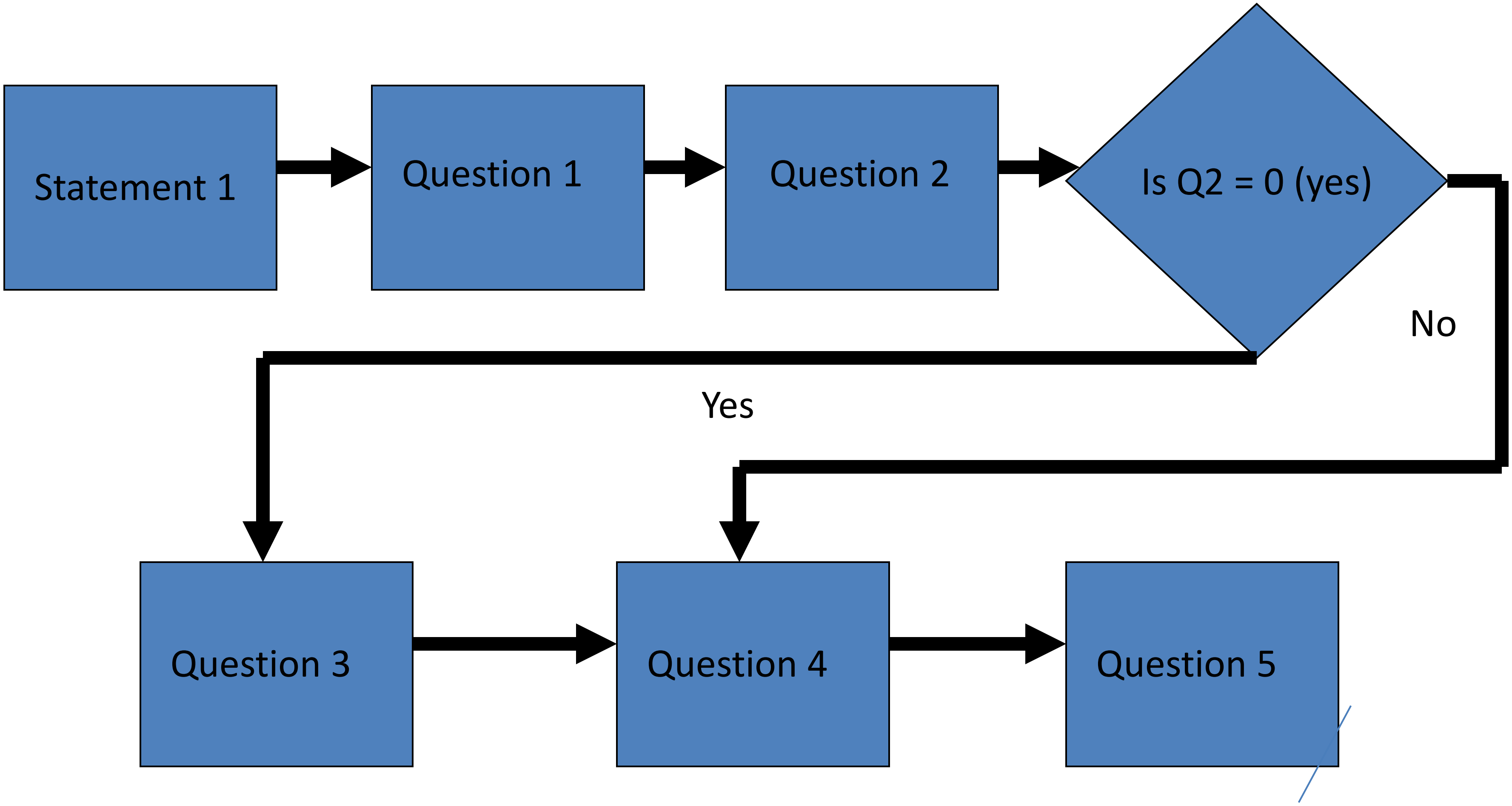


Skip Q3

- Questions
- Response Domains
  - Code
  - Numeric
  - Text
- Statements
- Instructions
- Flow


Statement 1
Question 1
Question 2
Is Q2 = 0 (yes)
No
Yes
Question 3
Question 4
Question 5

# Approach to Survey Analysis

- Identify
  - Question Text
  - Statements
  - Instructions or informative materials
  - Response Domains (by type)
- Determine the universe structure and concepts
- Walk through the flow logic

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- Walk through the flow logic

# Completing Question Items

- Create CodeSchemes reusing common categories
- Determine range for NumericDomains
- Determine maximum length of TextDomains
- Write up control constructs (easiest is to list all QuestionConstruct, all Statement Items)

# Example: Reusing Categories

Full list of all categories:

- Yes
- No
- Don’t know
- Yes
- No
- Yes
- No
- Yes, always
- Sometimes
- Some do, some don’t
- Not to my knowledge
- Never – I don’t let them
- Never – I don’t have a television
- Yes
- No
- Not to my knowledge

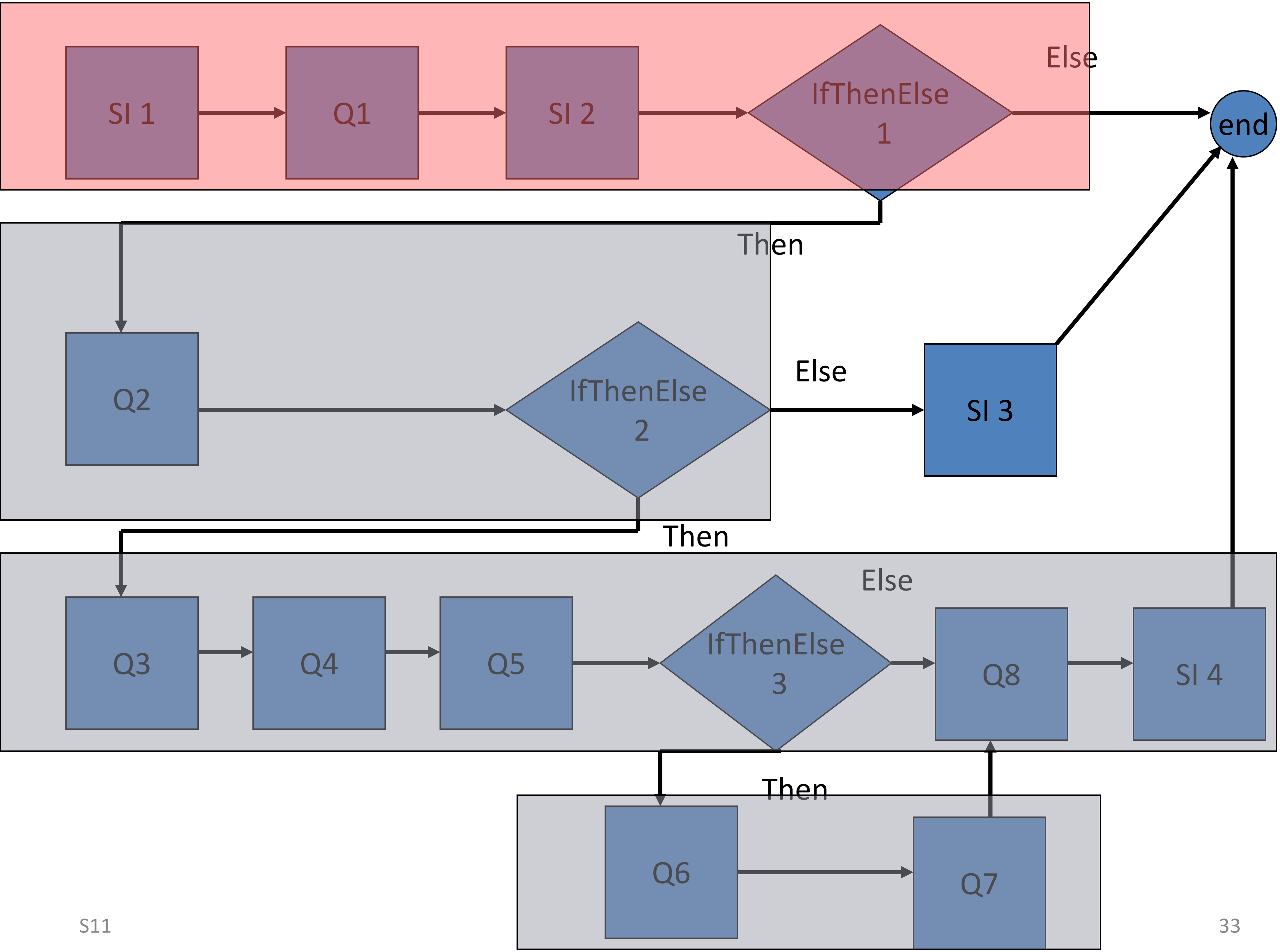
**BECOMES**

Shorter list of reusable categories:

- Yes
- No
- Don’t know
- Yes, always
- Sometimes
- Some do, some don’t
- Not to my knowledge
- Never – I don’t let them
- Never – I don’t have a television

# Flow Logic

- Master Sequence
  - Every instrument has one top-level sequence
- Question and statement order
- Routing – IfThenElse (see next slide)
  - After Statement 2 (all respondents read this)
  - After Q2 Else goes to statement
  - After Q5 Else goes back to a sequence


SI 1
Q1
SI 2
IfThenElse 1
Else
end
Then
Q2
IfThenElse 2
Else
SI 3
Then
Q3
Q4
Q5
IfThenElse 3
Else
Q8
SI 4
Then
Q6
Q7

# Example: Master Sequence

- Statement 1
- Question 1
- Statement 2
- IFThenElse 1
    - Then Sequence 1
        - Question 2
        - IFThenElse 2
            - Then SEQuence 2

                Question 3, Question 4, IFThenElse 3, Question 8, Statement 4<br>
                [Then SEQuence 3 (Question 6,Question 7)]
            - Else Statement 3

# Documentation of Data Processing

- There are two major places where processing is described in DDI 3, termed “Coding instructions”
  - General instructions
  - Generation instructions
  - Standard weight
- In DDI 3, the term “Coding” refers to the programming used to process data
  - Do not confuse it with “Code” or “CodeValue” (3 different things)
- These are used to describe the processing of both survey data and administrative data
  - Can also be used to describe harmonization, aggregation, and other processes later in the life cycle
- For collecting administrative data, the administrative system is described as a DataSource element in CollectionEvent and referenced by Generation Instruction

# Coding Instructions

- General Instruction
  - Handling non-response
  - Imputation or suppression rules
- Generation Instructions
  - Recoding
  - Derivation
  - Data from external sources
- Both human readable and machine-actionable instructions allowed
- If I have a questionnaire and coding instructions I can create the logical product, physical data product, and physical instance automatically with all relational links intact

# General Instruction

- Identification goes on the parent Coding element
- Description – human readable
- Command
  - Command Text – human readable
  - Command File (reference)
  - Structured Command
- IsOveride – reference to Instruction it overrides
- @isOveride (Boolean default=“false”)

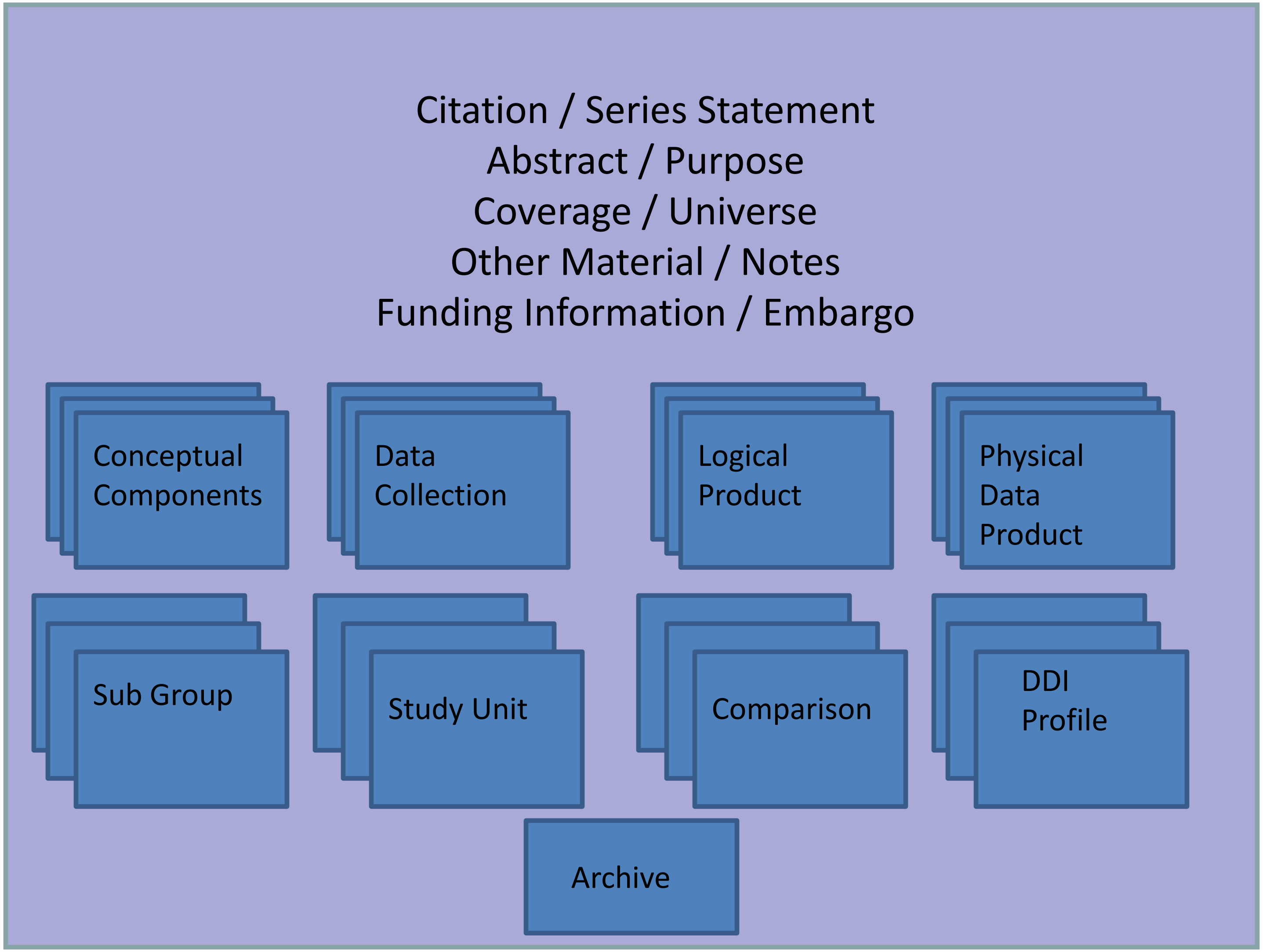
# Generation Instruction

- Source Question and Source Variable
  - can assign a mnemonic that is used in the command for this question or variable
- External Information (reference)
- Description – human readable
- Command
- Control Construct Reference
- Aggregation
  - for NCubes indicating independent and dependent components
- @isDerived

# Metadata Driven Data Capture

- Questions can be organized into survey instruments documenting flow logic and dynamic wording
  - This metadata can be used to create control programs for Blaise, CASES, CSPro and other CAI systems
- Generation Instructions can drive data capture from registry sources and/or inform data processing post capture

# Group



Citation / Series Statement
Abstract / Purpose
Coverage / Universe
Other Material / Notes
Funding Information / Embargo

# Group

- Resource Package
  - Allows packaging of any maintainable item as a resource item
- Group
  - Up-front design of groups – allows inheritance
  - Ad hoc (“after-the-fact”) groups – explicit comparison using comparison maps for Universe, Concept, Question, Variable, Category, and Code
- Local Holding Package
  - Allows attachment of local information to a deposited study without changing the version of the study unit itself

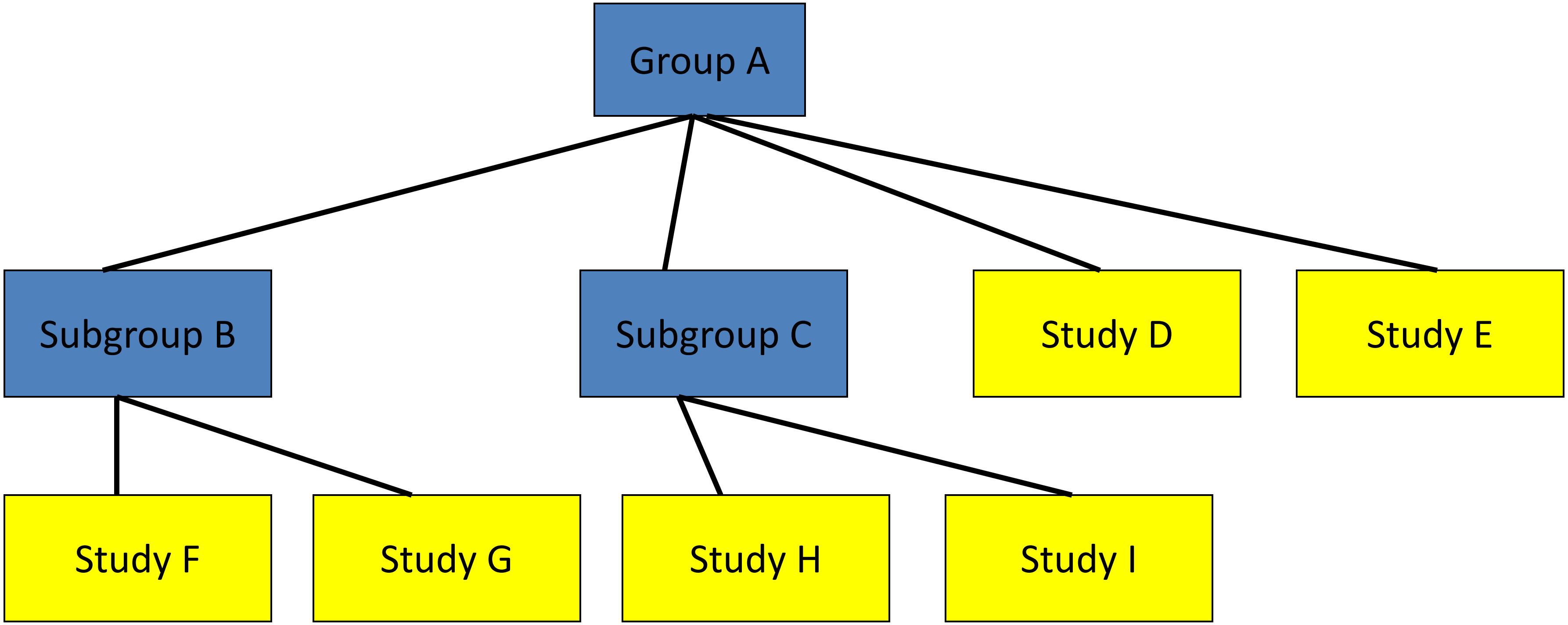
# Group:
# Grouping and Inheritance

- Grouping is the feature which allows DDI 3 to package groups of studies into a single XML instance, and express relationships between them
- To save repetition – and promote re-use – there is an inheritance mechanism, which allows metadata to be automatically shared by studies
- This can be a complicated topic, but it is the basis for many of DDI 3's features, including comparison of studies
- There is a switch which can be used to "turn off" inheritance

# Group Contents

- A group can contain study units, subgroups, and resource packages:
  - Study units document individual studies
  - Subgroups (inline or by reference)
  - Any of the content modules (Logical Product, Data Collection, etc.)
- Groups can nest indefinitely
- They have a set of attributes which explain the purpose of the group (as well as having a human-readable description):
  - Grouping by Time
  - Grouping by Instrument
  - Grouping by Panel
  - Grouping by Geography
  - Grouping by Data Set
  - Grouping by Language
  - Grouping by User-Defined Factor

# Inheritance



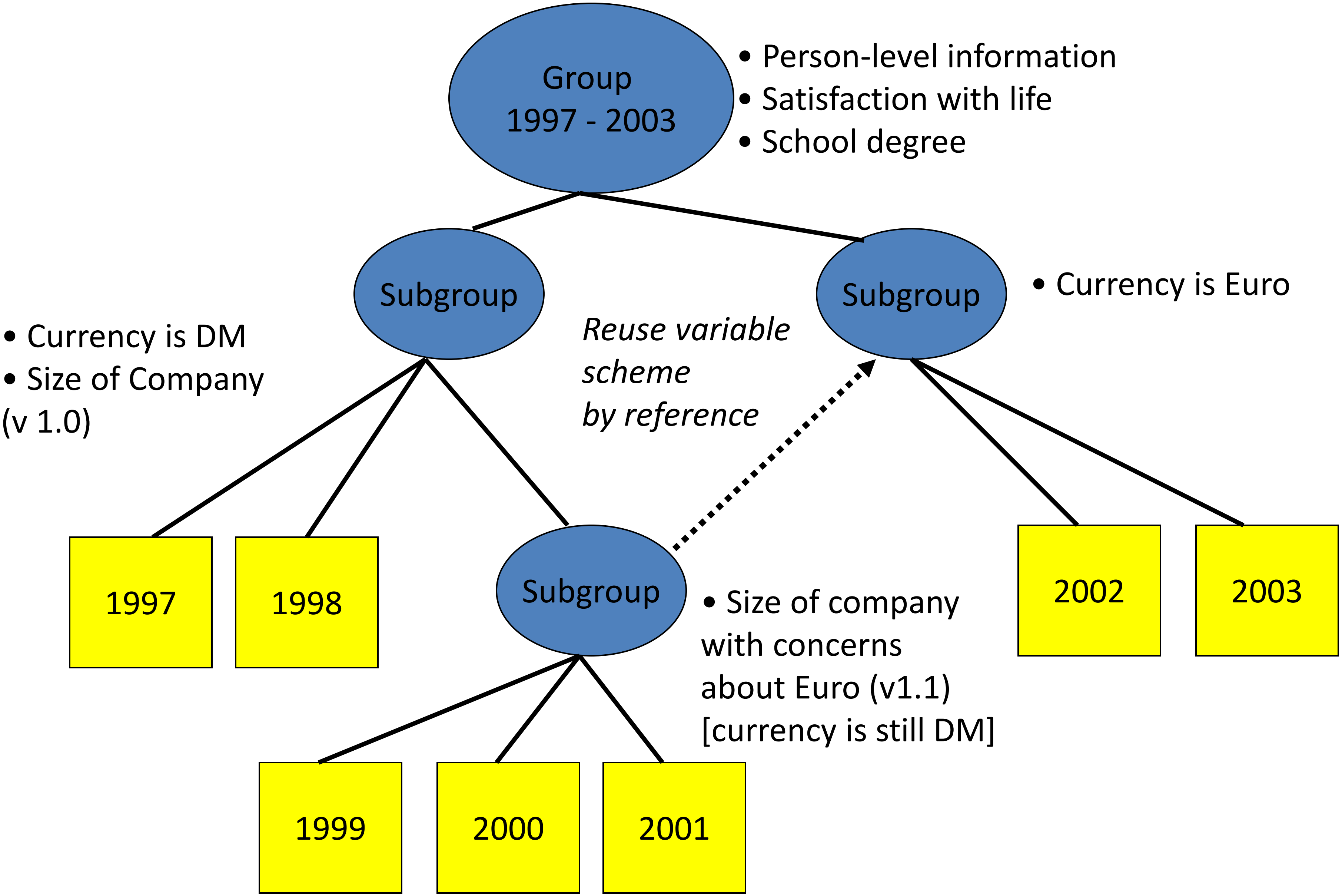
- Modules can be attached at any level
- They are shared – without repetition – by all child study units and subgroups
- If Group A has declared a concept called “X”, it is available to Study Units D – I.
- If Subgroup C has declared a Variable “Gender”, it is available to Study Units H and I without reference or repetition
- Inherited metadata can be changed using local overrides which add, update, or delete inherited properties

# Actions in Identifiers

- In some places – especially in groups where lots of metadata is being inherited – you can Add, Update, and Delete items using identifiers.
  - Using @action attribute = Add/Delete/Update
  - Repeat the identifier of the inherited object being locally modified
- This allows for local re-definition that is *not* reflected in a new version of the scheme
  - It cannot be reused
- For re-use, schemes should be versioned!

# German Social Economic Panel (SOEP) Study Example

- The following slides show how different types of metadata can be shared using grouping and inheritance
- The  SOEP is a panel study, with different panels on different years
  - Variables change over time
  - New questions and data are added



Group
1997 - 2003

- Person-level information
- Satisfaction with life
- School degree

Subgroup

- Currency is DM
- Size of Company
(v 1.0)

*Reuse variable*
*scheme*
*by reference*

Subgroup

- Currency is Euro

1997

1998

Subgroup

- Size of company
with concerns
about Euro (v1.1)
[currency is still DM]

2002

2003

1999

2000

2001

# Comparison

# Comparison

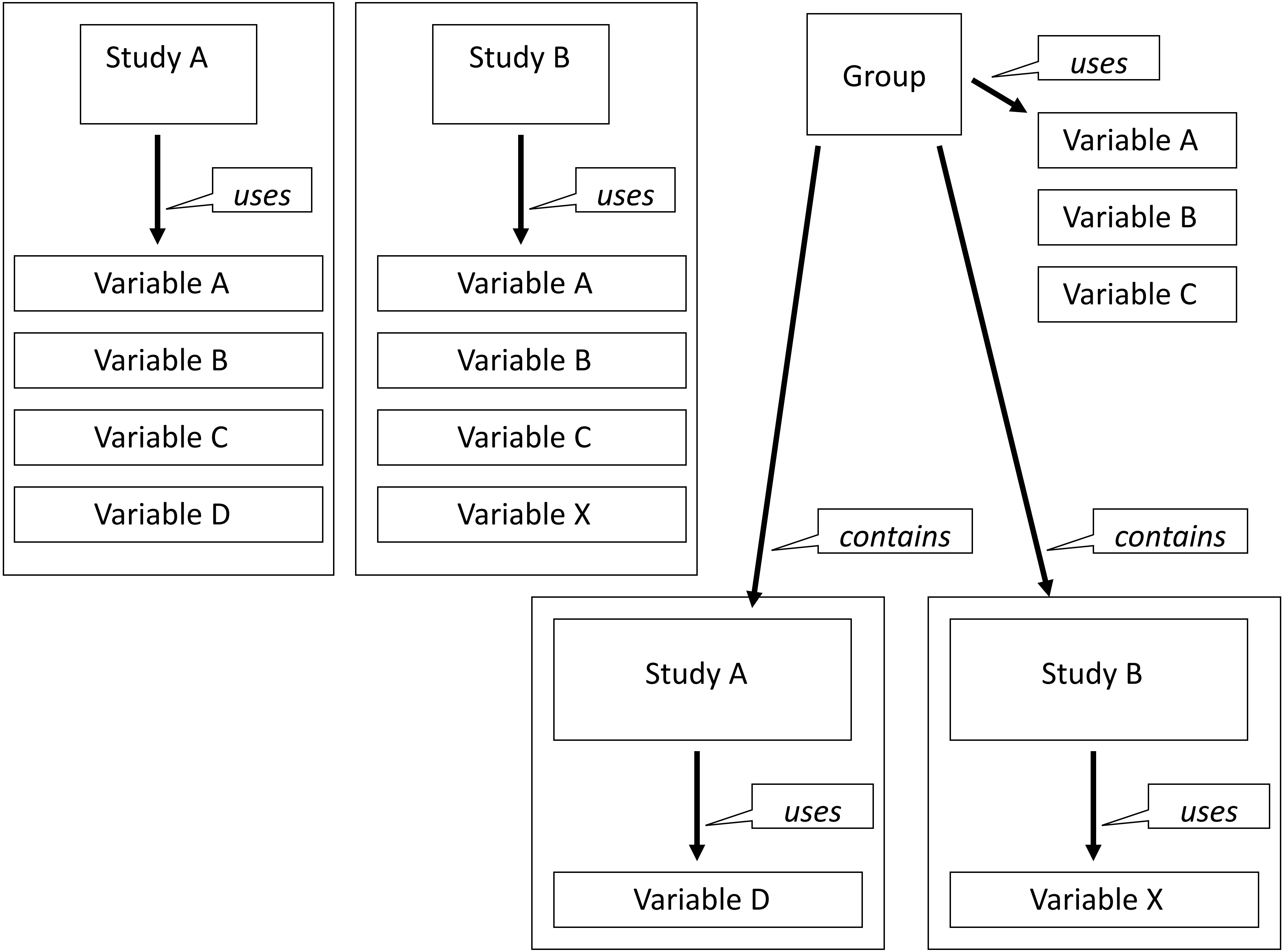
- There are two types of comparison in DDI 3:
  - Comparison by design
  - Ad-hoc (after-the-fact) comparison
- Comparison by design can be expressed using the grouping and inheritance mechanism
- Ad-hoc comparison can be described using the comparison module
- The comparison module is also useful for describing harmonization when performing case selection activities

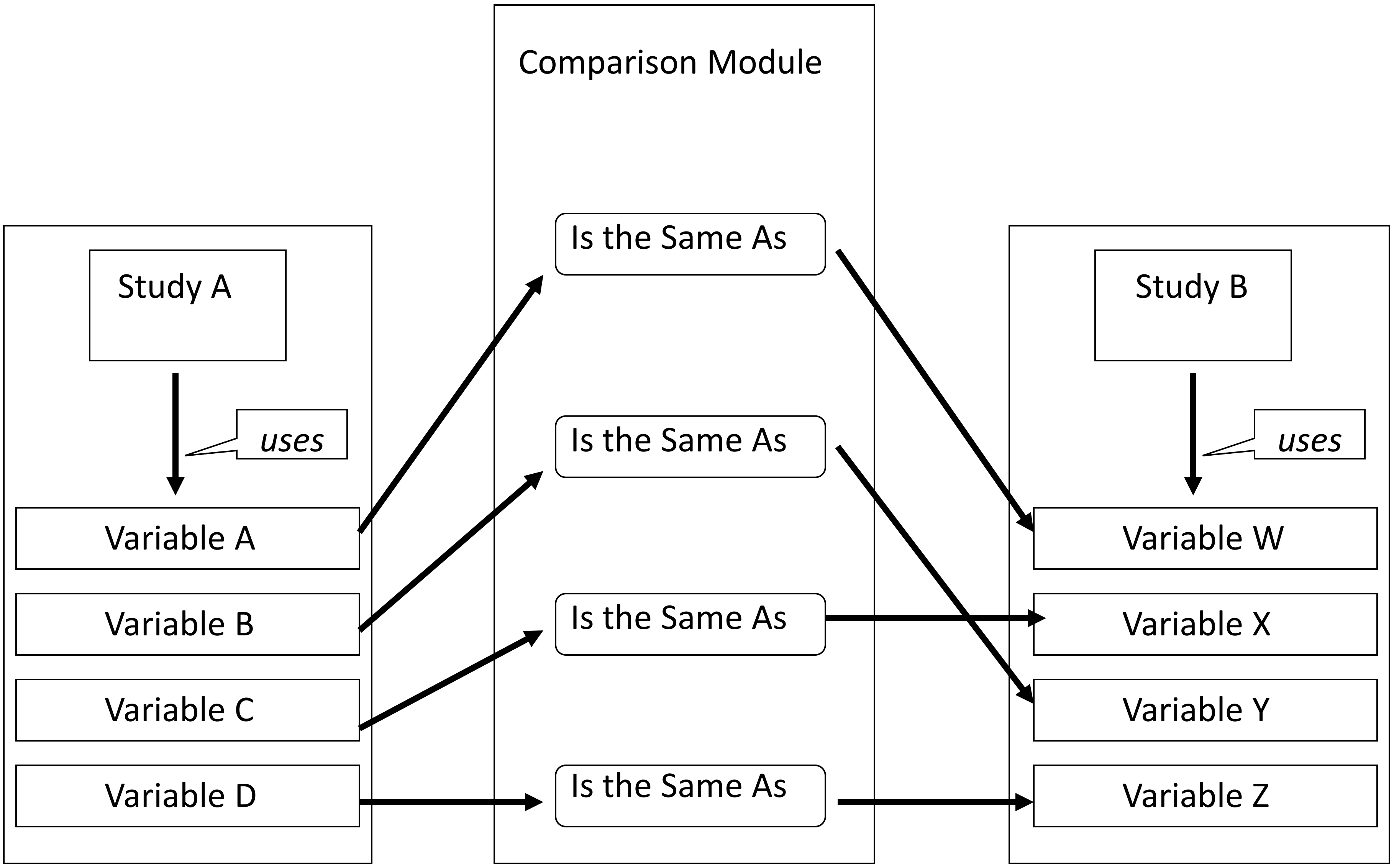
# Data Comparison

- To compare data from different studies (or even waves of the same study) we use the *metadata*
  - The metadata explains which things are comparable in data sets
- When we compare two variables, they are comparable if they have the same set of properties
  - They measure the same concept for the same high-level universe, and have the same representation (categories/codes, etc.)
  - For example, two variables measuring "Age" are comparable if they have the same concept (e.g., age at last birthday) for the same top-level universe (i.e., people, as opposed to houses), and express their value using the same representation (i.e., an integer from 0-99)
  - They *may* be comparable if the only difference is their representation (i.e., one uses 5-year age cohorts and the other uses integers) but this requires a *mapping*

# DDI Support for Comparison

- For data which is completely the same, DDI provides a way of showing comparability: Grouping
  - These things are comparable “by design”
  - This typically includes longitudinal/repeat cross-sectional studies
- For data which *may* be comparable, DDI allows for a statement of what the comparable metadata items are: the Comparison module
  - The Comparison module provides the mappings between similar items (“ad-hoc” comparison)
  - Mappings are always context-dependent (e.g., they are sufficient for the purposes of particular research, and are only *assertions* about the equivalence of the metadata items)


Study A
uses
Variable A
Variable B
Variable C
Variable D
Study B
uses
Variable A
Variable B
Variable C
Variable X
Group
uses
Variable A
Variable B
Variable C
contains
contains
Study A
uses
Variable D
Study B
uses
Variable X


Comparison Module
Study A
uses
Variable A
Variable B
Variable C
Variable D
Is the Same As
Is the Same As
Is the Same As
Is the Same As
Study B
uses
Variable W
Variable X
Variable Y
Variable Z

# Comparison Content

- A comparison element is placed on a group or subgroup
- It contains:
  - Description of the comparison
  - Concept maps
  - Variable maps
  - Question maps
  - Category maps
  - Code maps
  - Universe maps
  - Notes
- Each map provides for a description of how two compared items correlate and/or differ, and also allows for a coding to be associated with the correlation

# Ad Hoc Groups

- Creating a course specific group
  - 3 files on aging
  - Create the group and declare the reason for selecting and including these studies
  - Note common or comparable concepts OR clarify why they are similar but NOT the same
  - Map any needed recodes for comparability
  - Provide the links (for example geographic)

# Equivalencies

- FIPS
  - 01 Alabama
  - 02 Alaska
  - 04 Arkansas
  - 06 California
  - 08 Colorado
  - 09 Connecticut
  - 10 Delaware
  - 11 District of Columbia
  - 12 Florida

=

- CENSUS
  - 63 Alabama
  - 94 Alaska
  - 86 Arkansas
  - 71 California
  - 84 Colorado
  - 16 Connecticut
  - 51 Delaware
  - 53 District of Columbia
  - 59 Florida

# Providing Comparative Information

- Create the category and coding schemes
- Use the comparison maps to provide comparability
  - Codes, Categories, Variables, Concepts Questions, Universe
- Example:
  - 6 files using 3 different age variables
  - Single year, five year, and ten year cohorts
- Map each equivalent structure to a single example
- Map the single year to the five year
- Map the five year to the ten year
- Provide the software command to do the conversion

## SINGLE YEARS

< 1 year

1 year

2 years

3 years

4 years

5 years

6 years

7 years

8 years

9 years

10 years

11 years

12 years

13 years

14 years

15 years

16 years

17 years

18 years

19 years

20 years

Etc.

## 5 YEAR COHORTS

< 5 years

5 to 9 years

10 to 14 years

15 to 19 years

20 years plus

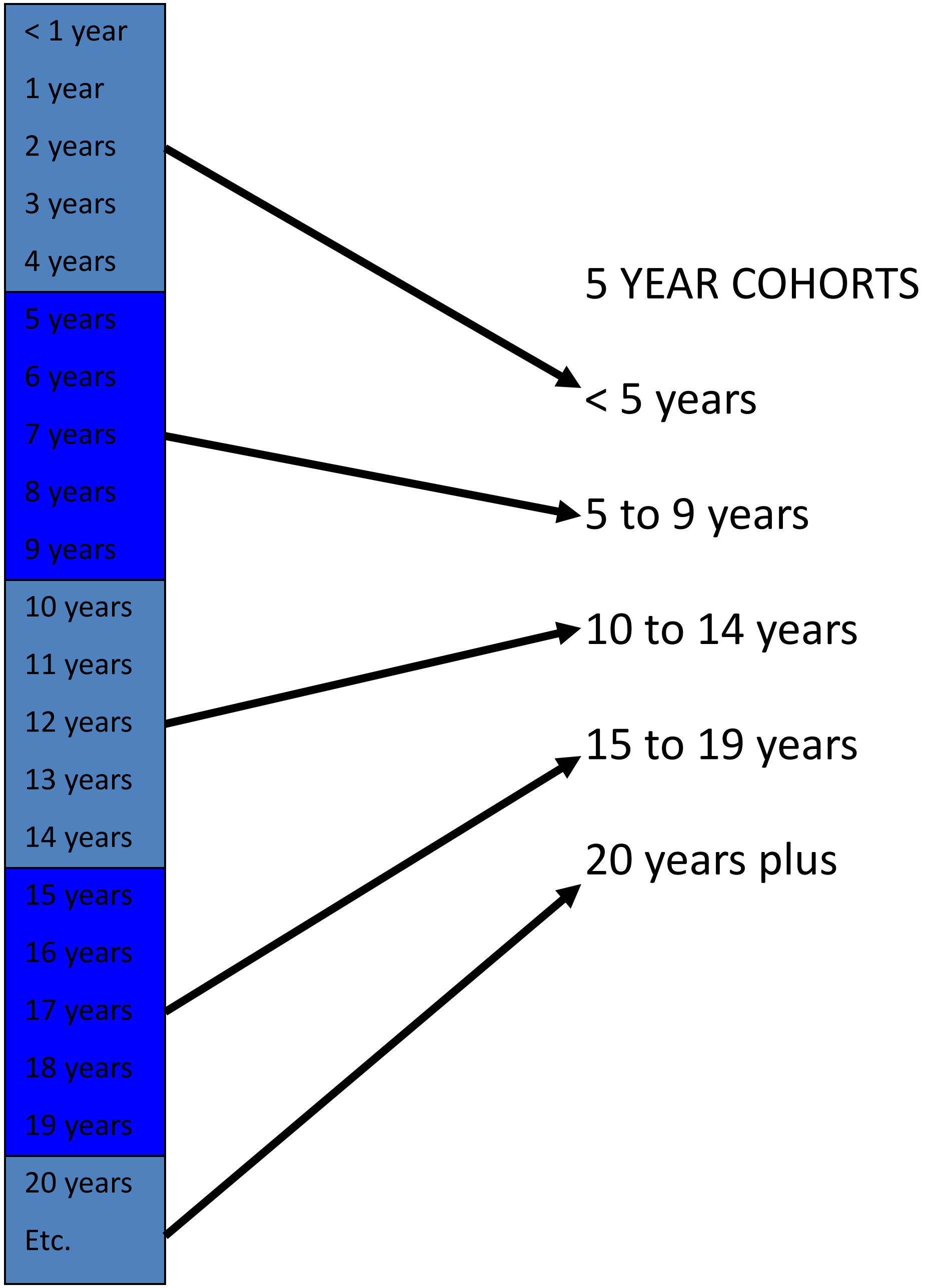
## 10 YEAR COHORTS

< 10 years

10 to 19 years

20 years plus

SINGLE YEARS



< 1 year
1 year
2 years
3 years
4 years
5 years
6 years
7 years
8 years
9 years
10 years
11 years
12 years
13 years
14 years
15 years
16 years
17 years
18 years
19 years
20 years
Etc.

5 YEAR COHORTS

< 5 years

5 to 9 years

10 to 14 years

15 to 19 years

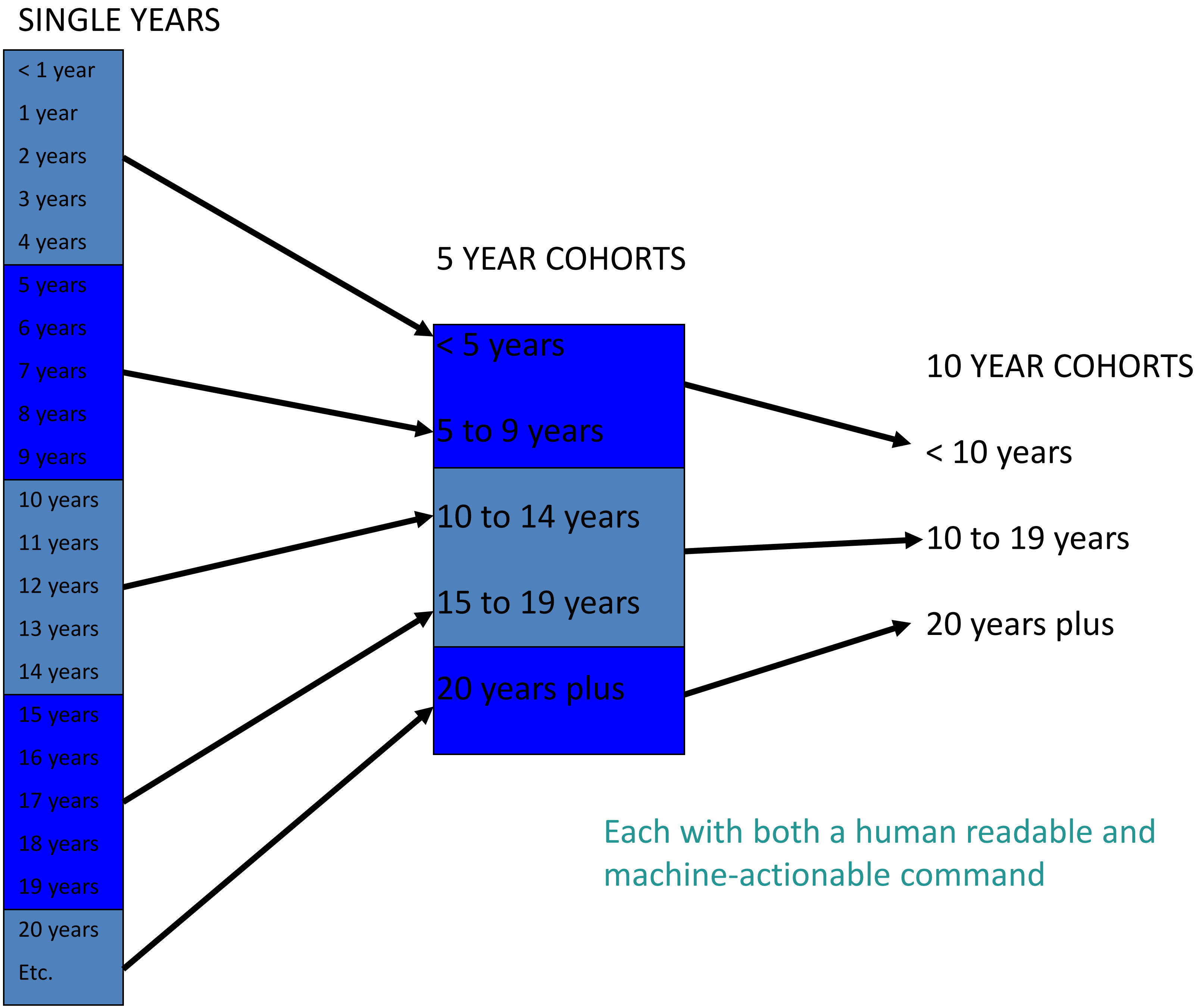
20 years plus

10 YEAR COHORTS

< 10 years

10 to 19 years

20 years plus



SINGLE YEARS

< 1 year
1 year
2 years
3 years
4 years
5 years
6 years
7 years
8 years
9 years
10 years
11 years
12 years
13 years
14 years
15 years
16 years
17 years
18 years
19 years
20 years
Etc.

5 YEAR COHORTS

< 5 years
5 to 9 years
10 to 14 years
15 to 19 years
20 years plus

10 YEAR COHORTS

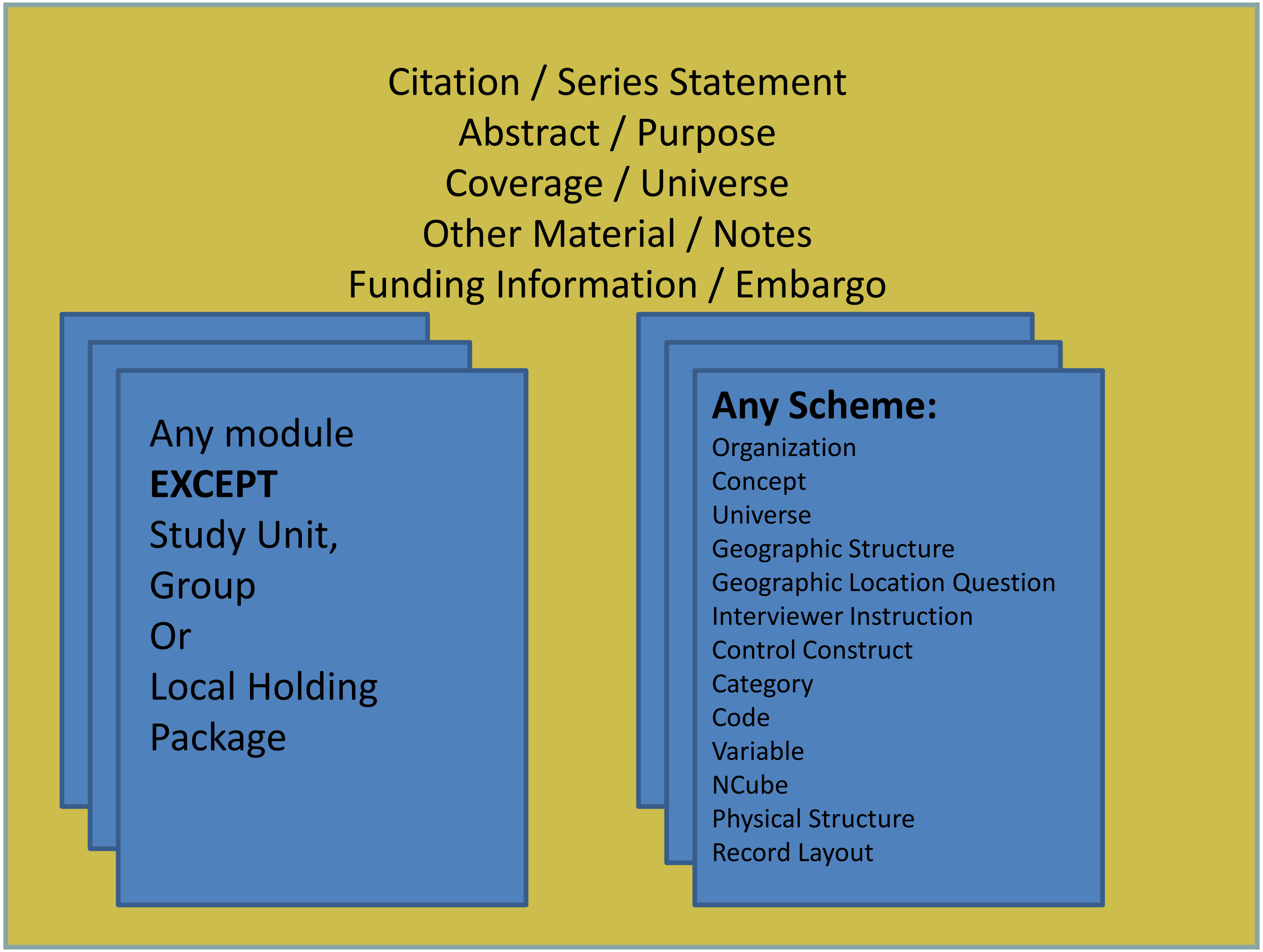
< 10 years
10 to 19 years
20 years plus

Each with both a human readable and machine-actionable command

# Comparability

- The comparability of a question or variable can be complex. You must look at all components. For example, with a question you need to look at:
  - Question text
  - Response domain structure
    - Type of response domain
    - Valid content, category, and coding schemes
- The following table looks at levels of comparability for a question with a coded response domain
- More than one comparability “map” may be needed to accurately describe comparability of a complex component

# Resource Package



Citation / Series Statement
Abstract / Purpose
Coverage / Universe
Other Material / Notes
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Any module
**EXCEPT**
Study Unit,
Group
Or
Local Holding
Package

**Any Scheme:**

Organization
Concept
Universe
Geographic Structure
Geographic Location Question
Interviewer Instruction
Control Construct
Category
Code
Variable
NCube
Physical Structure
Record Layout

# DDI Schemes

- Brief overview of what DDI schemes are and what they are designed to do including:
  - Purpose of DDI Schemes
  - How a DDI Study is built using information held in schemes

# DDI Schemes: Purpose

- A maintainable structure that contains a list of versionable things
- Supports registries of information such as concept, question and variable banks that are reused by multiple studies or are used by search systems to location information across a collection of studies
- Supports a structured means of versioning the list
- May be published within Resource Packages or within DDI modules
- Serve as component parts in capturing reusable metadata within the life-cycle of the data

# Reuse of Metadata

- You can reuse many types of metadata, benefitting from the work of others
  - Concepts
  - Variables
  - Categories and codes
  - Geography
  - Questions
- Promotes interoperability and standardization across organizations
- Can capture (and re-use) common cross-walks

# Virtual Data

- When researchers use data, they often combine variables from several sources
  - This can be viewed as a “virtual” data set
  - The re-coding and processing can be captured as useful metadata
  - The researcher’s data set can be re-created from this metadata
  - Comparability of data from several sources can be expressed

# Mining the Archive

- With metadata about relationships and structural similarities
  - You can automatically identify potentially comparable data sets
  - You can navigate the archive's contents at a high level
  - You have much better detail at a low level across divergent data sets

# Concepts

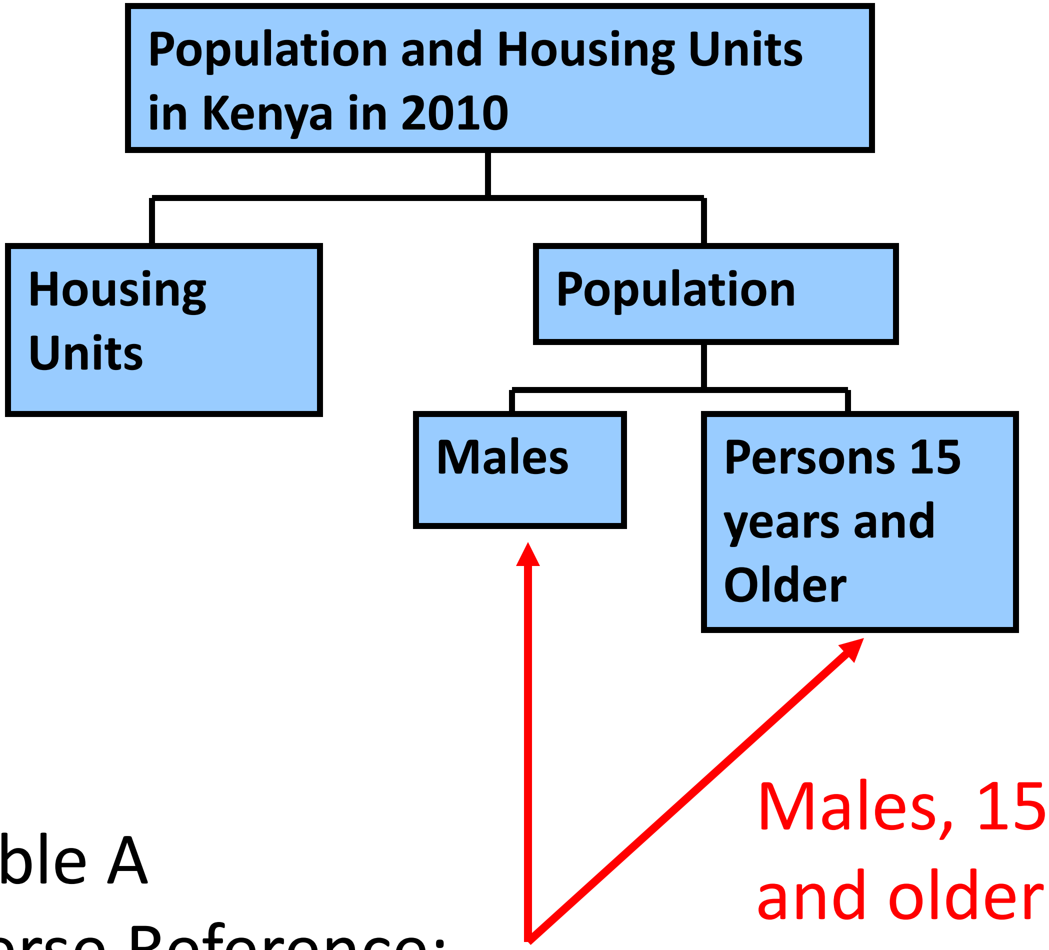
- A concept may be structured or unstructured and consists of a Name, a Label, and a Description. A description is needed if you want to support comparison. Concepts are what questions and variables are designed to measure and are normally assigned by the study (organization or investigator).

# Universe

- This is the universe of the study which can combines the who, what, when, and where of the data
- Census top level universe: “The population and households within Kenya in 2010”
- Sub-universes: Households, Population, Males, Population between 15 and 64 years of age, …

# Universe Structure

- Hierarchical
  - Makes clear that “Owner Occupied Housing Units” are part of the broader universe “Housing Units”
  - Can be generated from the flow logic of a questionnaire
- Referenced by variables and question constructs
  - Provides implicit comparability when 2 items reference the same universe



Population and Housing Units in Kenya in 2010

Housing Units

Population

Males

Persons 15 years and Older

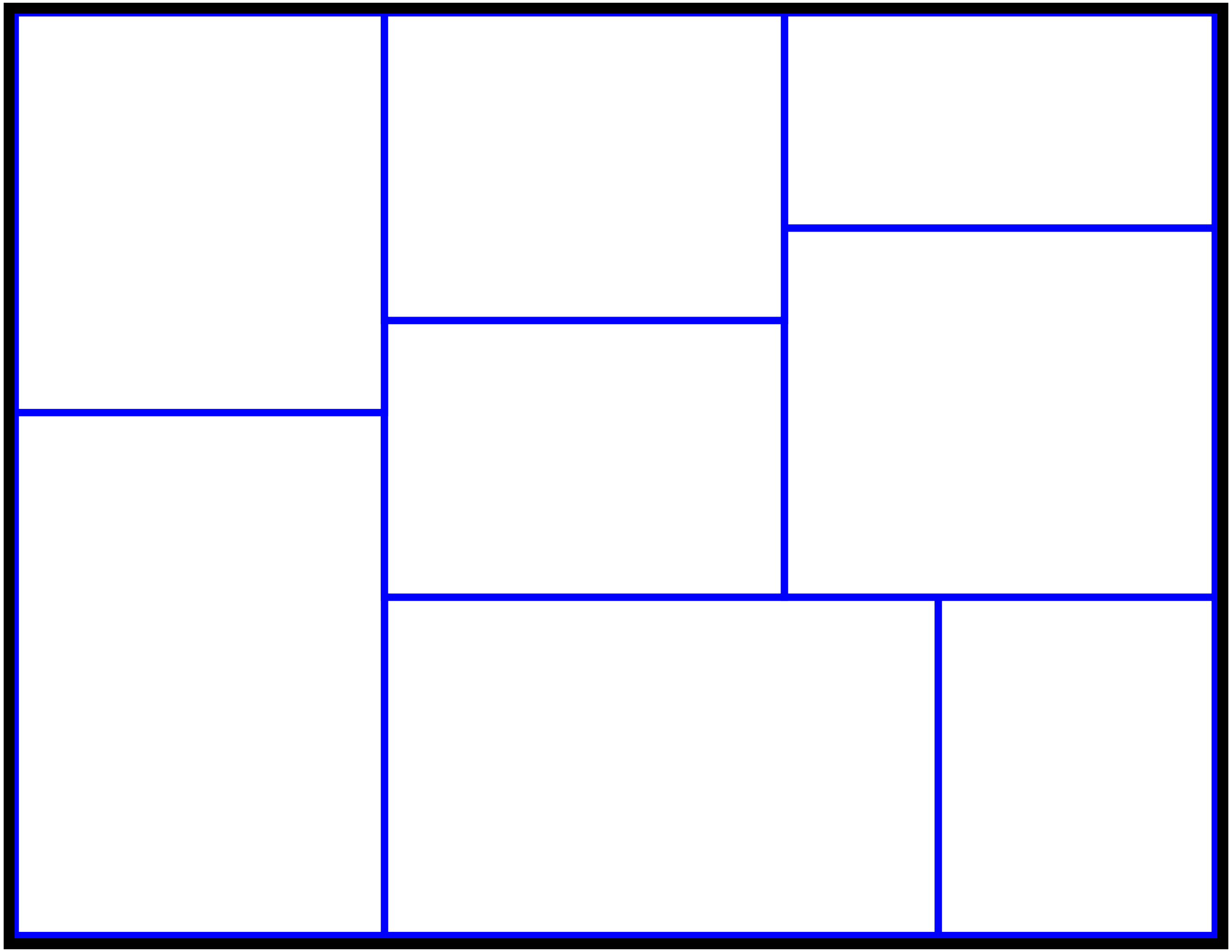
Variable A
Universe Reference:

Males, 15 years of age and older in Kenya in 2010

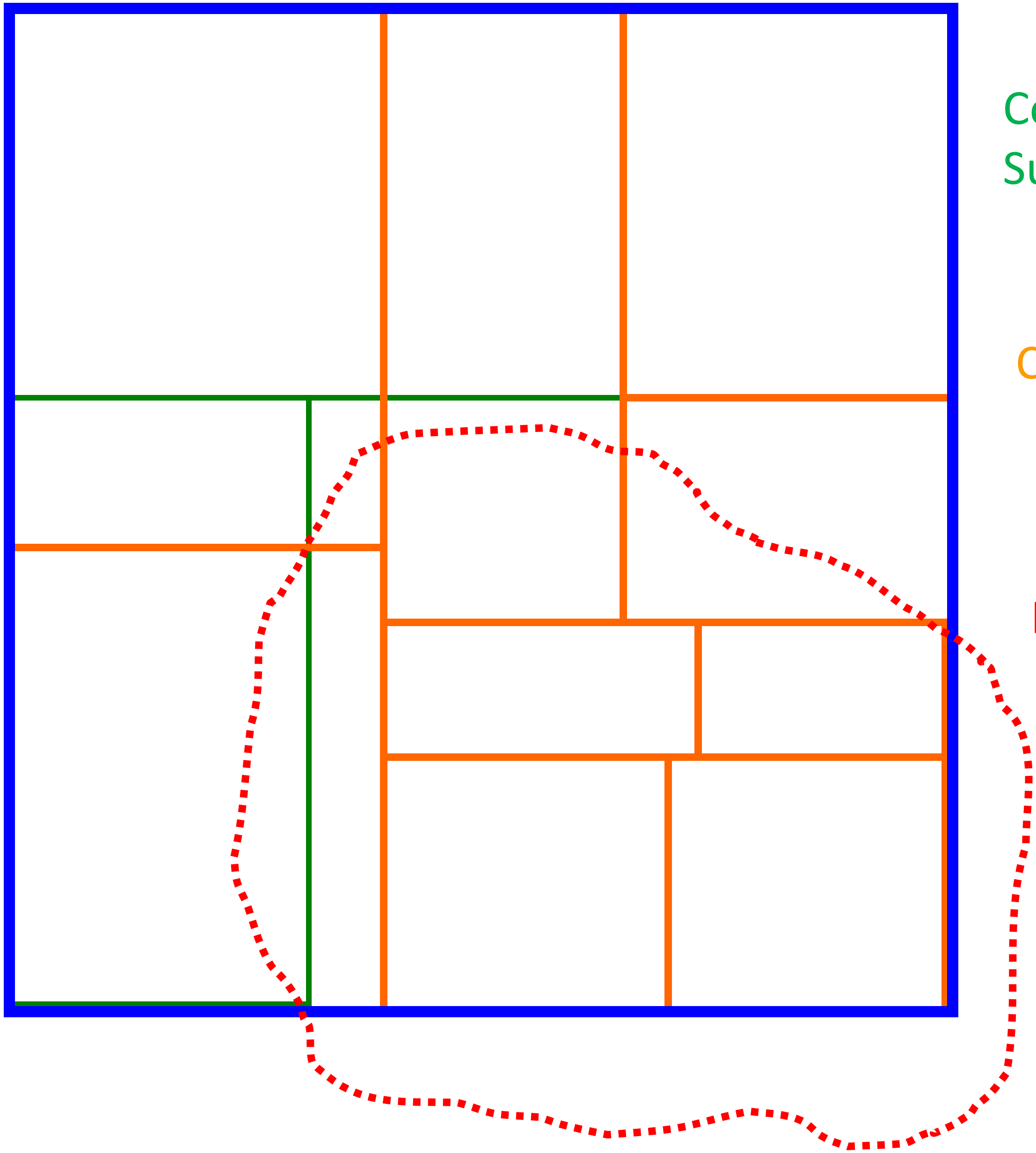
# Geographic Structure

- Level
  - Code, Name, coverage limitation, description
- Parent
  - Reference to a single parent geography
  - This is used to describe single hierarchies
- OR Geographic Layer
  - References multiple base levels where multiple hierarchies are layered to create a resulting polygon

STATE



# COUNTY



County Subdivision

Census Tract

Place

# Hierarchies and Layers

- State (040)
  - County (050)
    - County Subdivision (060)
    - Census Tract (140)
  - Place (160)

- Portion of a Census Tract within a County Subdivision within a Place
- Layer References:
  - 140
  - 060
  - 160

# Geographic Location

- Level description and/or a reference to the level description in the Geographic Structure
- Reference to the variable containing the identifier of the geographic location
- Description of a specific geographic location:
  - Code
  - Name
  - Geographic time
  - Bounding Polygon
  - Excluding Polygon

# Structure and Location

STRUCTURE:

- Level: 040
- Name: State
- U.S. State or state equivalent including Legal Territories and the District of Columbia
- Parent: 010 [country]

LOCATION:

- Level Reference: 040
- Variable Reference: STATEFP
- Name: Minnesota
- Code Value: 27
- Geographic Time: Start: 1857 End: 9999
- Bounding Polygon or Shape File Reference: for each boundary over time

# DDI Resources

- http://ddialliance.org
  - Specifications
  - Resources
    - Tools
    - Best Practices
    - Use cases
  - DDI Users list