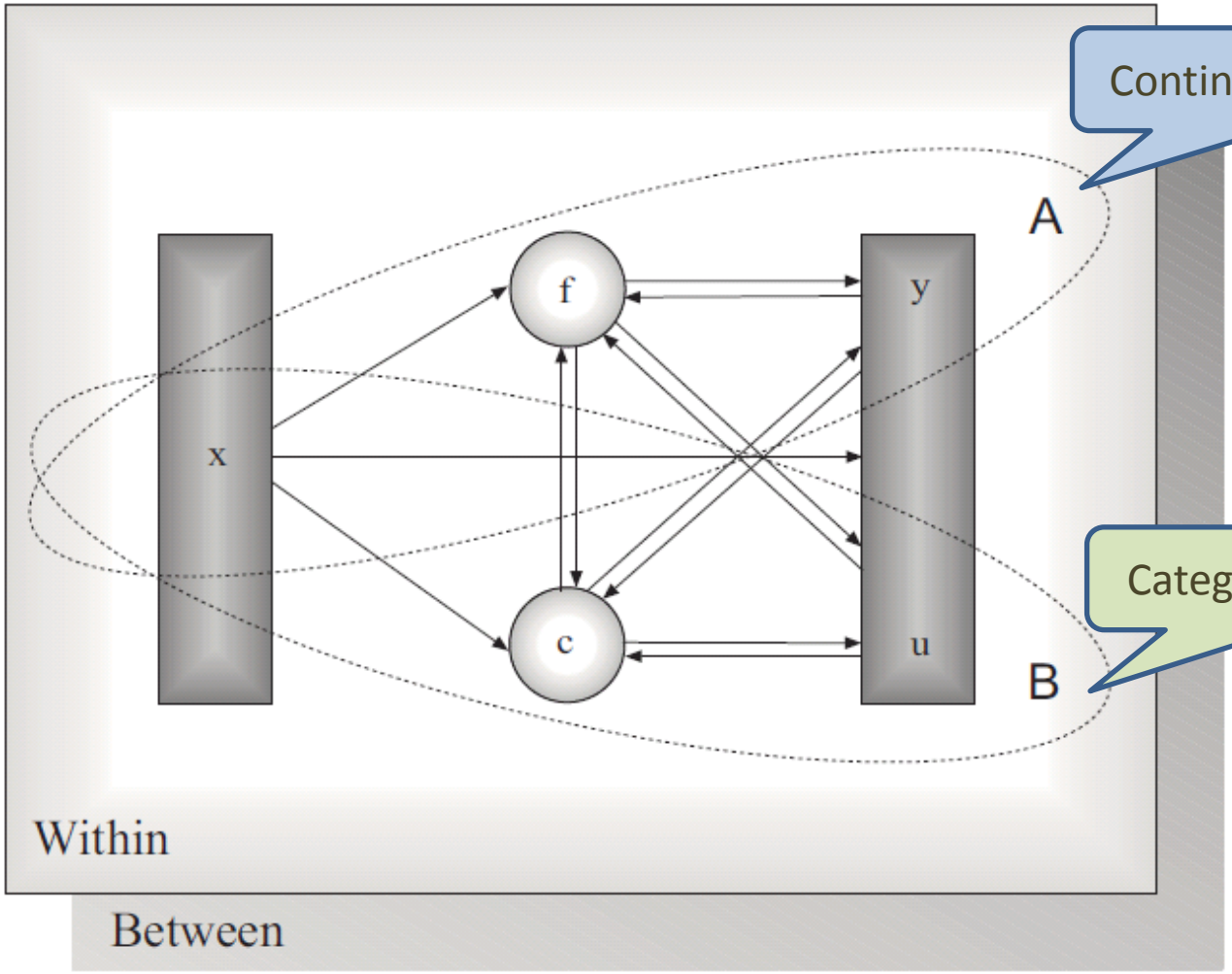
The M*plus* modelling framework



M*plus* syntax structure

TITLE: a title for the analysis (not part of the syntax)

DATA: (*required*) information about the data set

VARIABLE: (*required*) information about the variables in the data set

DEFINE: transform existing variables and create new variables

ANALYSIS: technical details of the analysis

MODEL: describe the model to be estimated

OUTPUT: request additional output

SAVEDATA: save the analysis data, auxiliary data, and results

PLOT: request graphical displays of observed data and results

MONTECARLO: details of a simulation study

Some conventions

- Order of syntax sections can be any
- The records in the input setup must be no longer than 90 characters
- Each command finishes with “**;**”
- Not case sensitive (but capital letters are often used for readability)
- A comment is anything followed by an exclamation mark, like this **!** This is a comment
- Clever with expanding names:

  item1-item100 is understood to be item1 item2 … item100

Data files

- Individual data (*default*)
  - Data must be in external ASCII file
  - No more than 500 variables
  - The maximum record length is 5000
  - Each case starts on new line
  - Free format (*default*)
    - Data values separated by <tab> <space> or comma
    - Note: do not use blanks to indicate missing values, or commas to indicate decimal points!
  - Fixed format (FORTRAN-like, e.g. 5F4.0, 10x, 6F1.0;)
- Matrix input
  - Sequence is means, standard deviations, correlations
  - Default is lower triangle only for correlations

DATA command (basic)

DATA:

FILE IS *filename*; full path or just name if in the same folder, in ‘ ’ if contains spaces

FORMAT IS 5F4.0, 10x, 6F1.0; not needed if *free*

TYPE IS covariance; Or *corr*, or *means* etc.
not needed if *individual*

NOBSERVATIONS ARE 581; only needed for summary data

- With summary data
  - means come first, then SDs, and then entries of the lower triangular correlation matrix
- Note that **IS**, **ARE** and **“=“** can be used interchangeably (apart from using “=“ in arithmetic operations)

VARIABLE command

VARIABLE:

NAMES ARE names of variables in the data set

USEVARIABLES ARE names of analysis variables; default is all variables in NAMES

USEOBSERVATIONS ARE conditional statement to select observations, default is all

MISSING ARE variable (#); or . ; * ; **BLANK;**

- And many more commands declaring type of variables, e.g.

CATEGORICAL ARE binary and ordinal dependent variables;

ANALYSIS command

ANALYSIS:

TYPE = GENERAL; (*default*, classical SEM)

BASIC; (compute basic statistics)

MEANSTRUCTURE; (*default*, models with means)

MISSING, H1; (*default*, MAR analysis incomplete data)

COMPLEX; (complex data)

EFA; (exploratory factor analysis)

Combinations apply, e.g. TYPE = COMPLEX MISSING;

ESTIMATOR =

- Choice of estimator depends on type of data and model
- Usually Maximum Likelihood (ML) or robust ML (MLR/MLM/MLMV)
- Also limited information ULS or DWLS (in Mplus ULSMV, WLS, WLSM, WLSMV)
- Bayes

ANALYSIS command (EFA)

ANALYSIS:
TYPE = EFA # #;
ROTATION = **GEOMIN**; ! (OBLIQUE) - default or (ORTHOGONAL)
QUARTIMIN !oblique only
CF-VARIMAX
CF-QUARTIMAX
CF-EQUAMAX
CF-PARSIMAX
CF-FACPARSIM
CRAWFER
OBLIMIN
PROMAX !oblique only
VARIMAX !orthogonal only
TARGET

MODEL command

MODEL: <specification>

- This is where the SEM model is specified
- Important keywords are BY, ON, WITH

  <factor> *Measured* BY <indicator>

  <outcome> *Regressed* ON <predictor>

  <(latent) variable> *Correlated* WITH <(latent) variable>
- @ fix parameter (specify a constraint)
- * free up parameter (if previously constrained)

Example CFA syntax

```
TITLE: CFA of Thurstone's correlation matrix
DATA: FILE IS THURSTONE.dat;
      TYPE IS CORRELATION;
      NOBSERVATIONS = 215;
VARIABLE:  NAMES ARE subtest1-subtest9;
ANALYSIS: !defaults are ok
MODEL:
      test1 BY subtest1-subtest3*;
      test2 BY subtest4-subtest6*;
      test3 BY subtest7-subtest9*;
      test1-test3@1;
OUTPUT: RES;
PLOT: TYPE=PLOT2;
```

OUTPUT command

OUTPUT:

SAMPSTAT; (sample statistics)

STANDARDIZED; (standardized solution)

RESIDUAL; (residuals)

MODINDICES; (modification indices > 10)

MODINDICES (#); (modification indices > #)

CINTERVAL; (confidence interval)

CINTERVAL (BOOTSTRAP / BCBOOTSTRAP);

FSCOEFFICIENT; (factor score coefficients)

TECH#; (various technical outputs, often used for finding problems)

Modification Indices

- Useful to guide modification of the model
- Modification index (M.I.) is the value by which chi-square will drop if the parameter currently fixed or constrained was freely estimated
- To request modification indices

  OUTPUT: MOD (<*min.value*>);

- E.P.C. is expected parameter change index
  - Expected value of the parameter if it was freely estimated