2.2.1 ESEM with Target rotation

ESEM with Target Rotation

- A stage in between of EFA and CFA: Rotation guided by substantive considerations, not using mechanical EFA rotation
- Same model fit as EFA, just a different rotation
- Choose rotation by giving target loading values (typically zero)
- Target values not fixed as in CFA — zero targets can come out big if misspecified
- Minimum requirement for identification is $m-1$ (m = # factors) zeros in each loading column which gives EFA which together with factor variances fixed at 1 results in the m^2 restrictions $m(m-1)+m$
- Mplus language using ESEM:
  -
```
f1 BY y1-y10 y1~0 (*1);
f2 BY y1-y10 y5~0 (*1);
```
- Tucker (1944), Browne (1972a, b). Asparouhov & Muthén (2024) suggests that PSEM does better than Target

Slide 46 discusses Target rotation. Target rotation represents an analysis stage that lies in between of EFA and CFA: The rotation is guided by substantive considerations, not using mechanical EFA rotation.

It has the same model fit as EFA, just using a different rotation. You choose a rotation by giving target loading values (typically zero).

Target values are not fixed as in CFA — zero targets can come out big if misspecified.

Minimum requirement for identification is $m-1$ (where m = #factors) zeros in each loading column which gives EFA which together with factor variances fixed at 1 results in the $m(m-1)+m = m^2$ restrictions.

The Mplus language uses ESEM for one factor at a time using the label 1 to denote the same EFA block. A curl $\sim$ is used together with a value to denote a target value for a loading, typically zero.

At the bottom are two early references for this technique and also the 2024 PSEM paper by us. As we will see, there are now better approaches to target rotation.

ESEM Target Input and Results for the H&S example

```
ANALYSIS:   ESTIMATOR = MLR;
            ROTATION = TARGET;

MODEL:      spatial BY visual-flags general-figurew~0 (*1);
            verbal BY visual-flags~0 general-wordm addition-figurew~0 (*1);
            speed BY visual-wordm~0 addition-straight wordr-figurew~0 (*1);
            memory BY visual-straight~0 wordr-figurew (*1);
            spatial-memory@1;
```

Grant-White has 9 significant cross-loadings, Pasteur has 12

Slide 47 shows the target input for the H&S example with 19 variables. The ANALYSIS uses ROTATION = TARGET. The MODEL command uses the loading pattern of slide 9 to give zero target values to all cross loadings.

This analysis results in 9 significant cross loadings for the Grant- White school and 12 for Pasteur. This is more than the 5 and 8 that we saw with regular EFA.

ESEM Bi-Factor Target Input for the H&S Example

```
ANALYSIS: ESTIMATOR = MLR;
          ROTATION = TARGET(ORTHOGONAL);

MODEL:    spatial BY visual-flags general-sentence~0 wordc-figurew(*1);
          verbal BY visual-paper~0 flags-figurew(*1);
          speed BY visual-straight wordr-figurer~0 object-figurew(*1);
          memory BY visual-wordm addition-counting~0 straight-figurew(*1);
          g BY visual-figurew(*1);
```

- This will be referred to as Model M5 in a later table

Slide 48 shows that Mplus also offers target rotation with bi-factor modeling. In the ANALYSIS command, this uses ROTATION = TARGET(ORTHOGONAL) so that all factors are uncorrelated. The MODEL command adds the general factor called g to the ESEM specification. On slides 56 and 57 this is the specification referred to as M5.