The Basic Idea Behind CFA:

1. First you usually test *factorial validity*
   1. The idea that the factor structure you propose (or are working on proposing due to an EFA) holds up in a confirmatory model
   2. Therefore you have some questions 🡪 that are predicted by a latent factor (unmeasured remember) 🡪 this mostly matches EFA due to theoretical direction of arrows, latent *predicts responses* on measures variables, whereas PCA says that the question answers all influence some *component*
2. One way to test factorial validity
   1. Run the theorized model and see what happens (yay good loadings)
   2. Run opposing models and hope that they don’t have good loadings
3. Model basics (a bit repetitive I know)
   1. Latent factors 🡪 unmeasured, circles
      1. These will usually have double headed arrows indicated that they are correlated (covariance)
      2. It would be very unusual to have no arrows 🡪 indicates they are orthogonal, which would be like using an orthogonal rotation in EFA (unlikely in psychology)
   2. Observed variables 🡪 measured stuff, boxes
      1. Arrow go from latent to measured
      2. Only load on one factor (this actually isn’t necessary…sometimes people predict they double load)
      3. Each variable has an error variance with a set regression weight of 1
   3. Something new!
      1. You know how degrees of freedom for things like t-tests and ANOVAs are N-1 where N is the number of people?
      2. Similar idea with loadings from latents to measured variables.
      3. ONE of the paths from a latent to a measured variable MUST be 1
         1. It’s basically the 1 one person who is not free to vary (N-1)
         2. Usually AMOS will set this for you (whew!)
4. Something I learned by actually reading the chapter
   1. View 🡪 path diagram for a visual with the estimates actually on the picture!
   2. You can cut and paste it into word! WHOA.
5. More on the output
   1. Model summary – shows you what you programmed into your model
      1. DFs
      2. Number of variables
      3. If it converged (minimum was achieved) and chi-square
   2. Model variables and parameters
      1. Shows you all the variables (did you make them the right bubble or square)
      2. Shows you parameters
         1. Regression weights 🡪 arrow lines
         2. Error variances
         3. Covariance (double headed arrows)
   3. Model evaluation
      1. Does the model “fit” or not?
6. Things to check/think about
   1. Feasibility of parameter estimates –heywood cases (correlations over 1, negative variance)
      1. Or if the direction of a relationship is completely wrong considering theory
   2. Standard errors – you do not want these to be zero (because you cannot really measure variables perfectly) or to be very large (you’ve measured badly)
      1. Remember this score will be based on scale of the variable
   3. Significance
      1. Although I don’t see this much in CFA, it should happen more often…you want all the estimates to be significant or they aren’t actually important
7. Fit Indices
   1. Model fitting process – basically you have this:
      1. Var/cov matrix of relationship between variables
      2. Estimated var/cov matrix from your diagram
      3. Matchy-matchy?
   2. Null hypothesis testing is bad! But it’s so easy and logical! But it’s bad! (wash, rinse, repeat)
   3. Goodness of fit statistics
      1. Independence model = one where none of the variables are related
      2. Your model = here are the theoretical relationships
      3. Saturated model = everything is related to everything
      4. Something also new I learned:
         1. CMIN is (N-1)Fmin from maximum likelihood estimation
         2. I’ve always known it’s influenced by sample size, but never why – since DF is about the number of parameters. Neat.
         3. Catch 22 since you have to have large samples to do SEM
   4. CMIN/df is more commonly used because of the implausibility of getting a chi-square value that is *non-significant* 🡪 as discussed <3 is a good number.
   5. RMR – root mean residual (want this to be small) talk about how to get standardized RMR
   6. Compared to “no model”
      1. GFI, AGFI – goodness of fit index – has fallen way out of favor because of the influence of sample size
         1. You can see this when you use a large sample but ill fitting model, they will be high while others are quite low
      2. PGFI – parsimony goodness of fit index – considers model complexity and you want this number to be above .5
   7. Compared to “some model”
      1. NFI – normed fit index (bentler is a big name in this field)
      2. CFI – comparative fit index is supposed to be better for smaller samples
      3. TLI – Tucker Lewis Index – quite popular
         1. .90 is good, .95 is excellent
      4. Ones on the output I never see printed
         1. RFI – relative fit index
         2. IFI – Incremental fit index
   8. Model parsimony
      1. PRATIO
      2. PNFI
      3. PCFI
      4. Based on their respective goodness of fit indices (if those are high, these will be high)
   9. RMSEA – root mean square error of approximation
      1. .08-.10 = ok fit
      2. <.06 = yay fit!
      3. Best! Always reported!
         1. Based partially on model complexity
         2. People know the rules about interpreting
         3. Confidence intervals (also commonly reported)
      4. You want the 90%CI to be small (indicating you have reasonable accuracy estimating your model
      5. PCLOSE you want to be over >.50 (although I never see this reported)
   10. The rest are all things you never see in normal CFA world…
8. Residuals
   1. Standardized residuals are the z-scores for parameters
   2. You are looking for ones that are very high >2.58
   3. This information will help you decide what parameters are not being estimated very well (even if their estimates are significant!)
9. Modification indices
   1. Tell you what parameters that are not being estimated might be important. You want to look for large change estimates
   2. In CFA you’ll want to look for examples of the latent to the question
      1. Not between questions…you don’t want question 1 answer to predict question 2 answer when thinking about how latents affect question answering.
      2. Is the chi square change large?
      3. Is the double loading something that makes sense?
   3. What to do?
      1. If the model fit is already good, the theory is good, and you are only fixing small things 🡪 leave it alone
      2. If model fit is bad and you are getting big changes 🡪 see what happens