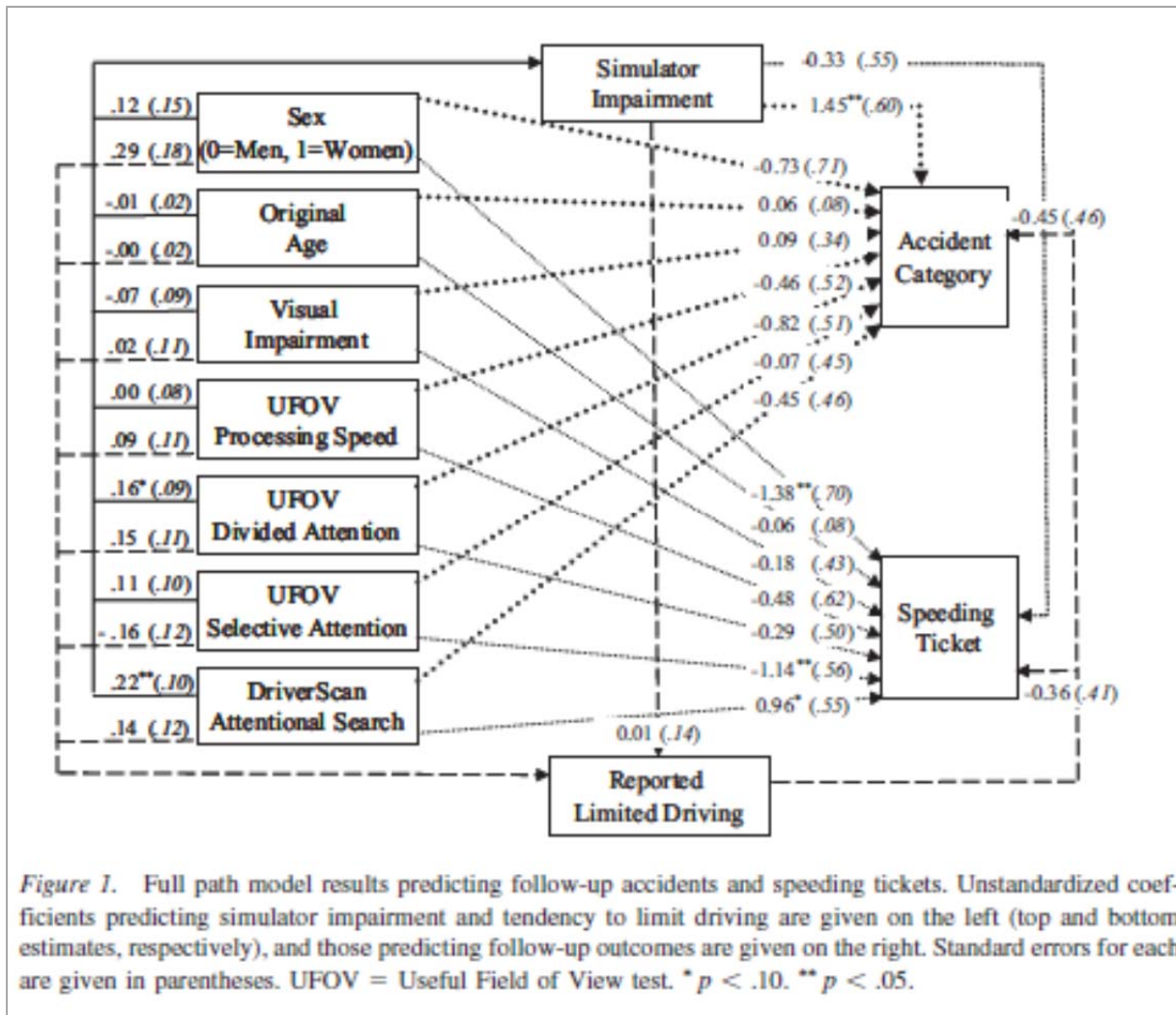


Path Models with Generalized Outcomes in Mplus (and STATA gsem, perhaps) from Hoffman & McDowd (2010, *Psychology and Aging*)

Mplus and STATA code and output for the model are shown below. In addition to the path model direct effects (and indirect effect), we are also estimating (by default) intercepts and residual variances for continuous outcomes.

Given that we are using a logit link, in Mplus we also estimate a threshold for each binary outcome, which is the logit of the probability of a 0 response when all predictors are 0 (i.e., it is the opposite of an intercept, which would provide the logit of the probability of a 1 response). By definition, though, the binary outcomes do not have estimated residual variances (they are determined by the conditional probability of each response in binary outcomes).



TITLE: Mplus Path Analysis for Dissertation Follow-up

DATA: FILE = driver.dat;

VARIABLE:

! List of variables in data file

```
NAMES = PartID sex age75 cs_1_5 cs_3 cs_6 cs_12 cs_18 far near
        zufov1 zufov2 zufov3 Dscan lane da_task crash stop speed time
        simfac part visfac attfac limit4 ticket2 speed2 follow attr
        nacc2 jacc2 jacc20 acc2;
```

! Variables to be analyzed in this model

```
USEVARIABLE = sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac
              limit4 speed2 acc2;
```

```

! Missing data identifier
MISSING = ALL (-999);
! Categorical outcomes (assumes normal otherwise by default)
CATEGORICAL = acc2 speed2;
ANALYSIS: LINK = LOGIT; ESTIMATOR = MLR; INTEGRATION = MONTECARLO;
OUTPUT: STDYX; ! Standardized coefficients
MODEL:
! Path model direct effects (labels for each path in parentheses)
simfac ON sex age75 visfac zufov1 zufov2 zufov3 Dscan (sim1-sim7);
limit4 ON sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac (lim1-lim8);
acc2 ON sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac limit4 (acc1-acc9);
speed2 ON sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac limit4 (spd1-spd9);
! Outcome intercepts (for continuous variables)
[simfac limit4];
! Outcome thresholds (for categorical variables)
[speed2$1 acc2$1];
! Estimated residual variances for continuous outcomes
simfac limit4;
MODEL CONSTRAINT: ! Like ESTIMATE in SAS
NEW(DstoAcc); ! List names of estimated effects on NEW
DstoAcc = sim7 * acc8; ! Indirect effect of Dscan --> Sim --> Acc

```

Following Example 34g from the STATA 13 manual, this code should have worked in theory, but the model would not converge (perhaps due to a difference in estimation options relative to Mplus):

```

display as result "STATA Path Analysis for Dissertation Follow-up"
display as result "Using coeflegend to get parm labels"
gsem ///
(simfac <- sex age75 visfac zufov1 zufov2 zufov3 Dscan) // X1-X7 to normal M1
(limit4 <- sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac) // X1-X7, M1 to normal M2
(acc2 <- sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac limit4, logit) // X1-X7, M1-M2 to binary Y1
(speed2 <- sex age75 visfac zufov1 zufov2 zufov3 Dscan simfac limit4, logit), // X1-X7, M1-M2 to binary Y2
method(ml) vce(robust) // full-information ML, robust SEs
coeflegend, // display parm labels
estat eggof, // R2 per variable

```

MPLUS output:

MODEL FIT INFORMATION

```

Number of Free Parameters          39

Loglikelihood

      H0 Value                    -356.400
      H0 Scaling Correction Factor  1.0066
      for MLR

Information Criteria

      Akaike (AIC)                 790.799
      Bayesian (BIC)               907.953
      Sample-Size Adjusted BIC     784.529
      (n* = (n + 2) / 24)

```

This is all the information about model fit that we get! There are 4 outcomes in the likelihood: M1, M2, Y1, and Y2, as well as 7 predictors not in the likelihood (for which no distributional assumptions are made).

But given that 2 of the outcomes are binary, the relationships among the 4 outcomes cannot be described by a covariance matrix. Thus, there is no saturated H1 model against which to compare fit, and thus no absolute fit statistics are given. The LL from our H0 model can be used to assess relative fit only.

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
SPEED2	0.416	0.209	1.994	0.046
ACC2	0.406	0.167	2.428	0.015
SIMFAC	0.201	0.067	2.985	0.003
LIMIT4	0.086	0.059	1.447	0.148

Mplus somehow calculates an R^2 for the proportion of explained variance in the binary outcomes, even though they do not have an estimated residual variance.

		UNSTANDARDIZED				STANDARDIZED STDYX			
		Estimate	S.E.	Est./S.E.	P-Value	Estimate	S.E.	Est./S.E.	P-Value
SIMFAC ON									
SEX		0.008	0.121	0.067	0.946	0.005	0.078	0.067	0.946
AGE75		-0.002	0.014	-0.111	0.911	-0.009	0.083	-0.111	0.911
VISFAC		-0.021	0.074	-0.287	0.774	-0.025	0.087	-0.286	0.775
ZUFOV1		0.033	0.069	0.482	0.630	0.043	0.089	0.482	0.630
ZUFOV2		0.085	0.086	0.992	0.321	0.111	0.110	1.003	0.316
ZUFOV3		0.105	0.082	1.283	0.200	0.135	0.105	1.277	0.201
DSCAN		0.216	0.081	2.661	0.008	0.279	0.104	2.681	0.007
LIMIT4 ON									
SEX		0.304	0.200	1.522	0.128	0.154	0.102	1.511	0.131
AGE75		-0.001	0.024	-0.054	0.957	-0.006	0.114	-0.054	0.957
VISFAC		0.009	0.108	0.080	0.937	0.008	0.099	0.080	0.937
ZUFOV1		0.098	0.127	0.772	0.440	0.100	0.129	0.775	0.438
ZUFOV2		0.149	0.124	1.205	0.228	0.152	0.124	1.225	0.221
ZUFOV3		-0.163	0.139	-1.178	0.239	-0.166	0.141	-1.181	0.238
DSCAN		0.154	0.131	1.178	0.239	0.157	0.134	1.171	0.242
SIMFAC		0.026	0.155	0.169	0.866	0.021	0.122	0.169	0.866
ACC2 ON									
SEX		-0.770	0.560	-1.374	0.169	-0.162	0.121	-1.341	0.180
AGE75		0.058	0.083	0.700	0.484	0.114	0.167	0.680	0.496
VISFAC		0.066	0.309	0.213	0.831	0.025	0.117	0.215	0.830
ZUFOV1		-0.438	0.608	-0.720	0.472	-0.186	0.240	-0.775	0.438
ZUFOV2		-0.822	0.379	-2.171	0.030	-0.350	0.149	-2.342	0.019
ZUFOV3		-0.066	0.391	-0.169	0.866	-0.028	0.165	-0.169	0.865
DSCAN		-0.477	0.320	-1.491	0.136	-0.202	0.130	-1.552	0.121
SIMFAC		1.497	0.532	2.813	0.005	0.492	0.131	3.759	0.000
LIMIT4		-0.387	0.411	-0.943	0.346	-0.161	0.161	-1.001	0.317
SPEED2 ON									
SEX		-1.387	0.749	-1.852	0.064	-0.290	0.129	-2.245	0.025
AGE75		-0.065	0.051	-1.265	0.206	-0.126	0.097	-1.299	0.194
VISFAC		-0.180	0.343	-0.525	0.599	-0.068	0.125	-0.549	0.583
ZUFOV1		-0.475	0.483	-0.982	0.326	-0.200	0.177	-1.133	0.257
ZUFOV2		-0.289	0.610	-0.474	0.636	-0.122	0.242	-0.503	0.615
ZUFOV3		-1.136	0.370	-3.067	0.002	-0.477	0.149	-3.195	0.001
DSCAN		0.968	0.518	1.868	0.062	0.408	0.174	2.345	0.019
SIMFAC		-0.382	0.682	-0.561	0.575	-0.125	0.208	-0.599	0.549
LIMIT4		-0.343	0.480	-0.715	0.475	-0.141	0.205	-0.690	0.490
Intercepts									
SIMFAC		0.016	0.090	0.174	0.862				
LIMIT4		0.062	0.160	0.389	0.697				
Thresholds									
SPEED2\$1		1.727	0.507	3.407	0.001				
ACC2\$1		2.059	0.546	3.772	0.000				
Residual Variances									
SIMFAC		0.479	0.052	9.140	0.000				
LIMIT4		0.876	0.122	7.169	0.000				
New/Additional Parameters									
DSTOACC		0.323	0.160	2.026	0.043				

Intercepts/thresholds for reference person:

$$\text{Prob(NO ticket)} = \frac{\exp(1.727)}{1 + \exp(1.727)} = .85$$

$$\text{Prob(NO acc)} = \frac{\exp(2.059)}{1 + \exp(2.059)} = .89$$

The nonsignificant Dscan → Acc (X → Y) path and this significant indirect effect together indicate “full” mediation.