

**Within-person analysis of developmental cascades between externalising and internalising  
problems**

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Running head: WITHIN-PERSON CASCADES

## Abstract

**Background:** In a large body of previous research, cross-lagged panel models (CLPMs) have been used to provide empirical support for developmental models that posit a cascade from externalising to internalising problems. These developmental models, however, arguably refer to within-person processes whereas CLPMs provide a difficult-to-interpret blend of within- and between- person effects.

**Methods:** We used autoregressive latent trajectory models with structured residuals (ALT-SR) to evaluate whether there is evidence for externalising to internalising cascades at the within-person level when disaggregating between- and within- person effects. We used 8 waves of data (age 7 to 15) from the Zurich Project on Social Development from Childhood to Adulthood (z-proso).

**Results:** ALT-SRs fit better than the corresponding CLPMs. Using an ALT-SR model, we found evidence for externalising-to-internalising cascades, consistent with previous CLPM studies.

However, we also found some evidence for effects in the ALT-SR that were not apparent in the CLPM, including a negative effect of externalising on internalising problems in adolescence. In addition, a negative effect of internalising on externalising problems in adolescence was found in both the CLPM and ALT-SR.

**Conclusions:** Within-person results were largely consistent with previous evidence from CLPMs; however, at the within-person level, externalising and internalising may negatively influence one another in adolescence.

**Keywords:** Externalising disorder; Internalising disorder; Comorbidity; Developmental psychopathology; Longitudinal studies

1 Externalising and internalising problems have a strong tendency to co-occur from childhood  
2 (Martel et al., 2017; Rhee, Lahey, & Waldman, 2015). Understanding the nature and cause of  
3 their co-occurrence is important for informing interventions. For example, identifying whether  
4 there are reciprocal or directional causal relations between the two domains and how these links  
5 are mediated provides key information on intervention targets. To date, developmental cascade  
6 models have proven valuable in illuminating the developmental relations between internalising  
7 and externalising symptoms. However, support for the developmental processes implied by  
8 these models has typically relied on statistical methodologies that arguably have not adequately  
9 operationalised said processes. In particular, typically utilised cross-lagged panel models  
10 (CLPMs) cannot disaggregate between- and within-person processes and their parameters  
11 reflect a difficult-to-interpret blend of the two. In this study, we apply autoregressive latent  
12 trajectory models with structured residuals (ALT-SR; Curran, Howard, Bainter, Lane, &  
13 McGinley, 2014) to more appropriately operationalise hypotheses regarding the developmental  
14 basis of externalising and internalising comorbidity.

15         Several developmental cascade models have been proposed to account for the  
16 association between externalising and internalising problems from childhood (see e.g.,  
17 Moilanen, Shaw, & Maxwell, 2010 for a helpful summary). Though there are some exceptions  
18 (e.g., Lee & Stone, 2012; Weeks et al., 2016) the weight of evidence suggests that while  
19 externalising problems are liable to lead to the development of internalising problems, the  
20 reverse is generally not true. This evidence supports developmental models such as the dual  
21 failure model (Capaldi, 1992), which proposes that externalising problems create difficult  
22 psychosocial conditions (e.g., academic failures and peer problems) that increase the risk of  
23 anxiety and depression.

24         Typical studies in this area have utilised repeated measures data over several years of  
25 child/adolescent development. CLPMs (with or without mediators) are fit to the data and the  
26 (direct or indirect) cross-lagged paths between internalising and externalising examined. For

27 example, Blain-Arcaro & Vaillancourt (2017) recently examined aggression-depression  
28 cascades across 7 waves during adolescence using data (n=643) from the *McMaster Teen Study*.  
29 They found significant and positive cross-lagged paths from aggression to depression but did  
30 not find significant paths from depression to aggression. Similarly, van Lier et al. (2012) used  
31 CLPMs to evaluate the longitudinal mediation of the relation between externalising and later  
32 internalising by peer victimisation and academic failure. Using a sample of n=1558 Canadian  
33 children measured between ages 6 and 8, they found evidence for an externalising-to-  
34 internalising pathway but not the reverse. The pathway was mediated by academic  
35 underachievement.

36 As several authors have recently pointed out, however, despite their contributions to  
37 advancing theory in developmental psychopathology, CLPMs ultimately yield parameters that  
38 represent an aggregation of between- and within-person effects (Berry & Willoughby, 2017;  
39 Curran et al., 2014). Developmental models of psychopathology, however, typically refer to  
40 within-person processes (or separate within- and between-person processes) thus creating a mis-  
41 match between theoretical model and statistical operationalisation. Arguably this issue applies  
42 to the developmental models that seek to explain externalising and internalising comorbidity.  
43 This can be illustrated using the example of the dual failure model. It holds that externalising  
44 problems lead to problems in the social and academic domains. Specifically, acting out is  
45 proposed to lead to poor academic performance and issues with peers, such as rejection and  
46 victimisation. These issues, in turn, are proposed to negatively impact self-esteem, making it  
47 more likely that an individual will develop internalising problems. The model implies that if an  
48 individual shows an increase in their externalising behaviour, this will ultimately lead to an  
49 increase in their internalising problems. Although it may occur in the context of between-person  
50 differences in externalising and internalising, this developmental process occurs within, and not  
51 between individuals. Substantively, this would have quite different meaning to a between-  
52 person association between externalising and internalising. A between-person association could

53 reflect, for example, risk factors with a stable component that differs across children (e.g., the  
54 effects of genes, adversity, social disadvantage, family discord, maladaptive parenting) that  
55 result in higher levels of both externalising problems and internalising problems. Previous  
56 studies utilising CLPMs blend these between-person sources of variation with within-person  
57 effects, obscuring the latter.

58         From a clinical perspective, knowing whether there are within-person effects of  
59 externalising on internalising problems is important for informing interventions. If a child is  
60 liable to develop internalising problems as a result of externalising problems (a within-person  
61 effect), then important targets for intervention lie in the pathways that link externalising  
62 problems to internalising problems (e.g., the academic, peer and self-esteem problems referred  
63 to in the dual failure model). However, if the previously observed cross-lagged effects of  
64 externalising on internalising problems reflect influences that vary between individuals but that  
65 are relatively stable over time (e.g., social disadvantage, genes with early effects on  
66 externalising and later effects on internalising; Wertz et al., 2015), then alternative intervention  
67 targets are likely to produce better effects.

68         A solution to the blending of between- and within-person effects in the CLPM is to  
69 employ the recently proposed autoregressive latent trajectory model with structured residuals  
70 (ALT-SR; Curran, Howard, Bainter, Lane, & McGinley, 2014). The ALT-SR represents an  
71 extension of the parallel process model, whereby a cross-lagged (or other) structure is fit to the  
72 time-specific residuals from a parallel process latent growth curve model. This specification  
73 disaggregates the between- and within-person relations between two constructs, with the cross-  
74 lagged effects on the residuals capturing the reciprocal within-person relations between the  
75 constructs. Unlike the CLPM, the ALT-SR thus partials out the effects of unmeasured between-  
76 person confounds (Berry & Willoughby, 2017).

77         Previous investigations using the ALT-SR and closely related models have suggested  
78 that issues deriving from the blending of within- and between- person effects in the CLPM are

79 not merely a problem in principle. Berry and Willoughby (2017) illustrated the issue in a  
80 simulation study in which they showed that a substantively important and significant cross-  
81 lagged effect could be driven by a between-person effect in the absence of a true within-person  
82 effect. They also re-examined the relations between corporal punishment and aggression in data  
83 from the *Family Life Project*. They found a non-significant within-person effect of corporal  
84 punishment on aggression, despite a significant cross-lagged effect. These results thus challenge  
85 the long-held belief that corporal punishment leads to increases in aggression; their association  
86 may instead reflect confounding factors such as gene-environment correlations or other factors  
87 that vary between parent-child dyads. Similarly, Besemer, Loeber, Hinshaw, & Pardini (2016)  
88 examined the within-person relations between maladaptive parenting and child externalising  
89 problems. Despite previous research supporting reciprocal relations consistent with ‘coercive  
90 cycle’ models (Patterson, 1982), they found no relations between dimensions of parenting and  
91 child behaviour problems in their within-person analysis of data from the *Pittsburgh Youth*  
92 *Study*.

93         When evaluating developmental relations between externalising and internalising  
94 problems, it is also important to consider gender differences in psychopathology. Although it is  
95 relatively well-established that internalising problems tend to be more common in females  
96 (from adolescence, where gender differences tend to emerge) and that most forms of  
97 externalising problems tend to be more common in males (e.g. Archer, 2004; Bongers, Koot,  
98 Van der Ende, & Verhulst, 2003; Demmer, Hooley, Sheen, McGillivray, & Lum, 2017), the  
99 evidence on gender differences in their developmental relations is mixed. While many studies  
100 have found no or few gender differences in developmental cascades involving externalising and  
101 internalising (Blain-Arcaro & Vaillancourt, 2017; Burt & Roisman, 2010; Hoglund &  
102 Chisholm, 2014; Lee & Stone, 2012; van Lier et al., 2012), a few have reported differences  
103 (Klostermann, Connell, & Stormshak, 2016; Leadbeater & Hoglund, 2009; Obradović et al.,  
104 2009; Wiesner, 2003). There is, for example, some evidence that females may be more likely to



130 recontact, and measurement protocols for z-proso can be found in previous publications (e.g.,  
131 M. Eisner & Ribeaud, 2007).

### 132 **Ethical Considerations**

133 Ethical approval was obtained from the Ethics Committee from the Faculty of Arts and  
134 Social Sciences of the University of Zurich. Active informed consent was obtained via parents  
135 up until age 12, after which active informed consent was obtained from the youth themselves  
136 (parents could opt their child out of the study up to age 18.)

### 137 **Measures**

138 *Externalising and internalising problems* were both measured using the teacher-  
139 reported *Social Behavior Questionnaire* (SBQ; Tremblay et al., 1991). Externalising was  
140 measured with 6 items covering symptoms of oppositional defiant disorder and non-aggressive  
141 symptoms of conduct disorder, and 9 that measured aggression. Internalising was measured  
142 using 3 items covering anxiety and 4 that covered depression.

143 Adding to existing evidence for the favourable psychometric properties of the SBQ  
144 (e.g., Tremblay et al., 1991) the psychometric properties of the SBQ in the current sample have  
145 been investigated in previous publications, providing support for the reliability and validity of  
146 its scores (e.g., Murray, Obsuth, Eisner, & Ribeaud, 2017).

147 Using the items from the SBQ, longitudinal factor models were fit separately for  
148 internalising and externalising and used to estimate factor scores. Briefly, externalising and  
149 internalising were specified as unidimensional. Residual covariances between items measured at  
150 different time points were freely estimated. Models were fit in lavaan in R statistical software  
151 using FIML estimation to deal with missingness. FIML provides unbiased parameter estimates  
152 provided that data are missing at random i.e., missing conditional on the modelled  
153 predictors/covariates (MAR; Rubin, 1976). It is not possible to test MAR against not missing at  
154 random (NMAR) missing mechanisms because this requires information about the unobserved

155 data; however, there were several reasons to assume that any bias due to NMAR would be  
156 minimal. Non-response and attrition rates were relatively low (94% participation, 92%  
157 retention), there were few differences between the non-respondents and respondents at baseline  
158 (N. L. Eisner et al., 2018), and data on individuals who were missing at some waves were  
159 included in the model through the use of FIML. Factor scores were estimated using the Bartlett  
160 method. Omega reliability coefficients (McDonald, 1999) for all factors were  $>.90$ . This two-  
161 step method of first estimating factor scores in a separate step (rather than specifying latent  
162 internalising and externalising factors in the main substantive models) was used to facilitate  
163 estimation given the complexity of a model that incorporates latent variable measurement  
164 models in the ALT-SR model.

### 165 **Informants**

166 Participants' teachers completed the SBQ. For most of the youth in the sample, the  
167 same teacher provided ratings between grades one and three, i.e., at the measurement waves  
168 when the participants were aged 7, 8, and 9. Children were then taught by another teacher  
169 between grades four to six; i.e., at the measurement waves at age 10, 11, and 12. The youth then  
170 transitioned to secondary school for the data collection waves at ages 13 and 15. For the first  
171 three waves of data collection, teachers were not compensated for their participation but for all  
172 others teachers who had at least seven participants in their class received a book voucher worth  
173 approximately 50 USD.

### 174 **Statistical Procedure**

175 Developmental relations between externalising and internalising problems were  
176 assessed using an ALT-SR model. For the latent growth curve model part of the model,  
177 intercept and linear slope factors were defined for both internalising and externalising. The  
178 intercept factor loadings were all fixed to 1. The slope factor loadings for observations at waves  
179 1 to 8 (ages 7 to 15) were fixed equal to 0, 0.095, 0.214, 0.395, 0.504, 0.629, 0.781 and 1,

180 reflecting the spacing of waves in time. Slope and intercept factor means and intercept factor  
181 variances were freely estimated and slope factor variances were fixed to 0. The intercept factors  
182 were allowed to covary. A cross-lagged structure was fit to the time-specific residuals of the  
183 growth curve part of the model. That is, internalising and externalising at each time point were  
184 regressed on internalising and externalising at the previous time point. (Residual) covariances  
185 between internalising and externalising at each time point were also included. For comparison, a  
186 standard CLPM was fit to the raw (non-residualised) factor scores. CLPMs and ALT-SRs were  
187 compared using the Bayesian Information Criterion (BIC). Smaller (more negative) BIC values  
188 indicate better-fitting models. In addition, when BIC differences are greater than  $|10|$ , the  
189 difference can be considered ‘very strong’ evidence in favour of the better fitting model  
190 (Raftery, 1995).

191 To examine gender differences, we fit ALT-SR and CLPMs in which all parameters  
192 were fixed equal across males and females. We compared these to the corresponding models in  
193 which the minimum necessary constraints for identification were imposed. If the BIC was better  
194 in the unconstrained model, modification indices and expected parameter changes were used to  
195 guide the iterative release of cross-gender equality constraints until a partially invariant model  
196 (with a BIC superior to both the fully constrained and unconstrained models) could be achieved.

197 All models were fit in *MPlus 8.0* using robust maximum likelihood estimation (MLR)  
198 with clustering by wave 1 teacher. Wave 1 teacher was used as the clustering variable because  
199 clustering effects were strongest in the earlier waves. This clustering also largely captures  
200 clustering at waves 2 and 3 because most children retained the same teacher across these waves.

## 201 **Results**

202

203 The ALT-SR with cross-gender equality constraints showed reasonably good fit  
204 (CFI=.90, TLI=0.90, RMSEA=.06, SRMR=.11, BIC=-5732.47) and better fit than the

205 corresponding CLPM (CFI=.86, TLI=0.84, RMSEA=.08, SRMR=.14, BIC= -5165.39).  
206 However, the unconstrained ALT-SR model fit better than the ALT-SR model with gender  
207 invariance constraints (CFI=.95, TLI=.93, RMSEA=.05, SRMR=.05, BIC=-6085.16). The  
208 unconstrained ALT-SR also fit better than the corresponding CLPM (CFI=.90, TLI=.85,  
209 RMSEA=.07, SRMR=.10, BIC=-5561.42).

210           Iterative release of cross-gender equality constraints from the ALT-SR model with  
211 cross-gender equality constraints gave a partially invariant model with good fit and superior fit  
212 to both the fully constrained and fully unconstrained models in terms of BIC (CFI=.94,  
213 TLI=0.93, RMSEA=.05, SRMR=.06; BIC=-6170.75). This model relaxed the cross-gender  
214 equality constraints on the within-person residual variances of externalising at ages 10, 11 and  
215 12, as well as the cross-gender constraint on the intercept factor variance for externalising. None  
216 of the within-person autoregressive or cross-lagged parameters constraints had modification  
217 indices or expected parameter changes indicating a need for their removal. For comparison, an  
218 analogous CLPM was estimated but it showed poorer fit than the ALT-SR (CFI=.89, TLI=0.88,  
219 RMSEA=.07, SRMR=.12, BIC=-5536.90). The partially invariant ALT-SR model was thus  
220 accepted as the best model although it is worth noting that all ALT-SRs fit better than the  
221 corresponding CLPM with  $|BIC| > 10$ , supporting the superiority of the ALT-SR in capturing the  
222 developmental relations between externalising and internalising problems in general. It is  
223 summarised in Table 1, which also includes the autoregressive and cross-lagged effects from the  
224 corresponding CLPM for comparison. Results from the partially invariant ALT-SR are also  
225 shown in Figure 1. For clarity, only autoregressive and cross-lagged paths are shown. Results  
226 suggested that with only a couple of exceptions externalising and internalising showed moderate  
227 to strong within-person stability. There was generally no within-person cross-lagged effect of  
228 internalising on externalising, with the exception of a negative cross-lagged effect between ages  
229 12 and 13. However, there was a relatively consistent cross-lagged effect of externalising  
230 problems on internalising problems. A descriptive comparison of the ALT-SR and CLPM

231 suggested strong similarity of results. There were two main differences. First, internalising  
232 showed low within-person stability between ages 9 and 10 in the ALT-SR but moderate stability  
233 in the CLPM. Second, the ALT-SR revealed a negative within-person effect of externalising at  
234 age 13 on internalising at age 15.

## 235 **Discussion**

236 In previous studies, applications of CLPMs have supported developmental cascade  
237 models such as the dual failure model which posit that externalising-internalising comorbidity  
238 can be explained in part because externalising creates risk for the development of internalising  
239 symptoms. However, here we argue that a more appropriate operationalisation of this  
240 hypothesis would involve examining within-person developmental relations between  
241 externalising and internalising. Thus, it was the aim of the current study to utilise the ALT-SRs  
242 to evaluate whether prior conclusions regarding externalising-internalising developmental  
243 relations hold at the within-person level. Our ALT-SRs fit better than the corresponding  
244 CLPMs, supporting the idea that ALT-SRs are more suitable for capturing externalising-  
245 internalising relations over developmental time. Our within-person analyses from our ALT-SR  
246 largely replicated the finding that externalising predicts later internalising in childhood.  
247 However, results also suggested that internalising and externalising problems negatively  
248 influence one another in adolescence, with internalising at age 12 negatively predicting  
249 externalising at age 13 and externalising at age 13 negatively predicting internalising at age 15.  
250 The latter effect was only revealed in the ALT-SR with between-person variance partialled out.

251 The ALT-SR results were largely in line with previous investigations using CLPMs in  
252 that in childhood, they suggested positive cross-lagged effects from externalising to  
253 internalising but no cross-lagged effects in the opposite direction (Hoglund & Chisholm, 2014;  
254 Leadbeater & Hoglund, 2009; Moilanen et al., 2010; van Lier & Koot, 2010; van Lier et al.,  
255 2012). These results bolster support for models that posit developmental cascades from  
256 externalising to internalising in childhood. Dominant among these models is the dual failure

257 model (Capaldi, 1992) which proposes that externalising-to-internalising pathways are mediated  
258 by failures in the academic and social domains. However, others have proposed alternative  
259 mediators, such as parental issues (Wertz et al., 2015). It would be valuable for future studies to  
260 evaluate whether proposed mediating mechanisms also hold at the within-person level.

261           Beyond age 12, however, our results suggested a potential protective effect of  
262 internalising although it was limited to a significant negative cross-lagged effect from age 12 to  
263 13 and a non-significant negative cross-lagged effect from age 13 to 15. Developmental  
264 relations between externalising and internalising in adolescence have been less well studied;  
265 however, most studies seem to indicate that externalising continues to have positive cross-  
266 lagged effects on internalising (Beyers & Loeber, 2003; Blain-Arcaro & Vaillancourt, 2017;  
267 Klostermann et al., 2016; Lee & Stone, 2012). Some previous studies have suggested that  
268 internalising also has positive cross-lagged effects on externalising during this phase of  
269 development (Beyers & Loeber, 2003; Bornstein, Hahn, & Haynes, 2010; Lee & Stone, 2012;  
270 McLaughlin, Aldao, Wisco, & Hilt, 2014). Only a small number of studies have previously  
271 hinted at any potential protective effects of internalising in adolescence (e.g., Masten et al.,  
272 2005).

273           There are several possible explanations for the negative cross-lagged effect observed in  
274 adolescence in the current study. In contrast to early onset externalising problems, increases in  
275 externalising behaviour in adolescence have been hypothesised to be quite normal and strongly  
276 linked to peer influences while internalising problems and attendant social isolation have been  
277 proposed to attenuate this peer effect (e.g., Moffitt, 2003). Alternatively, it may be that youth  
278 who are high in internalising are more likely to refrain from externalising behaviour because of  
279 higher levels of fear of its consequences. This effect may not emerge until adolescence due to a  
280 dependence on sufficient maturation of self-regulatory capacities. These explanations are  
281 speculative and will require further investigation in future studies.

282 Overall results were similar across our CLPM and ALT-SR models, however, the value  
283 of using the latter to disaggregate between and within-person effects was evident in the  
284 discrepancies that did arise. First, the ALT-SR showed that the within-person stability of  
285 internalising is low between ages 9 and 10 and that the within-person stability of externalising is  
286 low between ages 13 and 15, despite the moderate rank order stability stability observed for  
287 both in the CLPM. These periods of within-person instability may reflect the emergence of late  
288 childhood-onset anxiety/depression and adolescent-onset conduct problems respectively. Such  
289 transition points may not be detected easily using CLPMs due to a masking by the stability of  
290 between-person (rank order) differences: youth may show elevated symptoms relative to their  
291 peers across development (a between-person effect); however, their symptoms may not escalate  
292 relative to their own baseline until late childhood or adolescent (a within-person effect).

293 In addition, the ALT-SR suggested a negative cross-lagged effect of externalising at age  
294 13 on internalising at age 15 that was not detected in the CLPM. This negative effect (which  
295 occurred in the context of negative cross-lagged effects of internalising on externalising)  
296 suggests that psychopathology becomes increasingly differentiated in adolescence (e.g., Murray  
297 et al., 2016). One possibility is that in adolescence, high externalising problems become a more  
298 deliberate method of coping with distress that might otherwise be manifested as internalising  
299 problems. Further, as externalising problems have been argued to be quite normative in  
300 adolescence (Moffitt, 2003), showing an increase in externalising problems relative to one's  
301 baseline might indicate adaptive social functioning that would lower the risk of internalising  
302 problems. Again, these explanations are speculative and will require further testing in future  
303 studies; however, if externalising problems do protect against internalising problems, it would be  
304 worthwhile identifying the mechanisms as this could help inform prevention. For example, if  
305 the apparent protective effect of externalising problems reflects a benefit of 'letting off steam'  
306 safe and constructive alternatives to acting out could be explored with an adolescent to help  
307 replace maladaptive methods of coping.

308           Finally, our results did not support a gender difference in the developmental relations  
309 between externalising and internalising problems. Our gender invariance analysis suggested that  
310 differences were limited to some of the residual variances of externalising and internalising and  
311 not the autoregressive or cross-lagged parameters. This is consistent with a number of previous  
312 studies that have found gender invariance in CLPMs involving externalising and internalising  
313 problems (Blain-Arcaro & Vaillancourt, 2017; Burt & Roisman, 2010; Hoglund & Chisholm,  
314 2014; van Lier et al., 2012). Further, among studies that have found gender differences, these  
315 have typically been limited to a small subset of the totality of paths tested (e.g., Obradović et al.,  
316 2009; van Lier & Koot, 2010) and have not tended to be consistent across studies. Thus, there is  
317 no strong evidence for fundamental differences in the developmental relations between  
318 externalising and internalising problems across males and females.

#### 319           **Limitations and Future Directions**

320           A limitation of the current study includes the reliance on teacher reports, the only  
321 informants for whom data were available for both childhood and adolescence. Though teachers  
322 may provide more reliable data in the early years of life, by secondary school teachers may have  
323 more limited opportunities to observe youth. Further, the same teachers provided ratings across  
324 multiple waves, meaning that associations across these waves may have been inflated relative to  
325 the lags where different teachers provided ratings. In addition, our study did not have data on  
326 early childhood or adulthood, thus we could not evaluate externalising-internalising  
327 developmental dynamics outside the age 7 to 15 range.

328           It would be valuable for the present study to be replicated in other large longitudinal  
329 samples. Many studies with the requisite data exist, including previous developmental cascade  
330 studies cited in the current report. In addition, there are a number of additional developmental  
331 psychopathology models that potentially imply within-person effects that could be evaluated  
332 using the ALT-SR. These include, among others, Patterson's coercion model of the relation  
333 between parenting and externalising (Besemer et al., 2016; Patterson, 1982), the ontogenic

334 model of ADHD-conduct disorder comorbidity (Beauchaine & McNulty, 2013), and the  
335 dynamic mutualism model of comorbidity across the spectrum of common mental health  
336 problems.

### 337 **Conclusions**

338 Within-person analyses of the developmental relations between externalising and  
339 internalising largely led to the same conclusions as previous studies that have utilised CLPMs.  
340 This helps to address concerns that because developmental cascade theories may not be  
341 appropriately operationalised in CLPMs their results may not, in fact, provide the assumed level  
342 of support for these theories. Our results, however, also highlighted potential mutual antagonism  
343 between externalising and internalising states in adolescence.

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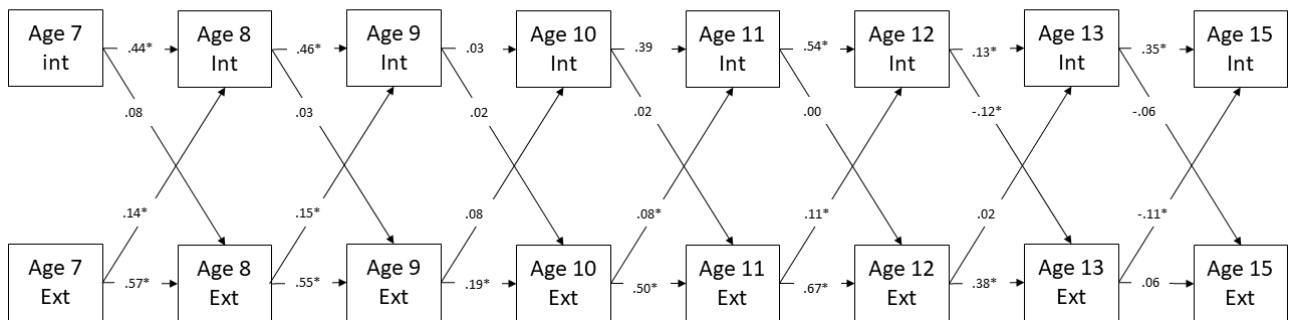
## Tables

Table 1: Key ALT-SR and CLPM parameters

	<i>ALT-SR</i>			<i>CLPM</i>		
	<i>B</i>	<i>SE</i>	<i>p</i>	$\beta$	<i>SE</i>	<i>p</i>
<i>Autoregressive parameters</i>						
Age 15 externalising on age 13 externalising	.06	0.08	.421	<b>.47</b>	0.04	<.001
Age 15 internalising on age 13 internalising	<b>.35</b>	0.04	<.001	<b>.48</b>	0.03	<.001
Age 13 externalising on age 12 externalising	<b>.38</b>	0.08	<.001	<b>.68</b>	0.03	<.001
Age 13 internalising on age 12 internalising	<b>.13</b>	0.04	.001	<b>.34</b>	0.03	<.001
Age 12 externalising on age 11 externalising	<b>.67</b>	0.03	<.001	<b>.78</b>	0.02	<.001
Age 12 internalising on age 11 internalising	<b>.54</b>	0.03	<.001	<b>.66</b>	0.02	<.001
Age 11 externalising on age 10 externalising	<b>.50</b>	0.04	<.001	<b>.63</b>	0.03	<.001
Age 11 internalising on age 10 internalising	<b>.39</b>	0.04	<.001	<b>.55</b>	0.03	<.001
Age 10 externalising on age 9 externalising	<b>.19</b>	0.05	<.001	<b>.35</b>	0.04	<.001
Age 10 internalising on age 9 internalising	.03	0.05	.537	<b>.30</b>	0.03	<.001
Age 9 externalising on age 8 externalising	<b>.55</b>	0.04	<.001	<b>.66</b>	0.03	<.001
Age 9 internalising on age 8 internalising	<b>.46</b>	0.03	<.001	<b>.58</b>	0.03	<.001
Age 8 externalising on age 7 externalising	<b>.57</b>	0.04	<.001	<b>.67</b>	0.03	<.001
Age 8 internalising on age 7 internalising	.44	0.04	<.001	<b>.56</b>	0.03	<.001
<i>Cross-lagged parameters</i>						
Age 15 externalising on age 13 internalising	-.06	0.03	.063	-.02	0.02	.402
Age 15 internalising on age 13 externalising	<b>-.11</b>	0.05	.017	.02	0.03	.441
Age 13 externalising on age 12 internalising	<b>-.12</b>	0.03	<.001	<b>-.07</b>	0.02	<.001
Age 13 internalising on age 12 externalising	.02	0.05	.625	.05	0.03	.187
Age 12 externalising on age 11 internalising	.00	0.02	.91	.01	0.02	.65
Age 11 externalising on age 10 internalising	<b>.02</b>	0.03	.462	.02	0.02	.393
Age 11 internalising on age 10 externalising	.08	0.04	.024	<b>.07</b>	0.03	.023
Age 12 internalising on age 11 externalising	<b>.11</b>	0.04	.008	<b>.09</b>	0.03	.004
Age 10 externalising on age 9 internalising	.02	0.03	.635	.00	0.03	.880
Age 10 internalising on age 9 externalising	.08	0.05	.116	.01	0.04	.748
Age 9 externalising on age 8 internalising	.03	0.03	.332	.01	0.03	.825
Age 9 internalising on age 8 externalising	<b>.15</b>	0.02	<.001	<b>.12</b>	0.03	<.001
Age 8 externalising on age 7 internalising	.08	0.04	.050	.05	0.03	.099
Age 8 internalising on age 7 externalising	<b>.14</b>	0.04	<.001	<b>.10</b>	0.03	.003

*Note.* Bold= significant at  $p < .05$ . ALT-SR=autoregressive latent trajectory model with structured residuals; CLPM= cross-lagged panel model.

**Figure 1: Within-person autoregressive and cross-lagged parameters from partially gender-invariant ALT-SR model**



*Note.* \*statistically significant at  $p < .05$ .

**Key Points**

- Previous evidence has supported developmental cascades from externalising to internalising problems as an explanation for externalising-internalising comorbidity.
- However, there is a need to verify that these cascades reflect the within-person processes implied by theory.
- Using the autoregressive latent trajectory model with structured residuals and 8 waves of longitudinal data, we provided support for this claim.
- We also identified reciprocal negative effects between internalising and externalising in adolescence.
- Results suggest that, externalising and internalising problems may negatively influence one another in adolescence; an observation which may help inform prevention.