On-line supplement to Lorber, M. F., Del Vecchio, T., & Slep, A. M. S. (in press). Infant externalizing behavior as a self-organizing construct. *Developmental Psychology*.

Psychometrics of the Infant Externalizing Questionnaire (IEQ)

In this supplement, we report on the psychometrics of the IEQ, including its (1) factor structure, (2) longitudinal stability, (3) interparental agreement, and (4) associations with observed infant behavior.

1. The Factor Structure of the IEQ

The factor structure of IEQ was evaluated via confirmatory factor analysis (CFA) in a structural equation modeling (SEM) framework, with the robust maximum likelihood (MLR) estimator and missing data handled via the full information maximum likelihood (FIML) method. We hypothesized the presence of two latent factors: physical aggression and defiance. Items by their hypothesized factors are listed in Table S1. The CFAs were conducted separately for mothers and fathers. Internal consistencies are reported in the accompanying article.

Table S1
Items by Hypothesized Factor

Physical Aggression	Defiance
Kicks people	Keeps playing w/ objects when told to leave alone
Pushes people	Keeps going when told to stop
Hits/smacks people	Pulls away/ wriggles/ resists when restrained
Hurts animals	Keeps doing things after adult tried to stop
Bites people	
Pulls people's hair	
Pinches/scratches people	

Mothers' reports. In Model 1, each item was modeled as an indicator of its respective construct at 8, 15, and 24 months. The loadings of "kicks people" and "keeps playing with objects", as well as the residual variances, were each set to 1 at each time. Covariances were allowed among each of the latent externalizing variables. Model 1 was a poor fit to the data, χ^2 (480) = 789.88, Comparative Fit Index (CFI) = .80, Tucker-Lewis Fit Index (TLI) = .78, Root Mean Square Error Approximation (RMSEA) = .05.

Based on modification indices, the addition of several residual covariances in Model 2 improved model fit, χ^2_{change} (9) = 72.97, $p < .001$. Yet, overall fit was still suboptimal, χ^2 (471) = 696.70, CFI = .852, TLI = .834, RMSEA = .043. Inspection of the loadings suggested that "hurts animals" and "pulls away/wriggles/resists when restrained" each had the persistently lowest loadings on their respective factors. Moreover, modification indices suggested the cross-loading

of "pulls away/wriggles/resists when restrained" on the physical aggression factors. Accordingly, these two items were removed and the CFA re-estimated in Model 3.

Model 3 adequately fit the data [χ^2 (302) = 421.89, CFI = .90, TLI = .90, RMSEA = .04] and was thus considered the final model. It is depicted in Figure S1. The three coefficients reported for each path correspond to the respective 8-, 15-, and 24-month values. The within-time residual covariances are depicted in Figure S1. The cross-time residual covariances are reported in Table S2.

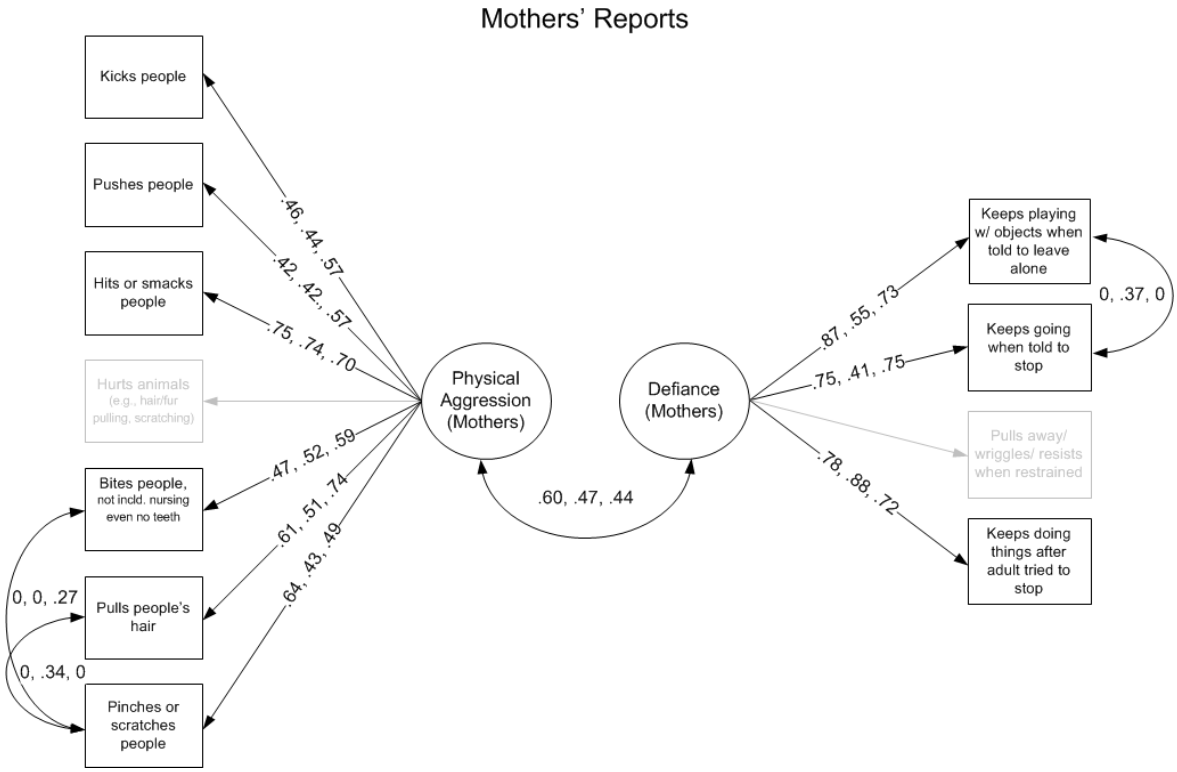

Figure S1. Confirmatory factor analysis results for mothers' reports on the IEQ.

Table S2

Cross-Time Residual Covariances

Residual covariance	*β*	*p*
Mother Report		
Bites people - 24 mos with Bites people - 15 mos	.34	.000
Hits/smacks people - 24 mos with Hits/smacks people - 15 mos	.25	.015
Kicks people - 24 mos with Kicks people - 15 mos	.26	.018
Pinches people - 24 mos with Pinches people - 15 mos	.16	.042

Note. Coefficients are standardized covariances.

Fathers' reports. The final CFA model for mothers, minus the residual covariances, was evaluated for fathers in Model 4. Model 4 adequately fit the data [χ^2 (309) = 403.14, CFI = .92, TLI = .91, RMSEA = .03], yet a large modification index value suggested the addition of a residual covariance for "pushes people" and "kicks people" at 8 months. This covariance was added to Model 5. Model 5 adequately fit the data [χ^2 (308) = 381.34, CFI = .94, TLI = .93, RMSEA = .03] and fit better than did Model 4, χ^2_{change} (1) = 6.24, p = .012; Figure S2. It was considered the final model.

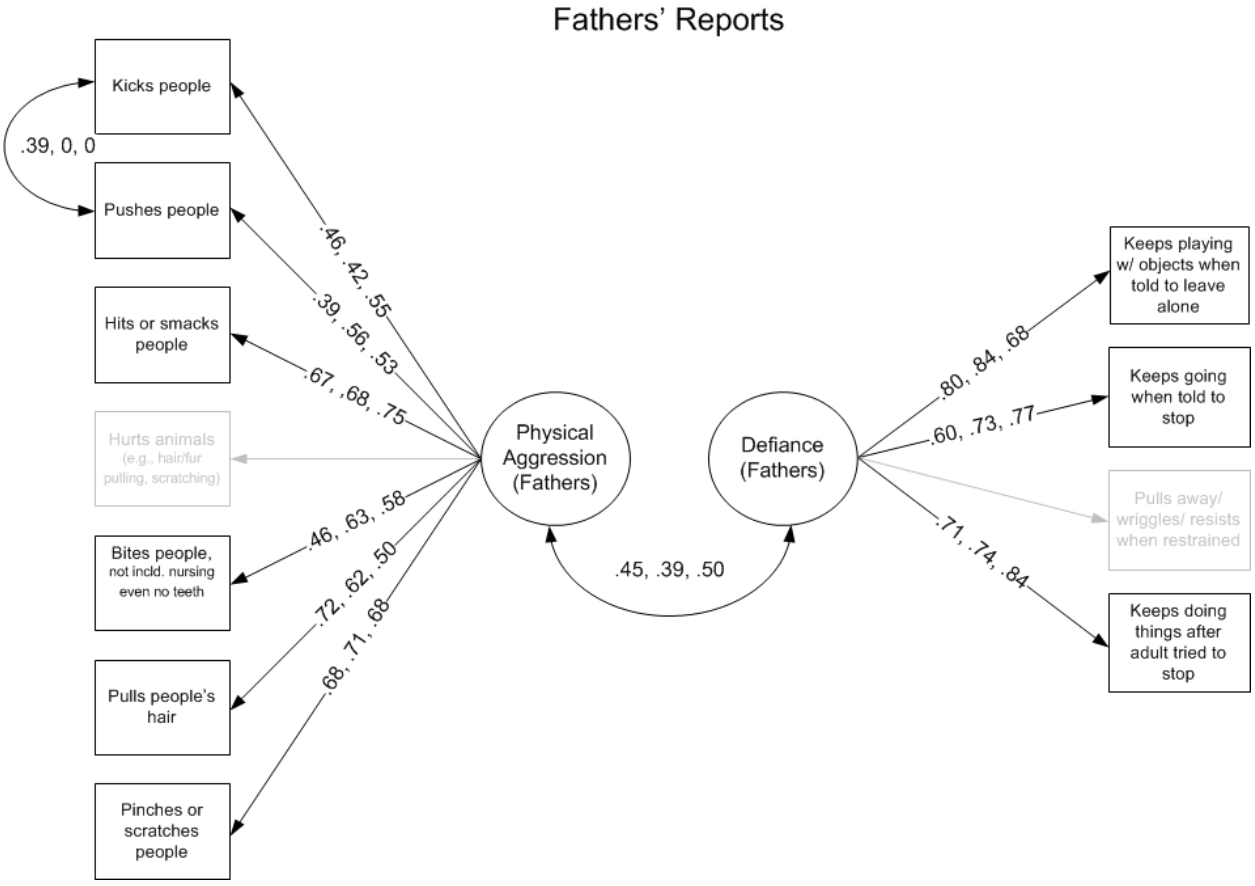

Figure S2. Confirmatory factor analysis results for fathers' reports on the IEQ.

2. Longitudinal Stabilities

Longitudinal stabilities were estimated in the context of the final CFA models. With one exception, the 8- to 15-, 8- to 24-, and 15- to 24-month stabilities were all significant (bolded coefficients in Table S3). Physical aggression stabilities (βs) ranged from .40 to .58. Father-reported defiance did not exhibit significant stability from 8 to 15 months. The significant defiance stabilities ranged from .30 to .57.

Table S3

Associations Among Latent Physical Aggression and Defiance Factors

	DEF – 8 mos	AGG – 8 mos	DEF – 15 mos	AGG – 15 mos	DEF – 24 mos	AGG – 24 mos
DEF – 8 mos	-	.60***	**.35*** **	.28*	**.36*** **	.17
AGG – 8 mos	.45***	-	.33**	**.56*** **	.34**	**.40*** **
DEF – 15 mos	**.17**	.37***	-	.47***	**.46*** **	.20*
AGG – 15 mos	.23*	**.41** **	.39***	-	.16	**.58*** **
DEF – 24 mos	**.30** **	.39***	**.57*** **	.46***	-	.44***
AGG – 24 mos	.28*	**.40** **	.19*	**.63*** **	.50***	-

Note. DEF = defiance; AGG = physical aggression; mothers' reports above and fathers' reports below diagonal; stabilities are in bold; coefficients are standardized covariances.
*p<.05. **p<.01. ***p<.001.

3. Interparental Agreement

Mothers' and fathers' final CFA models, as described above, were combined at each wave of assessment and the associations of mothers' and fathers' reports of physical aggression and defiance were estimated. The models fit adequately at 8 months [χ^2 (127) = 166.47, CFI = .94, TLI = .93, RMSEA = .04], 15 months [χ^2 (126) = 170.41, CFI = .93, TLI = .91, RMSEA = .04], and 24 months [χ^2 (126) = 203.94, CFI = .92, TLI = .90, RMSEA = .05]. Based on modification index values, mothers' and fathers' residual variances for "bites people" were allowed to covary at 8 and 15 months. The "pulls people's hair" and "pushes people" residuals of mothers and fathers were allowed to covary.

Mothers' and fathers' reports of physical aggression and defiance were significantly and positively associated at each wave of assessment (βs ranged from .28 to .51). The sole exception was defiance at 24 months (Table S4).

Table S4

Associations of Mothers' and Fathers' Reports of Physical Aggression and Defiance

	Physical Aggression	Defiance
8 months	.44***	.50***
15 months	.40***	.28**
24 months	.51***	.12

Note. Coefficients are standardized covariances.

**p<.01. ***p<.001.

4. Associations with Observed Infant Behavior

The IEQ Physical Aggression and Defiance scales were studied relative to infants' facial anger, distress vocalizations, and physical struggle during arm restraint tasks (Goldsmith & Rothbart, 1999) conducted at the 8- and 15-month home visits. In the arm restraint task, the infant is given a toy to play with briefly. After a brief period the parent, who is standing behind the child, is instructed to gently but firmly hold the infants' arms down to her/his own side for two periods of 30 s. The parent is further instructed not to speak to or make eye contact with the infant.

The intensity of facial anger (rated from 0 to 3; e.g., squarish mouth, inner corners of eyebrows lowered and drawn together), distress vocalizations (rated from 1 to 5; e.g., crying, screaming), and physical struggle (rated from 1 to 5; e.g., kicking, arched back) were each coded in 5-s intervals, using the definitions provided by Goldsmith (Goldsmith & Rothbart, 1999). The scores were subsequently averaged across all intervals. Interrater reliability was established against the coding supervisor on a randomly selected sample of 96 arm restraint episodes, distributed across the 8- and 15-month assessments. Raters were blind as to which these were. Mean intraclass correlations for each rater against the coding supervisor were .92, .94, and .82 for facial anger, distress vocalizations, and physical struggle, respectively.

Arm restraint variables were added to mothers' and fathers' final CFA models and allowed to covary with the physical aggression and defiance factors (Table S5). At 8 months, mothers' reports of physical aggression were positively associated with physical struggle observed during arm restraints; mothers' reports of defiance were positively associated with distress vocalizations and physical struggle. At 15 months, mothers' reports of physical aggression were positively associated with distress vocalizations. Fathers' reports of physical aggression and defiance were not associated with any behavior observed during arm restraints.

Table S5

Associations of Physical Aggression and Defiance with Infant Behavior During Arm Restraint

	Mothers' Report	Fathers' Report
8 months		
Physical Aggression, associations with		
Facial anger	.02	-.09
Distress vocalizations	.07	-.08
Physical struggle	.19*	.14
Defiance, associations with		
Facial anger	.02	.03
Distress vocalizations	.21*	.10
Physical struggle	.20*	.17
15 months		
Physical Aggression, associations with		
Facial anger	.17	.06
Distress vocalizations	.19*	.01
Physical struggle	.03	.02
Defiance, associations with		
Facial anger	.09	.04
Distress vocalizations	.13	.16
Physical struggle	.00	.10

Note. Coefficients are standardized covariances.

*$p<.05$.

Summary

The above results – in combination with those reported in Lorber et al. (2014) – were largely supportive of the psychometric validity of the IEQ's Physical Aggression and Defiance scales. The factor structure was similar to what had been specified a priori, with physical aggression and defiance factors explaining associations among the items. Each scale exhibited substantial longitudinal stability from 8 to 24 months. Mothers and fathers significantly agreed on who were the most and least physically aggressive and defiant infants. Modest associations were found between mothers' reports of physical aggression and defiance and distress vocalization and physical struggle observed during arm restraints. Although small, these associations are fairly typical of the associations between observed and parent reported behavior. We note that behaviors other than physical aggression and defiance were rated during arm restraints. One would expect aggression and defiance to correlate with these behaviors, but the correlations can be expected to be lower than if the observation and parent report were of the same behaviors. The psychometric validity of the IEQ is further suggested by its associations with distress to limitations and activity level, and the latent combination of these factors' associations with known correlates of child externalizing behavior in Lorber et al. (2014).

Reference

Goldsmith, H. H. &, Rothbart, M. K. (1999). *The Laboratory Temperament Assessment Battery* (version 3.1; locomotor version). Eugene: University of Oregon; 1990. Unpublished manuscript.