

## Supplemental material (Hirschtritt et al.)

### Online Supplement 1: Obsessive-compulsive, ADHD, and tic symptom assessment

*Obsessive-compulsive symptoms:* The OCD assessment component of the TICS includes an obsessive-compulsive symptom (OCS) checklist (80 items) and measures of severity modified from the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) (Goodman *et al* 1989a, Goodman *et al* 1989b), as well as age of onset. Severity of obsessions and compulsions was characterized jointly (e.g., severity of obsessions and/or compulsions) by time, interference, and distress when symptoms were worst. The highest possible sum score of these severity items was 12. OCS symptom checklist items were dichotomized according to lifetime presence or absence. Items were excluded if data were only available for <75% of the sample and if they were vague or not OCD specific (e.g., "has ritualized eating behaviors," "is bothered by certain sounds or noises"); 59 OCS items were included in the final analyses.

*ADHD symptoms:* ADHD symptom data in the TICS Inventory were collected using modified versions of multiple self-report forms across different waves of data collection, including the Conners' Parent Rating Scale (Conners 1998), Conners' Adult ADHD Rating Scales (Conners *et al* 1999), and the Swanson, Nolan, and Pelham questionnaire (Swanson 1992). For these analyses, symptom questions from each wave of data collection were mapped onto the 18 *DSM-IV-TR* ADHD symptoms in a dichotomous fashion (i.e., each symptom was rated present or absent). For example, if the item "Has difficulty sustaining attention in tasks or play activities, more so than his or her friends" on the Conners' Adult ADHD Rating Scales was marked as occurring "often" or

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“frequently”, the *DSM-IV-TR* symptom “often has difficulty sustaining attention in tasks or play activities” was marked as present. Age of onset was also assessed. ADHD symptom severity was not examined because these data were not consistently available across waves of data collection.

*Tic severity:* Tic severity items on the TICS Inventory were modified from the Yale Global Tic Severity Scale (YGTSS) (Leckman *et al* 1989) and were characterized by frequency, intensity, and interference of symptoms. The highest score resulting from summing the modified severity questions was 15.

## **References for Supplemental Material**

**Conners CK** (1998). Rating scales in attention-deficit/hyperactivity disorder: Use in assessment and treatment monitoring. *The Journal of clinical psychiatry* **59 Suppl 7**, 24-30

**Conners CK, Erhart D, Sparrow E** (1999). *Conners' Adult ADHD Rating Scales, Technical Manual*. Multi-Health Systems: New York

**Goodman WK, Price LH, Rasmussen SA, Mazure C, Delgado P, Heninger GR, Charney DS** (1989a). The Yale-Brown Obsessive Compulsive Scale. II. Validity. *Archives of General Psychiatry* **46**, 1012-1016

**Goodman WK, Price LH, Rasmussen SA, Mazure C, Fleischmann RL, Hill CL, Heninger GR, Charney DS** (1989b). The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry* **46**, 1006-1011

**Leckman JF, Riddle MA, Hardin MT, Ort SI, Swartz KL, Stevenson J, Cohen DJ** (1989). The Yale Global Tic Severity Scale: Initial testing of a clinician-rated scale of tic severity. *Journal of the American Academy of Child and Adolescent Psychiatry* **28**, 566-573

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**Swanson JM** (1992). School-Based Assessments and Interventions for ADD Students.  
KC Publishing: Irvine, CA

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Supplemental Table S1. Sample characteristics

	Probands only (N=1191)			Probands & family members (N=3494)		
	N	M	SD	N	M	SD
Age	1191	15.3	10.0	3494	30.6	17.2
TS age onset	1131	5.8	2.5	1692	6.1	2.7
Tic severity <sup>a</sup>	1181	11.4	2.6	3490	4.1	4.6
OCD age onset	442	7.1	4.0	712	8.2	5.3
OCD severity <sup>b</sup>	694	4.3	3.4	2442	3.0	3.3
	N	f	%	N	f	%
Male	1191	944	79.3	3494	2140	61.2
TS	1191	1191	100	3494	1841	52.7
OCD	1135	570	50.2	3286	1125	34.2
ADHD	1116	628	56.3	3220	1013	31.5
Mood Disorders	498	132	26.5	1603	487	30.4
Anxiety Disorders	507	176	34.7	1620	515	31.8
Disruptive Behavior Disorders	390	121	31.0	662	192	29.0

ADHD, attention-deficit/hyperactive disorder; CMVTD, chronic motor or vocal tic disorder; *f*, frequency; M, mean; OCD, obsessive-compulsive disorder; SD, standard deviation; TS, Tourette syndrome

<sup>a</sup> Tic severity maximum score = 15; <sup>b</sup> OCD severity maximum score = 12

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Supplemental Table S2. Fit statistics for OCD exploratory principal components models (59 Items)

Model	Number of free parameters	$\chi^2$ <sup>a</sup>	df	RMSEA	95% CI
<b>Individual models</b>					
1-factor	59	5460.10	1642	.04	.04-.05
2-factor	117	4208.03	1594	.04	.04-.04
3-factor	174	3346.69	1537	.03	.03-.03
4-factor	230	2679.33	1481	.03	.02-.03
5-factor	285	2334.74	1426	.02	.02-.03
6-factor	339	2049.95	1372	.02	.02-.02
7-factor	392	1830.62	1319	.02	.02-.02
8-factor	444	1657.82	1267	.02	.01-.02
<b>Comparisons between adjacent models</b>					
1-factor against 2-factor		901.66	58		
2-factor against 3-factor		682.47	57		
3-factor against 4-factor		545.57	56		
4-factor against 5-factor		334.01	55		
5-factor against 6-factor		264.31	54		
6-factor against 7-factor		228.29	53		
7-factor against 8-factor		185.51	52		

OCD, obsessive-compulsive symptoms; RMSEA, root mean square error of approximation.

The baseline  $\chi^2$  (df) model fit for the baseline model was 29982.17 (1711). Only 1- to 8-factor models are presented because models with >8 factors failed to converge on a plausible model.

<sup>a</sup> All  $\chi^2$  values are significant at  $p < .0001$ .

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**Supplemental Table S3. Non-loading items in the OCD EFA model**

<b>Item</b>	<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F6</b>	<b>F7</b>	<b>F8</b>
	<b>Reassurance/ Scrupulosity</b>	<b>Symmetry/ Exactness</b>	<b>Contamination</b>	<b>Aggressive urges</b>	<b>Fear of harm</b>	<b>Perfectionism</b>	<b>Superstitions</b>	<b>Hoarding</b>
Feels like needs to know or remember certain things	0.27	0.34	-0.05	-0.02	0.06	-0.11	0.10	0.27
Fears that will harm other because not careful enough	0.24	-0.03	-0.03	0.20	0.37	-0.02	0.11	0.22
Checks (more than once) on things (e.g., gas and electrical appliances, door locks)	0.32	0.30	0.08	-0.14	0.08	0.04	0.20	0.07
Is excessively concerned with a part of body or an aspect of appearance	0.16	0.16	0.19	0.21	-0.07	0.02	0.11	0.07
Has violent or horrific images in mind	0.15	0.01	0.12	0.33	0.16	-0.05	0.09	0.05
Checks that nothing terrible did happen or will happen	0.37	-0.06	0.27	0.15	0.04	0.30	0.07	0.03

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<b>Item</b>	<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F6</b>	<b>F7</b>	<b>F8</b>
	<b>Reassurance/ Scrupulosity</b>	<b>Symmetry/ Exactness</b>	<b>Contamination</b>	<b>Aggressive urges</b>	<b>Fear of harm</b>	<b>Perfectionism</b>	<b>Superstitions</b>	<b>Hoarding</b>
Fears being responsible for something else terrible happening (such as fire or burglary)	0.19	0.07	0.06	0.22	0.35	0.00	0.20	0.03
Checks that did not or will not harm self	0.29	-0.07	0.34	0.25	-0.01	0.29	0.00	0.03
Has forbidden or upsetting sexual thoughts, images, or impulses	0.34	0.02	0.00	0.36	0.12	-0.18	0.05	-0.01
Has compulsions that involve cleaning household items or other inanimate objects	0.09	0.37	0.31	0.02	-0.12	0.19	0.23	-0.06
Has counting compulsions	0.20	0.15	-0.10	0.28	-0.12	0.20	0.35	-0.07

EFA, exploratory factor analysis; OCD, obsessive compulsive disorder

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Supplemental Table S4. Correlations between OCD factors

	F1	F2	F3	F4	F5	F6	F7	F8
	Reassurance/ Scrupulosity	Symmetry/ Exactness	Contamination	Aggressive urges	Fear of harm	Perfectionism	Superstitions	Hoarding
F1	1							
F2	0.42 <sup>a</sup>	1						
F3	0.43 <sup>a</sup>	0.27 <sup>a</sup>	1					
F4	0.45 <sup>a</sup>	0.36 <sup>a</sup>	0.30 <sup>a</sup>	1				
F5	0.43 <sup>a</sup>	0.28 <sup>a</sup>	0.28 <sup>a</sup>	0.38 <sup>a</sup>	1			
F6	-0.08	-0.05	-0.01	-0.08	-0.14	1		
F7	0.56 <sup>a</sup>	0.46 <sup>a</sup>	0.41 <sup>a</sup>	0.43 <sup>a</sup>	0.31 <sup>a</sup>	-0.15	1	
F8	0.42 <sup>a</sup>	0.35 <sup>a</sup>	0.30 <sup>a</sup>	0.40 <sup>a</sup>	0.21 <sup>a</sup>	0.02	0.42 <sup>a</sup>	1

<sup>a</sup> Indicates significant correlations  $P \leq 0.05$



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Supplemental Table S5. Fit statistics for ADHD symptoms exploratory principal components models (18 items)

Model	Number of free parameters	$\chi^2$ <sup>a</sup>	df	RMSEA	95% CI
<b>Individual models</b>					
1-factor	18	1885.29	135	.10	.10-.11
2-factor	35	556.77	118	.06	.05-.06
3-factor	51	289.65	102	.04	.03-.05
4-factor	66	213.34	87	.04	.03-.04
<b>Comparisons between adjacent models</b>					
1-factor against 2-factor		678.49	17		
2-factor against 3-factor		194.97	16		
3-factor against 4-factor		71.06	15		

RMSEA, root mean square error of approximation

The baseline  $\chi^2$  (df) model fit for the baseline model was 21156.85 (153).

<sup>a</sup> All  $\chi^2$  values are significant at  $P < .0001$ .

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Supplemental Table S6. Factor loadings for ADHD symptoms exploratory factor model

	F1 inattentive	F2 hyperactive/ impulsive
<b>Cronbach's alpha</b>	0.89	0.87
<b>Item</b>		
Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace	<b>0.89</b>	0.06
Often has trouble organizing activities.	<b>0.89</b>	0.00
Is often forgetful in daily activities	<b>0.88</b>	-0.02
Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time	<b>0.82</b>	-0.01
Often loses things needed for tasks and activities	<b>0.79</b>	-0.01
Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities.	<b>0.74</b>	0.12
Often has trouble keeping attention on tasks or play activities.	<b>0.68</b>	0.23
Is often easily distracted	<b>0.61</b>	0.34
Often does not seem to listen when spoken to directly.	<b>0.58</b>	0.28
Is often "on the go" or often acts as if "driven by a motor"	-0.16	<b>0.91</b>
Often blurts out answers before questions have been finished	-0.02	<b>0.90</b>
Often excessively runs about or climbs when and where it is not appropriate	-0.10	<b>0.89</b>
Often interrupts or intrudes on others	0.06	<b>0.85</b>
Often fidgets with hands or feet or squirms in seat when sitting still is expected	0.04	<b>0.77</b>
Often gets up from seat when remaining in seat is expected	0.03	<b>0.76</b>
Often talks excessively	0.00	<b>0.74</b>
Often has trouble waiting one's turn	0.14	<b>0.72</b>
Often has trouble playing or doing leisure activities quietly	0.14	<b>0.71</b>

Primary loadings are in bold. The correlation between factors was .61 ( $P < 0.05$ ).

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**Supplemental Table S7. Fit statistics and class size for nested, factor sum score-based LCA solutions**

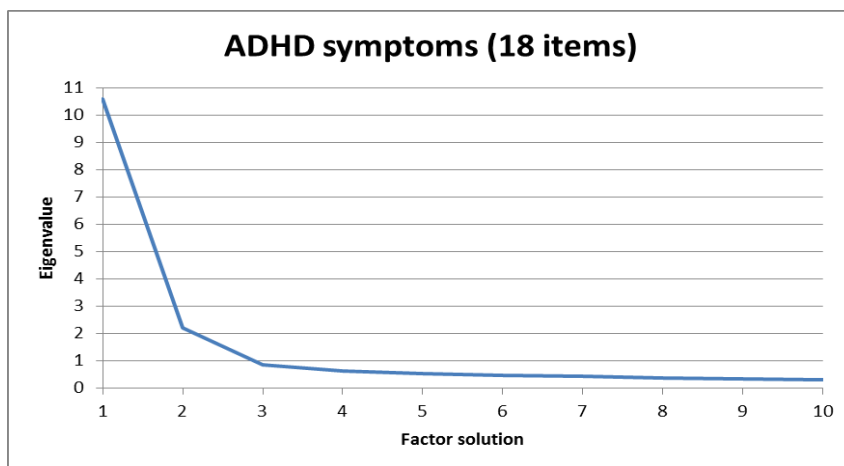
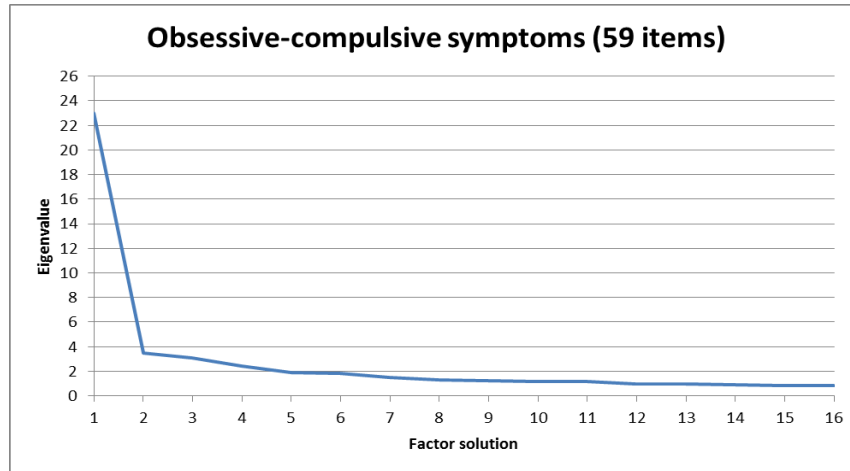
	1 class	2 classes	3 classes
<b>OCD &amp; ADHD factor sum scores, probands and family members</b>			
Entropy	–	.929	<b>.926</b>
LMR p-value	–	<.0001	<b>&lt;.0001</b>
BIC	4009.335	-5469.710	<b>-8316.519</b>
n of LC1	3493	2694	<b>2421</b>
n of LC2		799	<b>210</b>
n of LC3			<b>862</b>
<b>OCD &amp; ADHD factor sum scores, probands only</b>			
Entropy	–	.883	<b>.893</b>
LMR p-value	–	.0001	<b>&lt;.0001</b>
BIC	3748.362	1292.116	<b>426.382</b>
n of LC1	1191	309	<b>372</b>
n of LC2		882	<b>732</b>
n of LC3			<b>87</b>

BIC, Bayesian information criterion; LMR, Lo, Mendel, and Rubin parametric likelihood ratio test

Bold lettering indicates best fitting solution based on low BIC, significant LMR results, and clinically interpretable classes. Classes greater than 3 failed to converge for both probands and probands with family members; therefore, summary statistics are only presented for up to 3 classes.

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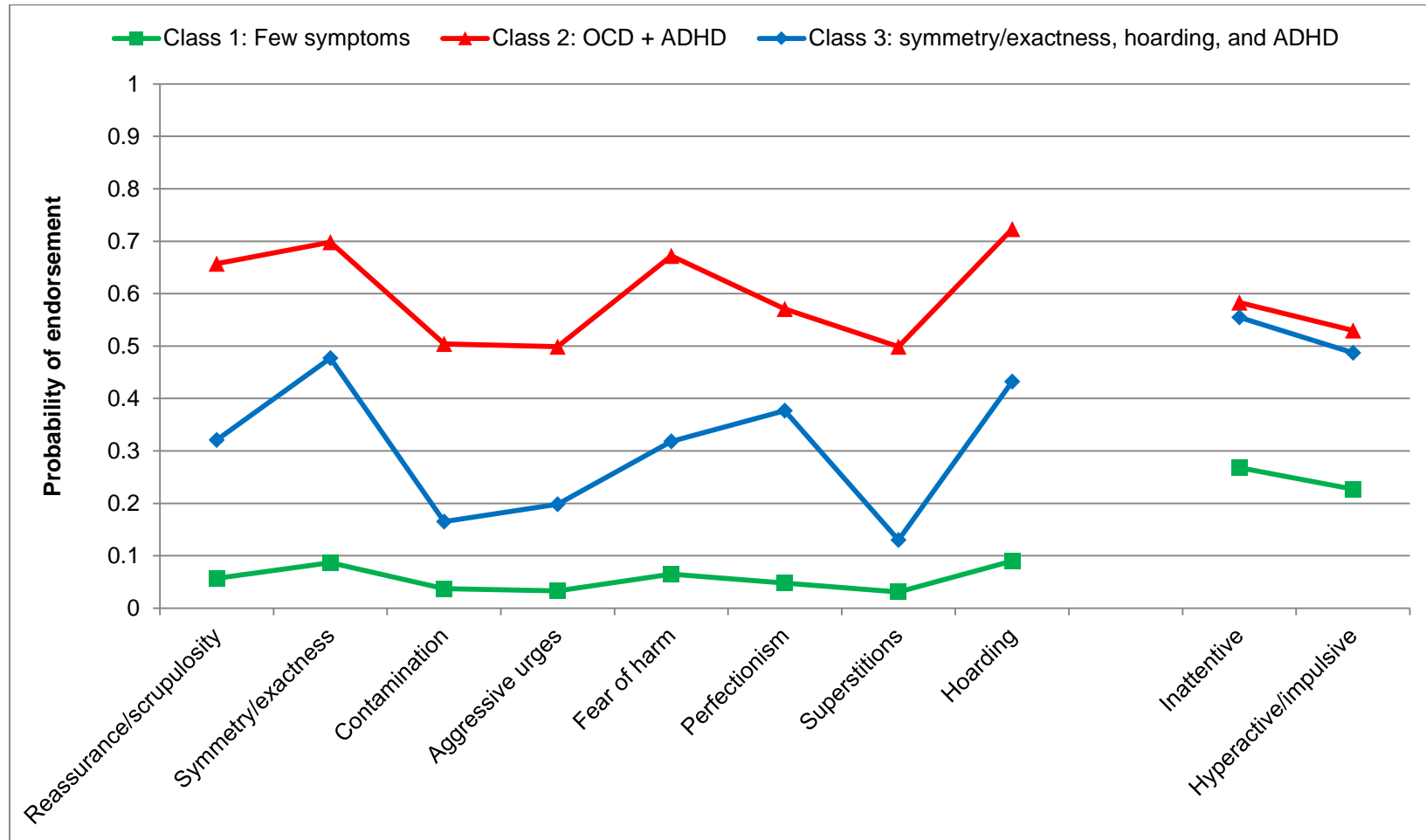
### Supplemental Figure S1. Scree plots of EFA for OCD and ADHD symptoms (probands only)



Horizontal axes have been truncated to allow clear visualization of the inflection point (“elbow”) of each scree plot.

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Supplemental Figure S2. Probability of endorsement of ADHD and OCD symptom items among nested, factor sum score-based latent classes (proband and family members)



**Author reply to editorial comments for manuscript PSM-D-17-00116R1:**

"In principle we are now prepared to accept it but before we can do so we need to ask if you wish to eliminate the unnecessary use of colour from the figures. You will be asked to pay for unnecessary colour printing. If you wish you may have colour online and black-and-white in print at no charge, in which case you should submit two copies of the figures, identical in every respect other than the colour."

**Thank you for this provisional acceptance of our manuscript for publication in *Psychological Medicine*. We understand that this acceptance is contingent on adhering to editorial guidelines. We have chosen to convert Figures 1 and 2 to grayscale (black-and-white), obviating the need for color charges. We have uploaded revised versions of these figures for your review. Please feel free to contact us with any questions or concerns.**