Abstract Title Page
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Title: Patterns of school readiness among low-income kindergarteners.

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Background / Context:
Description of prior research and its intellectual context.

School readiness is best conceptualized as a multidimensional construct that spans several skill domains. Academic and behavioral skills have been identified as important components of school readiness that uniquely predict learning and achievement (Bierman, Torres, Domitrovich, Welsh, & Gest, 2009; Duncan et al., 2007; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Few studies, however, have examined the effects of these skills simultaneously or explored how they interact within individuals. Person-oriented approaches show promise in furthering our understanding of variation in school readiness (e.g., McWayne, Cheung, Green Wright, & Hahs-Vaughn, 2012; Quirk, Nylund-Gibson, & Furlong, 2013; Sabol & Pianta, 2012).

This work also has important implications for school-based prevention and intervention efforts. It is widely agreed that early identification of children at risk for academic and behavioral difficulties in the classroom is crucial to early intervention. Person-oriented research contributes to this discussion by highlighting that children differ in the *nature* of their risk, not only in their overall *level* of risk. School readiness screenings that reveal information about children's patterns of specific strengths and weaknesses could facilitate the targeted delivery of prevention or intervention services that are most suited to children's individual needs.

Purpose / Objective / Research Question / Focus of Study:
Description of the focus of the research.

The current study had two primary aims. First, we examined whether teacher ratings of children's skills at the beginning of kindergarten could be used to identify school readiness profiles that differed in patterns of strengths and weaknesses across multiple domains (i.e., academic skills, learning engagement, social-emotional skills, aggression, and inattention/hyperactivity). Second, we explored the validity of profiles derived from teacher ratings by examining group differences on concurrent measures of language, executive functioning, peer relationships, and student-teacher relationships.

Setting:
Description of the research location.

The current study was conducted in a low-income, urban school district in Pennsylvania.

Population / Participants / Subjects:
Description of the participants in the study: who, how many, key features, or characteristics.

Participants were 301 kindergarteners (64% male) from a low-income, urban setting who were also part of a broader study about the development and prevention of aggression. At the start of kindergarten, teachers in 10 elementary schools rated children on aggression. These ratings were used to recruit children either to a "high aggression" group, if they scored in the top quartile of their class on aggression, or a "low aggression" group, if they scored in the bottom quartile of their class on aggression. The current study used data from 180 "high aggression"

children and 121 "low aggression" children with data on any of the 10 teacher-rated indicators of school readiness in the fall of kindergarten. About 70% of children were African American, 20% were Hispanic, 9% were Caucasian. On average, children were about 6 years old ($M = 6.09$, $SD = 0.38$) in the fall of kindergarten.

Intervention / Program / Practice:
Description of the intervention, program, or practice, including details of administration and duration.

Not applicable.

Research Design:
Description of the research design.

The current study was cross-sectional.

Data Collection and Analysis:
Description of the methods for collecting and analyzing data.

Teachers completed questionnaires during the fall of kindergarten on 10 indicators of school readiness in 5 domains (2 indicators in each domain): academic skills (Bierman et al., 2008), learning engagement (Bierman et al., 2008; McDermott, Green, Francis, & Stott, 1999), social-emotional skills (Conduct Problems Prevention Research Group, 1990), aggression (Goodman, 1997; Werthamer-Larsson, Kellam, & Wheeler, 1991), and inattention/hyperactivity (DuPaul, 1991). In addition, teachers also assessed children's relationships with peers and teachers (Goodman, 1997; Ladd & Profilet, 1996; Pianta, 2001), and children completed direct assessments of language (Brownell, 2000), executive functioning (Davis & Pratt, 1996; Diamond & Taylor, 1996, Frye, Zelazo, & Palfai, 1995; Smith-Donald, Raver, Hayes, & Richardson, 2007) and emotion recognition (Ribordy, Camras, Stafani, & Spacarelli, 1988).

We used latent profile analysis (LPA) to examine school readiness profiles in the fall of kindergarten, and we used a model-based method for estimating auxiliary distal outcomes discussed by Lanza, Tan, and Bray (2013) and implemented in Mplus 7 (see Asparouhov & Muthén, 2013) to examine between-profile differences on concurrent validation measures.

Findings / Results:
Description of the main findings with specific details.

Descriptive statistics and correlations among the study variables are presented in Table 1.

Model selection. To identify the appropriate number of school readiness profiles, eight models were estimated, starting with a 1-class solution and including an additional class in each successive model. Indicator means were free to vary across profiles, and indicator variances were set to be equal across profiles for estimation purposes. Multiple random starting values (500 and 250 sets, respectively, for initial and final stage optimization) were used to check model stability and identification. Solutions were compared using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), sample size adjusted BIC (a-BIC), entropy R^2, and solution interpretability.

Model fit information is presented in Table 2. Entropy values for each solution were above 0.90, indicating adequate classification, and greatest for the 2-class and 4-class solutions.

The AIC, BIC, and a-BIC decreased with the addition of each new class through the 8-class solution, which did not appear to be well-identified given low replication of the best log-likelihood. Following an approach used by Foti, Bray, Thompson, and Allgood (2012), we plotted the AIC, BIC, and a-BIC for each solution to identify where the decrease in fit criteria values appeared to level off. As shown in Figure 1, although all fit criteria decreased as the number of profiles increased, this appeared to level off somewhat after the 5-class solution. We thus examined the interpretability of the 3-class, 4-class, and 5-class solutions. The 3-class solution identified "high," "medium," and "low" school readiness profiles, whereas the 4-class and 5-class solutions identified similar profiles at the high and low extremes but allowed for more differentiation in the patterns of readiness exhibited by other children. In addition, the 5-class solution was quite similar to the 4-class solution, except that the profile of children characterized by high school readiness in the 4-class solution appeared to break down into two separate profiles in the 5-class solution, with children in the first profile exhibiting higher performance than children in the second profile, particularly on the academic indicators. For the sake of parsimony, and because our focus was on different patterns of school readiness *risk*, we selected the 4-class solution.

   Interpretation of profiles. Latent profile membership proportions and indicator means conditional on group membership are presented in Table 3. Latent profile analysis revealed four profiles that differed in their patterns of strengths and risk across the five domains of readiness we examined: (1) Comprehensive Strengths (43%), (2) Academic Strengths and Behavioral Risk (18%), (3) Multiple Risks, Non-Disruptive (22%), and (4) Extreme Risk (17%). With the highest membership proportion, the Comprehensive Strengths profile was characterized by above average academic skills, learning engagement, and social-emotional skills, and below average aggression and inattention-hyperactivity. With broad strengths and no notable deficits, children in this profile would be deemed "ready for school." At the other end of the spectrum, the Extreme Risk profile was characterized by severe deficits in every domain (.68 to 1.70 standard deviation units above or below the sample mean in the expected direction). The remaining two profiles fell between these two extremes on most indicators. The Academic Strengths and Behavioral Risk profile was characterized by above average academic skills but below average social-emotional skills and above average disruptive behavior (i.e., aggressive behavior, conduct problems, and hyperactivity). Children in this profile appeared to have average learning engagement and inattention, which might account for their above average academic performance despite their behavioral risk. Finally, the Multiple Risks, Non-Disruptive profile was characterized by risk in most domains; however, children in this profile exhibited minimal or below average disruptive behavior. Although these children had the greatest academic deficits in the sample, the remaining deficits of children in this profile were less severe than the deficits of children in the Extreme Risk profile.

   Differences across profiles on concurrent validation measures. To explore the validity of the four school readiness profiles derived from teacher ratings, we examined between-profile differences on a range of concurrent measures using a model-based method for estimating auxiliary distal outcomes discussed by Lanza, Tan, and Bray (2013) and implemented in Mplus 7 (see Asparouhov & Muthén, 2013). Simulation studies have shown that this approach produces estimates that are less biased than classify-analyze approaches (Lanza et al., 2013) and in some cases performs better than newer 3-step methods (Asparouhov & Muthén, 2013).

   Differences across profiles in percent male, age, and 10 validation measures are presented in Table 4. The Comprehensive Strengths profile and the Academic Strengths and Behavioral

Risk profile, both of which had somewhat even distributions of males and females, differed from the Multiple Risks, Non-Disruptive profile and the Extreme Risk profile, both of which had greater proportions of males. Children in the Comprehensive Strengths profile were older than those in the Multiple Risks profile and the Extreme Risk profile, and children in Academic Strengths and Behavioral Risk profile fell between these profiles in age.

As expected, children in the Comprehensive Strengths profile generally exhibited the highest level of functioning across the validation measures, and children in the Extreme Risk profile generally exhibited the poorest level of functioning across the validation measures. The relative performance of the remaining two profiles varied across validation measures. On the direct assessments of language, EF, and emotion recognition, children in the Academic Strengths and Behavioral Risk profile tended to perform similarly to (or better than, in the case of working memory) children in the Comprehensive Strengths profile, whereas children in the Multiple Risks, Non-Disruptive profile tended to perform similarly to children in the Extreme Risk profile. This pattern was consistent with differences across profiles on the teacher-rated school readiness indicators of academic ability, learning engagement, and inattention. That is, as discussed above, the Comprehensive Strengths profile and the Academic Strengths and Behavioral Risk profile were characterized by above average academic ability, average or above average learning engagement, and average or below average inattention; in contrast, the Multiple Risks, Non-Disruptive profile and the Extreme Risk profile were characterized by below average academic ability, below average learning engagement, and above average inattention.

Different trends emerged on the peer and student-teacher relational measures. Children in the Comprehensive Strengths profile had the fewest peer problems and best student-teacher relationships compared to children in the three other profiles, whereas children in the Extreme Risk profile had the greatest peer problems and poorest student-teacher relationships compared to children in the three other profiles. Interestingly, although the Academic Strengths and Behavioral Risk profile was characterized by poorer social-emotional skills and greater disruptive behavior relative to the Multiple Risks, Non-Disruptive profile, differences in the validation measures indicated that children in this profile actually exhibited fewer peer problems and greater teacher closeness than children in the Multiple Risks, Non-Disruptive profile. Children in the Academic Strengths and Behavioral Risk profile did experience greater teacher conflict, however.

Conclusions:
Description of conclusions, recommendations, and limitations based on findings.

Using teacher ratings from the fall of kindergarten, the current study identified four school readiness profiles that differed in their patterns of strengths and weakness across multiple domains of functioning. These profiles also differed on other measures of language, executive functioning, and relationships with peers and teachers, which suggests that profiles derived from teacher ratings are meaningful and valid. Future work should extend this work by exploring the predictive validity of school readiness profiles derived from teacher ratings into the early elementary school years.

Results highlight the importance of considering intraindividual patterns of school readiness skills. Person-oriented approaches can aid in the identification of kindergarteners with risky school readiness profiles, as well as inform the development and delivery of individually tailored interventions to meet the specific needs of children starting school.

Appendices
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Appendix A. References
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Appendix B. Tables and Figures

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Table 1.
Descriptive Statistics and Correlations among Study Variables

	M	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
Indicators																						
1. Reading Ability	3.02	1.38	--																			
2. Math Ability	3.04	1.34	0.94	--																		
3. School Readiness	4.38	1.25	0.61	0.62	--																	
4. Learning Behaviors	1.37	0.51	0.56	0.57	0.79	--																
5. Emotion Regulation	3.76	1.19	0.30	0.32	0.71	0.59	--															
6. Prosocial Behavior	3.69	1.20	0.45	0.47	0.81	0.67	0.84	--														
7. Aggressive Behavior	2.43	1.17	-0.23	-0.24	-0.71	-0.59	-0.80	-0.78	--													
8. Conduct Problems	2.46	2.81	-0.20	-0.21	-0.66	-0.55	-0.73	-0.72	0.91	--												
9. Inattention	1.20	0.98	-0.47	-0.46	-0.82	-0.72	-0.65	-0.69	0.72	0.65	--											
10. Hyperactivity	1.07	0.91	-0.26	-0.25	-0.67	-0.55	-0.66	-0.64	0.77	0.72	0.88	--										
Validation Measures																						
11. Expressive Language	83.15	12.02	0.48	0.45	0.32	0.24	0.18	0.30	-0.18	-0.13	-0.23	-0.15	--									
12. Working Memory	1.91	0.72	0.46	0.44	0.33	0.33	0.08	0.18	-0.08	-0.09	-0.26	-0.09	0.34	--								
13. Inhibitory Control	13.92	3.26	0.29	0.28	0.35	0.33	0.16	0.20	-0.18	-0.16	-0.24	-0.17	0.13	0.30	--							
14. Set-shifting	4.86	2.02	0.23	0.20	0.18	0.15	0.14	0.17	-0.09	-0.09	-0.17	-0.11	0.24	0.23	0.02	--						
15. Task Orientation	3.37	0.58	0.38	0.38	0.53	0.44	0.43	0.47	-0.42	-0.35	-0.48	-0.41	0.26	0.33	0.41	0.19	--					
16. Emotion Recognition	1.71	0.21	0.26	0.23	0.24	0.20	0.15	0.23	-0.13	-0.05	-0.16	-0.07	0.29	0.30	0.24	0.13	0.34	--				
17. Peer Poor Relations	1.93	0.94	-0.37	-0.37	-0.68	-0.55	-0.70	-0.74	0.68	0.68	0.56	0.56	-0.24	-0.22	-0.20	-0.14	-0.43	-0.21	--			
18. Peer Problems	1.84	1.88	-0.33	-0.34	-0.56	-0.49	-0.57	-0.60	0.52	0.52	0.46	0.42	-0.17	-0.17	-0.22	-0.09	-0.36	-0.16	0.80	--		
19. Teacher Closeness	4.07	0.69	0.34	0.36	0.64	0.53	0.47	0.63	-0.47	-0.45	-0.46	-0.31	0.24	0.19	0.20	0.13	0.24	0.16	-0.48	-0.43	--	
20. Teacher Conflict	2.26	1.15	-0.19	-0.20	-0.66	-0.59	-0.78	-0.75	0.87	0.84	0.67	0.72	-0.10	-0.05	-0.19	-0.14	-0.39	-0.08	0.63	0.44	-0.47	--

Note. Pairwise *n*s range from 282-301. For ease of interpretation, raw means and standard deviations are presented for all variables; however, indicators of school readiness were standardized and used in analyses. Correlation coefficients $\geq$ .12 in absolute value are significant (p < .05).

Table 2.

Model Fit for School Readiness Latent Profile Analyses

# of Profiles	Free Parameters	Log-likelihood	AIC	BIC	a-BIC	Entropy
1	20	-4231.94	8503.88	8578.03	8514.60	--
2	31	-3433.95	6929.91	7044.83	6946.51	0.95
3	42	-3159.15	6402.30	6557.99	6424.79	0.93
4	53	-3020.13	6146.26	6342.74	6174.65	0.95
5	64	-2887.77	5903.54	6140.80	5937.82	0.94
6	75	-2798.20	5746.39	6024.42	5786.57	0.94
7	86	-2718.68	5609.37	5928.18	5655.44	0.94
8[a]	97					

Note. AIC = Akaike Information Criterion. BIC = Bayesian Information Criterion. a-BIC = sample size adjusted BIC. Better model fit is indicated by lower values for AIC, BIC, and a-BIC, and values closer to 1.0 for entropy R^2.

[a] Model did not appear to be well-identified.

Table 3.

School Readiness Latent Profile Membership Probablities and Within-Profile Means

	Comprehensive Strengths	Academic Strengths & Behavioral Risk	Multiple Risks, Non-Disruptive	Extreme Risk
Membership Probabilities	0.43	0.18	0.22	0.17
Academic Skills				
Reading Ability	0.44	0.66	-0.90	-0.68
Math Ability	0.46	0.59	-0.90	-0.66
Learning Engagement				
School Readiness	0.84	0.01	-0.64	-1.35
Learning Behaviors	0.77	0.14	-0.81	-1.10
Social-Emotional Skills				
Emotion Regulation	0.86	-0.62	-0.27	-1.19
Prosocial Behavior	0.91	-0.53	-0.44	-1.17
Aggression				
Aggressive Behavior	-0.82	0.52	-0.04	1.60
Conduct Problems	-0.76	0.58	-0.29	1.70
Inattention-Hyperactivity				
Inattention	-0.83	0.06	0.58	1.34
Hyperactivity	-0.78	0.41	0.17	1.34

Note. All indicators were standardized in the latent profile analyses, so within-profile means above are standard deviation units from the sample mean.

Table 4.

Differences across Profiles in Sex, Age, and Validation Measures

	Comprehensive Strengths	Academic Strengths & Behavioral Risk	Multiple Risks, Non-Disruptive	Extreme Risk
% Male	56% a	51% a	79% b	84% b
Age (in years)	6.18 a	6.11 ab	5.96 c	6.00 bc
Expressive Language	86.66 a	84.84 a	76.65 b	80.30 b
Working Memory	2.03 b	2.28 a	1.52 c	1.68 c
Inhibitory Control	14.68 a	14.65 a	13.03 b	12.24 b
Set-shifting	5.16 ab	5.05 bc	4.48 c	4.34 c
Task Orientation	3.65 a	3.39 b	3.11 c	2.95 c
Emotion Recognition	1.75 ab	1.73 ab	1.62 c	1.69 bc
Peer Poor Relations	1.24 a	2.17 b	2.12 b	3.14 c
Peer Problems	0.72 a	1.83 b	2.52 c	3.80 d
Teacher Closeness	4.49 a	3.99 b	3.73 c	3.52 d
Teacher Conflict	1.28 a	3.09 c	2.20 b	3.84 d

Note. Estimated profile means, approximate standard errors, and test statistics were derived using Lanza and colleagues' (2013) distal outcome method as implemented in Mplus 7 (see Asparouhov & Muthén, 2013). Classes with different subscripts differed significantly ($p < .05$). M = mean. SD = standard deviation.
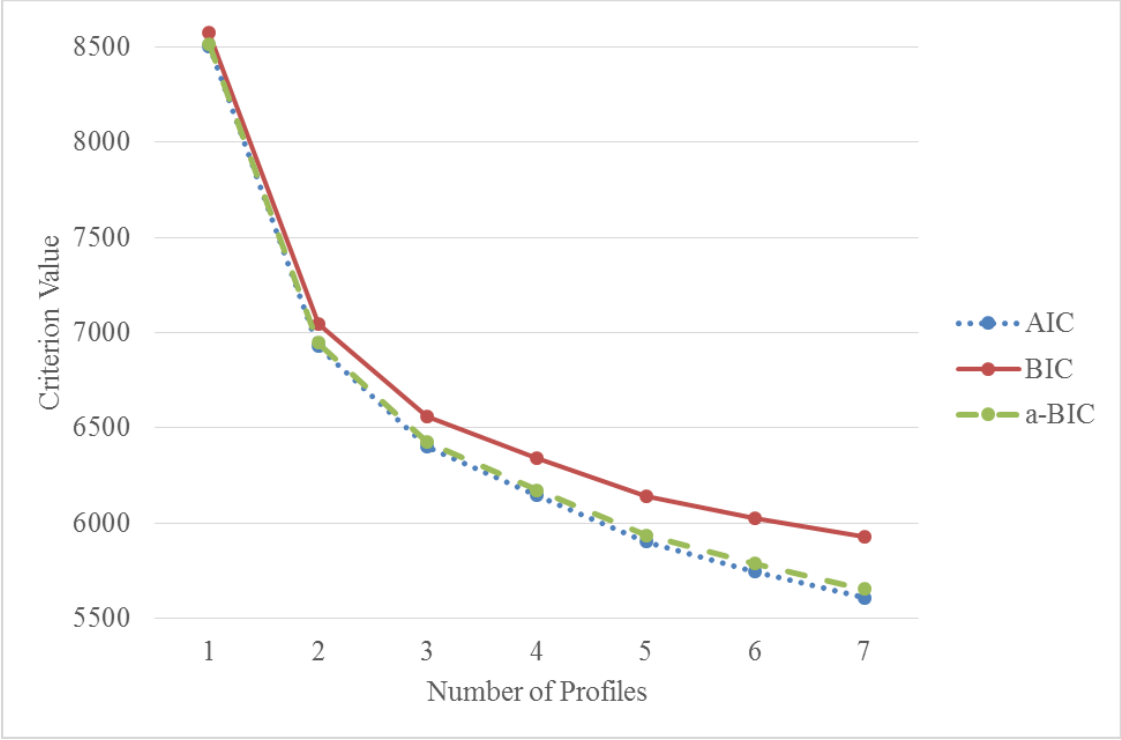
Figure 1. Model fit criteria decreased across successive models, with some leveling off after the 5-class solution.