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Social functioning questionnaires of adolescents born preterm show average profiles and attenuated gender differences

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Short title: Social functioning in adolescents born preterm
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ABSTRACT

Aim: Prematurity has been shown to affect social competence in children and adults. Our aim was to evaluate profiles of self-reported social behaviours and loneliness in preterm and term born adolescents.

Methods: Preterm (≤ 1500 g and, or, < 32 gestational weeks) and term born infants were recruited in Turku University Hospital from 2001 to 2006. The Multisource Assessment of Children's Social Competence and the Peer Network and Dyadic Loneliness Scale were completed at the age of 11. Profiles of social competence and loneliness were labelled as low, average or high.

Results: A total of 172 preterm and 134 term born adolescents returned the questionnaires. Most frequently, preterm adolescents reported a profile of average social competence and average levels of loneliness. Preterm born boys reported a profile of low social functioning less often (preterm 36% versus term born 54%), and preterm born girls reported a profile of high social functioning less frequently (preterm 26% versus term born 37%) than same-gender controls. Gender differences in social functioning profiles were smaller in preterm than term born adolescents.

Conclusion: The majority of young adolescents born preterm reported a high or average social functioning profile irrespective of gender. Prematurity seems to level out differences between genders.

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Key Notes:

1. Prematurity may affect social competence and loneliness in adolescents.
2. Preterm born boys reported low social functioning less often and preterm born girls reported high social functioning less often than same-gender controls.
3. Gender differences in social functioning profiles were smaller in preterm than in term born adolescents.

Keywords: loneliness, social competence, long-term follow up, school age, self-rating scales

INTRODUCTION

Children born very preterm have been shown to face an increased risk of long-lasting health and developmental problems.[1] Their social functioning problems have been shown to include low social competence,[2,3] social withdrawal, internalising behaviour, and attention deficits.[1,3,4] The social functioning of very preterm born children has been the topic of several studies. However, few studies have focused on how children born preterm function socially in adolescence.[2] Furthermore, there are no self-report studies of social competence and loneliness in young adolescents born preterm.

Social competence is a meta-level concept that consists of various aspects of social functioning, such as social adjustment, social performance, and social skills.[2] Among school-aged children, social competence has been defined as the ability to create and maintain social relationships, and it has been seen as a combination of prosocial and antisocial behaviours.[5] Low social competence has been associated with a high level of loneliness, while high social competence has predicted a low level of loneliness during elementary school.[6] Loneliness has been defined as a distressing subjective experience arising from a lack of desired social relationships.[7] The concept has been divided into social loneliness, which refers to a lack of a social network, and emotional loneliness, which refers to a lack of intimate relationships.[7,8] Long-term loneliness has been associated with poor mental and physical health, low cognition, increased mortality[9] and low social competence.[6] Social competence and loneliness have been associated with gender in term born children.[5,8,10] Girls have been shown to have better cooperation skills and to show more empathy toward others than boys at the age of 10.[5] Boys have been reported to be more disruptive and impulsive than girls[5], and they themselves have reported more emotional loneliness.[10]

Preterm born children have been suggested to be neurobiologically more sensitive to environmental stressors than term born children.[4] A combination of prematurity-related

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neurobiological deficits and environmental stressors have been shown to predict social functioning among preterm born children.[2,4] In early childhood, low social competence has been associated with extreme prematurity,[3] use of postnatal corticosteroids, lower birthweight z score,[11] and brain pathology at term.[3,11] In later childhood, cognitive, motor, and behavioural problems, as well as socioeconomic disadvantages and difficulties in early parent-child interaction, have been associated with low social competence, low peer acceptance, and a low number of friends.[2,3] The differences observed between preterm born boys and girls in social competence studies indicate a need for more systematic research.[2,11]

Most previous studies have focused on the social functioning of very preterm born children in early childhood. It is, however, especially important to understand how social functioning changes in early adolescence, as the importance of peer relations increases. This study aimed to describe and compare profiles of social functioning in very preterm and, or, very low birthweight (≤ 1500 g and, or, below 32 weeks of gestation) and term born adolescents at the age of 11. Latent profile analysis was used to identify the profiles of perceived social competence and loneliness for both groups and to assess social functioning in relation to gender. We also analysed how selected prematurity-related risks and parental education were associated with social competence and loneliness in preterm born young adolescents. We hypothesised that a higher proportion of preterm born adolescents than term born controls would be classified as having a profile of low social functioning. In addition, we tested the effects of gender, gestational age, cognitive performance and parental education on social functioning in young adolescents born very preterm.

PATIENTS AND METHODS

Participants

The present study was part of the Development and Functioning of Very Low Birthweight Infants from Infancy to School Age follow up study (PIPARI), which followed the children from birth to adolescence. All very low birthweight (≤ 1500 g) infants born at Turku University Hospital in Finland between 1 January 2001 and 31 December 2006 living in the hospital's catchment area were eligible. In addition, at least one parent's native language had to be Finnish or Swedish. From the beginning of 2004, the inclusion criteria were expanded to include all infants born before 32 weeks of gestation, regardless of birthweight. A total of 12 of the 289 eligible infants were excluded due to genetic syndromes and severe congenital anomalies, seven due to living outside the hospital's catchment area, and six due to parents who did not speak Finnish or Swedish. In addition, 35 of the 264 infants died during the neonatal period, and nine parents declined participation. During post-neonatal follow up, 48 of 220 children dropped out of the study for various reasons. Thus, the final study population consisted of 172 young adolescents who were born very preterm and, or, with very low birthweight.

The control group consisted of healthy infants born at term at the Turku University Hospital from 2001 to 2004. The control group participants were recruited at the maternity ward during the first week of life. Every Monday, the parents of the first term born boy and girl were invited to take part in the study. The infants included in the control group had to be born at or after 37 weeks of gestation without a need for neonatal care during the first week, and Finnish or Swedish had to be the native language of at least one parent. The exclusion criteria were genetic syndromes and severe congenital anomalies, the mother's use of illicit drugs or alcohol during the pregnancy and a birthweight at least two standard deviations below the mean for age and gender according to age- and gender-specific Finnish growth charts. Of the 200 control subjects we followed, 15 dropped out and two

were excluded during the follow up due to missing data. Of the remaining 183 control group participants, 49 did not return the questionnaires. The final control group consisted of 134 young adolescents.

The PIPARI study protocol was approved by the Ethics Committee of the Hospital District of Southwest Finland in December 2000 and January 2012.

All parents gave written informed consent for the follow up, and all young adolescents provided written informed consent for the follow up at the age of 11 after receiving written and verbal information.

Background and data collection

Data on the neonatal period were collected systematically as part of the PIPARI study protocol. The parents' education was surveyed when the children were five years old. Cognitive performance was evaluated using the Wechsler Intelligence Scale for Children, Fourth Edition (Finnish version, 2010) for preterm born adolescents at the age of 11.[13] During the same visit, the preterm born adolescents completed two self-rating questionnaires, one on loneliness and one on social competence. The controls only completed the questionnaires, which they received via mail at the same age and completed at home. There were two reminders: the self-rating questionnaires were re-sent once after three months, and if no response was received, the parents were contacted by telephone after one to three more months.

Social competence

Social competence was assessed using a self-rating form of the Multisource Assessment of Children's Social Competence Scale (MASCS).[5] The questionnaire contains 15 items measuring the child's social competence, including prosocial and antisocial behaviour at school. Each item is rated on a four point Likert scale. The subscales of social competence that indicate prosocial behaviour measure cooperation skills and empathy, while the subscales that indicate antisocial behaviour measure impulsivity and

disruptiveness. The subscales were coded according to the Finnish MASCS manual and used as continuous variables.[14] A combination of poor cooperation skills, low empathy, high impulsivity and high disruptiveness indicates low social competence. Cronbach's alpha for MASCS was 0.80 for cooperation skills, 0.68 for empathy, 0.80 for impulsivity, and 0.74 for disruptiveness.[5]

Loneliness

Social and emotional loneliness were evaluated using the Finnish version of the Peer Network and Dyadic Loneliness Scale.[8,10] It contains five paired statements on social loneliness and another five on emotional loneliness. First, the respondent chooses which of the two paired statements best describes his or her situation, then he or she evaluates whether the statement fits him or her "quite well" or "very well." Item scores range from one, meaning very low loneliness, to four, meaning very high loneliness, and sum scores vary between five and 20. Increasing values indicate increasing loneliness. The Cronbach's alpha values for this scale were 0.81–0.85 for social loneliness and 0.77–0.83 for emotional loneliness.[10]

Selected risks for social functioning in young adolescents born preterm

The selected prematurity-related risks were earlier gestational weeks, lower cognitive performance and lower parental education. Full-scale intelligence quotient, verbal comprehension, perceptual reasoning, working memory and processing speed were used to describe cognitive performance at the age of 11. Low parental education was defined as 12 or less years of education. These risks were selected because they were the most consistently associated with the social functioning of children born preterm.[2-4] Although other risks may also be associated with social functioning, the present study was limited to these key factors.

Statistical analyses

Statistical analyses were run on SPSS version 25 (IBM Corp, New York, USA), apart from the latent profile analyses, which were run on Mplus version 8.1.[15] *P* values < 0.05 were considered statistically significant. Continuous variables were described by means, standard deviations and minimum and maximum values. Categorical sample characteristics were described using frequencies and percentages. The sample characteristics between the participants and nonparticipants were compared using the independent samples *t*-test and the chi-square test as appropriate. The Bonferroni correction was used to decrease the probability of type I errors.[16] Latent profile analysis was used to identify patterns of social competence and loneliness in the sample.[17] A detailed description of latent profile analysis is presented in Appendix S1. Model fit estimates, distinguishability estimates, and class proportions for the latent profile analysis series are presented in Appendix S2. After establishing the latent classes, the auxiliary options of Mplus were used to test whether prematurity and gender were evenly distributed among the resultant latent classes.[15] Multinomial logistic regression analysis was used to assess the participant subpopulations' likelihood of belonging in the latent classes. Separate analyses were run as follows: term born versus preterm young adolescents; girls versus boys. Separate multinomial logistic regression analyses were run on preterm born adolescents to assess how gestational weeks, cognitive performance, and parental education influenced the risk of belonging to a given latent class. In all models, the average social functioning class was used as a reference. The comparisons were presented as odds ratios (ORs) and 95% confidence intervals for risk, as well as *p* values.

RESULTS

A total of 172 preterm born adolescents and 134 term born controls returned the questionnaires. Dropout analyses showed that the mothers of participants born preterm had a higher level of education than the mothers of preterm born dropouts (≤ 12 years in 35% of the participants and 57% of the dropouts, $p = 0.009$). The term born participants did not differ from the term born dropouts in this respect. The characteristics of the participants are presented in Table 1.

Perceived social competence and loneliness

Preterm born and term born young adolescents were included in the profile analyses. The three-class model was chosen based on theoretical and statistical reasons. It enabled more relevant clinical interpretations than the four-class model, where the group sizes would have become smaller. The most common social competence and loneliness profiles in the sample (latent classes) were labelled as 1) the high social functioning class (20%), 2) the average social functioning class (44%), and 3) the low social functioning class (36%). Adolescents in the high social functioning class reported high social competence and low levels of loneliness. Adolescents in the average social functioning class reported average social competence and average loneliness. Adolescents in the low social functioning class reported low social competence and average loneliness. Profiles of the three social functioning classes are presented in Table 2.

Effects of prematurity and gender on social functioning

Both prematurity and gender affected the distribution of young adolescents between the latent classes ($p < 0.001$ – 0.008). In the high social functioning class, 71.4% of the participants were girls. In the average social functioning class, 66.2% of participants were born preterm. In the low social functioning class, 67.3% of participants were boys. Figure 1 represents how participants in the sample were distributed between the latent classes.

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The majority of young adolescents born preterm belonged to the average social functioning class: 54.5% of the girls and 52.6% of the boys. A total of 26.0% of the preterm born girls and 11.9% of the preterm born boys belonged to the high social functioning class. A total of 19.5% of the preterm born girls and 35.8% of the preterm born boys belonged to the low social functioning class.

A total of 34.3% of the term born girls and 35.8% of the term born boys belonged to the average social functioning class. The majority of the term born girls, 37.3%, and 10.4% of the term born boys belonged to the high social functioning class. A total of 28.4% of the term born girls and the majority of term born boys, 53.7%, belonged to the low social functioning class.

Compared to adolescents born preterm, adolescents born at term belonged to the high or low social functioning classes more often (high versus average OR 2.021, 95% CI 1.102–3.705, $p = 0.023$; low versus average OR 2.197, 95% CI 1.305–3.700, $p = 0.003$). Girls belonged to the high social functioning classes more often and to the low social functioning classes less often (high versus average OR 2.846, 95% CI 1.501–5.398, $p = 0.001$; low versus average OR 0.553, 95% CI 0.326–0.938, $p = 0.028$) than boys.

Term born boys belonged to the low social functioning class more often than preterm born boys (low versus average OR 2.206, 95% CI 1.122–4.335, $p = 0.022$). Term born girls belonged to the high social functioning class more often than preterm born girls (high versus average OR 2.283, 95% CI 1.049–4.966, $p = 0.037$). Term born girls belonged to the high social functioning class more often than term born boys (high versus average OR 3.727, 95% CI 1.351–10.280, $p = 0.011$). No gender differences were observed in the social functioning of preterm born adolescents.

Effects of selected risks in preterm born adolescents

The associations between the assumed risk factors and the social functioning of the young adolescents born preterm are shown in Table 3. The effects of the selected risks

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9 were only evaluated in the adolescents born preterm, because they were the primary
10 focus of this study. Preterm born adolescents with better working memory and high
11 maternal education were more likely to belong to the high social functioning class than the
12 average social functioning class. There were no other statistically significant associations
13 between the social functioning classes and the assumed risk factors.
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DISCUSSION

In this study, we focused on perceived social functioning in young adolescents born preterm and, or, with very low birthweight. Social functioning was clustered into three classes: low, average, and high functioning. The profiles were modelled based on the adolescents' self-reported social competence and loneliness scores. In our study, 11-year-old adolescents born preterm most frequently reported average social functioning. Gender-wise comparisons showed that boys born preterm reported low social functioning less frequently and girls born preterm reported high social functioning less frequently than same-gender term born peers. In the whole sample, girls more frequently reported high and less frequently low social functioning than boys. The difference between boys and girls born preterm was smaller than between control group girls and boys. In adolescents born preterm, a good working memory and high maternal education were associated with high social functioning. Gestational age, other aspects of cognition, and paternal education did not associate with social functioning in adolescents born preterm. Our findings were partly in line with previous studies in the field, in which very preterm birth was shown to have a long lasting effect on social functioning.[1,2,] In the previous studies, young adolescents born very preterm have been shown to be more withdrawn, less impulsive, less disruptive and less aggressive than term born young adolescents.[1,18] In addition, they have been shown to have fewer friends and to be less active in their leisure time than term born adolescents.[18] According to our results, boys born preterm reported low social functioning less frequently than boys born at term. We found support from previous findings indicating less impulsive, disruptive, and aggressive behaviour in a preterm born population.[1] Our results, according to which girls born preterm reported high social functioning less frequently than girls born at term may be related to the cautious behaviour that individuals born preterm have been shown to

express.[1] However, the majority of the girls born preterm perceived their social functioning to be at least average.

The findings of this study, which show higher social functioning in girls than boys in the whole sample, is in line with the previous studies showing that Finnish school-aged girls had better social competence and experienced less loneliness than boys.[5,10] Our study expanded on previous findings by showing attenuated gender differences in adolescents born preterm. This highlights the relevance of gender-wise comparisons between preterm and term born adolescents in social functioning studies.

Our results also showed that young adolescents who reported average social competence reported a similar amount of lonely feelings as those adolescents who reported low social competence. This means that while most adolescents born preterm perceived their behaviour as moderately prosocial and not very antisocial, they still reported a moderate amount of lonely feelings. Although a moderate amount of lonely feelings is not a strong predictor for later mental health problems at a group level, it is noteworthy for two reasons.[19] First, loneliness, unlike being alone, is a distressing subjective experience that inevitably decreases quality of life. Second, for some children, loneliness increases with time, and increasing trajectories of lonely feelings during elementary school are shown to predict a greater likelihood of depression in adolescence.[19] Due to differences in social functioning, young adolescents born preterm may feel like outsiders in same-gender peer relations, which may evoke feelings of loneliness[20] at the age when the need to belong to a peer group is the strongest.[21] Our findings may have predictive value for mental health problems of adolescents born preterm, as both perceived limitations in social competence and increasing feelings of loneliness has been shown to predict mental health problems, such as depression and anxiety.[19] Anxiety and depression have been shown to be especially common among adolescents born preterm.[22]

In this study, high social functioning in young adolescents born preterm was associated with better working memory and high maternal education. Although the association between working memory and social functioning was weak and should be interpreted cautiously, it is theoretically interesting. Working memory is a part of executive function,[25] which has been shown to mediate the relationship between very preterm birth and the development of intelligence.[26] Likewise, a limited capacity to process social information may increase the risk for lower social functioning among children born very preterm. In addition to neurobiological characteristics, the social environment may also play a role in the social functioning of children born very preterm.[2-4,23] High maternal education has also been associated with better cognition among children born very preterm.[27] Regrettably, though, these familial factors have not been widely studied in relation to social competence.

Limitations

The first limitation of this study is that social competence was only evaluated from the perspective of the respondents. A multisource approach would have provided a more comprehensive view. Adolescents' self-assessments correlate with the assessments of parents, teachers, and peers.[5] However, self-rating is the only way to examine a child's understanding of his or her competence and obtain an indication of how it could affect his or her behaviour. The second limitation is that the young adolescents born preterm and at term completed the questionnaires in different settings: the preterm born adolescents completed them during research visits and the term born adolescents at home. In both settings, the participants completed the questionnaires independently. The experienced psychological safety of the environment may have influenced the answers. However, both questionnaires have been validated for self-rating in a sample of Finnish children, and the forms are usually completed at school.[5,10] The third limitation is that the level of

maternal education was higher among the preterm born participants than the dropouts, which may have supported the social functioning of young adolescents born preterm.

CONCLUSION

The majority of young adolescents born preterm perceived their social functioning as high or average irrespective of gender. Prematurity seems to level out differences between genders. Future studies are needed to better understand the trajectories and mechanisms behind the development of social functioning in the preterm born population.

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ABBREVIATIONS

CI	Confidence interval
MASCS	Multisource Assessment of Children's Social Competence Scale
OR	Odds ratio

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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TABLES

Table 1. Characteristics of the participants born preterm and term.

	Preterm	Term born
	<i>n</i> = 172	<i>n</i> = 134
	mean, SD,	mean, SD,
	min–max / <i>n</i> (%)	min–max / <i>n</i> (%)
Mother’s education ^a		
≤ 12 years	60 (35%)	48 (36%)
> 12 years	110 (64%)	73 (55%)
Father’s education ^b		
≤ 12 years	111 (65%)	58 (43%)
> 12 years	57 (33%)	58 (43%)
Boys	95 (55%)	67 (50%)
Gestational age (weeks)	29, 2.7, 23-36	40, 1.2, 37-42
< 28 weeks	57 (33%)	
Birthweight (grams)	1122, 318, 400-2120	3674, 427, 2570-4810
< 1000 g	67 (39%)	
> 1500 g	12 (7%)	
Birthweight z score ^c	-1.4, 1.5, -5-3	0.11, 0.88, -2-3
Age (years:months)	11:2, 3, 10:6-11:8	11:5, 3, 9:11-12:1
Cognitive performance ^d		
FSIQ	89, 17, 40–131	
VCI	90, 14, 46–122	
PRI	92, 17, 47–122	
WMI	93, 16, 46–133	

PSI 94, 17, 47–153

^a missing: preterm, $n = 2$ (1%); term born, $n = 13$ (10%); ^b missing: preterm, $n = 4$ (2%); term born, $n = 18$ (13%); ^c missing: preterm, $n = 0$ (0%); term born, $n = 1$ (1%)

^d measured at the age of 11; FSIQ, Full-Scale Intelligence Quotient; VCI, Verbal

Reasoning Index; PRI, Perceptual Reasoning Index; WMI, Working Memory Index; PSI, Processing Speed Index

Table 2. Elements of social competence and loneliness in the high, average and low social functioning classes, presented as standardised means.

	High	Average	Low
	(20%) ^a	(44%)	(36%)
	mean (SD)	mean (SD)	mean (SD)
Social competence			
Cooperation skills	.950 (.815)	.036 (.830)	-.590 (.865)
Empathy	1.079 (.317)	.052 (.775)	-.734 (.915)
Impulsivity	-.493 (.846)	-.287 (.734)	.694 (1.048)
Disruptiveness	-.550 (.692)	-.553 (.494)	1.059 (.792)
Loneliness			
Social	-.811 (.481)	.191 (1.019)	.240 (.963)
Emotional	-.977 (.142)	.327 (.993)	.166 (.938)

^aPercentage of participants. A combination of high cooperation skills, high empathy, low impulsivity and low disruptiveness indicate high social competence. Higher scores of loneliness indicate higher level of loneliness.

Table 3. Associations between the adolescent-related and parent-related risk factors and social functioning in the young adolescents born preterm.

	High social functioning versus Average social functioning			Low social functioning versus Average social functioning		
	OR	95% CI	P	OR	95% CI	P
			value			value
Gestational weeks	1.041	.895–1.210	.603	1.046	.920–1.189	.495
Full-scale intelligence quotient	1.026	.999–1.054	.060	1.003	.983–1.024	.771
Verbal reasoning	1.023	.993–1.053	.132	1.023	.998–1.049	.076
Perceptual reasoning	1.003	.979–1.028	.814	1.010	.988–1.031	.380
Working memory	1.045	1.015–1.076	.003	.997	.975–1.019	.776
Processing speed	1.020	.994–1.046	.132	.978	.957–1.000	.050
Mother's education ≤ 12 years	.317	.111–.903	.031	1.235	.608–2.508	.559
Father's education ≤ 12 years	.577	.251–1.329	.197	1.121	.521–2.410	.771

OR = Odds ratio; CI = Confidence interval

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FIGURE LEGENDS

Figure 1. Distribution of the preterm born and term born participants in the latent profile classes.

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Figure 1.

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Appendix S1. Latent Profile Analysis (LPA)

LPA is a model-based variant of traditional cluster analysis, aiming to find the unobserved subpopulations (latent classes) within the data.¹⁻³ To compare the resultant latent classes, we used the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). The AIC and BIC estimate guides to choosing between competing statistical models such that the smaller the value, the more parsimonious the model is indicated to be.⁴ Additionally, we used the entropy value (which varies between 0 and 1) since a value closer to 1 indicates a clearer classification and the relative risk estimates of cases belonging to each class.^{1,2} The LPAs were tested using standardized subscale scores of social competence and standardized total scores of loneliness. The resultant AIC, BIC, and Entropy estimates as well as the Class Propositions and Average Latent Class Posterior Probabilities for the consecutive amount of classes (1, 2, 3, 4, 5) are presented in Table 1. In order to choose the smallest amount of classes, we used the criterion to be guided with 1) the fit of the model (using AIC and BIC), 2) distinguishability of the latent classes (using Entropy and Average Latent Class Posterior Probabilities), 3) latent class sizes (class proposition), and 4) the theoretical justification and interpretability of the latent classes. Based on the model fit estimates (AIC and BIC) and distinguishability estimates the four class solution would have been the best. However, the same estimates were still relatively good for the three class solution, which has clinically meaningful latent classes (preterm children, girls and boys) and acceptable average latent class posterior probabilities. Based on the fit estimates, and the statistically significant differences in the vast majority of variables (cooperation skills, empathy, impulsivity, disruptiveness, social loneliness, emotional loneliness) between each classes as well as the theoretical justification we chose the three class solution.

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Appendix S2. Model Fit Estimates, Distinguishability Estimates and Class Proportions for the Series of Latent Profile Analyses

	AIC (diff.)	BIC (diff.)	Entropy	Class Proportions	Average Latent Class Posterior Probabilities
1 Class	5108.756	5153.439	1.000	1.000	1.000
2 Classes	4760.007 (-348.749)	4853.097 (-300.342)	.938	.188 / .812	.943 / .992
3 Classes	4661.822 (-98.185)	4803.318 (-49.779)	.783	.197 / .442 / .361	.918 / .884 / .918
4 Classes	4576.949 (-84.873)	4766.852 (-36.466)	.826	.212 / .403 / .275 / .120	.927 / .891 / .919 / .884
5 Classes	4713.822 (+136.873)	4952.131 (+185.279)	.852	.000 / .197 / .442 / .361 / .000	.000 / .918 / .884 / .918 / .000