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Manuscript Title: Subgroups of Temperament Associated with Social-Emotional Difficulties in Infants with Early Signs of Autism

Short Title: Subgroups of Temperament

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Lay Summary: This study explored whether infants with early signs of autism could be grouped according to temperament characteristics (i.e., emotional, behavioural, and attentional traits). Three subgroups were identified that differed with respect to emotional and behavioural difficulties. Specifically, 'inhibited/low positive' infants had high emotional difficulties, 'active/negative reactive' infants had high emotional *and* behavioural difficulties, while 'well-regulated' infants had the lowest difficulties.

Abstract: Links between temperament and social-emotional difficulties are well-established in normative child development but remain poorly characterized in autism. We sought to characterize distinct temperament subgroups and their associations with concurrent internalizing and externalizing symptoms in a sample of 103 infants (M_{age} = 12.39 months, *SD* = 1.97; 68% male) showing early signs of autism. Latent profile analysis was used to identify subgroups of infants with distinct temperament trait configurations on the Infant Behavior Questionnaire-Revised. Derived subgroups were then compared in terms of internalizing and externalizing symptoms on the Infant-Toddler Social and Emotional Assessment. Three distinct temperament subgroups were identified: (1) *inhibited/low positive* (*n*=22), characterized by low Smiling and Laughter, low High Intensity Pleasure, low Vocal Reactivity, and low Approach, (2) *active/negative reactive* (*n*=23), characterized by high Activity Level, high Distress to Limitations, high Sadness, high Fear, and low Falling Reactivity, and (3) *well-regulated* (*n*=51), characterized by high Cuddliness, high Soothability, and high Low Intensity Pleasure. There were no differences in infant sex ratio, mean age or developmental/cognitive ability. Inhibited/low positive infants had significantly more behavioural autism signs than active/negative reactive and well-regulated infants, who did not differ. Inhibited/low positive and active/negative reactive infants had higher internalizing symptoms, relative to well-regulated infants, and active/negative reactive infants also had higher externalizing

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symptoms. These findings align closely with those garnered in the context of normative child development, and point to child temperament as a putative target for internalizing and externalizing interventions.

Keywords: autism spectrum disorder; infants; temperament; internalizing; externalizing.

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Symptoms of autism spectrum disorder (hereafter, autism) co-occur at high rates with internalizing (anxiety and/or depression) and externalizing (inattentive/hyperactive, oppositional, and/or aggressive behaviour) symptoms, at both a subclinical and clinical level (Lundström et al., 2011; Joshi et al., 2010). Social-emotional difficulties are heightened among children with autism from very early childhood (Rescorla et al., 2019), and may contribute to functional impairment (Chiang & Gau, 2016), prognosis and differential treatment response (Vivanti, Prior, Williams, & Dissanayake, 2014). Therefore, it is critical to identify, early on in life, those children with autism features at greatest risk of internalizing and/or externalizing symptoms so appropriate supports can be allocated.

Existing literature on normative development suggests that individual variation in children's temperament may be associated with social-emotional difficulties; that is, early-emerging emotional and behavioural traits in domains of *negative emotionality*, the tendency to experience negative emotions, *sociability*, the tendency to engage actively with others, and *self-regulation*, the capacity to regulate emotions and action (Chetcuti, Uljarević, & Hudry, 2018). High negative emotionality and low self-regulation confer susceptibility towards both internalizing and externalizing symptoms, whereas low sociability more strongly relates to internalizing symptomatology (De Pauw & Mervielde, 2010; De Pauw, Mervielde, & Leeuwen, 2009). A similar pattern of relations has been reported among school-aged children and adolescents with autism (Burrows, Usher, Schwartz, Mundy, & Henderson, 2016; De Pauw & Mervielde, 2010; Schwartz et al., 2009). However, no studies have explored associations between temperament and social-emotional difficulties in

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infancy, when key differences in temperament associated with autism first become apparent (Clifford et al., 2013).

Furthermore, studies of normative development provide some indication that person-centered statistical methods (cluster/profile analysis) may be a useful alternative means of characterising relations among temperament and social-emotional difficulties (Chetcuti et al., 2018). In the seminal work of Thomas, Chess, and Birch (1968), three subgroups were identified by (top-down) qualitative analysis of temperament data collected through clinical observations and interviews with parents of 141 normative infants. Temperamentally *difficult* children were characterized by high and intense negative emotionality and activity, low sociability, and low self-regulation, while *easy* children showed the opposite trait pattern – low negative emotionality, high sociability, and high self-regulation. *Slow-to-warm-up* children showed a qualitatively different trait configuration – high negative emotionality (but of lesser intensity than difficult children), low sociability and activity, and average self-regulation. This typology was subsequently supported through factor analysis (Thomas & Chess, 1977) and replicated using data-driven (bottom-up) statistical techniques (Mcdevitt & Carey, 1978). Using person-centered statistical methods, recent studies have identified thematically similar temperament subgroups among other normative cohorts (e.g., Robins, John, Caspi, Moffitt, & Stouthamber-Loeber, 1996) that meaningfully map onto internalizing and externalizing outcomes. A slow-to-warm-up disposition appears to confer susceptibility towards internalizing symptoms/disorders, while a difficult temperament is associated with heightened externalizing symptoms/disorders. Temperamentally difficult children also appear more susceptible to both co-occurring internalizing *and* externalizing symptoms, while children with an easy disposition seem least prone towards the development of either (Putnam & Stifter, 2005; Robins et al., 1996; Thomas et al., 1968).

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Only a few studies have examined patterns of multiple temperament traits in the context of autism. Kasari and Sigman (1997) found that children with an autism diagnosis scored higher than normative children and children with Down syndrome on a composite score reflecting difficult temperament (a constellation of irregularity, withdrawal from new stimuli, low adaptability, high intensity, and negative mood). Similarly, Chuang et al. (2012) found that a higher percentage of children with autism had a difficult temperament trait constellation (34.3%) than children with normative development (18.2%). To our knowledge, only one study has characterized children into temperament subgroups that were not predefined by existing theory, but rather emerged 'bottom-up' from the analyzed data. Garon et al. (2009) used discriminant function analysis to identify temperament trait constellations that prospectively distinguished infants who did and did not go on to receive an autism diagnosis at preschool-age. Two temperament functions differentiated children with autism from normative children at 24-months: lower scores were apparent among children with autism for a 'behavioural approach' function reflecting sensitivity to social reward cues, and 'effortful emotion regulation' function reflecting the ability to manage negative emotions and behaviour. Garon et al. (2009) also investigated whether temperament function scores differed within their autism-diagnosed sample according to timing of autism diagnosis. A combination of higher autism symptoms, lower IQ, and lower behavioural approach was found to differentiate among children with autism diagnosed earlier vs later in life.

Taken together, evidence from existing studies suggests differences across multiple temperament traits among children with autism compared to non-autism controls, and according to timing of autism diagnosis. Apart from Garon et al. (2009), there have been no other efforts to characterize temperamentally distinct subgroups of children with autism features or explore the potential relevance of such subgroups for explaining variability in children's social-emotional

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outcomes. Therefore, among a unique cohort of infants referred with early autism signs we sought to (a) identify temperament subgroups using person-centered methods and (b) explore associations between these and concurrent social-emotional difficulties. We expected heightened internalizing symptoms among infants presenting with low sociability-related temperament traits, and elevated internalizing and externalizing symptoms among those with high negative emotionality and low self-regulation. In contrast, we expected the lowest internalizing and externalizing symptom levels among infants with high temperamental sociability and self-regulation.

Method

Participants were 103 infants aged 9-16 months (*M*=12.39, *SD*=1.97; 68% male) recruited into a larger study (citations withheld), for which prospective ethical approval was granted by institutional review boards. Referral to the study was by community healthcare providers, on the basis of infants showing ≥3 (of 5) key autism behaviours on the Social Attention and Communication Surveillance-Revised (SACS-R) tool (i.e., atypical/absent pointing, waving, imitation, eye contact, response to name; Barbaro & Dissanayake, 2013). The SACS-R is a revised version of the SACS (Barbaro & Dissanayake, 2010) designed as an autism surveillance tool for implementation by primary health professionals during routine well-child checks. The original SACS tool has excellent estimated sensitivity (84%) and specificity (99%) for detecting autism in childhood (based on a general population prevalence estimate of 1:100; Barbaro & Dissanayake, 2010). Similarly, in a more recent study, the SACS-R has shown good positive predictive value (72%) for subsequent autism diagnosis among 12-month-olds (Barbaro, Dissanayake, & Sadka, 2018; also see Mozolic-Staunton, Donelly, Yoxall, & Barbaro, 2020). Each infant was administered the Mullen Scales of Early Learning (MSEL; Mullen, 1995) to ascertain cognitive/developmental level, and the Autism Observation Scale for Infants (AOSI; Bryson et al., 2008) to quantify early behavioural autism signs.

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Caregivers (72% mothers) completed the Infant-Toddler Social and Emotional Assessment (ITSEA; Carter & Briggs-Gowan, 2006) to ascertain infant symptoms in Internalizing and Externalizing domains, and the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) to measure fine-grained temperament traits: Activity Level, Smiling and Laughter, High Intensity Pleasure, Vocal Reactivity, Approach, Perceptual Sensitivity (reflecting aspects of sociability), Distress To Limitations, Fear, Sadness, Falling Reactivity (aspects of negative emotionality), Duration Of Orienting, Low Intensity Pleasure, Cuddliness, and Soothability (aspects of self-regulation).

To address the issue of measurement confounding, ITSEA items that were conceptually and semantically similar to IBQ-R items were removed prior to calculation of ITSEA domain scores (Appendix A). Internal consistency was good for both scales of the IBQ-R (α=.65-.89) and domains of the ITSEA (Externalizing α=.82; Internalizing α=.62).

Analytic Strategy

Latent profile analysis (LPA) was conducted in M*plus* (Muthén & Muthén, 1998-2017) using the robust maximum likelihood estimator. Model fit concerning temperament subgroups identified from the 14 IBQ-R scales was assessed with the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Adjusted BIC, where lower values indicate better fit, and statistically significant Lo-Mendell-Rubin (LMRT) and Bootstrapped Likelihood Ratio tests (BLRT) indicate fit improvement with an additional subgroup (*k* vs *k*–1). Subgroup classification quality was assessed with the entropy statistic, with a value closer to 1 indicating less uncertainty. Model selection was also guided by parsimony and interpretability (Bauer & Curran, 2003). Once extracted, subgroup-level differences in mean IBQ-R scale scores were determined via bootstrapped (2,000 resamples) one-way analysis of variance (ANOVA) with a Bonferroni correction applied for multiple comparisons (i.e., alpha-level of 0.05/14 = 0.0036) and post-hoc tests. Pearson's chi-square tests and one-way

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ANOVAs were then performed to explore differences in infant clinical characteristics and ITSEA domain scores as a function of temperament subgroup. Eta squared (η^2) was the effect size measure computed for each ANOVA, with .01 interpreted as small, .06 medium, and .14 large.

Results

Table 1 summarises model fit indices. The three-subgroup model was selected as the best fitting solution, with lowest-value BIC and statistically significant BLRT. Although the four- and five-subgroup solutions also had statistically significant BLRT and lower AIC and Adjusted BIC values, Nylund, Asparouhov and Muthén, (2007) advocate better performance of the BIC in smaller samples. Further, the three-subgroup solution was most parsimonious, with accurate subgroup classification (i.e., entropy >.80; mean posterior membership probabilities >.70 [Profile 1=.97, 2=.92, 3=.98]; Clark, 2010; Nagin, 2005).

<Table 1>

Infants were assigned to temperament subgroups based on maximum probability of membership. Figure 1 shows IBQ-R scale mean scores for infants in the three identified temperament subgroups with ANOVA results in Table 2. The first subgroup (*n*=22) was characterized by low Smiling and Laughter, low High Intensity Pleasure, low Vocal Reactivity and low Approach; hereafter, labelled *inhibited/low positive.* The second (*n*=23) was labelled *active/negative reactive,* given high Activity Level, high Distress to Limitations, high Sadness, and high Fear, and low Falling Reactivity. The third (*n*=51), with high Cuddliness, high Soothability, and high Low Intensity Pleasure, was labelled *well-regulated.*

<Figure 1>

<Table 2>

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Between-subgroup differences are presented in Table 3. There were no differences in infant sex ratio, mean age[1] or developmental/cognitive ability (MSEL). *Inhibited/low positive* infants had significantly more behavioural autism signs (AOSI) than *active/negative reactive* and *well-regulated* infants, who did not differ. Infants classified as either *inhibited/low positive* or *active/negative reactive* had significantly higher Internalizing symptoms than *well-regulated* infants. *Active/negative reactive* infants had higher Externalizing symptoms than *well-regulated* infants. Those classified as *inhibited/low positive* had intermediate Externalizing symptoms but did not differ from the other two subgroups.

<Table 3>

Discussion

The aim of this study was to characterize associations between temperament and concurrent internalizing/externalizing symptomatology among a community-referred cohort of infants presenting with early autism symptoms. Three temperament subgroups were identified using a person-centered approach – *inhibited/low positive*, *active/negative reactive,* and *well-regulated* – that aligned closely with those observed in normative samples (e.g., Robins et al., 1996; Thomas et al., 1968, 1977).

The *active/negative reactive* subgroup showed close alignment with Thomas et al.'s (1968, 1977) difficult subgroup, sharing a tendency toward temperamental negative affect and self-regulation difficulties. Indeed, such a profile has been consistently replicated (e.g., Beekman et al., 2015; Prokasky et al., 2017). Similarly, the *well-regulated* subgroup was characterized by effective

[1] Non-significant correlation coefficients were obtained between infant age and each of the 14 IBQ-R subscale continuous scores (r =.000 [Cuddliness] to .175 [Vocal Reactivity])

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self-regulation; an attribute shared by Thomas et al.'s easy subgroup and similar other subgroups identified in the literature (Gartstein et al., 2017; Robins et al., 1996). The *inhibited/low positive* subgroup shared the low sociability characteristics of Thomas et al.'s slow-to-warm-up subgroup. However, previously identified low-sociability subgroups have also encompassed high trait self-regulation, which was not the case here. Rather, traits related to self-regulation – Low Intensity Pleasure, Cuddliness, and Soothability – were found to be comparable or even lower among *inhibited/low positive* infants relative to the remainder of the cohort. Alternatively, high self-regulation may not emerge among *inhibited/low positive* infants until later childhood, when attention comes under greater effortful control (Posner & Rothbart, 2006).

A further aim was to investigate whether temperament subgroup membership predicted variability in social-emotional difficulties in our cohort of infants showing early autism symptoms. Infants classified as *inhibited/low positive* and *active/negative reactive* had more co-occurring internalizing symptoms compared to *well-regulated* infants. Externalizing symptoms were similarly elevated in the *active/negative reactive* subgroup, relative to *well-regulated* infants, while *inhibited/low positive* infants had intermediate externalizing symptom levels which were not significantly different to the two other subgroups. These results are consistent with literature on normative development, suggesting that slow-to-warm-up children are prone towards internalizing symptoms while difficult children are prone towards both internalizing and externalizing symptoms. Moreover, the finding of fewer co-occurring internalizing/externalizing symptoms among well-regulated infants is consistent with findings pertaining to an easy temperament in normative development (Robins et al., 1996; Thomas et al., 1968).

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Infants classified as *inhibited/low positive* presented with more behavioural signs of autism compared to *active/negative reactive* or *well-regulated* infants. This is consistent with evidence that autism severity is negatively associated with temperamental sociability (Kamio, Takei, Stickley, Saito, & Nakagawa, 2018) and scores on the behavioural approach discriminant function identified by Garon et al. (2009). The precise nature of associations between temperament and autism features has yet to be elucidated. It may be that low sociability-related temperament traits (characteristic of the *inhibited/low positive* subgroup) increase vulnerability towards emergent autism symptoms (i.e., vulnerability association) or, alternatively, exist on the same continuum as autism such that autism represents an extreme variant of low temperamental sociability (i.e., spectrum association; see Chetcuti et al., 2019). Another possible explanation is that similarities in the behavioural expression and measurement of social interest/motivation deficits and temperament-related social reticence created a biased inflation of autism symptom ratings among *inhibited/low positive* infants. The presence of co-occurring social-emotional difficulties might also contribute to differences in autism severity, such that the heightened internalizing symptoms experienced by *inhibited/low positive* infants might exacerbate their autism-related difficulties (Duvekot, Ende, Verhulst, & Greaves-Lord, 2018). Conversely, autism-related difficulties might contribute to the development of internalizing symptoms over time (Pickard, Rijsdijk, Happé, & Mandy, 2017).

This study has several limitations. First, given the relatively modest sample size, replication across larger and phenotypically diverse samples is needed in order to evaluate the robustness of the three-subgroup solution. Second, temperament and social-emotional difficulties were both measured via parent-report; thus, the observed associations may be inflated through common-method variance. A related issue concerns conceptual overlap between temperament and internalizing/externalizing symptoms. Although the sample size precluded formal statistical testing

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of item-content, ITSEA items that were conceptually and semantically similar to IBQ-R items were removed to minimise measurement confounding. Moreover, previous studies have yielded significant associations after conceptual overlap was empirically determined through factor analysis (Lemery et al., 2002). Next, it is not possible to draw causal conclusions from the current cross-sectional results. While we conclude that temperament characteristics confer risk towards later social-emotional difficulties through evidence of concurrent associations, it is equally possible that social-emotional difficulties influence the expression of child temperament (see Shiner & Caspi, 2003). Finally, it remains unknown what proportion or which infants in our sample will go on to receive an autism diagnosis and/or other clinical diagnoses; nonetheless, comparison of AOSI characterisation data obtained here (see Table 3) and in familial 'at-risk' infants who went on to autism diagnostic outcome (Gammer et al., 2015) gives us encouragement that infants at elevated likelihood of autism diagnosis were successfully recruited. Future work should explore potential predictive relations between temperament patterns in infancy and clinical outcomes in childhood among large, well characterised, general-population samples.

The clinical implication of these findings is that inhibited*/low positive* and *active/negative reactive* infants with autism features might benefit most from interventions addressing social-emotional difficulties that target *specific* patterns of maladaptive temperamental responding. For example, INSIGHTS into Children's Temperament is a temperament-tailored intervention designed to equip caregivers with child management techniques that 'fit' a child's temperament type (McClowry, 2003), and more successfully reduces externalizing symptoms in children with normative development than a comparison program (McClowry, Snow, & Tamis Le-Monda, 2005). No such temperament-based interventions have been developed or trialled in the context of autism.

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Nonetheless, the apparent convergence of findings here with studies of normative development suggest a similar treatment approach might also be useful among children with autism features.

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Table 1. Comparison of Five LPA Models for Infant Temperament

# of subgroups	*n* for each subgroup	AIC	BIC	Adjusted BIC	LMRT *p*-value	BLRT *p*-value	Entropy
1	n_1=96	3775.87	3847.67	3759.26	-	-	-
2	n_1=20 n_2=76	3603.34	3713.61	3577.84	<.001	<.001	.95
3	n_1=22 n_2=23 n_3=51	3506.26	3654.99	3471.86	.056	<.001	.92
4	n_1=15 n_2=23 n_3=20 n_4=38	3474.53	3661.72	3431.23	.471	<.001	.90
5	n_1=19 n_2=10 n_3=15 n_4=42 n_5=10	3454.23	3679.88	3402.03	.293	<.001	.93

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; LMRT = Lo-Mendell-Rubin; BLRT = Bootstrapped Likelihood Ratio Test.

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Table 2. ANOVA Results Showing Mean IBQ-R Scale Scores for Infants in Each Temperament Subgroup

	Inhibited/ Low Positive	Active/Negative Reactive	Well-Regulated				BCa 95% CI		
IBQ-R Scale	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*F*	*p*	η^2	Contrast *a*	Contrast *b*	Contrast *c*
Activity	3.93 (0.70)	4.92 (0.65)	4.17 (0.61)	15.23	<.001	.25	**-1.38, -0.58**	**0.43, 1.04**	-0.1, 0.59
Smiling and Laughter	2.38 (0.66)	4.51 (0.71)	4.77 (0.80)	87.34	<.001	.66	**-2.52, -1.74**	-0.66, 0.04	**2.07, 2.79**
High Intensity Pleasure	4.62 (0.70)	5.59 (0.68)	6.08 (0.55)	41.92	<.001	.48	**-1.38, -0.56**	**-0.81, -0.17**	**1.13, 1.78**
Vocal Reactivity	2.63 (0.72)	4.1 (0.96)	4.09 (0.95)	22.09	<.001	.32	**-1.98, -0.97**	-0.47, 0.46	**1.05, 1.87**
Approach	3.75 (1.04)	5.11 (0.74)	5.36 (0.86)	25.95	<.001	.36	**-1.89, -0.82**	-0.63, 0.14	**1.11, 2.11**
Perceptual Sensitivity	2.98 (1.35)	3.74 (1.10)	3.89 (1.28)	3.88	.024	.08	**-**	-	**-**
Distress to Limitations	3.78 (1.01)	4.57 (0.75)	3.45 (0.92)	11.86	<.001	.20	**-1.35, -0.28**	**0.69, 1.52**	-0.82, 0.21
Fear	2.54 (0.87)	3.49 (0.93)	2.67 (0.86)	8.40	<.001	.15	**-1.43, -0.46**	**0.34, 1.23**	-0.29, 0.61
Sadness	3.48 (0.78)	4.39 (0.79)	3.15 (0.97)	14.82	<.001	.24	**-1.37, -0.46**	**0.81, 1.64**	-0.75, 0.14
Falling Reactivity	5.14 (0.96)	3.98 (0.8)	5.47 (0.55)	33.20	<.001	.42	**0.63, 1.69**	**-1.83, -1.14**	-0.07, 0.74
Duration of Orienting	2.75 (0.76)	3.28 (0.87)	3.3 (1.18)	2.27	.109	.05	**-**	-	**-**
Low Intensity Pleasure	3.95 (0.85)	4.18 (0.72)	5.03 (0.81)	18.46	<.001	.29	-0.69, 0.25	**-1.24, -0.50**	**0.70, 1.49**
Cuddliness	4.35 (0.79)	4.85 (0.73)	5.63 (0.71)	27.25	<.001	.37	**-0.99, -0.01**	**-1.13, -0.45**	**0.91, 1.70**

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Soothability	4.42 (0.77)	4.37 (0.48)	5.26 (0.5)	27.60	<.001	.38	-0.34, 0.42	**-1.14, -0.65**	**0.5, 1.20**

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Note. Contrast *a* = Inhibited/Low Positive vs. Active/Negative Reactive. Contrast *b* = Active/Negative Reactive vs. Well-Regulated. Contrast *c* = Well-Regulated vs. Inhibited/Low Positive. Bolded BCa 95% CIs do not span zero, signifying statistical significance. ITSEA = Infant-Toddler Social and Emotional Assessment. BCa = bias-corrected and accelerated. CI = confidence interval.

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Table 3. Sample and Temperament Subgroup Characteristics and Between-Subgroup Comparisons

	Full sample (*N* = 103)	Inhibited/Low Positive (*n* = 22)	Active/Negative Reactive (*n* = 23)	Well-Regulated (*n* = 51)	Between Subgroup Comparisons			BCa 95% CI		
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	χ^2/F	*p*	ϕ/η^2	Contrast *a*	Contrast *b*	Contrast *c*
Male (%)	70 (68)	17 (77.27)	17 (77.27)	31 (60.78)	2.44	.295	0.16	-	-	-
Age	12.39 (1.97)	12.13 (2.18)	12.61 (2.16)	12.39 (1.76)	0.34	.713	0.01	-	-	-
MSEL ELC	86.02 (16.76)	82.95 (20.44)	84.13 (12.66)	88.18 (13.73)	0.88	.418	0.02	-	-	-
AOSI Total[2]	8.90 (4.31)	10.91 (4.63)	7.30 (3.56)	7.45 (3.61)	7.73	.001	0.14	**1.38, 5.97**	-1.96, 1.63	**-5.93, -1.24**
ITSEA Int	0.38 (0.23)	0.45 (0.25)	0.50 (0.23)	0.28 (0.17)	7.04	.002	.17	-0.22, 0.12	**0.09, 0.34**	**-0.30, -0.02**
ITSEA Ext	0.32 (0.25)	0.33 (0.24)	0.42 (0.27)	0.27 (0.23)	7.16	.002	.18	-0.27, 0.01	**0.09, 0.34**	-0.18, 0.02

Note. Contrast *a* = Inhibited/Low Positive vs. Active/Negative Reactive. Contrast *b* = Active/Negative Reactive vs. Well-Regulated. Contrast *c* = Well-Regulated vs. Inhibited/Low Positive. Bolded BCa 95% CIs do not span zero, signifying statistical significance. MSEL = Mullen Scales of Early Learning. ELC =

[2] AOSI temperament items (Reactivity and Transitions) were removed from the computation of total scores counts prior to ANOVA

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Early Learning Composite. AOSI = Autism Observation Schedule for Infants. ITSEA = Infant-Toddler Social and Emotional Assessment. INT = Internalizing. EXT = Externalizing. BCa = bias-corrected and accelerated. CI = confidence interval.

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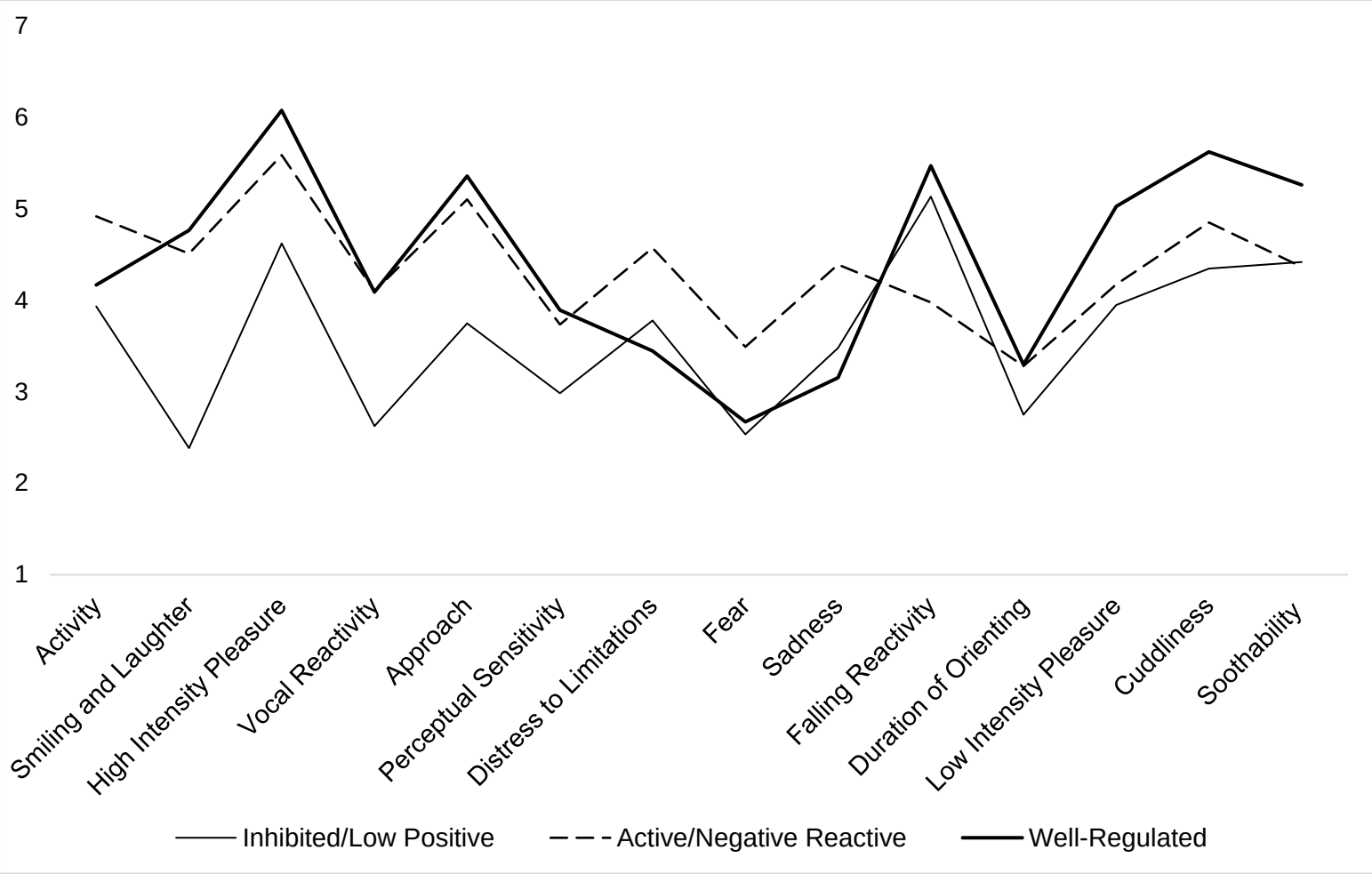
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Figure 1. Infant Behavior Questionnaire-Revised (IBQ-R) scale mean scores for each temperament subgroup.

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