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Early temperamental and psychophysiological precursors of adult psychopathic personality

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Abstract

Emerging research on psychopathy in children and adolescents raises the question of whether indicators, such as temperament or psychophysiology, exist very early in life in those with a psychopathic-like personality in adulthood. This study tests the hypothesis that individuals who are more psychopathic in adulthood would be less fearful and inhibited, and more stimulation seeking / sociable at age 3, and would also show reduced age 3 skin conductance responsivity. In a community sample of 335 3-year olds, behavioral measures of temperament were taken and electrodermal activity recorded in response to both orienting and aversive tones. Hare's Self-Report Psychopathy scale (SRP-II) was administered at follow-up at age 28. Individuals scoring higher on the measure were significantly less fearful and inhibited, more sociable, and displayed longer SC half-recovery times to aversive stimuli compared to controls at age 3. Contrary to predictions, they also showed *increased* autonomic arousal and skin conductance orienting. Findings appear to be the first to suggest that a prospective link may exist between temperament and psychophysiology in very young children, and psychopathic personality in adulthood.

Despite decades of research on adult psychopathy, very little is known about the early antecedents of this disorder. Recent research has begun to identify psychopathic personality in children and adolescents (Frick, O'Brien, Wooton, & McBurnett, 1994; Lynam, 1997), raising the question of whether precursors to psychopathy may exist very early in life. Adult psychopaths have been hypothesized as having unique temperaments and psychophysiological characteristics (Frick, 1998; Hare, 1978). A gap in the psychopathy literature is the lack of prospective, longitudinal studies examining early childhood factors in individuals who later demonstrate psychopathic personality in adulthood.

The personality of adult psychopaths is characterized by a lack of fear and inhibition, and a tendency toward stimulation seeking (Hare, 1998). However, there are multiple ways in which these characteristics may develop. One possibility is that a psychopathic way of life leads to the disinhibition, stimulation-seeking / sociability, and lack of fear observed in adult psychopaths. For example, after experiencing trauma or continuous psychosocial hardship in adolescence and early adulthood, these individuals might be less responsive to laboratory stressors. Another possibility is that individuals characterized as psychopaths in adulthood possess qualities of disinhibition, stimulation-seeking / sociability, and lack of fear very early in their lives (and prior to the onset of their antisocial lifestyle) and are thus predisposed to a psychopathic personality at a young age. A longitudinal study, examining the role of early temperament on prospective adult psychopathic personality would be necessary to help clarify whether these risk factors precede adult psychopathic personality.

In addition to this hypothesized temperamental style, adult psychopaths have also been characterized by lower psychophysiological arousal and hyporesponsivity to stimuli. An extensive meta-analysis by Lorber (2004) found psychopaths to have lower levels of electrodermal activity at rest. Psychopathy has also been

associated with reduced skin conductance (SC) orienting, reflecting reduced allocation of attentional resources to external stimuli (Dawson, Schell, & Filion, 1990). Both Hare (1968) and Blackburn (1979) have found reduced responding to orienting stimuli in psychopaths; however, some studies have failed to replicate this finding (Aniskiewicz, 1979; Raine & Venables, 1988). It remains unknown whether reduced arousal and orienting in adult psychopaths is a characteristic developed in adolescence or adulthood, or whether it may be present and influential in the first few years of life.

Longer SC half-recovery time is another psychophysiological characteristic that has been associated with psychopathy. Mednick (1977) cited three studies prior to 1977 which suggested longer recovery time in antisocial individuals. One review of studies conducted since 1977 reported seven studies finding significantly longer SC half-recovery times in both psychopaths and antisocial individuals, and one failing to find a significant association (Raine, 1993). Additionally, *shorter* SC half-recovery time has been identified as a possible protective factor, as antisocial adolescents who desisted from adult crime were found to have shorter SC half-recovery times than both life-course persistent criminals and controls (Raine, Venables, & Williams, 1996). Long SC half-recovery time has been interpreted by Venables (1975) as representing a closed stance to environmental stimuli, which would include cues of future punishment. Despite many studies in the adult literature, longer SC half-recovery time does not appear to have been examined as a potential developmental precursor of adult psychopathy.

In attempts to gain a developmental perspective, recent research has begun to examine whether the same mechanisms that underlie adult psychopathy may also be present in children and adolescents with psychopathic-like characteristics. Children with callous and unemotional traits similar to those seen in primary psychopaths have been found to demonstrate fearlessness (Frick, Lilienfeld, Ellis, Loney, & P., 1999) and a lack of behavioral inhibition (Frick et al., 2003). Several studies have found that juveniles with psychopathic traits demonstrate similar deficits observed in adult psychopaths including reduced responding to distressing stimuli (Kimonis, Frick, Fazekas, & Loney, 2006), difficulty recognizing sadness and fear (R. J. R. Blair, Colledge, Murray, & Mitchell, 2001), slower reaction times to negative words (Loney, Frick, Clements, Ellis, & Kerlin, 2003) and deficits in moral and emotional processing (R. J. R. Blair, 1997). In preschool-aged children, Fowles, Kochanska, & Murray (2000) showed that those characterized by fearless and uninhibited temperaments had reduced skin conductance responsivity. To our knowledge, only two studies thus far have examined the psychophysiological characteristics of specific psychopathic characteristics in juveniles. Blair (1999) found that 13 year-olds with psychopathic tendencies showed less skin conductance responding to distress cues and threatening stimuli. Moreover, Fung et al. (2005) found that 16 year-olds scoring high on the Child Psychopathy Scale (Lynam, 1997) showed reduced anticipatory skin conductance responding to white noise bursts. These studies suggest that psychophysiological differences may be linked to psychopathy in adolescents as well as adults, but no studies appear to have examined the psychophysiological characteristics of children who later develop a psychopathic personality.

The present longitudinal study involves a community sample in which psychophysiology and temperament are first measured at the relatively early age of three years, and psychopathic personality assessed 25 years later at age 28 years. It would be predicted that individuals who score higher in psychopathy in adulthood would be characterized as less fearful and inhibited, but higher on stimulation-seeking / sociability in early childhood. Furthermore, based on long-standing theoretical perspectives, these individuals would be predicted to have lower autonomic arousal, reduced orienting responses, reduced responding to aversive stimuli, and longer SC half-recovery time. If reduced psychophysiological activity similar to that found in adolescents and adults can be identified in early childhood, they would advance our understanding of the early developmental processes that predispose to adult psychopathy. Conversely, it is possible that the very early correlates of psychopathy are different to the pattern of findings observed later in life in adolescent and adult psychopaths, suggesting that our current understanding of the etiology of adult psychopathy might require some revision.

Method

Participants

The larger population from which the subjects were drawn consisted of 1,795 children from the island of Mauritius (a country lying in the Indian Ocean between Africa and India). All children born in 1969 in the two towns of Vacoas and Quatre Bornes were recruited into the study when aged 3 years between September 1972 and August 1973. The two towns were chosen to be representative of the ethnic distribution of the island. Informed consent was obtained from the mothers at age 3 and from the subjects at age 28.

From this birth cohort, a sample of 335 subjects completed a self-report measure of psychopathic personality at the age of 28. To assess the unbiased selection of this group, comparisons of the means of those tested and those not tested were conducted on measures of temperament (inhibition, t = -.761, p = .447, d = -.0228, fearfulness, t = -.649, p = .517, d = -.0401, stimulation seeking / sociability, t = .375, p = .708, d = .0226), psychophysiology (non-specific SCRs, t = -1.789, p = .074, d = -.113, heart rate, t = .479, p = .501, d = .0354, SC level left, t = -.891, p = .374, d = -.000271, SC level right, t = -.043, p =.966, d = -.0555, average orienting amplitude, t = .112, p = .911, d =.00652, average SC half-recovery time, t = .909, p = .087, d =.138, average amplitude to aversive stimuli, t = -.837, p = .300, d = .0466), socioeconomic status at age 3, t = -2.267, p = .023, d = -.147, social adversity at age 3, t = 1.901, p = .057, d =.116, and IQ at age 3. Only socioeconomic status was found to be significantly different (higher in the untested group than the tested group). This variable was consequently entered as a covariate to determine whether it influenced results. Details of the social adversity and IQ measures are found in Raine, Reynolds, Venables, & Mednick (2002).

Comparisons of gender and ethnicity revealed that the sample consisted of more males (60.6%) than females (39.4%), and consequently gender was included as a moderator in all analyses. Ethnic distribution was as follows: Indian 68.7%, Creole (African origin) 25.7%, and others (Chinese, English, French, and ethnically unidentified) 5.1%. Census data for the island as a whole indicated 66% Indian, 29% Creole, and 5% other, indicating that the study achieved its goal of sampling an ethnically representative population.

Age 28 Psychopathy Scale

Hare's (1985) Self-Report Psychopathy scale (SRP-II), administered at age 28, is a 60-item self-report version of the Psychopathy Checklist-Revised (PCL-R; Hare, 2003). The SRP-II has the advantage of a close theoretical association with the PCL-R and is designed to assess the same constructs. In a sample of 100 prison inmates, Hare (1991) found the SRP-II and the PCL-R correlate .54. Furthermore, it has been shown to be a valid measure of psychopathy in non-forensic, non-clinical populations (K. M. Williams & Paulhus, 2004). In a sample of 289 undergraduates, Williams and Pauhus (2004) found the SRP-II to correlate .77 with the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996), another well-validated self-report measure of psychopathy. Lilienfeld and Andrews (1996) found a .91 correlation between the PPI and the SRP-II. Zagon and Jackson (1994) found the SRP-II to correlate positively with narcissism, impulsivity and dishonesty, and negatively with anxiety and empathy. Williams and Paulhus (2004) reported that the SRP-II correlates with narcissism and Machiavellianism, and that it captures the interpersonally dark nature of psychopaths. They also showed that the SRP-II correlates with delinquency even in non-forensic samples such as undergraduates. Lilienfeld (1999) also showed that the SRP-II is significantly correlated with the MMPI-2 psychopathy deviate subscales. Salekin (2001) also showed that the SRP-II has a high discriminant validity from other personality disorders. Based on this research, the SRP-II appears to be comparable to other self-report measures of psychopathy.

Each item on the SRP-II is scored from 1 (strongly disagree) to 7 (strongly agree). High-scoring (n=56) and low-scoring (n=56) psychopathy groups were created using a cutoff of 1 SD above and below the mean on the Self-Report Psychopathy Scale. The mean and standard deviation of each group is as follows: High (M = 244.65, sd = 10.68), Low (M= 173.61, sd = 8.87). The mean for all 335 individuals was 207.62, sd = 23.71. To provide a reference for the scores, the mean SRP-II scores for a group of community psychopaths from the United States as defined by the PCL-R was 223.2, sd = 27.9 (Raine, 2006), which is lower than the mean for the high-scoring group in this study. The community psychopath grouping has been used in several previously

published studies (Ishikawa, Raine, Lencz, Bihrle, & Lacasse, 2001; Raine et al., 2004; Raine et al., 2003). In the present study, the high-scoring group was 68.5% male and 31.5% female. The low-scoring group was 46.4% male and 53.6% female. Coefficient α for the SRP-II was .85.

Temperament Measures

Inhibited/disinhibited temperament at age 3. A measure of general inhibited/disinhibited temperament was developed on this population by Scarpa, Raine, Venables, and Mednick (1995) and uses ratings based on the criteria described by Kagan and colleagues (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). Briefly, ratings of the child's behavior in the laboratory were made by a trained research assistant before and during psychophysiological testing on crying behavior (1 = no crying to 5 = cries uncontrollably) and sociability (1 = friendly, 2 = unresponsive), and by a trained psychologist before and during cognitive testing on crying (1 = no crying to 5 = cries uncontrollably), approach-avoidance (1 = independent exploration to 5 = clings to mother), verbalizations (1 = many spontaneous comments to 4 = extremely reluctant to speak), ease of relationship with tester (1 = immediately friendly to 4 = fearful), and social involvement with other children (1 = cooperative play and exchanges to 5 = solitary, away from others). All variables were scored in the direction of higher scores reflecting more inhibited behavior. An inhibition score was calculated by averaging the standard scores (i.e., z-scores) for these variables, which were chosen to reflect the measures of inhibition used by Kagan, Reznick, Clarke, Snidman, and Garcia-Coll (1984). Complete data at this age were available for 1,793 subjects. Item-total correlations ranged from 0.19 to 0.61 (mean = 0.43). Coefficient α for the scale was .72 (Scarpa et al., 1995). Only one rater was used to observe the behaviors of the children at age 3, so inter-rater reliability was unable to be assessed. The rater, however, was naïve with respect to any other variables assessed and to the research hypotheses, and thus provided an unbiased report of the behaviors.

Stimulation-seeking / sociability and fearfulness / reactivity at age 3. Two relatively independent factors have been shown to underlie a collection of 8 measures taken from the 3-year-old assessment battery, i.e. stimulation-seeking / sociability, and fearfulness / reactivity (see Raine, Reynolds, Venables, Mednick, & Farrington, 1998, for full psychometric details of these two measures). Briefly, four putative indices of stimulation-seeking / sociability were taken at age 3 years as follows: (1) The child's exploration away from the mother toward new toys was assessed in a laboratory room by a research assistant. Exploratory behavior was rated on a 4-point scale as follows: 1 = passive, clings to mother, withdrawn; 2 = shows interest, examines toys but stays close to mother; 3 = leaves mother, mild independent exploration, comes and goes to mother; 4 = active independent exploration. This behavior was rated on 4 occasions during the entire testing session (soon after arrival, before psychophysiological testing, between tests, after completion of tests). Scores for the 4 ratings were summed to obtain an overall index of exploration. (2) Extent of verbalizations to the research assistant during cognitive testing was rated on a 4-point scale (1 = very reluctant to speak; 4 = many spontaneous comments). (3) Friendliness with the research assistant during cognitive testing was rated on a 4-point scale (1 = fearful; 4 = immediately friendly). (4) Active social play with other children during free play in a sandbox was rated by a research assistant on a 5-point scale (1 = solitary; 3 = associates with others; 5 = cooperative relationship with role reciprocity). These four items intercorrelated from 0.25 to 0.68 (mean = 0.43). Item-total correlations for this scale ranged from 0.48 to 0.59 (mean = 0.53). Coefficient α for the scale was .75 (Raine et al., 1998).

Four putative indicators of fearfulness / reactivity were assessed by a research assistant during psychophysiological testing at age 3 years as follow: (1) crying behavior was assessed on a 5-point scale (1 = no crying; 5 = uncontrollable crying), (2) the child's fearful reaction was rated on a 4-point scale (1 = interested; 4 = very frightened), (3) unresponsiveness to the experimenter was rated on a 2-point scale (unresponsive versus friendly), (4) tremor (shaking with fear) was rated on a 4-point scale (1 = little activity; 4 = tremor). These four items intercorrelated from 0.48 to 0.72 (mean = 0.56). Item-total correlations ranged from 0.57 to 0.76 (mean = 0.68). Coefficient α for the scale was .84 (Raine et al., 1998). Scores for stimulation seeking / sociability and fearfulness / reactivity were calculated by averaging the standard scores (z-scores) for the respective variables.

Confirmatory factor analysis using LISREL 8 (Joreskog & Sorbom, 1993) established that stimulation-seeking / sociability and fearfulness / reactivity constitute relatively independent temperamental factors (see Raine et al., 1998, for full details). The two factors intercorrelated at a level of 0.04, and thus were largely orthogonal. Virtually identical findings were obtained for boys and girls and for Indians and Creoles (Raine et al., 1998).

Autonomic Measures

Resting levels at age 3. The electrocardiogram (ECG) was recorded using Beckman silver/silver chloride electrodes and Cambridge electrode gel. A Standard Lead I recording configuration was used, with ECG amplified using a Grass type 79 polygraph and a 7P5 preamplifier. Resting heart rate was recorded during a 1-minute rest period preceding the orienting paradigm (described in detail by Venables, 1978). Interbeat intervals were measured for the first artifact-free 10 beats in the rest period, and heart rate in beats per minute was calculated from the average of these 10 interbeat intervals.

Initial skin conductance levels and number of nonspecific skin conductance responses were measured for one minute prior to the onset of the first orienting tone (see below). SC was recorded from bipolar leads on the medial phalanges of the first and second fingers of the left hand using a constant voltage system (Venables & Christie, 1973). Beckman miniature Ag/AgCl type (4 mm in diameter) electrodes were filled with 0.5% KCl in 2% agar–agar as the electrolyte. The number of non-specific SC responses > 0.05 μS occurring during the one-minute rest was taken as an indicator of electrodermal arousal.

Responsivity to orienting and aversive stimuli. Full details of skin conductance measures and stimuli are given in Venables (1978). Subjects were presented with orienting stimuli consisting of six neutral pure tones of 75-dB intensity and one-second in duration followed by six aversive stimuli of 90-dB intensity and 4.5-seconds in duration. The stimuli were presented to the subject binaurally through headphones while the child was positioned on the mother's lap. The amplitude and SC half-recovery time of each response was recorded. Average SC half-recovery time to aversive stimuli was computed based on the averaged SC half-recovery times to the stimuli on which the subject gave a skin conductance response. SC half-recovery time to orienting stimuli could not be calculated due to the more substantial number of subjects failing to give orienting responses from which SC half-recovery could be calculated (Venables, 1978). Inter-stimulus intervals ranged from 30 to 45 seconds and all stimuli were of one second duration. Responses >0.05 μS occurring within a 1–3-second post-stimulus window were scored.

Statistical Analyses

T-test comparisons were two-tailed in all cases. Effect sizes reported are Cohen's *d* (Cohen, 1988). Effect sizes of 0.20 are deemed as "small," 0.50 as "medium," and 0.80 as "large" (Cohen, 1988). A 2 (higher/lower psychopathy group) x 6 (stimulus) repeated measures multivariate analysis of variance was used to test the group by stimulus interaction for orienting and aversive stimuli. Partial eta squared is the effect size used in analysis of variance tests and describes the proportion of variance accounted for. The ability of measures to independently predict group membership was assessed using logistic regression and the Wald χ^2 statistic with a classification cutoff of 0.5, and with the Nagelkerke statistic used for variance estimation. Temperament and autonomic variables were entered using a stepwise forward procedure (Wald χ^2) with an entry probability of .05 and a removal probability of .10.

The relationship between measures of temperament and psychophysiology for the full sample of 1,795 subjects at age 3 has been published previously (Scarpa, Raine, Venables, & Mednick, 1997). While some measures correlate to a limited extent, they also may make independent contributions to psychopathy and thus are evaluated and discussed independently.

Results

Temperament

Means and standard deviations of temperament and psychophysiology measures are listed in Table 1. Those scoring higher on the psychopathy measure relative to those scoring lower on the measure at age 28 were less inhibited at age 3, t = -2.424, df =109, p =.017, d =.46 (see figure 1). They were also less fearful at age 3, t = -2.103, df =109, p =.038, d =.40. The higher-scorers were non-significantly higher on stimulation-seeking / sociability, t = 1.633, d f=106, p =.106, d = .32. To explore this latter trend further, analyses were conducted on each of the four components of stimulation-seeking / sociability. The group scoring higher in psychopathy was significantly higher on three of the four components of stimulation-seeking / sociability, with significantly more verbalizations, t = 2.157, df =109, p =.033, d =.28, social involvement, t = 2.052, p =.043, df = 109 d =.41, and friendliness toward the experimenter, t =2.044, p =.043, df = 109, d =.39 , but did not significantly differ on the amount of exploration away from the mother, t =-.875, p =.384, df = 109, d =.17. As the three significant components seemed to be most closely related to the sociability aspect of the scale, these components were combined into a single index; the higher-scoring psychopathy group was found to be significantly more sociable at age 3, t = 2.22, p = .029, d = .436. It should be noted that this new sociability index has not been tested as an independent factor.

Table 1. T-test Comparisons between Higher- and Lower-Scoring Psychopathy Groups for Temperament and Psychophysiology Measures

	High psychopathy			Low psychopathy						
	M	*SD*	*n*	*M*	*SD*	*n*	*t*	*df*	*p*	*d*
Temperament										
Fearful	**-.089**	**.765**	**55**	**.267**	**1.00**	**56**	**-2.103**	**109**	**.038**	**.40**
Inhibition	**-.106**	**.643**	**55**	**.197**	**.673**	**56**	**-2.424**	**109**	**.017**	**.46**
Stim. seek.	.077	.584	52	-.116	.638	56	1.633	106	.106	.32
Verbal	**2.91**	**1.83**	**55**	**2.30**	**1.03**	**56**	**2.157**	**109**	**.033**	**.28**
Social	**2.76**	**2.00**	**55**	**2.14**	**1.05**	**56**	**2.052**	**109**	**.043**	**.22**
Friendly	**3.16**	**1.87**	**55**	**2.54**	**1.32**	**56**	**2.044**	**109**	**.043**	**.39**
Explore	1.78	.712	55	1.93	1.02	56	-.875	109	.384	.17
Arousal										
nSCR	**2.80**	**2.29**	**55**	**1.89**	**2.12**	**56**	**2.167**	**109**	**.032**	**.41**
Heart rate	124	16.0	55	126	18.1	51	-.676	104	.501	.12
SC level-L	2.46	1.84	55	2.35	1.85	50	.300	103	.765	.06
SC level-R	2.62	1.80	55	2.54	1.55	48	.237	101	.813	.05
Orienting										
Amp-Trial 1	**.137**	**.216**	**56**	**.067**	**.148**	**56**	**1.992**	**110**	**.049**	**.38**
Avg. amp.	.084	.128	56	.056	.084	56	1.335	110	.185	.26
Aversive										
Half-rec	**4.17**	**2.51**	**45**	**2.96**	**2.07**	**34**	**2.278**	**77**	**.025**	**.53**
Avg. amp.	.196	.213	47	.133	.182	51	1.556	96	.123	.48

Note. All correlations in boldface are statistically significant at $p < .05$, two-tailed.

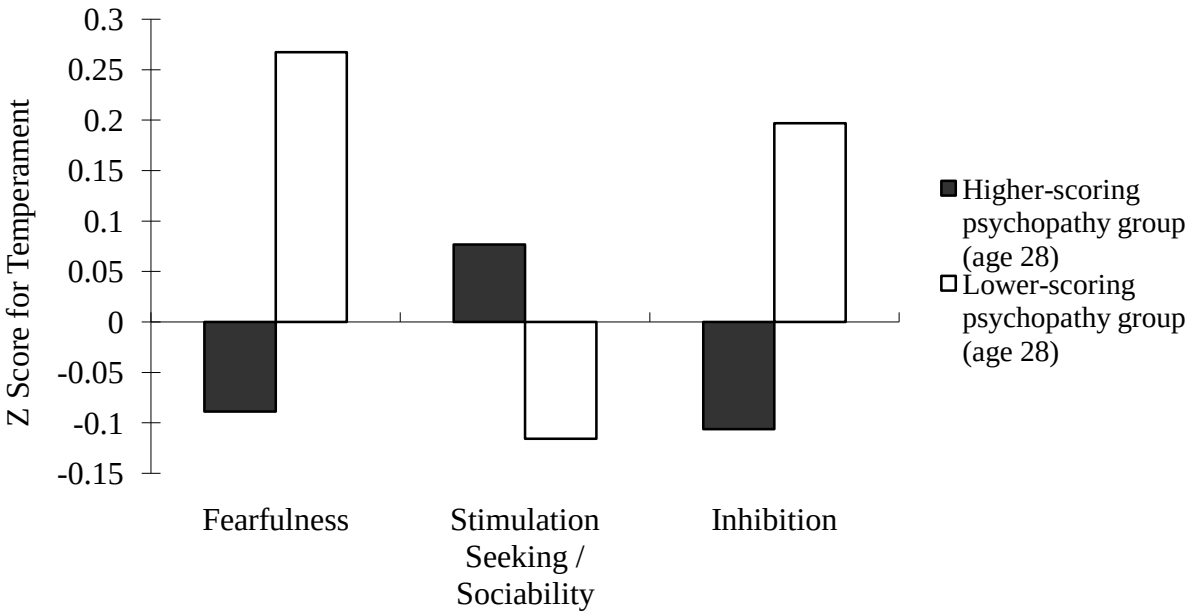

Figure 1. Mean z-scores for measures of fearfulness, stimulation-seeking / sociability, and inhibition at age 3 for the higher-scoring (n=53) and lower-scoring (n=53) psychopathy groups at age 28.

Autonomic

Arousal. During the rest period, the higher-scoring group gave more non-specific SCRs than the lower scorers, t = 2.167, df =109, p =.032, d =.41. The higher-scoring psychopathy group did not differ from the lower-scoring group on mean resting heart rate, t= -0.676, p=.501, df =104, or skin conductance levels in the left hand, t =.300, p =.765, df = 103, or right hand, t =.237, p = .813, df = 101.

Orienting stimuli. A repeated measures multivariate analysis of variance revealed a significant group x stimulus interaction (F = 2.569, p =.045, eta^2=.029, see Figure 2). Those scoring higher in psychopathy showed higher amplitudes on the first orienting trial, t_1 = 1.992, df =109, p =.05, d =.38, but comparisons were nonsignificant on subsequent trials, p>.207.

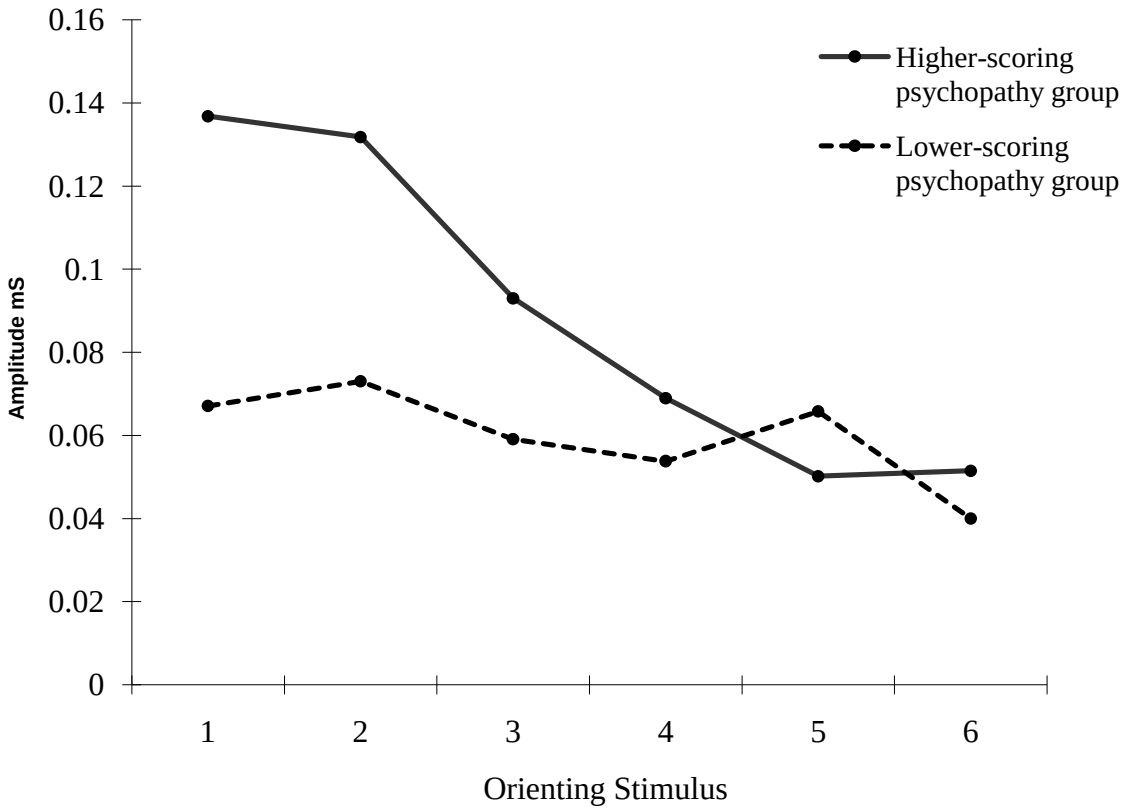

Figure 2. Age 3 mean amplitudes to the six orienting stimuli for the higher-scoring (n=53) and lower-scoring (n=53) psychopathy groups at age 28.

Aversive stimuli. The higher-scoring group showed longer average SC half-recovery time to the 90 db stimuli than the lower-scoring group, $t = 2.278$, $df = 104$, $p = .025$, $d = .53$. A 2 (higher/lower psychopathy group) x 6 (aversive stimulus) multivariate repeated measures analyses of amplitudes revealed no main effect of group ($F = .879$, $p = .475$) and no significant interaction between group and stimulus ($F = 2.303$, $p = .133$).

Correlations

Correlations for SRP-II scores and temperament and psychophysiology measures of the entire sample of 335 participants can be found in Table 2. Significant positive correlations were found for measures of amplitude to first orienting response, and half-recovery time to aversive stimuli. Significant negative correlations were found for measures of inhibition and fearfulness.

Table 2. Correlations between SRP-II scores and Measures of Temperament and Psychophysiology

	SRP-II		
	n	*r*	*p*
Temperament			
Inhibition	333	**-.123**	**.025**
Fearful	333	**-.125**	**.023**
Stim. seeking / sociable	333	.042	.453
Verbal	333	.106	.054
Social	333	.088	.108
Friendly	333	.102	.063
Explore	333	-.036	.515
Arousal			
Non-specific SCR	333	.064	.241
Heart rate	318	-.059	.292
SC level (left)	320	-.007	.895
SC level (right)	312	-.032	.569
Orienting			
Average amplitude	334	.084	.125
Amplitude to 1st response	334	**.128**	**.019**
Aversive			
Avgerage SC half-recovery	334	**.150**	**.021**
Average amplitude	332	.047	.387

Note. All correlations in boldface are statistically significant at $p < .05$, two-tailed.

Potential moderating effects

The comparisons of temperament and autonomic variables were repeated using gender and ethnicity as moderators. There was no significant interaction effect of gender with psychopathy grouping for temperament ($p>.298$) or psychophysiology ($p>.197$). There was also no interaction effect of ethnicity for temperament ($p>.126$) or psychophysiology ($p>.335$). Gender, ethnicity, socioeconomic status, social adversity, and IQ at age 3 were also entered as covariates but results remained significant (Table 3).

Table 3. Group Differences on Temperament and Psychophysiological Variables after Controlling for Demographic and Cognitive Factors

Covariates	Inhibition		Fear		nSCRs		Amp. 1st OR		Half-recovery	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*P*	*F*	*p*
Ethnicity	4.092	.046	3.951	.042	4.775	.031	3.967	.049	6.040	.016
Gender	5.752	.018	4.851	.030	4.727	.032	3.561	.042	3.481	.046
SES	6.431	.013	4.526	.036	4.892	.029	4.071	.046	5.516	.021
Adversity	6.646	.011	4.697	.032	4.985	.028	4.080	.046	7.036	.003
IQ total	12.04	.001	5.910	.017	9.007	.004	4.016	.047	3.640	.047
Verbal IQ	11.178	.001	5.483	.022	8.991	.004	3.770	.046	3.700	.044
Spatial IQ	6.896	.010	4.781	.032	10.018	.002	3.652	.049	3.945	.048

Independent predictors

The above results show that the high-scoring psychopathy group was characterized by low fearfulness, high sociability, increased non-specific skin conductance responses, higher amplitude to the first orienting response, and longer half-recovery time to aversive stimuli. Although inhibition was also significantly lower, it was not included due to the considerable overlap with fearfulness. To assess which of these measures independently predicted to group membership, each was entered on the second step of a logistic regression after entry of all other variables on the first step (see Table 4). Results indicated that non-specific skin conductance responses and sociability did not predict group membership over and above all other variables. Fearfulness and the amplitude of the first orienting response increased the percentage of variance explained, but were only marginally significant. Half-recovery time to aversive stimuli was a significant *independent* predictor of group membership. Taken together, the predictors accounted for 21% of the variance in group membership.

Table 4. Test of whether Temperament and Psychophysiological Variables Predict Group Membership

Predictors	Wald Chi-Square	p	% increase in variance	Beta weights*
Half-recovery time	5.819	.036	8.7 %	.261
Amplitude to 1st response	3.428	.064	5.0 %	2.493
Fearful	3.020	.082	4.4 %	-.577
Non-specific SCRs	.215	.643	0.3 %	.057
Sociability	.000	.988	0.0 %	-.004

**Beta weights for all variables entered on Step 2 of the Logistic Regression*

Discussion

This study aimed to explore the possible existence of very early temperamental and psychophysiological precursors of adult psychopathic personality. Individuals with higher psychopathy scores in adulthood were significantly less fearful and inhibited at age 3 than those with lower psychopathy scores as adults, and scored higher on the sociability component of the stimulation seeking measure. Similar to findings in adult psychopaths, the higher-scoring psychopathy group at age 3 had significantly longer SC half-recovery times to aversive stimuli. Contrary to predictions, however, the higher-scoring group demonstrated significantly *increased* arousal, as measured by more nonspecific SCRs, and *increased* amplitude (a two-fold increase) to orienting stimuli. Effect sizes were small to moderate in all cases, with values of 0.40 for fearfulness, and 0.46 for disinhibition, 0.44 for sociability, 0.41 for nonspecific SCRs, 0.38 for SC orienting, and .53 for SC half-recovery time. To the authors' knowledge, this is the first report demonstrating a prospective relationship between characteristics of preschool children and psychopathic-like personality in adulthood. These prospective longitudinal findings suggest that at least some biological and temperamental predispositions to psychopathic personality may be in place at a young age.

The more psychopathic adults were characterized as being noticeably less fearful and inhibited at age 3. Kochanska (1993) suggested that children's fearfulness contributes to the development of moral emotions such as guilt, shame, and empathy; children who are more fearful tend to feel remorse after wrongdoing, are concerned with consequences related to their actions, and are generally deterred from future wrongdoings by

feelings of discomfort compared to non-fearful children. This study provides initial prospective, longitudinal evidence that young children with low levels of fearfulness and inhibition are at risk for the subsequent development of a psychopathic personality in adulthood.

Stimulation-seeking / sociability, which is often thought to be linked to the antisocial behavior features of psychopathy, was nonsignificantly higher at age 3 in the higher-scoring psychopathy group at age 28 (p =.11, d =.32). Statistically-significant results were found for three of the four components of the measure: verbalizations, friendliness, and active social play. These three components seem to be most related to the sociability aspect of the measure, suggesting that being particularly sociable at an early age may be one component of developing a psychopathic-like personality later in life. Sociability in childhood may translate into traits such as glibness, superficial charm, conning, and manipulation observed in adult psychopaths. What remains unresolved is what other process morphs such positive early sociability into the deviant psychopathic features of glibness and conning.

Consistent with prior studies of psychopaths (Lorber, 2004; Raine, 1993), no differences were detected in heart rate or SCLs between the higher- and lower-scoring psychopathy groups. Contrary to predictions however, the higher-scoring group at age 28 demonstrated significantly *higher* arousal, as measured by nonspecific SCRs, and higher orienting amplitudes at age 3, two measures that tend to be closely associated (Crider, 1993). These findings are discrepant with the literature on antisocial and psychopathic behavior in adults. As these findings contradict the hypotheses, the authors can only speculate about possible interpretations and replication in future research is recommended. One potential explanation for these findings is that increased arousal and orienting may be a factor that distinguishes individuals in this community sample who have relatively higher levels of psychopathic traits from caught and convicted psychopaths. This sample may be similar to "successful" psychopaths (Ishikawa et al., 2001) who have been found to demonstrate *heightened* autonomic stress reactivity versus "unsuccessful" psychopaths who show reduced reactivity in comparison to controls (Ishikawa et al., 2001). High levels of arousal and orienting are thought to be indicative of more proficient attentional processing. Individuals at high risk for an antisocial outcome may be protected from adult antisocial behavior by increased arousal and orienting, or are better able to avoid detection (Raine, Venables, & Williams, 1995). It should be noted that no data are available to classify individuals in the higher-scoring group as truly "successful" psychopaths; the suggestion that these individuals may be similar to prior work on "successful" psychopaths as defined by Ishikawa et al. (2001) is based on the fact that they were living in the community and were not incarcerated, at the time of testing at age 28.

Increased SC orienting may also reflect better functioning of the prefrontal cortex, in contrast to deficits in prefrontal functioning sometimes seen in incarcerated psychopaths (LaPierre, Braun, & Hodgins, 1995; Mitchell, Colledge, Leonard, & Blair, 2002). Prior structural and functional brain imaging research has shown that SC orienting is related to both prefrontal structure (Raine, Reynolds, & Sheard, 1991) and frontal functioning (Hazlett, Dawson, Buchsbaum, & Nuechterlein, 1993; L. M. Williams et al., 2000). Good prefrontal functioning may contribute to some of the more adaptive features of psychopathy, such as glibness, superficial charm, lying / conning, and the ability to manipulate others (Hare, 2003). Yang et al. (2005) found that "successful" psychopaths do not show the reduction in prefrontal gray volume that "unsuccessful" psychopaths show. Furthermore, Ishikawa et al. (2001) showed that "successful" psychopaths have significantly *better* executive functioning than both "unsuccessful" psychopaths and controls. Increased orienting in the group scoring higher in psychopathy could potentially mean that these individuals lack the impairments in prefrontal functioning frequently observed in "unsuccessful," incarcerated psychopaths, and thus may be more skilled at deceiving and manipulating others to avoid negative consequences and detection. Further, the same pattern of orienting observed in this study (increased amplitude on the first but not subsequent orienting stimuli) has also been found in high sensation-seekers (Feij, Orlebeke, Gazendam, & Van Ziulen, 1985; Neary & Zuckerman, 1976; Robinson & Zahn, 1983), who have been found to be significantly more attentive to novel stimuli (Zuckerman, 1994). This heightened awareness of environmental cues may be beneficial, especially in situations involving impending punishment. However, additional research is needed to explore the possible causes and implications of increased arousal and orienting.

The finding of longer SC half-recovery time in children who score higher in psychopathy as adults is consistent with the hypothesized association between long SC half-recovery time and antisocial behavior (Venables, 1975). In animal studies, long SC half-recovery time has been associated with lesions in the amygdala (Pribram & McGuiness, 1975) a region thought to be compromised in psychopathic individuals (R. J. Blair, 2004; Patrick, 1994). The amygdala is important in processing cues of threat or harm, (LeDoux, 1995; Morris et al., 1996) and in fear conditioning (Davis, 2000; Knight, Nguyen, & Bandettini, 2005; Maren, 2001). Long half-recovery time has also recently been associated with low levels of harm avoidance (Mardaga, Laloyaux, & Hansenne, 2006), which is conceptualized as reflecting fearfulness of physical danger (Tellegen, 1982) and has been shown to be negatively correlated with psychopathy (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Levenson, Kiehl, & Fitzpatrick, 1995). In addition, individuals with low levels of harm avoidance demonstrated relatively little amygdala activity in response to irrelevant emotional distractors (Most, Chun, Johnson, & Kiehl, 2006). The finding of long SC half-recovery time at age 3 in adults scoring higher in psychopathy could therefore be an indicator of amygdala dysfunction at an early age resulting in a failure to learn to avoid harm or punishment. Future prospective longitudinal imaging studies could test this initial hypothesis.

An alternative position that should be considered is that SC half-recovery time is an artifact. Fowles (1993) has argued that long SC half-recovery time simply reflects reduced prior electrodermal activity, although Dawson, Schell, and Filion (2000) and Raine, et al. (1996) have argued that this issue remains unsettled. Venables and Fletcher (1981) argue that it is still worthwhile to measure SC half-recovery time as an independent variable as there is insufficient evidence to consider it redundant. If long-recovery time to aversive stimuli was a function of reduced prior electrodermal activity, one would predict reduced amplitudes to aversive stimuli in the higher-scorers. No such effects were observed, and indeed the higher-scoring psychopathy group demonstrated nonsignificantly *higher* amplitudes to the aversive stimuli. The correlation between the amplitude to aversive stimuli and half-recovery time was 0.162, $p = .013$. As such, while the counter-explanation of Fowles (1993) may ultimately be correct and would help resolve discrepant results in the current study, it cannot easily be invoked in the context of these specific findings.

The logistic regression indicated that 21% of the variance in psychopathy grouping could be explained by temperament and autonomic variables. Conversely, 79% of the variance remains unaccounted for. This clearly illustrates that temperament and autonomic functioning represent only two of the likely multiple early processes that shape psychopathic personality. In conjunction with other constructs, however, measures of temperament and psychophysiology may ultimately help elucidate the etiological basis to psychopathic personality. Half-recovery time was found to predict psychopathy group membership independent of all other predictors, suggesting that it is not confounded by other temperament and psychophysiological variables. A relationship between long half-recovery time and psychopathy has been found in all but one prior study and is surprisingly robust (Raine, 1993). There was also more limited evidence that fearfulness and amplitude of the first orienting response also independently contribute to the prediction of group membership, suggesting that they too may be factors in the development of psychopathy and are worthy of further investigation in longitudinal studies.

An alternative interpretation of the overall results of this study which should also be considered is that the expected precursors of adult psychopathy do not clearly exist as early as age 3. The strongest predictor of adult psychopathic traits is skin conductance half-recovery time; while this is a characteristic of adult psychopathic individuals (Hare et al., 1978), some have expressed reservations about the interpretation of this correlate (Fowles, 1993). The significant findings on orienting and arousal contradict some of the most consistent findings in adult psychopathy, while findings on SC levels were non-significant. In addition, temperament findings can be taken to indicate that the lower-scoring group was inhibited and fearful, rather than the higher-scoring group being fearless and disinhibited (see Figure 1). Budding psychopaths instead may simply be gregarious as children, inconsistent with the characterization of adult psychopaths as unfriendly. Alternatively, we believe from clinical experience (Cleckley, 1941) that psychopaths frequently present as superficially friendly and gregarious, not as unfriendly. The contradictory findings of high arousal and orienting would be consistent with prior findings on successful psychopaths (see above), or alternatively could be specific

to the self-report outcome measure of psychopathy which has limitations; findings more theoretically consistent with the adult literature could have emerged using an interview-based measure of psychopathy. Despite these alternative perspectives, results are the first of their kind and may truly represent important processes in the development of psychopathy; future prospective longitudinal research is required to replicate and extend these preliminary findings before firm conclusions can be drawn.

Several limitations of this study should be recognized. Findings do not inform us of the early antecedents of psychopathy in caught and convicted offenders; conclusions can only be applied at this point in time to community samples with psychopathic personality. While the self-report measure of psychopathy used correlates quite highly with the "gold standard" (PCL-R) measure of institutionalized psychopathy (Hare, 2003), those scoring higher on the psychopathy measure are not necessarily psychopaths but instead constitute individuals with a psychopathic personality. Results should be extended in future studies with a more objective measure of psychopathy. However, Hare's SRP-II appears to be a reasonably good correlate of psychopathy in noninstitutionalized populations (Forth, Brown, Hart, & Hare, 1996; Hare, 1991; Paulhus & Williams, 2002; Zagon & Jackson, 1994). A more stringent study with appropriate corrections for Type I error would also render several of the significant effects non-significant, but at the same time would run the risk of Type II errors and misleading null conclusions which are particularly serious in initial, preliminary studies. Finally, no other psychobiological or behavioral measures were taken at age 28, so we could not determine whether participants scoring high on the SRP-II display other factors often observed in psychopathy.

The prospective longitudinal design is thought to be a strength of the study in that it helps to begin the process of establishing the early developmental precursors of psychopathy, as opposed to the more common examination of the cross-sectional correlates of this condition. Furthermore, this study eliminates the problems associated with retrospective data and provides relatively unique psychophysiological knowledge of early autonomic functioning which can never be determined retrospectively.

In conclusion, the present study suggests that some indicators of adult psychopathic personality may originate and be observable very early in life. Individuals who were higher in psychopathy at age 28 were characterized by a less fearful and inhibited temperament at age 3, and were also more sociable. Psychophysiologically, they showed longer SC half-recovery times, similar to findings in adult psychopaths. However, contrary to previous SC findings in adult psychopaths, this group of community individuals showed increased autonomic arousal and electrodermal orienting. This raises the possibility that (1) high arousal and orienting may reflect increased attentional processing, which may serve to protect them from being caught and convicted, despite their psychopathic personality, and (2) increased arousal and orienting may reflect good prefrontal functioning which allows for the more adaptive features of psychopathy such as the ability to be smooth, engaging, and manipulative. Findings of this study must be treated as initial and provisional, but nevertheless could have implications for furthering our understanding of the development of psychopathy, a first step towards intervention and prevention.

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