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Parental Expressed Emotion and Psychophysiological Reactivity in Disturbed and Normal Children

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Increased spontaneous fluctuations in skin conductance (SC) in adult schizophrenics have been associated with high expressed emotion (EE) in their relatives. This is the first study in children where parental EE, parental psychopathology, and autonomic activity, indexed by SC levels and reactivity, have been assessed. The subjects were children and adolescents with disruptive behaviour disorders (DBD, $n = 35$), a psychiatric contrast group with obsessive-compulsive disorders (OCD, $n = 42$) and normal controls (NC, $n = 45$). Children living in homes with two high-EE parents had higher SC activity during rest period and slower adaptation to relaxation. Fathers' EE and maternal psychiatric diagnosis were related to higher SC activity, especially for the OCD group.

Over the past ten years, several studies have assessed the effects of relatives' expressed emotion (EE) – a measure of criticism and/or overinvolvement – on the psychophysiological reactions of adult schizophrenics. Because schizophrenic patients from high-EE homes have been found to relapse sooner than those from low-EE homes, it was hypothesised that the former might display more autonomic nervous system activity in the relative's presence. Tarrier *et al* (1979) measured the psychophysiological reactions of schizophrenics in remission and those of normal controls. The measure that best discriminated patients living with high-EE and low-EE relatives was the number of spontaneous fluctuations (SFs) in skin conductance (SC) per minute. While both groups were highly aroused when the relative was not present, when the low-EE relatives entered the room patients habituated rapidly and the SF rate was similar to that of control subjects, while when the high-EE relatives entered patients failed to habituate. Sturgeon *et al* (1984) replicated Tarrier's procedure with 30 acutely ill schizophrenic in-patients, also finding differences in SF rate between patients with low-EE and high-EE relatives when the relative was present but also when the relative was absent. A similar study by Tarrier *et al* (1988) found anew that SFs were elevated only in patients when talking with their high-EE relatives. In the latter study, however, another measure of sweat gland activity – skin conductance level – was significantly higher in patients with high-EE relatives throughout the entire session. Valone *et al* (1984) assessed skin conductance reactivity in non-psychotic but 'disturbed' adolescents and reported that both high-EE parents and their offspring had higher SC levels during confrontation than their low-EE counterparts. In addition, adolescents showed greater arousal when anticipating interactions with the high-EE parent.

The concept of expressed emotion is still controversial as to its definition and validity because its measurement is usually made at a time of stress, when the patient is newly admitted to hospital (Hatfield *et al*, 1987), and no studies have demonstrated its stability over time. Nevertheless, many investigators have found EE to be a predictor of relapse in schizophrenia (Brown *et al*, 1972; Vaughn & Leff, 1976; Kottgen *et al*, 1984; Moline *et al*, 1986; Parker & Johnson, 1987) and a predictor of poor outcome in depression (Vaughn & Leff, 1976; Hooley, 1986; Hooley *et al*, 1986), and bipolar illness (Miklowitz *et al*, 1986). Whatever the controversy, it is reasonable to suppose that emotionally vulnerable people have particularly low coping capacity when they are dealing with criticism and hostility from people on whom they depend. The psychophysiological studies support the idea that high-EE in a significant person in the patient's life is a chronic stress (Leff & Tarrier, 1981) which provokes autonomic nervous system arousal, especially when the high-EE relative is present or anticipated.

This study tests the generality of the effects of EE on autonomic activity outside the schizophrenia spectrum. To our knowledge, there has been no work on EE and autonomic nervous system activity in child psychiatric populations. Since one might suppose that living with high-EE parents would be a significant stress on children, we hypothesised that at least for some groups of children there would be a relationship between autonomic activity in the child and EE in the parents. As part of an ongoing study of biological and psychological predictors in children with psychiatric disorders, we measured parental EE status, parental

psychiatric disorders, which were found to be significantly related to parental EE status (Hibbs *et al*, 1991), and autonomic activity in three groups of children and adolescents: those with primary diagnoses of disruptive behaviour disorder (DBD) and obsessive–compulsive disorder (OCD), and in normal controls (NC). The children, who were not taking any prescribed drugs, were tested without a parent being present, in a protocol in which SC level was measured during a rest period, a series of innocuous, non-signal tones, and a reaction-time procedure. The 'target' variables of SF rate and SC level during rest, and the mild stress of task performance, were evaluated in an attempt to replicate partially the previous work in this area. For more exploratory purposes, we also evaluated the children's habituation to the novel situation and to a novel stimulus, and measured their SC responses to the non-signal tones and reaction-time stimuli, in order to estimate their sensitivity to various types of stimulation. Although these latter variables have not been assessed in previous studies on EE, they have been of value in research on a great variety of types of child and adult psychopathology (reviewed by Zahn, 1986), they are related to the target variables (Zahn *et al*, 1986), and might allow inferences about the effects of the independent variables on processes other than simple arousal.

Method

There were 35 children with a primary diagnosis of disruptive behaviour disorder (DBD) (33 boys, mean (s.d.) age 11.63 (3.22) years, 2 girls, mean (s.d.) age 16.45 (0.49) years); 42 children with a primary diagnosis of obsessive–compulsive disorder (OCD) (25 boys, mean (s.d.) age 13.57 (3.28) years, 17 girls, mean (s.d.) age 14.37 (2.07) years); and 24 children, screened to be free of psychiatric disorders, who served as a normal control (NC) group (16 boys, mean (s.d.) age 13.25 (2.88) years, 8 girls, mean (s.d.) age 15.81 (2.13) years). There was a total of 101 children (74 boys, 27 girls).

All children were examined using the Diagnostic Interview for Children and Adolescents (DICA) (Herjanic & Campbell, 1977; Welner *et al*, 1987). Parents were interviewed concerning the index child using the Diagnostic Interview for Parents (DICA-P) (Herjanic & Reich, 1982). A best estimate diagnosis was assigned to each child based on the DICA and DICA-P findings plus additional information derived from school, medical and therapist records. Information on recruitment and assessment of the children and their families is reported elsewhere (Leonard *et al*, 1989; Hibbs *et al*, 1991; Kruesi *et al*, 1989, 1990*a*, 1990*b*).

The children of the two psychiatrically ill groups were admitted as in-patients in the children's ward and were drug free for at least three weeks before admission to the programme. They were tested in the psychophysiology laboratory on the second or third day of their stay in the ward. The normal controls were admitted for two days and were tested in the laboratory on the second day. The parents had liberal access to and visits with the children on a daily basis.

Parents

The Five Minute Speech Sample (Magaña *et al*, 1986) was used to examine the expressed emotion in the parents of the three groups. This method had been validated by Magaña *et al* against the Camberwell Family Interview. Comparing the scores of three independent raters against a criterion rater resulted in three kappas of 0.70, 0.70 and 0.80.

The modified Schedule for Affective Disorders and Schizophrenia-Life (SADS-L) (Spitzer & Endicott, 1975; Gershon *et al*, 1982) was used to determine the diagnostic status of the parents for major psychiatric disorders, and the DSM–III (American Psychiatric Association, 1980) guidelines were used for the assessment of personality disorders. The scoring was done by the interviewer and a rater who was blind to proband status. They reached an agreement kappa (k) of 0.99 for the DBD group, $k=0.88$ for the OCD group and $k=0.98$ for the NC group, using the Mezzich *et al* (1981) assessment of agreement between two raters and multiple diagnoses. The composition of the parent group with respect to EE and diagnosis is presented in Table 1.

Table 1
Expressed emotion and psychiatric status of the parents of children with DBD, OCD and normal controls

	DBD				OCD				NC				Total			
	fathers		mothers		fathers		mothers		fathers		mothers		fathers		mothers	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
High EE	22	(81)	25	(74)	19	(46)	31	(74)	5	(24)	3	(13)	46	(52)	59	(59)
Low EE	5	(19)	7[1]	(21)	22	(54)	11	(26)	16	(76)	21	(87)	43	(48)	41	(41)
With psychiatric diagnosis	23	(85)	26	(76)	26	(63)	37	(88)	2	(10)	3	(13)	51	(57)	66	(66)
Without psychiatric diagnosis	4	(5)	8	(24)	15	(37)	5	(12)	19	(90)	21	(87)	38	(43)	34	(34)

1. Two additional mothers refused to talk, so their EE status could not be determined.

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Psychophysiological assessment

The general method is presented in more detail in Zahn *et al* (1986). Briefly, skin conductance (SC) was recorded from Ag/AgCl electrodes on the distal phalanges of the middle and ring fingers of the left hand via a constant voltage (0.5 V) circuit.

The procedure was designed to produce a range of activation levels. It consisted of a three-minute rest period, a series of ten 1000-Hz 80 dB non-signal tones lasting 1.5 seconds at 20–30-second intervals, and finally a simple warned reaction-time task. In this task, each trial began with a visual warning signal. The child then depressed a telegraph key for a foreperiod of 4 or 8 seconds before an 80-dB tone sounded. Subjects had been instructed to release the key as quickly as possible to the tone. An instruction and practice period was followed by the test proper in which nine trials with 4 second foreperiods and nine with 8 second foreperiods were given.

Physiological variables

For the rest period we assessed the SF rate per minute, where an SF is an SC response of at least 0.02 μ Siemens (μS) in amplitude, the mean amplitude of the SFs, mean SC level in μS, measured at one-minute intervals, the change (linear slope) in SC level across the period, and mean heart rate.

An SC orientating response to the non-signal tones was scored if it was at least 0.02 μS in amplitude and had a 0.8 to 4 second onset latency. The number of trials to a habituation criterion of two consecutive no-response trials was assessed as was the SC response magnitude (sum of all amplitudes divided by the number of stimuli) and amplitude (sum divided by the number of responses).

For the task instruction period, which typically is the period of maximum SC activity, we assessed the SF rate and amplitude and also their product, which is an index of the overall amount of SC activity and is analogous to a magnitude measure. In addition, we computed the mean heart rate, the maximum SC level reached, the difference between the maximum SC level and the minimum SC level in the preceding period, and the difference between the SF rates in the two periods. The latter two measures index the increase in tonic SC activity due to the demands imposed by the task.

Skin conductance responses elicited by the ready signal and tone stimulus in the reaction time were evaluated separately in terms of their frequency, amplitude and magnitude. The mean onset latency of the responses to the tone stimulus was also measured.

Statistical analyses

One way analyses of variance (ANOVA) on each autonomic variable in the children were carried out:

(a) for two-parent families comparing the effects of the number of high EE parents
(b) for all families comparing the effects of high EE v. low EE in mothers and fathers separately
(c) comparing the effects of a psychiatric diagnosis in mothers and in fathers separately.

ANOVAs were done for all children combined and for each diagnostic group separately.

Results

The autonomic variables showing significant effects of parental EE status for all three groups combined are shown in Table 2. It may be seen that the subjects living in families where both parents are of high-EE status had significantly greater SC activity during the rest period as manifested by more frequent and larger SFs and a slower decline in SC level indicating slower adaptation during that period. In addition, there was a trend for larger magnitude orientating responses and larger responses to the reaction-time stimuli, and these tended to have shorter latencies in children with two high-EE parents.

These effects, however, cannot be unequivocally attributed to EE differences because the frequency of high EE might be confounded with the child's diagnosis. Therefore, we compared the children's psychiatric groups separately. For

Table 2
Group means, standard deviations and significance tests of psychophysiological variables discriminating children ($n = 85$) with two low-EE, one high-EE, and two high-EE parents

Variables	ANOVA		Group A: two low-EE parents ($n = 21$)		Group B: one high-EE parent ($n = 34$)		Group C: two high-EE parents ($n = 30$)		*Post hoc* analysis difference between groups
	F	*P*	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)	
Rest									
SF rate	5.02	0.01	2.22	(2.77)	1.87	(1.71)	3.93	(3.46)	B<C[1]
SF amplitude	4.43	0.02	0.24	(0.20)	0.30	(0.30)	0.48	(0.40)	A<C
change in SC level	6.71	0.002	−0.38	(0.40)	−0.43	(0.46)	−0.02	(0.53)	A<C B<C
Orientating responses									
magnitude	2.73	0.08	0.58	(0.70)	0.30	(0.32)	0.55	(0.50)	NS
Reaction time to task: SC responses to time stimulus									
magnitude	3.71	0.05	0.45	(0.38)	0.38	(0.29)	0.59	(0.37)	B<C
amplitude	4.10	0.02	0.54	(0.40)	0.45	(0.30)	0.70	(0.40)	B<C
latency	2.46	0.09	1.44	(0.24)	1.43	(0.45)	1.26	(0.21)	NS

1. B<C indicates that group B was significantly lower than group C on the *post hoc* test.

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Table 3
Group means, standard deviations and significance tests discriminating psychophysiological reactivity in disruptive (DBD) and obsessive-compulsive (OCD) children with two low-EE, one high-EE, and two high-EE parents

	ANOVA		Group A: two low-EE parents ($n=8$)		Group B: one high-EE parent ($n=15$)		Group C: two high-EE parents ($n=17$)		*Post hoc* analysis difference between groups
	F	*P*	mean	(s.d.)	mean	(s.d.)	mean	(s.d.)	
OCD children ($n=40$)									
Rest									
SF rate	5.05	0.01	2.58	(2.48)	1.56	(1.53)	4.24	(3.27)	B<C[1]
SF amplitude	5.71	0.01	0.19	(0.09)	0.25	(0.02)	0.59	(0.39)	A<C B<C
Orientating responses									
magnitude	3.18	0.05	0.18	(0.20)	0.34	(0.31)	0.63	(0.61)	NS
Reaction-time task-response to time stimulus									
magnitude	2.77	0.07	0.28	(0.20)	0.34	(0.31)	0.58	(0.40)	NS
amplitude	2.95	0.07	0.38	(0.15)	0.39	(0.31)	0.66	(0.40)	NS
DBD children ($n=26$)[2]									
Rest: change in SC level	9.92	0.006			−0.42	(0.57)	0.21	(0.38)	

1. B<C indicates that group B was significantly lower than group C on the *post hoc* test.
2. For the DBD children, groups A and B were combined because of the small number of two low-EE parents (three children had 2 low-EE parents, eight had one high-EE parent). Group C ($n=15$).

the OCD group, similar results were obtained for the relationship between parental EE and resting SF activity, and there were statistical trends for SC responsivity to both non-signal and signal stimuli to be higher in those living with two high-EE parents (Table 2). For the DBD group, because there were only three children with two low-EE parents, we compared those with two high-EE parents to those with at least one low-EE parent. The decline in SC level during the rest period was smaller in the high-EE group. The number of high-EE parents in the NC group was too small for meaningful analyses.

Children of families with two high-EE parents exhibited higher SC baselines and responsivity than children with one high-EE parent or those with two low-EE parents who tended to be similar. These effects were most pronounced in OCD children.

Because a previous study (Hibbs *et al*, 1991) found that different factors affected the EE status of fathers and that of mothers, we examined the effects of EE in mothers and fathers separately.

Mother's EE

Only a few differences attributable to the EE in mothers were found. For all children, and also for just OCD children, high EE in the mother was related to a large SF amplitude in the rest period ($F=8.14$, $P=0.006$, and $F=4.83$, $P=0.035$ respectively). For the OCD group, high EE in mothers also tended to be related to large SC amplitudes to the ready signal in the reaction-time task ($F=2.97$, $P=0.094$).

For the DBD group, however, those with high-EE mothers had a lower SF rate in the instruction period ($F=5.46$, $P=0.026$) and a smaller increase in SFs in that period from that in the preceding period ($P=6.01$, $P=0.020$).

Father's EE

Much more widespread effects were found when we examined the relationships of the fathers' EE to the children's autonomic measures. For the total group of children, high EE in the father was associated with generally high resting SC activity, including a slower decline in SC level across the rest period, and more frequent, larger, and faster responses to the reaction-time tones.

The OCD children with high-EE fathers consistently showed significantly elevated baseline SC activity in the rest period and higher SC responsivity and slow habituation to the non-signal tones in the orientating period. Trends in the same direction were observed in the case of the reaction-time stimuli.

In contrast, the DBD children with high-EE fathers had trends for greater SF rate during the task instructions, both in absolute terms and in relation to the previous level, and were significantly more responsive to the reaction-time stimuli than DBD children with low-EE fathers.

It will be recalled that for several variables for the total group and for the OCD group, children with two high-EE parents stood out as different from those with no high-EE parents or one high-EE parent (Tables 2 and 3). Yet on the same variables, children with high-EE fathers were different from those without high-EE fathers while the presence of a high-EE mother did not have a significant effect. Careful examination of the data showed that these apparent conflicts are due to a combination of four factors:

(a) in the analysis by separate parents, the high-EE groups included subjects with two high-EE parents as well as those with just that single parent
(b) the two-parent analysis included only two-parent families while the one-parent analysis included single-parent families as well
(c) there were a larger number of families with just high-EE mothers than families with just high-EE fathers

(d) in some cases the subjects with just high-EE mothers had data somewhat closer to the low-EE end than those with just high-EE fathers.

The relative importance of these four factors differed for the various groups and variables.

Parental diagnosis

Because of the significant association of the presence of a psychiatric diagnosis with high EE, particularly in fathers (Hibbs *et al*, 1991), we examined this variable in order to see if the above results might possibly be secondary to it. For fathers this was definitely not the case. The presence or absence of psychopathology in the father did not affect any of the autonomic variables significantly for all the subjects or any subgroup.

For mothers, on the other hand, many variables showed an effect of diagnosis, mainly in the OCD group. All subjects whose mothers had a diagnosis had more SFs, and a trend towards a slower decline in the rest period. OCD children whose mothers had a psychiatric diagnosis showed a very general propensity to have significantly larger SC response amplitudes and magnitudes during all phases of the protocol. These results are in the same direction as those associated with mothers' EE, but they are of much wider scope in the OCD group.

In order to see if confounds of age and/or gender differences with parental EE or diagnosis differences might account for part of the effects of these variables, step-wise regression analyses, in which age and gender were forced into the model before it considered the other independent variables, were carried out on the individual groups and variables for which significant results for parental EE and diagnosis were obtained. The results of these showed that controlling for age and gender differences in this manner did not affect the positive results appreciably for either the OCD or DBD groups. The joint effects of the two control variables rarely exceeded 5% of the variance, and the significance levels obtained for the other variables were in every case similar to those obtained with the ANOVAs.

Discussion

This study supports the hypothesis that high EE in parents is related to elevated autonomic activity in their children as measured in a laboratory setting under conditions of minimal to moderate stress. The strongest and most widespread effects were obtained in families in which both parents were rated high EE and in families in which fathers were of high-EE status.

Although the effects were strongest for analyses of all subjects combined across diagnostic groups, this finding could be spurious because of the confounding of diagnosis with differences in proportion of high-EE parents and proportions of male and female children. Separate analyses by group revealed that the OCD children showed many significant effects of the EE of their parents, especially their fathers, independent of age and gender. The DBD group not only showed fewer effects but mothers' EE was inversely related to SF rate in the instructions. This suggests the possibility of a group difference in sensitivity to parental criticism, or a difference in nature of the EE in the high-EE parents in the OCD group compared to the DBD group. However, it could also be influenced by the more even balance in the proportion of high- and low-EE parents in the OCD group. The ability to detect a difference is probably lower in the DBD group because of the very high proportion of high-EE parents.

The effects of EE on OCD children were stronger in the non-demanding part of the protocol – the base levels during the rest period and the SC responses to non-signal tones – than during the task, although the latter differences were also in the direction of greater SC activity in children with high-EE parents. The results are consistent with those found in previous studies of EE (Tarrier *et al*, 1979, 1988; Sturgeon *et al*, 1984; Valone *et al*, 1984) in which SFs and/or SC level were higher in subjects from high-EE homes than those from low-EE homes. In those studies, SC activity was measured only during interactions with other persons. Although the present study does not constitute an exact replication of them, the specific variables affected are the same. It is possible, however, that in the present study the procedure was socially stressful at first to the children because of the novel environment of the laboratory and the interaction with newly introduced adults during the hookup and instructions.

Previous studies have not reported that EE in fathers had more influence on the SC activity of their offspring than EE in mothers. For some variables, this might have been due in part to a higher proportion of high-EE fathers than high-EE mothers being part of families with two high-EE parents. However, Valone *et al* (1984) reported higher SC levels in adolescents when discussing problems with their fathers than with their mothers. If this is true in OCD family interactions, then the effects of EE in fathers on SC activity might be more likely to generalise outside the interaction situation to the laboratory than that for the mothers.

That these results may have some clinical significance is uncertain. However, according to Tarrier *et al* (1979, 1988) and Sturgeon *et al* (1984) schizophrenics from high-EE homes have a poorer clinical course than those from low-EE homes. In addition, in a prospective follow-up study of an earlier sample of OCD children (Flament *et al*, 1990), poor outcome was successfully predicted by slow habituation of SC orientating responses (and non-significantly by high SF rate and SC level) recorded three to five years earlier. Also, Norton (1982) reported that disturbed adolescents with two high-EE parents had a higher risk for the development of schizophrenia spectrum

disorders than those with low-EE parents. Although causal relationships cannot be inferred from these studies, taken collectively they suggest that EE and SC activity are not only consistently inter-related but have a relationship to important clinical variables as well, at least as markers. It would be of interest to examine, in a future study, if altering EE would result in changes of autonomic activity and improvement of the clinical status of the probands.

DBD children did show some effects of the EE status of their parents, but those for EE in mothers were the opposite direction from the other results. Thus, these findings do not suggest a relationship of EE to general autonomic hyperactivity as was the case in the OCD group. The meaning of these results is not immediately apparent, but it is interesting that compared to control children, DBD children were lower in SF increase to the task instruction, but were hyper-responsive to the reaction-time stimuli and had a slower decline in SC level during the rest period (Zahn *et al*, submitted). If confirmed in future research, these data indicate that parental EE may be a significant determinant of group differences in psychophysiology involving DBD children.

A striking finding concerned the effects of the number of high-EE parents. Here, there was a sharp discontinuity between children with one and two high-EE parents; two low-EE parents and one high-EE parent were virtually indistinguishable. This suggests that having one low-EE parent may be protective against the untoward effects of high EE in the other. Alternatively, it might be that when one parent is high EE the other might be especially supportive either because of concern for the child or from some other family dynamic.

A very strong set of effects were those from the presence or absence of a psychiatric diagnosis in the mother on SC reactivity in the OCD children. An interesting aspect of these data is their specificity – all the effects are on SC response magnitudes and amplitudes (plus the increase in SC level during task instructions). The distinction between this set of findings and those for fathers' EE is paralleled by the results of a factor-analytic study in adults (Zahn *et al*, 1986) which found two SC factors: one loaded by SFs and SC level and the other by SC response amplitudes and a difference measure for SC level. Thus, there is independent evidence that the sets of variables affected by father's EE and mother's diagnosis in the OCD group cluster together in separate factors rather than being just a chance collection of results. The first set is interpretable in terms of the overworked and ambiguous concept of 'arousal'. For the second set it is not so clear, but it seems reasonable that large SC responses under a variety of conditions may reflect an unusually high sensitivity to stimuli in general. In contrast the 'arousal' factor may be determined more on the efferent side. However, the sensitivity hypothesis needs to be tested using other effector systems.

Additional evidence for the significance of large SC responses comes from two studies of subjects at genetic risk for schizophrenia in which large SC responses have been the major difference from controls. This was true in a group of non-schizophrenic monozygotic co-twins of schizophrenic probands (Zahn, 1975) and in adolescent offspring of schizophrenic mothers (Mednick & Schulsinger, 1968).

The absence of effects of parental diagnosis in the DBD group and for the fathers of the OCD children cannot easily be attributed to the imbalance of cell sizes (see Table 1). A possible reason for the specificity of the effects to mothers of OCD children is that they are more likely than parents of the other two groups to have a diagnosis in the anxiety–depression spectrum (Hibbs *et al*, 1991), which may be accompanied by high SC activity, and their children have acquired elevated SC responsivity through environmental or genetic transmission (Zahn, 1977; Hume, 1983).

In summary, one major set of results of this study was that OCD children with two high-EE parents and/or high-EE fathers had high resting SC activity. This is similar to results in studies on schizophrenia, and compatible with the hypothesis that living with high-EE parents is a 'chronic stress' (Leff & Tarrier, 1981), the effects of which continue beyond the presence of the high-EE relative. A second strong set of results was that OCD children whose mothers had a psychiatric diagnosis had unusually large SC responses under all conditions of the study. That there is a genetic contribution to these findings seems highly plausible, but given the gender specificity of the effective independent variables, the relative contributions of environmental and genetic factors cannot be easily disentangled.

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