

An experimental test of differential susceptibility to parenting among emotionally-dysregulated children in a randomized controlled trial for oppositional behavior

Stephen Scott¹ and Thomas G O'Connor²

¹King's College London, Institute of Psychiatry and National Academy for Parenting Research, London, UK; ²Wynne Center for Family Research, Department of Psychiatry, University of Rochester Medical Center, New York, NY, USA

Background: The concept of differential susceptibility has challenged the potential meaning of personal traits such as poor ability to regulate emotions. Under the traditional model of diathesis/stress, personal characteristics such as liability to angry outbursts are seen as essentially disadvantageous, emerging under duress in a way that is maladaptive. In contrast, with differential susceptibility, there is the same poorer functioning under adverse conditions but, under favorable conditions, individuals with the trait function *better* than those without it. To date, there have been limited studies on response under positive environments. We used the experimental power of an intervention trial to test the differential susceptibility hypothesis that children with emotional dysregulation would show greater response to an experimentally induced improvement in their parenting environment. **Methods:** Data were from the SPOKES trial (ISRCTN 77566446), a randomized controlled trial of 112 school children who were 5–6-years old, screened for elevated levels of oppositionality, randomized to parenting groups or control; 109 (97%) were followed-up a year later. Using DSM-IV oppositional-defiant symptoms, children were divided into an Emotionally-Dysregulated type (ED, $n = 68$) and a Headstrong type ($n = 44$). The parenting intervention was the Incredible Years program supplemented by positive strategies to use when reading with children. Assessment of conduct problems and parenting was by semistructured interviews. **Results:** At follow-up, parents of Emotionally-Dysregulated and Headstrong children allocated to the intervention showed significant improvements in their parenting strategies to an equal extent compared to parents in the control group. However, the Emotionally-Dysregulated children showed a significantly greater decrease in conduct problems between intervention and control groups (treatment effect-size 0.84 standard deviations) than the Headstrong (es 0.20 *SD*), $p = 0.04$. **Conclusions:** Using the power of a controlled experiment, this study showed that children who exhibited Emotionally-Dysregulated behavior pretreatment were more responsive to improvements in parental care that were experimentally induced. The findings extend prior work on differential sensitivity in suggesting that children exhibiting irascibility and emotionality may show greater susceptibility to the caregiving environment, and may identify a subset of children who respond better to existing treatments. **Keywords:** Emotional dysfunction, parenting, differential susceptibility, RCT.

Introduction

The notion that some individuals respond differently to the same stimulus or set of circumstances is not new. However, measuring and predicting how children might respond differently to defined aspects of the environment is a more recent enterprise. Thomas and Chess (1977) provided evidence that infants with an irritable temperament grew up to become children with somewhat increased levels of emotional and behavioral difficulties, and, importantly, that this tendency was exacerbated if the quality of parenting did not meet their needs, i.e., a 'goodness of fit' between parent and child temperament was lacking. The notion that children may have an innate tendency or diathesis that is only or mainly brought

out under certain stressful conditions has been repeatedly replicated for behavioral characteristics (e.g., 'difficult temperament'), and under the rubric of gene–environment interactions, for genetically transmitted traits (e.g., criminal tendencies, Bohman, 1996), and specific genotypes ('risk alleles' e.g., the MAOA gene, Foley, Eaves, Wormley, et al., 2004). Individuals who lack the vulnerability factor and do not succumb are then considered resilient (Cicchetti & Garmezy, 1993).

Recently, the diathesis/stress model has been challenged as being too limited. In both the physiological/medical domain and the psychological domain, it is hypothesized that it may be evolutionarily advantageous for some individuals to be more sensitive to their environment than others (Belsky & Pluess, 2009; Ellis & Boyce, 2011). To meet criteria for being differentially susceptible, individuals should do

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worse under adverse conditions *and* should function better under favorable conditions; it is this latter proposition that distinguishes the differentially susceptible model from a diathesis/stress model. With regard to physiological characteristics and illness outcomes, Boyce et al. (1995) found that in 3–5-year-old children, those with low cardiovascular or immune reactivity to stressors had approximately equal rates of respiratory illnesses in both low- and high-adversity settings. However, highly biologically reactive children exposed to high-adversity child-care settings or home environments had substantially higher illness rates, as might be expected under a diathesis/stress model; however, when such children were living in lower adversity conditions (i.e., more supportive child-care or family settings), they had the lowest illness rates of any children. As an example in the psychological domain, Bakermans-Kranenburg and van IJzendoorn (2006) showed that 3-year-old children carrying the 7-repeat dopamine receptor D4 (DRD4) allele displayed the most externalizing behavior when mothers were insensitive responders, but the least when mothers were judged highly sensitive.

While there are a number of examples of genotypes conferring differential susceptibility to environmental influences (reviewed in Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van Ijzendoorn, 2011), there have been rather few examples of behavioral traits or phenotypes that do this. However, in the diathesis/stress literature, there are many examples of traits that appear to moderate effects of early experiences. They are characterized, for example, by 'difficult temperament' in infants and toddlers (Thomas & Chess, 1977) – proneness to negative emotional expression, low adaptability, high activity, and poor emotional regulation. For example, Kochanska, Clark, and Goldman (1997) found that the quality of maternal discipline – gentle guidance versus forceful control – accounted for more variance in the self-control of infants and toddlers who scored high rather than low on fearfulness. In work testing the differential susceptibility hypothesis, Belsky, Hsieh, and Crnic (1998) observed that the ability of parenting to predict 3-year olds' externalizing problems and inhibited behavior was substantially greater for children who showed high levels of distress in the Strange Situation at 1 year than for those who did not.

Testing the hypothesis that emotional dysregulation might be relevant for oppositional/conduct problems by conferring differential susceptibility is worthwhile as oppositional/conduct problems are amongst the commonest, most impairing child and adolescent mental health problems and are associated with lower quality of the parenting environment (Moffitt & Scott, 2008). Oppositional/conduct problems have generally been seen as a vulnerability or risk factor for a range of poor outcomes. At home, the children's aggressive behavior evokes criticism and

impairs sibling and peer relationships, and at school, the children are typically disruptive and leave with no qualifications; by adulthood unemployment, criminality, and substance misuse are increased 5- to 10-fold (Fergusson, Horwood, & Ridder, 2005). Patterson (1982) and his colleagues successfully applied social learning theory to understand the development of oppositional/conduct problems in a manner that is consistent with the notion of adaptation to an ecological context. Their detailed observational studies were convincing in showing that children with oppositional/conduct problems had been brought up in families where their prosocial behavior was ignored, but their noncompliance and aggression was rewarded; as a result, these behaviors became learned habits that led to some instrumental gains in the short-term within the home, but were socially maladaptive in the wider community over the longer term. This mechanism explained how any child reared under those conditions could develop conduct problems; there was an implicit assumption that this learning process was broadly or generally applicable. Support for this is found in the observation that treatments based on reversing the adverse balance of parental contingencies are very successful in reducing conduct problems and continue to be one of the most successful interventions in child psychology (Kazdin, 2005; Scott, 2008).

With the rapid growth of behavioral-genetic studies in the 1990s, it was soon shown that there was a heritable element to oppositional/conduct problems and that this interacted with adverse parenting to increase symptoms in a diathesis/stress manner (reviewed in Dodge & Rutter, 2011). However, most of these behavior-genetic studies did not examine subtypes or seek to account for the sizable heterogeneity of oppositional/conduct symptoms when looking for diathesis/stress or gene-environment interactions. To become a valid taxon, subtype should show standard criteria of (1) phenomenological differences (the starting point for considering a distinct entity); (2) different independent correlates; (3) a different longitudinal course; and (4) different response to specific treatments. This study examines emotional dysregulation as a category using the fourth criterion, differential treatment response.

Emotional dysregulation manifesting as irritability has been the subject of increasing research interest in recent years. For example, Leibenluft and colleagues have been investigating a phenotype that they have named Severe Mood and Behavior Dysregulation (SMD). These children have abnormal baseline mood plus inappropriate reactivity to negative emotional stimuli at least three times weekly; the irritability is persistent, rather than occurring in clearly defined episodes (Leibenluft, 2011). These children also have ADHD-like symptoms (hyperactivity, distractibility, intrusiveness) and are more prone to emotional problems and disorders such as anxiety and depres-

sion, but not especially bipolar disorder; their relatives have an increased prevalence of mood disorders (Leibenluft, 2011). Individuals with this form of dysregulation have deficits in labeling emotions on faces, and different areas of brain activation during cognitive tasks, suggesting different neural activation patterns (Adleman et al., 2011).

The possibility that emotional dysregulation in the setting of oppositional/conduct problems may be associated with different independent correlates was investigated by Stringaris and Goodman (2009a). They studied 18,415 children and took the eight DSM IV oppositional-defiant symptoms. They created three dimensions on a priori grounds, based on their ODD item profile, the dimensions were *Irritable* (tempers; touchy; angry); *Hurtful* (spiteful, vindictive); *Headstrong* (argues; defies rules; annoys others; blames others). While all dimensions were cross-sectionally associated with Conduct Disorder (CD), they found that the other psychopathological associations differed. For the Irritable dimension, there was a marked increase in emotional symptoms and disorders; for the Hurtful dimension, the aggressive symptoms of CD were raised; for the Headstrong dimension, symptoms of Attention Deficit Hyperactivity Disorder (ADHD) were raised, as well as the nonaggressive symptoms of CD. The authors suggested that the three dimensions may reflect heterogeneity in etiology, pathophysiological mechanisms, prognosis, and treatment choice. In a subsequent article (Stringaris & Goodman, 2009b), they took the 23% highest scorers from one survey and showed that 3 years later, the Irritable type was more predictive of depression and anxiety, the Hurtful of conduct disorder, especially aggressive symptoms, and the Headstrong of ADHD and conduct disorder.

The Irritable and Hurtful types each display manifestations of emotional dysregulation: the Irritable type in terms of anger control and the Hurtful in terms of empathy. The longitudinal pathological associations of each type also support the notion of disturbed emotional regulation, with the Irritable type showing increased mood symptoms and the Hurtful type showing increased physical aggression. Together, these two subtypes exhibit characteristics of a broader emotionally-dysregulated phenotype that are absent in the Headstrong subtype, which is more characterized by stubbornness and refusal to comply. In this study (see below), we were unable to replicate the three groups identified by Stringaris and Goodman because the Hurtful subtype was formed from only one question in this study; we took the view that this was insufficient to make a valid subtype, so decided to merge it with one of the other two larger groupings.

Most reports assessing differential sensitivity have used cross-sectional or longitudinal observational methods, which carry the risk that findings are due to unmeasured confounders such as gene-environment correlation rather than true differential susceptibility. The advantage of a randomized design is that the

different environment is experimentally controlled, and consistent with differential susceptibility theory, it should examine a positive environmental influence (e.g., a parenting program that leads to an increase in positive care) and compare it with a negative one. A rare example of using this design is the study of Cassidy, Woodhouse, Sherman, Stupica, and Lejuez (2011), which showed that infants with negative reactivity benefitted most in terms of attachment security from a parenting intervention. Second, it is important to measure the purported environmental factor using good quality indicators. The review by McGuffin, Alsabban, and Uher (2011) found that using short questionnaires alone failed to find a genetic influence of the serotonin transporter gene on susceptibility to adversity, whereas semistructured interviews did detect an effect. In this study, we wished to address both these points, by experimentally manipulating the parenting environment in a positive way and by using good-quality semistructured interview measures.

Aim

The aim of this study was to evaluate whether children whose oppositional/conduct problems were predominantly of an emotionally-dysregulated type would be more sensitive to the positive effects of a parenting program than those without such a symptom profile.

Methods

Design Secondary analysis of a Randomized Controlled Trial.

Screen Originally, 936 children in reception and year-one classes (kindergarten) in schools in a disadvantaged area of London were screened: their teachers and parents were asked to complete the conduct problems scale of the Strengths and Difficulties Questionnaire (Goodman, 2001) and the eight DSM IV oppositional-defiant disorder. The cutoff was one standard deviation above the population mean for 5–6-year olds. A total of 41% of the population was above the cutoff, typical for a deprived area. Parents of 112 children above the cutoff were available and willing to take part in the trial; they were randomized individually to the intervention ($n = 61$) or control group ($n = 51$).

Sample These were the 112 children who were 4–6 years old, who took part in the SPOKES trial, fully described in Scott et al. (2010). Table 1 shows that the sample was notably disadvantaged.

Measures

Measures were taken before randomization, and 1 year later when 109/112 families were successfully followed up. Researchers were blind to treatment allocation.

Participant characteristics An interview covered family structure and income, housing type, ethnicity,

Table 1 Characteristics of children by intervention group

	Parenting groups (n = 61)	Helpline Controls (n = 51)	Mean values for England
Child age in years (mean, <i>SD</i>)	5.18 (0.30)	5.24 (0.31)	–
Child male	41 (68%)	38 (73%)	51% [□]
Child in ethnic minority	24 (33%)	18 (35%)	9% [□]
Single parent	35 (56%)	24 (48%)	22% [□]
Public housing	32 (53%)	22 (42%)	17% [□]
Household income < £175 (\$ 280) per week	24 (40%)	18 (34%)	5% [□]
Child conduct problem score (PACS interview; mean, <i>SD</i>)	1.12 (0.44)	1.15 (0.49)	0.8 (0.4) ⁺

[□] data from *Social Trends* London: ONS, 2000

⁺ data from Taylor et al. 1991.

and parental education; the General Health Questionnaire 12 (GHQ) covered maternal psychiatric symptoms (Goldberg, Gater, Sartorius, et al., 1997).

Child antisocial behavior The Parent Account of Child Symptoms (PACS; Taylor, Schachar, Thorley, & Wieselberg, 1986) is a standard investigator-based interview similar to, but shorter than the Child and Adolescent Psychiatric Assessment (Angold, Prendergast, Cox, et al., 1995), and has been used in several major studies (e.g. Taylor, Chadwick, Heptinstall, & Danckaerts, 1996). Eight conduct problems (lying, stealing, tantrums, rudeness, disobedience, refusal to go to bed, destructiveness, aggressiveness) were scored 0–3 in the last month for both severity and frequency and the mean calculated (range 0–3); ICC was 0.89.

Parenting Interview We used a semistructured interview that has shown discriminant validity between parents whose children were hyperactive & controls (Woodward, Dowdney, & Taylor, 1997), and concurrent validity when compared to direct observation (Dowdney, Mrazek, Quinton, & Rutter, 1984). The version used had six scales, each with five rating points; for this study we focus on three scales, Play, Praise, and Harsh Discipline. The parent gives detailed recent examples, then after further questioning the investigator makes a rating covering the previous month. Reliability between the three interviewers was calculated on 30 interviews after 2 months of training on pilot study cases; intra-class correlations ranged from 0.62 to 0.77.

Expressed emotion (EE) this is a measure of emotions expressed towards the child throughout the interview. It was rated on a 5-point scale using Camberwell Family Interview criteria (Vaughn, 1989); for warmth the ICC was 0.76, for criticism 0.73.

Interventions and effects

The intervention was the 12-week 'Incredible Years' (IY; Webster-Stratton & Reid, 2003) school age program. The content covers promotion of desirable child behavior and on-task attending through play, praise, and rewards, handling misbehavior, applying consequences, and time out. This was followed by a child literacy program (Sylva, Scott, Totsika, Ereky-Stevens, & Crook, 2008), which had a similar process to the IY program. Control parents were offered a telephone helpline.

The median attendance at parenting groups was 15/28 sessions. Children allocated to the intervention arm showed a reduction of 0.52 *SD* in conduct problems on

the PACS interview compared with controls. Parent interviews revealed that compared with controls, intervention parents were warmer, less critical, used more play, praise, and less harsh discipline (spanking and prolonged exclusion) at follow up.

Construction of Emotional Dysregulation subtypes

Following Stringaris and Goodman (2009a), three subtypes were constructed based on the eight DSM IV oppositional-defiant disorder items, which had been rated by the parent as part of the screen. We took the mean score for the items in each of the three dimensions and allocated the child to a subtype group according to which was highest for that individual, the dimensions being *Irritable* (mean of three items: loses temper; touchy or easily annoyed by others; angry and resentful); *Hurtful* (one item, spiteful or vindictive); *Headstrong* (mean of four items: argues with adults; actively defies or refuses to comply with adults' requests; deliberately does things that annoy other people; blames others for his/her mistakes or misbehavior). Tied scores were coded according to the presence of dysregulation: if there was a zero score on all three dimensions, they were coded as not dysregulated, because of our a priori interest in the presence of emotional dysregulation (three cases), whereas if there was a positive score on either of the dysregulated dimensions (*Irritable*, five cases; *Hurtful* four cases) which tied with the not-dysregulated one (*Headstrong*), they were put in the relevant dysregulated group. This procedure gave *n* = 44 *Headstrong* subtype cases, *n* = 60 *Irritable* subtype cases, and *n* = 8 *Hurtful* subtype cases. Because the *Hurtful* subtype group was based on only one item and had too few cases (*n* = 8) to be analyzable alone, the *Irritable* and *Hurtful* subtypes were then combined to give *n* = 68 Emotionally-Dysregulated cases.

We chose to put the *Hurtful* subtype in the Emotionally-Dysregulated category because the notion of hurtfulness seems similar to that of callous-unemotional traits, where there is strong evidence that children with CU traits are poor at regulating their emotions, for example behaving more negatively in Time Out (Haas et al., 2011) and committing more violent acts (Pardini & Fite, 2010). Underlying their increased tendency to violent outbursts are deficits in response modulation, formulated by Blair (2010) as deficits in the Integrated Emotion Systems, for which there are demonstrable neurocognitive substrates, for example in reduced amygdala and ventromedial prefrontal cortex functioning (Blair, 2010). Supporting our decision

taken on *a priori* grounds to put Hurtful in with the Emotionally-Dysregulated category, the empirical factor analytic study of oppositional defiant disorder symptoms by Burke, Hipwell, and Loeber (2010) found in a large sample that the spiteful/vindictive (Hurtful) item loaded with emotional dysregulation items (touchy, angry) but not defiance, forming a factor that predicted independently assessed emotional disorder symptoms. However, there is a lack of consistency in where the spiteful/vindictive item segregates, thus Rowe, Costello, Angold, Copeland, and Maughan (2010) found it loaded with a Headstrong factor.

Statistical analysis

We first present descriptive statistics on the sample and descriptive data on the Emotionally-Dysregulated and Headstrong subtypes. We then present cross-sectional evidence prior to treatment, suggesting that emotional dysregulation may be an index of differential susceptibility/sensitivity. Next, we examined whether treatment changes in parenting were similar for the Emotionally-Dysregulated and Headstrong subtypes. In this analysis, we use a regression model and include baseline parenting, child sex, child age, and family income as covariates; treatment, Emotionally-Dysregulated subtype, and the treatment X Emotionally-Dysregulated subtype interaction were included as predictor variables. Finally, we use a regression model to test the hypothesis that oppositional children in the Emotionally-Dysregulated subtype show greater response to treatment than oppositional children classified as Headstrong; for this analysis, baseline conduct problems and child sex, age, and family income are included as covariates and treatment, Emotionally-Dysregulated subtype, and the treatment X Emotionally-Dysregulated subtype interaction were included as predictor variables. All analyses were on an intention-to-treat basis, using the statistical package SPSS 20 (IBM Corporation, 2011).

Results

Preliminary analyses

Descriptive data of the families in the intervention and control groups are provided in Table 1. The data confirm the high psychosocial disadvantage of the sample. Characteristics of the Emotionally-Dysregulated and Headstrong children are shown in Table 2. There were no significant differences between the Emotionally-Dysregulated and Headstrong children on any of the sociodemographic measures, total number of conduct problems (although they did differ significantly on specific symptoms of conduct problems as expected due to subtype construction), or parenting style measures; in addition, there was no association between the Emotionally-Dysregulated versus Headstrong categorization and treatment exposure, either in terms of treatment allocation ($\chi^2(1) = .16$, ns) or percent of sessions attended ($F(1,59) = 3.09$, ns).

Table 2 Characteristics of children and their families according to Emotional Dysregulation typology[§]

	Emotionally-Dysregulated Children (<i>n</i> = 68)	Headstrong Children (<i>n</i> = 44)
Demographics		
Child age in years (mean, <i>SD</i>)	5.2 (0.29)	5.2 (0.31)
Child male	51 (75%)	28 (64%)
Child in ethnic minority	25 (37%)	17 (39%)
Single parent	39 (58%)	21 (44%)
Public housing	35 (52%)	18 (41%)
Household income <£175 (\$280) weekly	28 (41%)	18 (26%)
DSM IV items means scores (<i>SD</i>)		
Loses temper; touchy; angry	1.45 (.63)	1.03 (.64)***
Spiteful and vindictive	0.59 (.73)	0.23 (.48)**
argues; defiant; annoys; blames	1.15 (.64)	1.47 (.71)*
Child conduct problems (PACS interview; mean, <i>SD</i>)	1.14 (0.51)	1.15 (0.36)
Parenting		
GHQ score of mother (mean, <i>SD</i>)	12.6 (6.1)	11.3 (4.6)
Expressed Emotion – Warmth	2.0 (.77)	1.9 (.70)
Expressed Emotion – Criticism	1.2 (.63)	1.1 (.69)
Play	5.46 (4.34)	4.97 (4.16)
Praise	1.90 (.95)	1.95 (1.06)
Harsh discipline	1.04 (1.60)	.68 (1.13)

§ none of the differences is statistically significant, except for the DSM IV items, where * $p \leq .02$, ** $p \leq .005$ *** $p < .0001$. GHQ = General Health Questionnaire. Expressed Emotion and parenting were assessed by semistructured interview.

Cross-sectional evidence suggesting Emotional Dysregulation indicates greater susceptibility

If the Emotionally-Dysregulated/Headstrong distinction indexes susceptibility to caregiving influence, then it would follow that the associations between both positive and negative parenting behaviors and conduct problems would be greater among Emotionally-Dysregulated children. Analyses from time one (pre-treatment) are generally consistent with this expectation (Table 3). Although none of the corresponding

Table 3 Correlations between Parenting and Conduct Problems According to Emotionally-Dysregulated typology

	Emotionally-Dysregulated	Headstrong
GHQ	.38**	.18
EE warmth	-.36**	.18
EE criticism	.49***	.37*
Play	-.24*	.07
Praise	-.18	.04
Harshness	.18	.02

Note: EE = Expressed Emotion; it and the parenting measures was assessed by semistructured interview; GHQ = General Health Questionnaire. Conduct problems were assessed with the PACS semistructured clinical interview.

* $p < .05$; ** $p < .01$; *** $p < .001$.

pairs of correlations are significantly different at $p < .05$ (using the Fisher r to z transformation; but for play, $z = 1.58$, 1-tailed t -test, $p = .057$), the pattern is for the Emotionally-Dysregulated children to show greater sensitivity both to positive and negative dimensions of parenting, as indexed by the magnitude of association between positive and negative parenting and severity of conduct symptoms. Interestingly, the greater sensitivity to the environment is also observed with parental distress, as measured by the GHQ.

Emotion dysregulation as a moderator of treatment response

Regression analyses indicated a significant effect of treatment on each of the parenting measures included in Table 4 after controlling for baseline parenting, child age, child sex, income, and the Emotionally-Dysregulated subtype; treatment main effects were (B coefficient [standard error]), for warmth on the Expressed Emotion, $B = .52$ [.14], $p < .001$; for criticism on the Expressed Emotion, $B = .31$ [.10], $p < .01$; for play from the parental interview, $B = .26$ [.08], $p < .01$; for praise from the parental interview, $B = .39$ [.11], $p < .001$; for harsh parenting from the parental interview, $B = .34$ [.09], $p < .001$. However, despite these pervasive treatment effects on parenting, there was no evidence that the treatment effect on parenting varied according to Emotionally-Dysregulated/Headstrong subtype. The far-right column of Table 4 provides the F ratios (and degrees of freedom and p values) for the treatment X Emotionally-Dysregulated subtype interactions for the five parenting variables; none is significant at $p < .05$ (Table 4). The implication is that the intervention was equally effective at changing parents of

emotionally-dysregulated and nonemotionally dys-regulated children. This is an important nonfinding because it eliminates differential change in parenting by subtype as a confounder for the treatment X Emotionally-Dysregulated subtype interaction for conduct problems, which we discuss next.

The hypothesis that Emotional Dysregulation moderated the impact of treatment on conduct problems was tested using a regression model. Results are shown in Table 5. Model 1 shows that the initial level of conduct problems is the strongest predictor of conduct problems at follow-up and that the treatment was effective in changing final conduct problem level in the intervention group after accounting for covariates; ED type is not a predictor the level of conduct problems at follow-up. Results from Model 2 indicate that the treatment effect was moderated by Emotional Dysregulation (for the interaction: $B = -.29$ [.14], $p < .05$). The interaction indicated that the treatment effect was significantly stronger in the Emotionally-Dysregulated than Headstrong groups. This differential effect of treatment compared with controls for the Emotionally-Dysregulated versus the Headstrong subtypes of children is illustrated in Figure 1: there was a non-significant effect for treatment in the Headstrong subset compared to controls ($B = -.09$, ns; effect size $d = 0.20$), but a significant treatment effect for the Emotionally-Dysregulated subset ($B = -.37$, $p < .0001$; effect size $d = 0.82$).

Supplementary analyses

To check whether the Irritable subtype alone was as susceptible to treatment as the combined Irritable and Hurtful subtypes that we had merged into the

Table 4 Parenting and child conduct problem scores before intervention and at follow-up, in Emotionally-Dysregulated (ED) and Headstrong oppositional types

Parenting Measure		Intervention		Control		Treatment test*	Treatment X ED*
		Before	FU	Before	FU		
EE warmth	ED	1.85 (.82)	2.15 (.62)	2.18 (.67)	1.92 (.74)	$F(1,80) = 13.17$ $p = .001$	$F(1,79) = .51$ $p = .48$
	Headstrong	1.91 (.75)	2.13 (.62)	1.87 (.64)	1.76 (.83)		
EE Criticism	ED	1.26 (.67)	.79 (.55)	1.14 (.59)	1.08 (.74)	$F(1,80) = 8.11$, $p < .01$	$F(1,79) = .29$ $p = .59$
	Headstrong	.91 (.52)	.78 (.67)	1.40 (.83)	1.12 (.49)		
Play	ED	5.54 (4.0)	4.27 (4.0)	5.38 (4.8)	2.92 (3.7)	$F(1,94) = 4.83$ $p = .05$	$F(1,93) = .07$ $p = .80$
	Headstrong	4.90 (4.3)	3.73 (3.3)	5.05 (4.1)	2.28 (2.8)		
Praise	ED	1.96 (1.1)	2.09 (1.1)	1.84 (.85)	1.53 (.86)	$F(1,68) = 8.01$ $p = .01$	$F(1,67) = .11$ $p = .74$
	Headstrong	2.19 (1.2)	2.30 (1.2)	1.65 (.79)	1.41 (.62)		
Harshness	ED	1.32 (1.9)	.62 (.92)	.74 (1.2)	1.04 (.89)	$F(1,51) = 10.82$ $p = .01$	$F(1,50) = 1.99$ $p = .17$
	Headstrong	.75 (1.3)	.68 (.95)	.59 (1.0)	1.00 (1.4)		
Child Outcome							
Conduct Problems	ED	1.22 (.49)	.91 (.36)	1.04 (.53)	1.18 (.55)	See Table 5	See Table 5
	Headstrong	1.05 (.33)	.88 (.37)	1.27 (.37)	1.15 (.40)		

Note: The number of participants for the ED subgroup was 36 Intervention, 32 Control, for the Headstrong subgroup 25 Intervention, 19 Control. EE = Expressed Emotion; parenting measures and conduct problems were assessed by semistructured interview.

* F (df) and p values for the treatment main effect (entered as a separate step in a hierarchical regression model) and treatment X emotionally-dysregulated subtype interaction (entered on a subsequent step in a hierarchical regression model) are provided; the base model includes baseline parenting, child sex, child age, income, and Emotionally-Dysregulated subtype as covariates.

Table 5 Moderation of Treatment Effect on Conduct Problems by Emotional Dysregulation

	Model 1		Model 2	
	B (SE)	beta	B (SE)	beta
Child sex	-.13 (.08)	-.12	-.14 (.08)	-.13
Child age	.09 (.11)	.06	.12 (.11)	.08
Income	.04 (.07)	.04	.05 (.07)	.06
Conduct problems before	.60 (.08)	.60***	.62 (.07)	.63***
Treatment	-.25 (.07)	-.28***	-.08 (.11)	-.09
Emotional dysregulation	.06 (.07)	.07	.22 (.10)	.24*
Treatment X Emotional dysregulation			-.29 (.14)	-.30*
Statistics for Model	R ² = .49 F(6,92) = 14.14***		R ² = .51; ΔR ² = .02* F(7,91) = 13.43***; Δ F(1,91) = 4.16*	

Note: * $p < .05$ *** $p < .001$

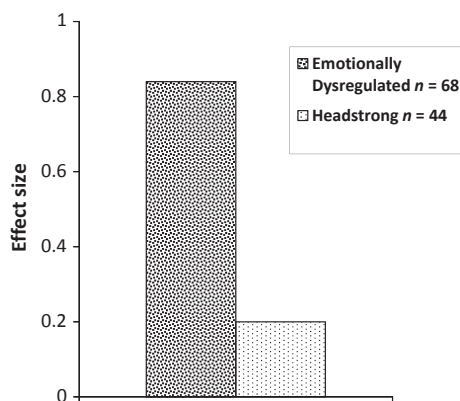


Figure 1 change in conduct symptoms in children allocated to parenting intervention compared with controls, by dysregulation subtype.

Emotionally-Dysregulated grouping, we reran the regressions on the 60 Irritable cases, removing the eight Hurtful cases. The pattern of results was the same, the treatment effect on the Irritable group was almost identical ($B = -.33$, $p < .001$; effect size $d = 0.79$). Second, to check whether the differential susceptibility in the Emotionally-Dysregulated group was mainly due to their changing on conduct symptoms that could be construed as emotionally-dysregulated but not the other symptoms, we reran the regression removing the tantrums item from the PACS interview measure. Again, the pattern of results was the same (ED group $B = -.32$, $p < .0001$; effect size $d = 0.76$; Headstrong group $B = -.08$, ns; effect size $d = 0.19$). Further evidence that the moderation effect detected with the Emotionally-Dysregulated group is not a proxy for conduct problems is the finding that initial level of conduct problems did not moderate treatment response (the interaction for treatment X initial conduct problems interaction was $B = -.14$, $SE = .15$, $p = .26$). Neither was there evidence that the psychosocial risks from Table 1 or parental depression on the GHQ-moderated treatment response (all p 's $> .10$). The implication is that the treatment moderation effect associated with emotional dysregulation in the child is particular and not confounded with psychosocial risk or conduct problem subtype or severity.

Discussion

The notion that there are individual differences in children's responses to environmental stimuli and demands is well established and is found even for extreme circumstances, including adversities as severe as institutional rearing (O'Connor, Rutter, Beckett, Keaveney, & Kreppner, 2000) and positive environments such as treatment outcomes (Scott & Dadds, 2009). These observations underlie basic developmental concepts of resilience and vulnerability. A more recent hypothesis suggests that there may be a more fundamental reason for individual differences in responsiveness: different sensitivity to the environment (Ellis et al., 2011). This study adds to the growing literature on differential susceptibility by showing that a dimension of child emotional-dysregulation moderated treatment response to a parenting intervention. Importantly, several alternative explanations were ruled out. Specifically, the findings were not due to parents of the emotionally-dysregulated changing more in response to the intervention: it was the emotionally-dysregulated children, rather than their parents, who were more responsive to change in their psychosocial environments. Nor were the findings due to the ED children having more severe initial total conduct problems, nor due to other child characteristics moderating responsiveness.

Although several studies have purported to show evidence of differential sensitivity to the environment, there are important limitations. One concerns uncertainties about the behavioral phenotype. Our operationalization of that phenotype was based on Stringaris and Goodman's typology of conduct and oppositional symptoms. Although not used in previous studies of differential sensitivity, it may be comparable to behavioral dimensions, notably irritable temperament, that have been used in prior work. That, in turn, may be compatible with the physiological and genetic evidence pointing to reactivity as a potential marker of differential sensitivity to the environment. Clearly, more work is needed on identifying the core phenotype that may index differential sensitivity before its clinical impact may be realized.

Evidence that emotional dysregulation may be a marker of differential sensitivity was detected in two types of analyses. The first, based on correlations between parenting and conduct symptoms prior to treatment, suggested that emotionally-dysregulated children were more sensitive to both positive and negative aspects of their caregiving environment – a novel and essential component of the differential sensitivity model. That was seen in the generally stronger links between measures of the caregiving environment – the use of play, praise, warmth, criticism, and maternal distress – and conduct symptoms. But the stronger evidence derives from the power of the randomized control trial, in which parents of dysregulated and headstrong children changed similarly as a result of the intervention, but the impact on their children's conduct symptoms was not similar. Stated differently, it was for the emotionally-dysregulated children that a change in parenting environment had the strongest impact on child behavior. A second feature of this study is that it focused on differential sensitivity to positive changes in the environment created from an experimental manipulation. That contrasts with the focus in most prior work on adverse environments and observational designs. The propensity to improve more under favorable conditions is what distinguishes differential susceptibility from vulnerability/resilience.

A limitation of the study is that it is based on parent reports of clinical symptoms and parenting assessments. Although these data were derived from established clinical interviews whereby the ratings were made using investigators', rather than parents' evaluations, it is possible that method variance may nevertheless confound the effects obtained. However, against this, there was no evidence that parents of Emotionally-Dysregulated children were prone to report greater parenting change, or greater initial levels of conduct problems. A further limitation is that the study is comparatively small and the findings require replication, particularly concerning the phenotypic description of emotional dysregulation. Future studies would be likely to benefit from using instruments specifically designed to assess emotional dysregulation. These limitations are offset by several strengths, including the use of a randomized controlled design, high-quality clinical assessments of child symptoms and both positive and negative parenting, and good rates of attendance in the treatment, which engendered substantial changes in the parenting environment.

There were few Hurtful children in this study, so including a larger number in future treatment trials would be helpful, as the literature is somewhat mixed on whether callous-unemotional children, whom they resemble, are more or less sensitive to parenting. While several studies (e.g. Hawes & Dadds, 2005) have suggested they may be less so,

others have found they are more sensitive to some aspects of parenting interventions. Thus Hawes, Dadds, Frost, and Hasking (2011) found that positive parenting, parental involvement, and poor monitoring/supervision uniquely predicted change in CU traits; Haas et al. (2011) found that CU children were more responsive to intervention than CP children without CU traits on the outcome of peer rejection, but less on social skills. Kolko and Pardini (2010) found CU traits unrelated to any posttreatment outcomes. Future studies will hopefully elucidate further the usefulness of including Headstrong children in a larger Emotionally-Dysregulated group for predicting treatment response.

There may be clinical applications of this study if the findings are replicated. In treatment trials, there is a wide spread of responses to intervention, and researchers are beginning to use different statistical procedures to model this (e.g., Thase, Klaus, Larsen, & Kennedy, 2011). While not all children would be expected to respond similarly to parenting interventions, it is perhaps surprising that we do not yet have robust evidence of many child moderators of treatment response to parenting interventions. The meta-analysis by Reyno and McGrath (2006) looked only at predictors of worse outcome, which were applicable to both control and intervention groups and thus were not true moderators; the only child predictor that they found was more severe initial conduct problems predicting poorer outcomes after treatment. In contrast, Reid, Webster-Stratton, and Baydar (2004) found that more severe initial levels of conduct problems moderated better treatment outcome, whereas Gardner, Hutchings, Bywater, and Whitaker (2010) found that initial severity of conduct problems had no effect, although being a boy and older moderated treatment response favorably. Beauchaine, Webster-Stratton, and Reid (2005) reported that higher initial levels of anxiety moderated the effects of parent training negatively. Therefore, robust, replicated child moderators of treatment response to parent training have yet to be established. The findings of this study suggest that emotionally-dysregulated children may be more responsive (operationalized as a reduction in conduct problems) to changes in their parents than are children who do not show emotional dysregulation. Conversely, if the Headstrong subtype are confirmed as less responsive to existing treatment, then new approaches for them need to be devised. It might be worthwhile to prescreen children before allocating parenting interventions, which could be delivered in a more efficient manner if there were a better understanding of what worked for whom. It may be important in future to integrate the differential susceptibility model with stronger efforts to identify moderators of treatment response, with the hope that a better understanding of the underlying processes may lead to more effective interventions.

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Correspondence to

Stephen Scott, King's College London, P85 Institute of Psychiatry, de Crespigny Park, London SE5 8AF, UK.
Email: stephen.scott@kcl.ac.uk

Key points

- It has been recognized for several decades that some temperamental and character traits such as irritability and emotional lability may become more pronounced under stressful circumstances, and be maladaptive.
- However, recently, the notion of differential susceptibility has raised the possibility that under favorable circumstances, such traits might also confer positive advantages in adjustment and functioning.
- This concept was tested experimentally in children with oppositional/conduct symptoms, by dividing them into a group with and without emotional dysregulation symptoms such as angry outbursts.
- The findings showed that the dysregulated children did better (showed fewer conduct symptoms) when their parenting environment became more favorable, but did worse when it was harsher.
- The implications are that first, emotional lability may be a positive asset under benign conditions, and second that it may in future become advisable to assess emotionality to give children with oppositional symptoms the most appropriate treatment.

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