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Current Parental Depression and Offspring Perceived Self-Competence: A Quasi-Experimental Examination

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Abstract

A genetically-informed, quasi-experimental design was used to examine the genetic and environmental processes underlying associations between current parental depressive symptoms and offspring perceived self-competence. Participants, drawn from a population-based Swedish sample, were 852 twin pairs and their male (52%) and female offspring aged 15.7 ± 2.4 years. Parental depressive symptoms were measured using the Center for Epidemiological Studies Depression scale. Offspring perceived self-competence was measured using a modified Harter Perceived Competence Scale. Cousin comparisons and Children of Twins (CoT) designs suggested that associations between maternal depressive symptoms and offspring perceived self-competence were due to shared genetic/environmental liability. The mechanism responsible for father-offspring associations, however, was independent of genetic factors and of extended-family environmental factors, supporting a causal inference. Thus, mothers and fathers may impact offspring perceived self-competence via different mechanisms and unmeasured genetic and environmental selection factors must be considered when studying the intergenerational transmission of cognitive vulnerabilities for depression.

Keywords

Perceived self-competence; perceived competence; parental depression; quasi-experimental design; Children of Twins; cousin comparison

Perceived self-competence is a dimension of self-concept and self-evaluation related to self-esteem, self-worth, and perceived ability across several domains (Harter 1982). Perceived self-competence is an indicator of adaptive development and is associated with a variety of personality and psychopathological conditions (Neiss et al. 2002). The construct is thought to reflect an individual’s actual ability in cognitive, social, and physical domains, as well as internalizations of feedback obtained from significant others (Cole et al. 2001). Research has focused on direct social and environmental influences of perceived self-competence (Harter 2006); however, alternative genetic and background environmental processes could explain

the statistical associations between putative social factors and perceived self-competence. Previous research has supported a genetic component to perceived self-competence (McGuire et al. 1999; Neiss et al. 2002; Hansson et al. 2008), but underlying common genetic and environmental contributions to the outcome and predictors of perceived self-competence need to be clarified (Mann et al. 2004).

Perceived self-competence is consistently associated with depressive symptomatology (Cole et al. 2001; Neiss et al. 2002), but its role in the development of depression is still undecided. The construct of perceived self-competence has been shown to be distinct from the construct of depression (e.g. Bonds et al. 2010), however, Cole (1990) proposed a competency-based model of depression that asserts that negative perception of self-competence may be a cognitive vulnerability for depression. Research has also suggested that low perceived self-competence predicts later depression (Orth et al. 2008; Whitney et al. 2010) and low self-esteem predicts later suicidal ideation in male and female adolescents (Kim and Kim 2009) and not vice-versa (Orth et al. 2009).

Perceived self-competence has also been shown to mediate negative maternal feedback and adolescent depressive symptoms (Tram and Cole 2000; Jacquez et al. 2004). Levels of offspring perceived self-competence may be influenced by parental depression (Goodman 2007) through the social/environmental effects that include altered parenting (Lamborn et al. 1991), negative feedback, and distorted appraisals due to a depressed state (Lovejoy et al. 2000). An alternative explanation, however, is that perceived self-competence is a genetically-influenced cognitive vulnerability that contributes to the development or maintenance of depression. Research suggesting that there is a genetic component to adolescent perceived self-competence (McGuire et al. 1999; Neiss et al. 2002; Hansson et al. 2008) gives rise to the possibility that genetic factors could account for the association between parental depression and adolescent perceived self-competence. Most studies concerning genetic influences underlying offspring perceived self-competence have examined the heritability of adolescents' and young adult perceived self-competence (Neiss et al. 2002) rather than investigating the mechanisms through which intergenerational transmission occurs. Thus, explanations for the intergenerational relation of parental depression and offspring perceived self-competence include both environmental (e.g., parental appraisal) and genetic (e.g., transmission of genetic susceptibility for a cognitive vulnerability to depression) possibilities. The current study seeks to test these hypotheses by elucidating the mechanisms through which parental depression influences offspring perceived self-competence.

Quasi-Experimental Designs

Although several research projects have sought to identify the mechanisms responsible for the intergenerational transmission of depressive symptoms (e.g., Pettit et al. 2008; Tully et al. 2008; Singh et al. 2010), none have examined the association of parental depression to offspring perceived self-competence and included estimates of the balance of genetic and environmental mechanisms (Neiss et al. 2002; Hammen et al. 2004). To understand the mechanisms, genetic and environmental transmission needs to be pulled apart (Rutter 2007). Advanced methodological designs must be used to estimate the contributions of genes and environment because genetically influenced behavior and individual characteristics may passively or actively influence or select environments (for in-depth explanation see Plomin et al. 1977). For example, adolescent non-aggressive rule-breaking may evoke peer acceptance (Burt 2009). Adolescent rule breaking, however, has genetic influences and thus, a correlation exists between genetic influences of adolescent rule breaking and the environmental experience of peer acceptance. Unsurprisingly, gene and environment confounding is expected, pervasive, and constitutes a plausible alternative causal

explanation for associations between putative environmental risks and outcomes (Rutter 2007). Fortunately, quasi-experimental methods can control for possible genetically-driven selection factors and aid in the delineation of co-occurring genetic and environmental risk factors (Shadish et al. 2002).

Cousin comparisons and the Children of Twins (CoT) models (Heath et al. 1985; D'Onofrio et al. 2003; Silberg and Eaves 2004) can account for selection factors and divide genetic and environmental mechanisms. The comparison of differentially exposed cousins controls for similarity in environmental risk (i.e., familial factors that influence cousins similarly such as parents' own rearing conditions) and some genetic factors, given that the parents share a portion of their genetic makeup (Slutske et al. 2008). Additionally, in a CoT design, because the adolescent cousins are children of either monozygotic (MZ) or dizygotic (DZ) twin pairs, it is possible to disentangle genetic and environmental influences. Cousin offspring of MZ twin pairs share 25% of their genes (50% with their parent and their parent's cotwin). Cousin offspring of DZ twin pairs, however, share approximately 12.5% of their genes (50% with their parent and 25% with their parent's cotwin). Given the differences in both genetic (25% vs. 12.5%) and environmental (differential exposure) risk associated with parental depression, the CoT model provides an approach for separating the direct environmental influences of depression within the nuclear family from (a) genetic factors shared by both generations due to passive gene-environment correlation (i.e. the genetically influenced environment parents provide) and (b) environmental influences that effect all cousins in a family.

In the current study, the CoT model was used to compare offspring perceived self-competence in cousins exposed to varying degrees of parental depressive symptoms. If associations remain strong even when controlling for genetic and environmental factors that influence both generations, the associations may be due to the social/current environmental impact of parental depression symptomatology on offspring perceived self-competence. If, on the other hand, the relation between parents and offspring is attenuated or eliminated after controlling for background genetic and environmental factors, then the importance of genetic factors and/or shared environmental factors is implicated. We hypothesized that (1) increased depressive symptomatology in parents would be associated with decreased offspring perceived self-competence, (2) offspring perceived self-competence would mediate the intergenerational association between parental current depressive symptoms and offspring current depressive symptoms in line with previous research, (3) the intergenerational associations found would be robust to the inclusion of statistical covariates, and (4) cousin comparisons and CoT analyses were viewed as exploratory due to the limited extant literature.

Methods

Participants

Participants were drawn from the Twin and Offspring Study in Sweden (TOSS) that included 909 same-sex twin pairs, their long-term partner or spouse, and their adolescent child recruited through the Swedish Twin Registry (Lichtenstein et al. 2002; Neiderhiser and Lichtenstein 2008). After institutional approval and informed consent, twins, spouses, and offspring completed questionnaires via mailed and in-home visits. The study was comprised of two cohorts: Cohort 1 included 326 female twin pairs, their spouses, and one of their adolescent children. Cohort 2 included 583 female and male twin pairs, their spouses, and one of their adolescent children. Both cohorts followed the same inclusion criteria to ensure similar living experiences among related individuals: Each twin had to (1) have an adolescent or young adult offspring who was the same gender and within 4 years of age as his or her cotwin's offspring, and (2) be in a cohabitating relationship of 5 or more years.

Cohorts did not differ on a majority (89%) of the measures (Reiss et al. 2001; Neiderhiser and Lichtenstein 2008).

Twins describing themselves as similar as “two berries on a bush” (Nichols and Bilbro 1966) were classified as MZ twins. Twins describing themselves as different and indicating that others have little difficulty distinguishing them were classified as DZ twins. Agreement with DNA assignments was 96%. After removing pairs with missing or disagreeing zygosity, 852 twin pairs were used in the current investigation. Thus, the sample was 521 female twin pairs (246 MZ twin pairs and 275 DZ twin pairs) and 313 male twin pairs (126 MZ twin pairs and 187 DZ twin pairs). Mothers’ mean age was 44.0 (± 4.7) years. Fathers’ mean age was 46.4 (± 5.3) years. Offspring were 15.7 (± 2.4 , range 11–22) years old and were 52% male. MZ and DZ twins did not differ in age, education, occupation level, age or gender of their children or partner (Ganiban et al. 2007).

Highest level of completed parental education was grouped into six categories: (1) 10.9% of mothers and 19.3% of fathers completed elementary school, (2) 1.4% of mothers and 2.0% of fathers completed junior high school, (3) 27.4% of mothers and 27.2% of fathers completed 2 years of high school, (4) 11.5% of mothers and 15.1% of fathers completed 3–4 years of high school, (5) 37.9% of mothers and 28.1% of fathers completed college or university study, and (6) 11.0% of mothers and 8.4% of fathers indicated that they fell into an “other” category. Socioeconomic status was determined by the highest parental occupation indicated by self-report: (1) unskilled and semiskilled worker, 10.7% (reference group), (2) skilled worker and assistant non-manual employee, 25.3%, (3) intermediate non-manual employee and self-employed without employees, 32.5%, and (4) employed and self-employed professionals, higher civil servants and executives, 34.4%. Consistent with the population of Sweden, the majority of the sample was Caucasian (Neiderhiser and Lichtenstein 2008).

Depressive Symptoms and Perceived Self-Competence Measures

Parental current depressive symptoms within the last week were measured using the Center for Epidemiological Studies Depression (CESD) self-report scale (Radloff 1977). To calculate Cohen’s *d* effect size estimates, parental CESD scores were separated into the top 20% for “high” and lower 80% scores for “low”. Offspring current depressive symptoms were measured using the CESD scale for adolescents (Radloff 1977; Roberts et al. 1991). As adolescent depressive symptomology was not a focus of the current project, scores from the adolescent CESD scale were used to verify the perceived self-competence measure and to test for mediation. A modified version of the self-report Harter Perceived Competence Scale (Harter 1982, 1990) for a Swedish population (Ouvinen-Birgerstam 1985) was used to measure offspring perceived self-competence. The questionnaire consists of 72 questions with higher scores indicating greater feelings of self-competence. Factor analysis revealed that subscales (physical well-being, physical qualities, skills and talents, relation to family, and relations to others) loaded on one general factor which had high internal consistency (Cronbach’s $\alpha = .82$) and because previous research has shown additive predictive value for competence subscales when predicting depression (Cole 1990), one general measure of perceived self-competence was formed by summing the standardized subscales. Scores on the measure were converted to z-scores. Perceived self-competence was normally distributed in the sample, unlike measures of offspring’s current depressive symptoms. Additionally, there were no overlapping items on the perceived self-competence and CESD for adolescents.

Statistical Analyses

Beyond variable Pearson correlation analyses and tests for mediation of parent current depressive symptoms to offspring current depressive symptoms by offspring perceived self-competence, the primary models of analysis can be grouped into epidemiological and quasi-experimental in nature. All models controlled for socioeconomic status, mother and/or father education level, adolescent gender, offspring age, and current depressive symptoms scores of the other parent to address spousal effects (Eaves et al. 2005). Participants included in these analyses were not completely independent because they may have shared extended family. Therefore, SAS Mixed Procedure was utilized to fit a multilevel model to the nested data (Littel et al. 2006). Table 1 outlines all regression models. Models are broken down by relatedness of parent generation, and therefore, the robustness of the model and whether it can be categorized as epidemiological or quasi-experimental (i.e. cousin comparisons and CoT analyses). The parameter of interest, whether the model targets the father-offspring association or mother-offspring association, and the sample size by model are also listed in Table 1.

Models 1–3 characterized associations between parental current depressive symptoms and offspring perceived self-competence in unrelated offspring. Models 4–7 used more rigorous cousin comparisons and CoT designs. If the intergenerational relation was ostensibly caused by the environmental effect of being exposed to a parent with high depressive symptoms, then associations between parental depressive symptoms and adolescent perceived self-competence would be evident at every level of analysis. Models 1 and 2 independently predicted offspring perceived self-competence from mother and father current depressive symptoms, respectively. Model 3 predicted offspring perceived self-competence from mother and father current depressive symptoms simultaneously, thereby assessing whether maternal and paternal depressive symptoms were uniquely associated with offspring perceived self-competence while controlling for depression in the other parent.

Through Models 4–7, the comparison of differentially exposed cousins was based on the inclusion of two variables in the multilevel model: (1) the between-family effect as measured by the mean level of depression in the mothers/fathers in the extended family (i.e., the mother/aunt or the father/uncle mean), and (2) the within-family effect as measured by the deviation of each specific mother's/father's depression score from the mean of the extended family (Neuhaus and McCulloch 2006). Model 4 (focused on maternal depressive symptoms) and Model 5 (focused on paternal depressive symptoms) contrasted cousins differentially exposed to parental current depressive symptoms regardless of parental zygosity. Cousins were considered to be differentially exposed to greater or less depressive symptoms when the biologically-related parents' deviation scores differed.

Models 6 (maternal depressive symptoms) and 7 (paternal depressive symptoms) tested alternative explanations for the statistical relations found by separating cousins from MZ and DZ twin pairs. To test if genetic relatedness moderated the association between parental depressive symptoms and offspring perceived self-competence, an interaction term [cousin comparison variable by twin zygosity (coded MZ=0 and DZ=1)] was included in Models 6 and 7. Therefore, Models 6 and 7 provided (1) a specific comparison of differentially exposed cousins from MZ twin families and (2) the difference between the magnitudes of the statistical relation in DZ twin families versus MZ twin families. The interaction term in Model 6 and 7 is a measure of the difference between the within-family effect in MZ families and the within-family effect of DZ families. Thus, if the interaction parameter is large, results would suggest that genetic factors account for part of the intergenerational association. If there are no differences in the magnitude of association between offspring of MZ versus DZ twins, then the role of environmental factors influencing both generations are implicated because the background familial factors were not related to genetic risk. More

details about the statistical approaches, including algebraic expressions of the models, are available elsewhere (D'Onofrio et al. 2005).

Results

Epidemiological Analyses

Offspring perceived self-competence was negatively associated with their current depressive symptoms, $r(1046) = -.62, p < .0001$. Table 2 shows that parental current depressive symptom levels were negatively correlated with offspring perceived self-competence and offspring current depressive symptoms.

To test for consistency with previous findings (Jacquez et al. 2004) in the current cross-sectional sample, supplemental mediation analyses (MacKinnon et al. 2007) were performed. Using a Sobel test of product terms (Sobel 1990), analyses explored the degree to which offspring perceived self-competence accounted for the association between parental current depressive symptoms and offspring current depressive symptoms. Mother ($b = 0.14$; $SE = 0.04$; $p < .001$) and father ($b = 0.12$; $SE = 0.04$; $p < .01$) current depressive symptoms were independent predictors of offspring current depressive symptoms in a simultaneous regression, and the indirect effects of parental current depressive symptoms on offspring current depressive symptoms accounted for by offspring perceived self-competence were significant ($b_{\text{mother}} = 0.07$; $SE = 0.02$; $p < .001$; $b_{\text{father}} = 0.07$; $SE = 0.02$; $p < .001$). Thus, results support previous findings showing that offspring perceived self-competence may mediate (Jacquez et al. 2004; MacKinnon et al. 2007) the association between parental current depressive symptoms and offspring current depressive symptoms.

Models 1–3 (Table 3) explore the associations between parental current depressive symptoms and offspring perceived self-competence in the entire sample. Model 1 revealed that mothers' level of current depressive symptoms were negatively associated with adolescent perceived self-competence ($b = -0.17$; $SE = 0.02$; $p < .0001$, $d = -0.27$). Model 2 showed that fathers' level of current depressive symptoms were negatively associated with adolescent perceived self-competence ($b = -0.20$; $SE = 0.02$; $p < .0001$, $d = -0.35$). Both parents' level of current depressive symptoms (Model 3) also predicted lower adolescent perceived self-competence scores even when controlling for spousal symptomatology ($b_{\text{mothers}} = -0.11$; $SE = 0.03$; $p < .0001$ and $b_{\text{fathers}} = -0.15$; $SE = 0.03$; $p < .0001$). The interaction between maternal and paternal current depressive symptoms was not statistically significant.

Quasi-experimental Analyses

Table 4 (Models 4–7) summarizes findings from the more rigorous cousin and CoT comparisons. Figure 1 presents the results of models predicting offspring perceived self-competence from current parental depressive symptoms. The figure illustrates the contrasting associations between maternal and paternal current depressive symptom level and offspring perceived self-competence across varying degrees of methodological control.

Model 4 revealed that a statistical trend remained and the magnitude of association was reduced for the association between maternal current depressive symptom level and offspring perceived self-competence ($b = -0.07$; $SE = 0.04$; $p = .07$, $d = -0.06$) when comparing differentially exposed cousins (from both MZ and DZ twin parents). Model 5 also revealed that father's current depressive symptom level still strongly predicted offspring perceived self-competence when comparing cousins differentially exposed ($b = -0.17$; $SE = 0.04$; $p < .0001$, $d = -0.46$). As seen in Figure 1, the associations across Models 1–5 are consistently elevated despite the increasing statistical control that cousin comparisons allowed.

Models 6 and 7 examined the association between current parental depression and offspring perceived self-competence separately for MZ and DZ twin parents (Figure 1). Model 6 revealed that the relation between maternal current depressive symptom level and offspring perceived self-competence was no longer present in differentially exposed cousins from MZ twin mothers ($b_{MZ} = 0.12$; $SE = 0.08$; $p = .16$, $d = -0.03$). The difference between cousins from MZ twins and DZ twins was significant ($b_{DZ\text{difference}} = -.34$; $SE = 0.11$; $p = .003$, $d = -0.08$). As seen in Figure 1, the attenuation of the effect of maternal depressive symptom level on offspring outcome when controlling for more genetic factors (the comparison of offspring of MZ twins) suggests that the intergenerational relation between maternal depressive symptoms and offspring perceived self-competence was primarily due to an underlying shared genetic liability for depressive states.

Model 7, however, showed that the effect of MZ twin father's current depressive symptom level on offspring perceived self-competence remained comparably large ($b = -0.21$; $SE = 0.15$; $p = .16$, $d = -0.21$) to the relations found in Model 5 (adolescent cousins from MZ or DZ twins) and Model 3 (unrelated adolescent comparisons), albeit statistically non-significant. Non-significance may have been due to decreased sample size ($N=588$) because of the restriction to offspring from twin males separated by zygosity which increased the SE. There was no difference, however, between cousins from MZ and DZ father twin pairs ($b = -0.13$; $SE = 0.18$; $p = .44$) and the effect size remained large for offspring from DZ twin pairs ($d = -0.50$). Therefore, as seen in Figure 1, the magnitude of association between paternal depressive symptom level and offspring perceived self-competence is consistently elevated even after increasingly rigorous methodological and statistical control across models. Thus, following replication and testing using various methodologies, the results suggest that the intergenerational relation between paternal depressive symptoms and offspring perceived self-competence is independent of shared genetic liability and is due to environmental processes specifically associated with paternal depressive symptom exposure. Again, this conclusion is evidenced by the non-attenuating magnitudes of the association between MZ offspring versus DZ offspring for the father-offspring associations in Figure 1.

Discussion

The processes underlying the association between parental current depressive symptoms and offspring perceived self-competence was examined using a large Swedish twin-family dataset. Significant intergenerational associations emerged among maternal and paternal current depressive symptom level and offspring perceived self-competence wherein the greater the parental depression symptoms, the lower the offspring perceived self-competence scores. The negative correlation remained significant when predicting offspring perceived self-competence with mothers' and fathers' current depressive symptomatology simultaneously. The importance of perceived self-competence in the intergenerational transmission of depression was highlighted by the fact that perceived self-competence mediated the association between parental current depressive symptom level and offspring current depressive symptom level, as was suggested by previous research (Tram and Cole 2000; Jacquez et al. 2004). Although the lack of temporal information in the current, as well as any cross-sectional design, limited our ability to rigorously examine the mediation hypothesis. Given these and previous significant findings, however, we sought to clarify the mechanisms that account for associations between parental current depressive symptoms and adolescent perceived self-competence.

Cousin comparisons and CoT analyses were used to investigate the mechanisms through which parental current depressive symptom level impacts offspring perceived self-competence. Cousin comparisons, regardless of the genetic relatedness of the parents (Models 4 and 5), suggested that unmeasured family background characteristics (e.g. family

culture, negative patterns of cognition, genetic liability, etc.) account for associations in the mother-offspring relation and environmental mechanisms account for the father-offspring relation. To further elucidate these associations, the relations between offspring from MZ and DZ twin pairs were compared using the CoT design.

The CoT design (Models 6 and 7) controlled for additional genetic selection factors of the extended family by splitting cousin comparisons by genetic similarity of the twin parents. Findings suggested that the association between maternal current depressive symptoms and offspring perceived self-competence may be due to a shared genetic liability because the magnitude of the association decreased and the association was no longer statistically significant when comparing cousins from MZ maternal pairs. Additionally, the intergenerational association in MZ twin families was significantly smaller than in DZ twin families.

The father-offspring relation was found to be due to different mechanisms than the mother-offspring relation. Magnitudes of association between paternal current depressive symptom level and offspring perceived self-competence were comparable when examining differentially exposed offspring of MZ and DZ twins, suggesting that associations may be due to a direct effect of paternal depressive symptoms within the nuclear family, such as an effect through the father's parenting. A large caveat in this relation, however, is that although high in magnitude, as others have shown the relation between father depression and offspring depression to be (Lieb et al. 2002), the associations between paternal current depressive symptoms and offspring perceived self-competence in male MZ twin families was not statistically significant. Reduced sample size of the father sample may have contributed to increased SE in the father-offspring relations (Heath et al. 1985) and caution should be taken when interpreting the findings.

The current results should be considered in light of similar findings across populations, study methodologies, and measures. A CoT design has been used in a US-based sample of parents and adolescent offspring (Silberg et al. 2010) to show that parental depression may operate through a direct environmental mechanism to influence offspring depression. Also using a CoT design, but in an Australian sample, Singh et al. (2010) showed that intergenerational mechanisms predicting lifetime depression in adult offspring are consistent with a causal (environmental) inference. Unfortunately, however, they were unable to separate the analyses by parental sex. Using offspring conceived through in vitro fertilization in the UK, Harold et al. (2011), was able to examine genetic and environmental influences of parental depressive symptoms on child depressive symptoms while testing for mediation by parenting. Overall, their findings indicated the importance of non-inherited factors in the transmission of depressive symptomology (Harold et al. 2011). Although they also suggested that environmental mechanisms may operate more strongly in mother-offspring dyads than father-offspring dyads, differences in offspring age (4–10 years old versus 11–22 years old in the current study) may have contributed to this difference in findings. Similar results were found while controlling for shared adversity such as negative life events, family income strain, and low socioeconomic status (Lewis et al. 2011) in a comparable sample. Using an adoption design in a US sample, Tully et al. (2008) also showed that maternal depression was an environmental liability, rather than a genetic liability. Although they showed that paternal depression was not significantly associated with increased risk for adolescent depression (Tully et al. 2008), the magnitude of association between fathers and offspring in adopted pairs was large, possibly suggesting a causal environmental association similar to the current results. While there are variations across study findings and further research is needed on perceived self-competence in particular, evidence supporting the importance of a direct influence of parental depression appears to be building.

Hypotheses concerning why the mechanistic differences in mother-offspring and father-offspring associations were found in the current study include that maternal depressive symptomatology reflects the mothers' own perceived self-competence. As was suggested by Cole (1990), there is a high correlation between self-evaluation measures and depression in adults (Risch et al. 2010). The associations found between mothers and offspring may reflect one of parental perceived self-competence to offspring perceived self-competence, and this relation may show a stronger genetic component for mothers and offspring than fathers and offspring. Another hypothesis is that high levels of paternal depressive symptoms may be associated with different parental deficits than for mothers and previous findings (Harold et al. 2011) may be suggestive of this. A father's current depressive symptoms may impact their negative appraisals of the offspring and thereby impact the offspring's perceived self-competence. Interestingly, research has shown that variability in an offspring's depressive mood, a measure shown to be closely associated with perceived self-competence, is related to conflicts with parents, especially fathers (Sallinen et al. 2007) and expressed emotion may mediate the association between father's depression and offspring depression (Brennan et al. 2002). A measure of parental appraisal of their offspring's competence and a longitudinal measure of parenting would clarify these possibilities (Harold et al. 2011).

Interpretation of the results must also consider limitations. The models used cannot prove causation because they are not experiments based on random assignment (Rutter et al. 2001; D'Onofrio et al. 2003). Thus, other unmeasured factors, such as parental externalizing behaviors, may still be accounting for the associations found. When comparing MZ and DZ cousins, it is assumed that any differences in level of contact (if they exist) do not influence the outcome of interest (D'Onofrio et al. 2003). If violations of the equal environments assumption exist, then estimations of genetic factors may be exaggerated. Additionally, genetic and environmental influences are not entirely separate (Rutter et al. 2006). Epigenetics, gene-environment correlations, and gene-environment interactions may play important roles in influencing offspring perceived self-competence. Our results do not suggest that gene-environment interactions are unimportant; rather, the results suggest that these possibilities should be investigated.

Our findings warrant continued investigation into the mechanisms responsible for associations between parental depressive symptoms and adolescent perceived self-competence, as well as the role of adolescent perceived self-competence as a cognitive vulnerability for depression. Future research should examine the possibility of a bidirectional relation between adolescent perceived self-competence and parental depression (Gross et al. 2008; Narusyte et al. 2008). The role of parenting behaviors should be examined given the possible causal environmental mechanism underlying the father-offspring association. Using teachers and peers as informants would be beneficial given the increased saliency of peer influences during adolescence (Steinberg and Morris 2001) and their genetic separation from the offspring in question. Additional research on the possible protective or cross-parental parenting effects (Kahn et al. 2004) would also be informative.

The current study has expanded the field's knowledge of the intergenerational association of parental depressive symptoms and offspring vulnerabilities to depression. With the use of a rigorous quasi-experimental design, and by predicting the normative construct of offspring perceived self-competence, the current study closely examined the intergenerational mechanisms that may contribute to the development of adult psychopathology (Cole 1990; Neiss et al. 2002). Our findings suggest that the mechanisms through which depressed mothers and fathers impact their offspring may be different (Harold et al. 2011). These findings, combined with future work on perceived self-competence and its role in depression, may provide insight into differential prevention targets based on which parent is experiencing depression. Thus, the present findings shed new light on the role and

implications of exposure to parental depressive symptoms on offspring development and adaptation.

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Figure 1.
Impact of Current Parental Depression on Adolescent Perceived Self-Competence

Table 1

Description of Analytical Models

Model Number	Parameters of Interest	Explanation	Sample Utilized	Sample Size
Epidemiological				
1	Maternal CESD	Association of maternal CESD and offspring PSC	Offspring of twin and non-twin mothers	1564
2	Paternal CESD	Association of paternal CESD and offspring PSC	Offspring of twin and non-twin fathers	1584
3	Maternal and paternal CESD	Association of maternal and paternal CESD and offspring PSC	Offspring of twin and non-twins	1544
Cousin Comparisons				
4	Maternal CESD	Association between maternal CESD and cousin offspring PSC	Offspring of any twin mothers	1554
5	Paternal CESD	Association between paternal CESD and cousin offspring PSC	Offspring of any twin fathers	1565
Children of Twins				
6	Maternal CESD	Association between maternal CESD and cousin offspring PSC by maternal genetic relatedness (MZ or DZ)	Offspring of twin mothers separated by zygosity (MZ or DZ)	935
7	Paternal CESD	Association between paternal CESD and cousin offspring PSC by paternal genetic relatedness (MZ or DZ)	Offspring of twin fathers separated by zygosity (MZ or DZ)	588

Note: CESD=Center for Epidemiological Studies of Depression scale; PSC=Perceived Self-Competence; Models 4–7 covaried the twin spouses CESD levels. All models covaried SES, parental education, and offspring age and sex.

Table 2

Correlations Between Maternal, Paternal and Offspring Measures

Variable	1	2	3	4	5	6	7	8
Mother								
1. CESD	--							
2. Education	0.04 (1685)	--						
Father								
3. CESD	0.37** (1695)	0.04 [†] (1690)	--					
4. Education	0.03 (1693)	0.21** (1688)	0.01 (1703)	--				
Offspring								
5. CESD	0.13** (1062)	0.07 [†] (1057)	0.11* (1063)	-0.04 (1057)	--			
6. PSC	-0.16** (1671)	0.01 (1667)	-0.17** (1679)	0.07* (1676)	-0.62** (1048)	--		
7. Age	-0.08 [†] (1707)	-0.02 (1702)	-0.08* (1714)	-0.02 (1712)	0.13** (1084)	-0.15** (1706)	--	
8. Sex	0.03 (1707)	0.02 (1702)	0.02 (1714)	-0.01 (1712)	0.20** (1084)	-0.05 [†] (1706)	0.00 (1745)	--

Note: (N);

[†] p < .10,

[‡] p < .05,

* p < .01,

** p < .0001;

CESD=Center for Epidemiological Studies of Depression scale; PSC=Perceived Self-Competence.

Table 3

Epidemiological Models Predicting Offspring Perceived Self-competence from Parental Current Depressive Symptom Level

Parameter	Model					
	1		2		3	
	b	SE	b	SE	b	SE
Maternal CESD	-0.17**	0.02			-0.11**	0.03
Paternal CESD			-0.20**	0.02	-0.15**	0.03
Maternal Education	-0.01	0.02			-0.01	0.02
Paternal Education			0.03 [†]	0.02	0.03 [†]	0.02
Family SES 1	-0.02	0.09	-0.02	0.09	-0.01	0.09
Family SES 2	0.06	0.09	0.02	0.09	0.04	0.09
Family SES 3	0.15	0.09	0.13	0.09	0.14	0.09
Offspring Age	-0.07**	0.01	-0.07**	0.01	-0.07**	0.01
Offspring Sex	-0.08	0.05	-0.09 [†]	0.05	-0.08	0.05
N	1564		1584		1544	

Note:

[†] p < .10,

[‡] p < .05,

* p < .01,

** p < .0001;

CESD=Center for Epidemiological Studies of Depression scale; PSC=Perceived Self-Competence; Referent SES = unskilled and semiskilled worker, SES 1 = skilled worker and assistant non-manual employee, SES 2 = intermediate non-manual employee and self-employed without employees, SES 3 = employed and self-employed professionals, higher civil servants and executives.

Table 4
Methodological Controls: Cousin Comparison and Children of Twins Models Predicting Offspring Perceived Self-competence from Parental Current Depressive Symptom Level

Parameter	Model											
	4			5			6			7		
	b	SE		b	SE		b	SE		b	SE	
<u>Cousin Comparison</u>												
Maternal CESD	-0.07 [†]	0.04										
Paternal CESD			-0.17 ^{**}	0.04								
<u>Within-MZ Twins</u>												
Maternal CESD						0.12	0.08					
Paternal CESD									-0.21	0.15		
<u>MZ / DZ Difference</u>												
Maternal CESD						-0.34 [‡]	0.11					
Paternal CESD									-0.13	0.18		
<u>Covariates</u>												
Maternal CESD			-0.12 ^{**}	0.03					-0.13 [‡]	0.05		
Paternal CESD	-0.15 ^{**}	0.03				-0.11 [‡]	0.03					
Maternal Education	-0.01	0.02				0.00	0.02		-0.04	0.03		
Paternal Education			0.03 [‡]	0.02		0.04 [‡]	0.02		0.03	0.03		
Family SES 1	-0.01	0.09	-0.02	0.09		-0.07	0.12		0.05	0.14		
Family SES 2	0.07	0.09	0.02	0.09		-0.07	0.12		0.18	0.14		
Family SES 3	0.19 [‡]	0.09	0.13	0.09		0.11	0.12		0.16	0.16		
Offspring Age	-0.07 ^{**}	0.01	-0.07 ^{**}	0.01		-0.08 ^{**}	0.01		-0.07 ^{**}	0.02		
Offspring Sex	-0.07	0.05	-0.08	0.05		-0.12 [‡]	0.06		0.02	0.08		
N	1554		1565			935			588			

Note:

[†] p < .10,

[‡] p < .05,

*
p < .01,
**
p < .0001;

CESD=Center for Epidemiological Studies of Depression scale; PSC=Perceived Self-Competence; Referent SES = unskilled and semiskilled worker, SES 1 = skilled worker and assistant non-manual employee, SES 2 = intermediate non-manual employee and self-employed without employees, SES 3 = employed and self-employed professionals, higher civil servants and executives.