Parental Conflict and Neural Response to Social Reward as Predictors of Response to Cognitive Behavioral Therapy for Depressed Adolescents

Nicole Herman

Dr. Autumn Kujawa

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Abstract

Depression is a prevalent disorder among adolescents, with evidence that rates have been increasing over the past 10 years. Cognitive behavioral therapy (CBT) is a leading evidence-based treatment option, but it is not effective for all depressed adolescents, raising questions about who benefits the most. Past research has separately identified low social support and an enhanced reward positivity (RewP) event-related potential (ERP) component to be predictive of decreased responsivity to treatment; however, these factors have not been examined within the same study. This study followed 70 adolescents with depression (14-18 years old) across 16 sessions of group CBT. Baseline parental conflict and RewP in an EEG social reward task were examined as predictors of clinician-rated improvement across treatment. Results showed that while both maternal and paternal conflict were predictive of lower clinician-rated improvement within treatment, only paternal-child conflict was significant when accounting for baseline depression and anxiety symptoms. Additionally, the association between RewP and parental conflict was not significant. Future research is needed to identify various interventions that would increase the efficacy of CBT for individuals who are less likely to succeed in treatment. The results indicate that it may be helpful for clinicians to assess parental-child conflict at the beginning of treatment to determine whether the patient is likely to respond to CBT and to administer individualized interventions accordingly.

Key Words: depression, cognitive behavioral therapy, adolescent, parental conflict, reward, treatment outcomes

Parental Conflict and Neural Response to Social Reward as Predictors of Response to Cognitive Behavioral Therapy for Depressed Adolescents

Depression is a prevalent and impairing disorder in adolescence. Unfortunately, the prevalence of adolescent depression has continually increased over the past 10 years, especially among adolescent girls (Keyes et al., 2019). As a result, it is essential to determine the best course of treatment to alleviate the symptoms and long-term functional impairments associated with adolescent depression. Years of research have provided support for cognitive behavioral therapy (CBT) as a gold-standard treatment option for addressing adolescent mood disorders, but it does not work for all adolescents (McDermut et al., 2001; Spirito et al., 2011).

CBT is based on the principle that depression is driven in part by maladaptive ways of thinking and patterns of behavior. To address these deficits, clinicians encourage patients to identify cognitive distortions and to reframe negative thoughts into more realistic and positive alternative thoughts. Patients also use behavioral activation skills to intentionally increase the number of pleasurable activities they experience throughout the day. Treatment often involves role-playing, relaxation techniques, and the assignment of homework for practice outside of sessions. CBT is relatively short-term, and clinicians usually work with patients for approximately 8 to 12 weeks before termination (What Is Cognitive Behavioral Therapy?, 2017).

Despite its status as an empirically-supported treatment for depression, the success rate of CBT for children and adolescents is only 40 to 60% (James et al., 2013). As a result, there is a large percentage of youth who do not benefit significantly from CBT. To address this problem, it is necessary to identify specific factors that are predictive of responsiveness to CBT. By doing so, researchers can then develop individualized interventions, aimed at those least likely to respond to treatment, to mitigate this disparity. Clinicians will be able to identify certain risk

factors at the start of treatment and implement individualized interventions accordingly. In theory, the success rates of CBT would rise as a result. This would not only decrease symptomatology, but it would decrease the long-term negative outcomes associated with youth depression as well.

Past research has attempted to identify factors associated with successful responses to CBT among depressed adolescents. This research has focused on either the environmental factors or individual differences in brain function that may contribute to CBT outcomes. These two factors have been repeatedly studied in isolation to each other, even though they are both likely to impact results. While there are several types of depressive disorders, this study will focus on individuals with either major depressive disorder (MDD) or persistent depressive disorder (PDD). Identifying predictors of improvement within treatment is a multifaceted issue with several factors at play, such as earlier onset of depression, attention deficit/hyperactivity disorder (ADHD), functional impairment, feelings of hopelessness, excessive negative thoughts, low family cohesion, and lack of coping skills (Rohde et al., 2006). This current study focuses on parental conflict and neural response to social reward as predictors of response to treatment.

Parental Conflict and Treatment Response

One area of research focuses specifically on how parental conflict is associated with CBT outcomes. A study conducted by Feeny et al. (2009) included 439 depressed adolescents who were randomly assigned to four different groups: fluoxetine (a prescription medication commonly used to treat anxiety and depression), CBT, fluoxetine and CBT, and a placebo. Participants and their parents were asked to complete the Conflict Behavior Questionnaire (CBQ) to measure conflict between the two. Adolescents whose mothers reported less conflict with their child were more likely to successfully respond to treatment, regardless of treatment

type. CBT was also shown to be less effective in participants with greater family instability, characterized by conflict and tension that impedes family functioning. That is, participants with more stable family environments experienced greater levels of symptom reduction with CBT. A second study found similar results in that clinically significant parental conflict, greater than nine on the CBQ, predicted lower success within treatment (Rengasamy et al., 2013). Importantly, however, parental conflict also decreased following the CBT intervention, indicating that CBT can be helpful for relationship conflicts.

While the CBQ is reliably used to measure parental conflict, analyses of child temperament and parenting styles can give insight into family dynamics as well. Research conducted by Festen et al. (2013) included a sample of 145 children and adolescents with anxiety disorders. The results highlighted decreased treatment responsiveness in participants who reported their mothers as having more negative affect and less emotional warmth. Paternal parenting style and temperament were not found to be predictive of treatment outcome. While this study did not directly measure parental conflict, certain parenting styles and temperaments may cause tension between children and their parents, leading to greater conflict. A separate line of research has examined more objective predictors of CBT response, using neural measures.

Neural Reward Responsiveness and Treatment Response

Recent research has investigated the neural mechanisms associated with treatment response in depressed and anxious participants. Electroencephalogram (EEG) is often used to measure reward responsiveness. While EEG data have poor spatial resolution, they do offer good temporal resolution which allows researchers to examine fast processes such as affective processing. By administering an EEG, researchers can measure the reward positivity (RewP) component, which is an event-related potential component that occurs around 250-350ms

following the presentation of a reward (Tunison et al., 2019). Additionally, EEGs have the potential for clinical utility due to affordability compared to other brain imaging techniques, which is especially important to note when reviewing the implications of the results of this study. Nonetheless, the use of EEGs to measure reward responsiveness as a predictor of response to treatment is a relatively new field of research.

Burkhouse et al. (2016) used EEGs to measure the relationship between neural responses to reward and CBT treatment outcomes for mood disorders in adults. All participants (30 with anxiety and 22 with anxiety and depression) received the same CBT treatment and completed a monetary reward EEG task. The results of the study revealed that reduced reward responsiveness, as measured by RewP, before treatment was associated with greater success to CBT. Additionally, participants with reduced reward responsiveness and both depression and anxiety, as opposed to just anxiety, had greater depressive symptom reduction at the end of treatment. This may indicate that reward responsiveness is especially predictive of treatment outcomes in individuals with depression.

More recently, this approach was extended to include children and adolescents as well. Kujawa et al. (2019) recruited a sample of 27 children, ranging from 7 to 19 years old, with either social and/or generalized anxiety disorders to assess how RewP to monetary reward predicted change in symptomology following either a CBT or selective serotonin reuptake inhibitor (SSRI) intervention. The results of the study indicated that reduced reward responsiveness was predictive of greater changes in depressive symptoms, particularly following the CBT intervention.

Another recent study conducted by Webb et al. (2021) found late positive potentials (LPP), a more sustained response to emotionally salient stimuli, to be predictive of depressive

symptom change. Participants (36 adolescent girls with depression and 29 age-matched healthy controls) completed a monetary reward gambling task at three different time points (pretreatment, mid-treatment, and posttreatment). The clinical group underwent a 12-week CBT treatment program. The results of the study revealed greater pretreatment LLP to be predictive of increased depressive symptom change. Pretreatment RewP, on the other hand, was not significant, suggesting that only the later stages of reward processing affected pre-to-post treatment symptom change.

Most of the studies concerning the neural mechanisms involved with varying treatment outcomes relied on monetary reward tasks. While this is a reliable measure, it does not necessarily fit into the framework of adolescent depression and CBT as well as social reward does due to the inherently social nature of communication and building relationships during adolescence and in group therapy. To create more ecologically valid neural tasks, researchers have begun to develop innovative approaches to measuring social processes, including social reward responsiveness, in adolescents with depression.

For example, Silk et al. (2017) had the mother of each participant record 30-second audio clips of praise, criticism, and neutral statements that were then played for the participants as they underwent an fMRI scan. The researchers found that participants with MDD had a blunted neural response to maternal praise when compared to neutral statements, which was not found in the control group. The same methodology was used in a study investigating the three-way relationship between maternal acceptance, peer victimization, and neural response to parental feedback in relation to the development of depressive symptoms (Sequeira et al., 2019). The results of the analyses revealed that the positive association between peer victimization and depressive symptoms was strongest amongst participants who reported low maternal acceptance

and had increased neural activation to parental praise. While Silk et al. (2017) found that blunted neural activation to praise is associated with depression, Sequeira et al. (2019) suggests that high neural activation to praise is indicative of increased risk of developing depressive symptoms. This inconsistency reveals the need for further research investigating the relationship between neural reward responsiveness and adolescent depression.

Limitations of Prior Studies

In addition to several discrepancies between results, the limitations of these studies should also be acknowledged. One limitation is that many of these studies relied solely on self-report data which can be biased. An individual who reports high family instability and high conflict, for example, may have more negative perceptions in general which could impact treatment responses. Additionally, many of the studies relied on relatively small sample sizes which may lead to inflated results or minimal effect sizes.

Current Study

Based on the variability and limitations of past literature, more research is needed to understand the complexity of predictors of response to treatment in depressed adolescents. By understanding the environmental and neural factors that affect treatment outcomes, clinicians may be able to tailor interventions to increase treatment responsiveness. The current study examines the relationship between parental conflict, neural responsiveness to social reward, and treatment outcomes. While past research may have investigated one or two of these factors, no studies have examined all three within the same group of participants. This study attempted to answer three research questions: (1) is neural response to social reward associated with parental conflict, (2) does neural response to social reward predict treatment outcomes, and (3) does parental conflict impact successful response to CBT? Based on psychological theories and the findings from past research, the results of this study were hypothesized to reveal that (1) neural

response to social reward would be associated with parental conflict, (2) blunted neural response to social reward would predict better response to treatment, and (3) greater parental conflict would be indicative of less improvement within treatment.

Method

Participants

Participants were 70 clinically depressed adolescents between the ages of 14 and 18 years old with a mean age of 15.81 (*SD* = 1.46). At baseline, 25.71% of participants were diagnosed with MDD, 38.57% with PDD, and 35.71% with concurrent PDD and MDD. The sample was 34.3% male and 65.7% female. Of the 70 participants, 59 were White/Caucasian, five were Black/African American, three were Hispanic/Latinx, two were Asian, and one was mixed race. The participants were recruited through Vanderbilt University Medical Center psychiatric and pediatric clinics and Pennsylvania State College of Medicine before the study was moved exclusively to Vanderbilt University. Additionally, advertisements were put up on websites and social media platforms and were mailed to the university and the community.

Interested parents of minors and adult participants (18 years old) first completed a phone screening to determine initial eligibility, followed by a baseline assessment with a full diagnostic interview. The inclusion criteria required the participants to have MDD, PDD, or PDD with major depressive episodes (MDE) as measured by the Kiddie Schedule for Affective Disorders and Schizophrenia – Present and Lifetime Version (K-SADS - PL; Birmaher et al., 2009) and a Clinical Global Impression (CGI; Guy, 1976) severity rating of four or greater, indicating moderate severity of depression. Adolescents who had comorbid externalizing or anxiety disorders were included in the study. Adolescents were excluded from the study if they had lifetime substance use disorders, intellectual or developmental disabilities, or have had psychosis, schizophrenia, or mania. Participants who were taking antipsychotic medications,

mood stabilizers, or had changes in the dosage of their antidepressants within 30 days of intake were also ineligible to participate. Further, if participants had started other forms of therapy within 30 days of intake, were already in a CBT group, or were in an inpatient care facility, they did not meet eligibility for the study. If the potential participant had current suicidal intent, they were referred to outside individual resources and were excluded from the study. The referral may have involved an immediate safety plan and visit to the hospital depending on the severity of the situation. Participants who did not speak fluent English or had visual or hearing impairments that would potentially interfere with study procedures were also excluded.

Of the 70 participants who completed all intake measures, 66 participants completed the EEG, 56 participants participated in some treatment sessions, and 36 participants completed treatment through session 16.

Design

This study was a longitudinal between-subjects design with a single intervention condition. All participants went through the same CBT group treatment. Participants completed assessments prior to treatment, every two weeks during treatment, four weeks following treatment, and eight weeks following treatment. The CBQ and EEG measures were completed before treatment, and the CGI measure was completed by the clinician during treatment every two weeks. In the case of participant withdrawal from treatment, the last CGI score obtained was used for analysis. The variables assessed were parental conflict, RewP to social acceptance relative to rejection feedback, and clinician-rated improvement across treatment.

Procedure

After participants were informed that they were eligible for the study, they visited the lab and gave their informed consent/assent to participate. Participants and parents then underwent the initial diagnostic interview conducted by either a clinical psychology PhD student or a

master's level research assistant under the supervision of a licensed psychologist. The diagnostic interview included the DSM-V version of the Kiddie Schedule for Affective Disorders to obtain clinical diagnoses and lifetime history of psychopathology. The interviews were recorded and the diagnoses were confirmed by a licensed psychologist. The CGI was also used to determine severity of depression at intake. Participants also completed The Mood and Feelings Questionnaire (MFQ) and the PROMIS Anxiety Pediatric Scale, which were used to control for both depression and anxiety symptom severity in the analyses. The Conflict Behavior Questionnaire for both moms and dads were completed by participants as well.

EEG data were then collected from the participants. The EEG was either administered the same day as the intake interview or approximately one week later depending on the availability of the participant. The researchers recorded six minutes of resting-state EEG data while the participant rested comfortably. The participant then completed the social reward Island Getaway (Kujawa et al., 2014) EEG task and were debriefed.

After the EEG assessments were completed, the CBT group intervention sessions began. Up to ten participants were included in each group, and the sessions ran twice a week for eight weeks (16 sessions total). The groups were led by one master's or doctoral level clinician and one bachelor's or master's level co-leader. The sessions were audio recorded to ensure that the content was similar across groups. Each session lasted from one and a half to two hours in duration. The sessions followed The Adolescent Coping with Depression Course (Rohde et al., 2005). Each session included relaxation skills, behavioral activation, cognitive therapy, social skills, problem solving, and relapse prevention.

After the intervention was completed, participants completed the same questionnaires from baseline and were also re-assessed at four- and eight-week follow-up visits to measure longer term outcomes.

Measures

The five measures that were included in the study were depression symptom severity, anxiety symptom severity, parental conflict, the reward positivity event-related potential (ERP) derived from a social reward task, and treatment response as measured by clinician-rated improvement.

Depression and Anxiety Symptoms at Baseline

The MFQ was used to measure depressive symptom severity at intake (Angold et al., 1995). The assessment consists of 33 phrases pertaining to how the subject has been feeling over the past two weeks. The participant can respond as "true", "sometimes true", or "not true." The MFQ is scored as a sum of all responses where "true" corresponds to two points, "sometimes true" corresponds to one point, and "not true" corresponds to zero points. The scores can range from zero, indicating no depressive symptoms, to 66, indicating high levels of depressive symptoms.

The PROMIS Anxiety Pediatric Scale was administered to determine anxiety symptom severity at intake (Irwin et al., 2010). Participants are asked to think how they have felt over the past week and answer the 13 corresponding statements accordingly. The participant can record their response as "never" (one point), "almost never" (two points), "sometimes" (three points), "often" (four points), and "almost always" (five points). The scores are then added up and range from 13, which suggests no anxiety, to 65, which is indicative of high anxiety.

Parental Conflict

To quantify parental conflict, the participant completed the CBQ. The questionnaire consisted of 20 true or false questions pertaining to the parent-child dynamic (Robin & Foster, 1989). Participants were instructed to think about their home lives over the previous two weeks

and answer the questions accordingly. After the questionnaire is completed, the researchers score the assessment by referencing the key. Depending on the participant responses, the researcher adds a point for questions that correspond to greater conflict. Therefore, the scores range from zero to 20, with zero indicating no conflict and 20 indicating high conflict. The CBQ has been used to reliably assess parent-child conflict in past research. Each participant completed a CBQ for the parent(s) involved in their lives (n=67 for mothers; n=60 for fathers).

Neural Response to Social Feedback

The second measure examined RewP, a neuropsychological measure of reward responsiveness, recorded during a social reward EEG task. The EEG data was collected on a BrainProducts actiCHamp System and BrainVision software for data acquisition and processing. The task, entitled The Island Getaway Task, is based off the TV show *Survivor* where contestants vote each other off the island (Kujawa et al., 2014). During the task, participants were asked to create a profile for themselves. A photograph was taken using the web camera on the computer that served as their profile picture. Participants filled out their basic profile, which included their location, age, gender, and hobbies, for other users to see. After their profile was completed, the participant then viewed the profiles of their co-players. Participants were led to believe these other profiles to be real, but they were computer generated. The participant then voted to either keep or to kick out other users. Each voting round consisted of trials corresponding to the number of players left in the game (e.g. 11 trials in round one, 10 trials in round two, etc.) Once the participant voted, a "+" sign appeared to indicate that the other players were voting. After a fixed interval modeled after real response times, either a green thumbs up was presented, to indicate the other players had voted to keep the participant in, or a red thumbs down appeared, to indicate the other players had voted to kick the participant out (Figure 1). This feedback was presented for 2000 milliseconds followed by a blank screen presented for 1500

milliseconds to indicate the beginning of a new round. In between each round, participants would answer "poll questions" to get to know the other participants even more. An example of a prompt is "who do you most admire?" After six rounds of voting, the participant was informed that they won the game and made it to the Big Island with a group of peers before the EEG stopped recording. The participants were then debriefed. Researchers informed the participants that the other profiles were not actual participants and that the feedback they received was fixed and was not based on how others perceived their profile. Participants were additionally given the option to have their data excluded from the study.

EEG data were analyzed using BrainVision Analyzer software (Brain Products, Munich, Germany). Data were band-pass filtered with cutoffs of 0.1 and 30 Hz and corrected for ocular movements according to protocols given in Gratton et al. (1983). Data were segmented 200 ms prior to and 800 ms following feedback. Faulty recordings at single electrode sites were interpolated using the signal from surrounding electrodes. Artifacts were removed using a semiautomated procedure according to the following criteria: voltage steps greater than 50 μV, maximum voltage difference of 175 μV, a minimal allowed amplitude of -200 μV and maximal allowed amplitude of 200 μV, and lowest allowed activity of 0.50 μV within 100 ms intervals, followed by visual inspection of the data to reject any remaining artifacts. ERPs were averaged separately across acceptance/win (reward) trials and rejection/loss (non-reward) trials. The baseline was set to 200 ms prior to feedback. RewP was scored 275-375 ms at Cz, consistent with prior work (Foti & Hajcak, 2009; Ethridge et al., 2017; Pegg et al., 2020; Rappaport et al., 2019). The difference between acceptance and rejection trials was used in analyses (Figure 2).

Clinician-Rated Improvement with Treatment

The final measure encompassed the participant's response to treatment as measured by the CGI every other week. Group leaders considered the progress each participant had made

from their first session to the current session. The leaders then ranked that progress on a scale from one to seven (one = very much improved; two = much improved; three = minimally improved; four = no change from baseline (the initiation of treatment); five = minimally worse; six = much worse; seven = very much worse). This measure served as a tool to determine treatment response.

Data Analysis

The data were analyzed using Jamovi 2.0 and R statistical software. Three main analyses were conducted that corresponded to the three hypotheses of the study: (1) bivariate correlations to explore the association between parental conflict and neural response to social reward, (2) a linear regression to test the relationship between neural response to social reward and treatment outcome, (3) and a linear regression to examine the relationship between parental conflict and treatment outcome. Both linear regressions controlled for age, gender, baseline depressive symptoms, and baseline anxiety symptoms. These covariates were included to ensure that individuals with greater symptomology, who may have more conflict and less improvement within treatment to begin with, were not confounding the results. By controlling for these factors, the results highlight the effects specifically related to the relevant variables. In cases of missing data, listwise deletion was used.

Results

Clinical Characteristics and Differences between Treatment Completers and Non-Completers

A paired-samples t-test was used to determine if there were any significant differences in terms of age between those who completed treatment and those who did not. A Chi Square test of independence was used to test whether gender affected who did and did not finish treatment as well. Both tests revealed that were no significant differences between participants who finished

treatment and those who did not on account of age, $t(54)=.41$, $p = .69$, or gender, $X^2(1, n = 56) = 1.11$, $p > .05$.

Bivariate Correlations

Bivariate correlations between parental conflict, anxiety symptoms, depressive symptoms, RewP at baseline, and the last completed clinician-rated improvement are reported in Table 1. Lower clinician-rated improvement was strongly correlated with greater paternal conflict and moderately correlated with greater maternal conflict. Neural response to social reward was not significantly correlated with treatment response or parental conflict.

Linear Regressions

Next, linear regression analyses were conducted to examine both parental conflict and RewP predictors of clinician-rated improvement across treatment. Results are presented in Table 2. Greater paternal conflict uniquely predicted change in improvement when controlling for age, gender, and baseline anxiety and depressive symptoms. Interestingly, maternal conflict was not significantly predictive of improvement across treatment in regression analyses. Further, reward responsiveness as measured by the RewP did not significantly predict change in improvement.

Discussion

This study examined environmental and biological predictors of response to CBT among depressed adolescents. More specifically, parental conflict and social RewP were used to predict improvement in treatment. The results of the study supported the hypothesis that greater parental conflict decreased improvement within treatment, however, only conflict with dads remained a significant predictor when accounting for baseline depression and anxiety. Neural response to social reward was not found to be significantly associated with parental conflict or predictive of treatment response.

The hypothesis regarding the predictive value of parental conflict on treatment improvement was based on previous literature demonstrating the negative relationship between parental conflict and treatment responsiveness. Specifically, several studies have found that less maternal conflict was predictive of greater success in treatment, suggesting conflict with mothers had a stronger relationship with treatment outcome than conflict with fathers (Feeny et al., 2009; Rengasamy et al., 2013; Festen et al., 2013). Although the hypothesis of this study did not differentiate between maternal and paternal conflict, the results revealed that conflict with moms no longer significantly predicted treatment response when accounting for baseline symptoms and paternal conflict. This outcome is certainly unexpected considering there is limited literature supporting only paternal conflict as a predictor of treatment responsiveness. This may be explained by the fact that participants in the sample reported relatively more conflict with their dads (mean = 5.29) as opposed to their moms (mean = 4.91). Additionally, adolescents tend to have distinct relationships with their mothers versus their fathers. Starting from a young age, mothers, for example, are more involved with the physical care of their child while fathers tend to focus on recreational activities. The same study found that fathers are less likely to provide physical care to their daughters as opposed to their sons (Yoshida, 2012). These differences in childcare may extend to adolescence and young adulthood as well. Female college students consistently reported greater communication and closeness with their mothers as opposed to their fathers (Nielsen, 2007). Adolescents are also more likely to disclose personal information to their mothers as opposed to their fathers (Smetana et al., 2006). Due to this emotional distance, conflict with fathers, especially among girls, may have a stronger adverse effect on adolescent mental health than conflict with mothers.

While neural response to social reward was hypothesized to be associated with parental conflict, the results did not reveal a significant interaction which differs from previous literature.

Research regarding the interaction between neural reward responsiveness and depressive symptomology used recordings of parental praise and criticism as the stimuli when measuring brain activity. (Silk et al., 2017; Sequeira et al., 2019). Although these studies did not actually measure the relationship between neural responsiveness and parental conflict, the use of parental feedback as an emotional stimulus for brain imaging reveals the impact the two have on one another. If an individual is particularly sensitive toward social reward, for example, they may interpret seemingly neutral statements as hostile or aggressive. The reverse may also be true. Parental conflict may cause an individual to seek validation from peers as opposed to family, which places an increased importance on social reward within adolescence. Based on the results, however, the association between the two factors was not found to be statistically significant. Therefore, there is not as clear of a connection between neural responsiveness to social reward and parental conflict as previously thought.

While this study and previous research (Fryer, 2021) did not identify significant associations for social RewP and improvement within treatment, prior literature has largely found a predictive relationship between monetary RewP and treatment response (Burkhouse et al., 2016; Kujawa et al., 2019), such that reduced monetary reward responsiveness is predictive of greater success in CBT treatment. These mixed results may suggest specificity in types of reward processing, which may account for differences in treatment response. Perhaps monetary reward responsiveness has a greater impact on treatment outcome than social reward. The varying results could be on account of the several limitations discussed later in the section.

There are several implications related to the findings of this study. Clinicians can either administer the CBQ or talk to their client to evaluate their relationship with their father prior to the start of treatment. If the CBQ or the client identifies distress from parental conflict, the clinician can then tailor the intervention to focus on interpersonal relationships. Based on

previous research highlighting the lack of effective father-daughter communication (Nielsen, 2007), interventions that promote successful communication may be of particular interest. Additionally, while CBT primarily focuses on cognitive processes, the addition of social processes, such as interpersonal problem solving and conflict resolution skills, could increase the efficacy of treatment. By targeting social processes during treatment, individuals may not only experience less conflict in general, but may be able to respond to conflict more appropriately. More research is needed to understand exactly if this emphasis, however, is sufficient to mitigate this risk factor.

In addition to its implications, the study has limitations that should be mentioned as well. The sample was largely White (84.3%) and identified as predominately female gender (65.7%). A larger sample that is more racially diverse and inclusive of all gender identities is needed to generalize to the broader adolescent population. This limitation is further exacerbated by the amount of participant attrition and, subsequently, may have been underpowered. While 70 participants completed the intake session, only 36 completed treatment through session 16. As a result, only half of the initial participants were included in the majority of analyses. The study additionally relies on several self-report assessments at intake which can be biased on account of the recency effect or the tendency to respond in a socially acceptable way. This limitation is somewhat counteracted by the inclusion of several other variables that do not rely on self-report data. While the Island Getaway task, used to measure RewP, provides more objective measures, it has limitations as well. The task is primarily used to imitate social reward among peers, which may not extend to parental relationships. This could explain why there was not a significant effect between RewP and parental conflict. A task that utilizes parental praise and criticism, for example, may have been a more appropriate measure.

Future research should conduct similar methodology within a larger and more diverse sample to increase the generalizability of results. Studies could include a comparison group to identify if various factors, such as type of disorder, affect the results. Future research could also investigate how conflict with fathers may be fundamentally different than conflict with mothers in relation to adolescent mental health outcomes. While there are some hypotheses relating to this outcome, more experimental research is needed to conclusively understand this phenomenon. Additional research should be dedicated towards not only determining risk factors, but also identifying interventions that may mitigate the negative implications of paternal conflict. Based on the results of this study, interventions such as a parent-child programs or mindfulness courses, both of which are linked to increased family functioning (Adams, 2001; Xie et al., 2021), would be appropriate to investigate. It is important to note that while many parent training programs are designed for both mothers and fathers to engage with, there are generally much lower rates of paternal participation (Tully et al., 2019). As a result, it is important to include an equal proportion of mothers and fathers when investigating the efficacy of parent training intervention programs and to encourage more fathers to participate in these programs in general.

The purpose of this study was to include both environmental (parental conflict) and biological (RewP) factors when assessing depressed adolescents' likelihood to improve within group CBT sessions. The results revealed that greater paternal conflict is predictive of less improvement within treatment. While more research is needed to confirm these conclusions, the results offer an invitation to further investigate potential interventions to increase improvement in treatment. As more literature is published, the closer researchers and clinicians will be to improving treatment options and decreasing depressive symptomology across all adolescents.

References

Adams, J. F. (2001). Impact of parent training on family functioning. *Child & Family Behavior Therapy*, *23*(1), 29–42. https://doi.org/10.1300/j019v23n01_03

Angold, A., Costello, E. J., Messer, S. C., Pickles, A., Winder, F., & Silver, D. (1995). The development of a short questionnaire for use in epidemiological studies of depression in children and adolescents. *International Journal of Methods in Psychiatric Research*, *5*, 237–249.

Birmaher, B., Ehmann, M., Axelson, D. A., Goldstein, B. I., Monk, K., Kalas, C., Kupfer, D., Gill, M. K., Leibenluft, E., Bridge, J., Guyer, A., Egger, H. L., & Brent, D. A. (2009). Schedule for affective disorders and schizophrenia for school-age children (K-SADS-PL) for the assessment of preschool children--a preliminary psychometric study. *Journal of psychiatric research*, *43*(7), 680–686. https://doi.org/10.1016/j.jpsychires.2008.10.003

Burkhouse, K. L., Kujawa, A., Kennedy, A. E., Shankman, S. A., Langenecker, S. A., Phan, K. L., & Klumpp, H. (2016). Neural reactivity to reward as a predictor of cognitive behavioral therapy response in anxiety and depression. *Depression and Anxiety*, *33*(4), 281–288. https://doi.org/10.1002/da.22482

Ethridge, P., Kujawa, A., Dirks, M. A., Arfer, K. B., Kessel, E. M., Klein, D. N., & Weinberg, A. (2017). Neural responses to social and monetary reward in early adolescence and emerging adulthood. *Psychophysiology*, *54*(12), 1786-1799. https://doi.org/10.1111/psyp.12957

Feeny, N. C., Silva, S. G., Reinecke, M. A., McNulty, S., Findling, R. L., Rhode, P., . . . March, J. S. (2009). An exploratory analysis of the impact of family functioning on treatment

for depression in adolescents. *Journal of Clinical Child & Adolescent Psychology*, *38*(6), 814-825. https://doi.org/10.1080/15374410903297148

Festen, H., Hartman, C. A., Hogendoorn, S., de Haan, E., Prins, P. J., Reichart, C. G., Moorlag, H., & Nauta, M. H. (2013). Temperament and parenting predicting anxiety change in cognitive behavioral therapy: The role of mothers, fathers, and children. *Journal Anxiety Disorders*, *27*(3), 289–297. https://doi.org/10.1016/j.janxdis.2013.03.001

Foti, D., & Hajcak, G. (2009). Depression and reduced sensitivity to non-rewards versus rewards: Evidence from event-related potentials. *Biological Psychology*, *81*(1), 1-8. https://doi.org/10.1016/j.biopsycho.2008.12.004

Fryer S. L. (2021). Doubling down on developing reward system neurobiology markers of antidepressant treatment response. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, *6*(1), 3–5. https://doi.org/10.1016/j.bpsc.2020.10.017

Gratton, G., Coles, M. G., & Donchin, E. (1983). A new method for off-line removal of ocular artifact. *Electroencephalography and Clinical Neurophysiology*, *55*(4), 468-484. https://doi.org/10.1016/0013-4694(83)90135-9

Guy, W. (1976). *ECDEU assessment manual for psychopharmacology*. US Department of Health, Education, and Welfare, Public Health Service, Alcohol, Drug Abuse, and Mental Health Administration, National Institute of Mental Health, Psychopharmacology Research Branch, Division of Extramural Research Programs.

Irwin, D. E., Stucky, B., Langer, M. M., Thissen, D., Dewitt, E. M., Lai, J. S., Varni, J. W., Yeatts, K., & DeWalt, D. A. (2010). An item response analysis of the pediatric PROMIS anxiety and depressive symptoms scales. *Quality of Life Research: An International*

Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, *19*(4), 595–607. https://doi.org/10.1007/s11136-010-9619-3

James, A. C., James, G., Cowdrey, F. A., Soler, A., & Choke, A. (2013). Cognitive behavioural therapy for anxiety disorders in children and adolescents. *The Cochrane Database of Systematic Reviews*, (6), CD004690. https://doi.org/10.1002/14651858.CD004690.pub3

Keyes, K. M., Gary, D., O'Malley, P. M., Hamilton, A., & Schulenberg, J. (2019). Recent increases in depressive symptoms among US adolescents: trends from 1991 to 2018. *Social Psychiatry and Psychiatric Epidemiology*, *54*(8), 987–996. https://doi.org/10.1007/s00127-019-01697-8

Kujawa, A., Arfer, K. B., Klein, D. N., & Proudfit, G. H. (2014). Electrocortical reactivity to social feedback in youth: A pilot study of the Island Getaway task. *Developmental Cognitive Neuroscience*, *10*, 140–147. https://doi.org/10.1016/j.dcn.2014.08.008

Kujawa, A., Burkhouse, K. L., Karich, S. R., Fitzgerald, K. D., Monk, C. S., & Phan, K. L. (2019). Reduced reward responsiveness predicts change in depressive symptoms in anxious children and adolescents following treatment. *Journal of Child and Adolescent Psychopharmacology*, *29*(5), 378-385. https://doi.org/10.1089/cap.2018.0172

McDermut, W., Miller, I. W., & Brown, R. A. (2001). The efficacy of group psychotherapy for depression: A meta-analysis and review of the empirical research. *Clinical Psychology Science and Practice*, *8*(1), 98–116. https://doi.org/10.1093/clipsy.8.1.98

Nielsen, L. (2007). College daughters' relationships with their fathers: a 15 year study. *College Student Journal*, *41*(1), 112+. https://link.gale.com/apps/doc/A161282236/AONE?u=tel_a_vanderbilt&sid=bookmark-AONE&xid=8a5a90f4

Pegg, E. J., Taylor, J. R., & Mohanraj, R. (2020). Spectral power of interictal EEG in diagnosis and prognosis of idiopathic generalized epilepsies. *Epilepsy & Behavior*, *112*, 107427. https://doi.org/10.1016/j.yebeh.2020.107427

Rappaport, Xing, Y., Kanhere, O., Ju, S., Madanayake, A., Mandal, S., Alkhateeb, A., & Trichopoulos, G. C. (2019). Wireless Communications and Applications Above 100 GHz: Opportunities and Challenges for 6G and Beyond. *IEEE Access*, *7*, 78729–78757. https://doi.org/10.1109/ACCESS.2019.2921522

Rengasamy, M. R., Mansoor, B. M., Hilton, R., Porta, G., He, J., Emslie, G. J., … Brent , D. A. (2013). The bi-directional relationship between parent–child conflict and treatment outcome in treatment-resistant adolescent depression. *Journal of the American Academy of Child & Adolescent Psychiatry*, *52*(4), 370–377. https://doi.org/10.1016/j.jaac.2013.01.012

Robin, A. L., & Foster, S. L. (1989). *The Guilford family therapy series. Negotiating parent–adolescent conflict: A behavioral–family systems approach.* Guilford Press.

Rohde, P., Lewinsohn, P. M., Clarke, G. N., Hops, H., & Seeley, J. R. (2005). The adolescent coping with depression course: A cognitive-behavioral approach to the treatment of adolescent depression. In E. D. Hibbs & P. S. Jensen (Eds.), *Psychosocial Treatments for Child and Adolescent Disorders: Empirically Based Strategies for Clinical Practice*. 219–237. American Psychological Association.

Rohde, P., Seeley, J. R., Kaufman, N. K., Clarke, G. N., & Stice, E. (2006). Predicting time to recovery among depressed adolescents treated in two psychosocial group interventions. *Journal of Consulting and Clinical Psychology*, *74*(1), 80–88. https://doi.org/10.1037/0022-006X.74.1.80

Sequeira, S. L., Butterfield, R. D., Silk, J. S., Forbes, E. E., & Ladouceur, C. D. (2019). Neural activation to parental praise interacts with social context to predict adolescent depressive symptoms. *Frontiers in Behavioral Neuroscience*, *13*, 222. https://doi.org/10.3389/fnbeh.2019.00222

Silk, J. S., Lee, K. H., Elliott, R. D., Hooley, J. M., Dahl, R. E., Barber, A., & Siegle, G. J (2017). 'Mom-I don't want to hear it': Brain response to maternal praise and criticism in adolescents with major depressive disorder. *Social Cognitive and Affective Neuroscience* *12*(5), 729–738. https://doi.org/10.1093/scan/nsx014

Smetana, J. G., Metzger, A., Gettman, D. C., & Campione-Barr, N. (2006). Disclosure and secrecy in adolescent-parent relationships. *Child Development*, *77*(1), 201–217. https://doi.org/10.1111/j.1467-8624.2006.00865.x

Spirito, A., Esposito-Smythers, C., Wolff, J., & Uhl, K. (2011). Cognitive-behavioral therapy for adolescent depression and suicidality. *Child and Adolescent Psychiatric Clinics of North America*, *20*(2), 191–204. https://doi.org/10.1016/j.chc.2011.01.012

Tully, L. A., Piotrowska, P. J., Collins, D., Frick, P. J., Anderson, V., Moul, C., Lenroot, R. K., Kimonis, E. R., Hawes, D., & Dadds, M. R. (2019). Evaluation of 'the father effect' media campaign to increase awareness of, and participation in, an online father-inclusive parenting program. *Health Communication*, *34*(12), 1423–1432. https://doi.org/10.1080/10410236.2018.1495160

Tunison, E., Sylvain, R., Sterr, J., Hiley, V., & Carlson, J. M. (2019). No money, no problem: Enhanced reward positivity in the absence of monetary reward. *Frontiers in Human Neuroscience*, *13*, 41. https://doi.org/10.3389/fnhum.2019.00041

Webb, C. A., Auerbach, R. P., Bondy, E., Stanton, C. H., Appleman, L., & Pizzagalli, D. A. (2021). Reward-related neural predictors and mechanisms of symptom change in cognitive behavioral therapy for depressed adolescent girls. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, 6*(1), 39-49. https://doi.org/10.1016/j.bpsc.2020.07.010

What Is Cognitive Behavioral Therapy? (2017, June). Retrieved November 16, 2020, from https://www.apa.org/ptsd-guideline/patients-and-families/cognitive-behavioral

Xie, Q.-W., Dai, X., Lyu, R., & Lu, S. (2021). Effects of mindfulness-based parallel-group interventions on family functioning and child and Parent Mental Health: A systematic review and meta-analysis. *Mindfulness*, *12*(12), 2843–2864. https://doi.org/10.1007/s12671-021-01728-z

Yoshida, A. (2012). Dads who do diapers: Factors affecting care of young children by fathers. *Journal of Family Issues*, 33(4), 451–477. https://doi.org/10.1177/0192513X11415358

Table 1. Descriptive statistics and bivariate correlations (Pearson's r) between study variables

	M (SD)	**1**	**2**	**3**	**4**	**5**	**6**
1. Anxiety Symptoms	31.77 (11.68)	--					
2. Depression Symptoms	34.53 (14.85)	.58***	--				
3. RewP (accept-reject)	1.81 (4.91)	.17	.10	--			
4. Conflict - Mom	4.91 (5.19)	-.02	.19	-.11	--		
5. Conflict - Dad	5.29 (4.95)	-.19	.01	-.23	.20	--	
6. Clinician-rated improvement	3.02 (0.90)	.08	.20	-.21	.32*	.40**	--

Note: RewP = Reward positivity; *p<.05. **p<.01. ***p<.001.

Table 2. Linear regression of treatment outcome and study variables

	Clinician-rated improvement	
Step 1	***b* (SE)**	**β**
Age	-.09 (.08)	-.14
Gender (girls)	-.08 (.25)	-.04
Step 2		
Anxiety Symptoms	.00 (.01)	.04
Depression Symptoms	.01 (.01)	.20
Step 3		
RewP (accept-reject)	-.03 (.02)	-.14
Conflict - Mom	.04 (.03)	.21
Conflict - Dad	.06 (.03)	.32*

Note: RewP = Reward positivity; *p <.05. *b* = unstandardized coefficient; SE = standard error; β = standardized coefficient

Figure 1. Stimuli presented in the Island Getaway task

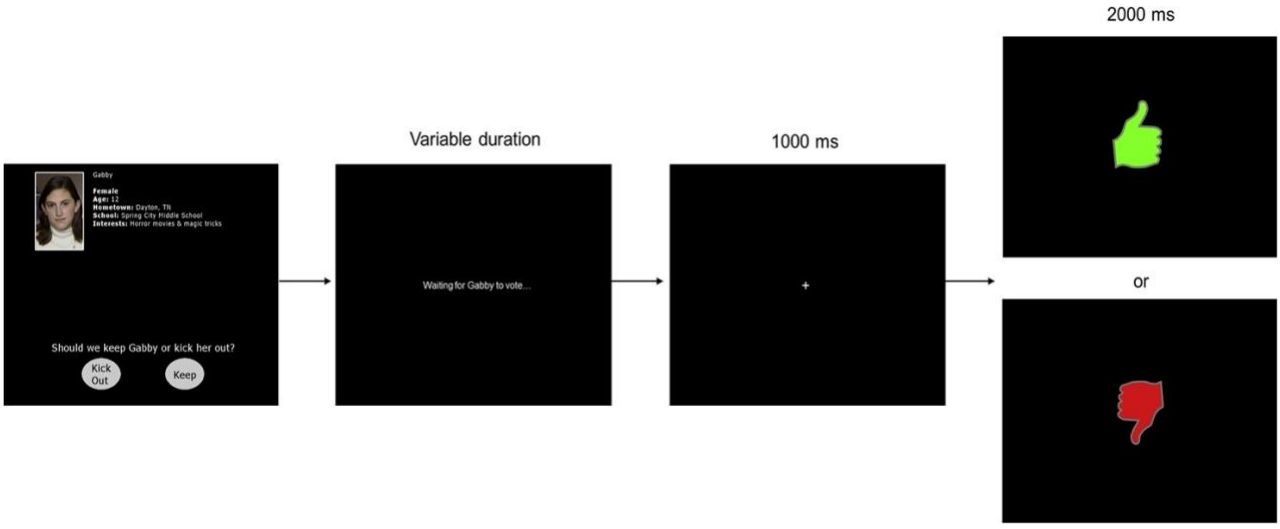

Figure 2. Three-dimensional scalp distribution of the difference in ERPs between accept – reject conditions 250-350 milliseconds after feedback in the overall sample.