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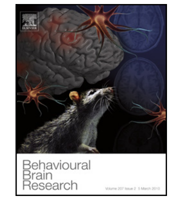

Research report

The impact of therapists' words on the adolescent brain: In the context of addiction treatment

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HIGHLIGHTS

- This study aimed to evaluate how therapist language influences the adolescent brain.
- We evaluated this question with 17 binge drinking youth.
- All youth showed significant reductions in drinking post-treatment.
- Therapist language was linked to brain response in parieto-temporal, reward, and self-reflection areas.
- Brain response in these areas was associated with adolescent behavior change.

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ABSTRACT

At this time, we still do not know how *therapist* behaviors influence adolescent brain response and related treatment outcomes. Therefore, we examined this question with 17 binge drinking youth (mean age = 16.62 years; 64.3% female; 42.9% Hispanic; 28.6% bi-/multi-racial). In this within-subjects design, all youth completed a baseline assessment, two therapy sessions, an fMRI scan, and were re-evaluated for behavior change at one-month post-treatment. During the fMRI session, youth were presented with two types of responses from their treating therapist: higher-skill statements prescribed in an empirically-supported addiction treatment (complex reflections) vs. language standard within addiction treatment more broadly (closed questions). In terms of behavior change, at the one-month follow-up, youth showed significant reductions in number of drinking days and binge drinking days. Further, we found main effects for complex reflections and closed questions across the superior middle temporal gyrus and middle temporal gyrus (FWE-corrected, $p < .05$). Greater brain response was observed for complex reflections versus closed questions within the bilateral anterior cingulate gyrus. Greater BOLD response in the parietal lobe during closed questions was significantly associated with less post-treatment drinking. Lower BOLD response during complex reflections and closed questions in the precuneus were associated with greater post-treatment ratings of importance of changing. This study represents a first step in understanding how therapist behaviors influence the developing adolescent brain and how that neural response may be associated with youth treatment outcomes.

1. Introduction

Not only do adolescents exhibit high levels of binge drinking (defined as ≥3 drinks/occasion for adolescent females; ≥4 drinks/occasion for adolescent males) [1], binge drinking is associated with a panoply of risk behaviors within this age group [2]. One of the greatest reasons for concern is that binge drinking has been directly linked to an increased incidence of accidents and injuries

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[1], which is the leading cause for mortality for adolescents [3]. Importantly, despite engaging in this risk behavior, binge-drinking youth do not self-refer; therefore, they are unlikely to seek, receive, or complete indicated addiction treatment [4]. Concretely, recent American surveys indicate that 89.6% of individuals with substance use disorders (SUDs) never receive intervention [5].

Subsequently, it is not only critical to improve access to brief behavioral treatments, it is also critical to improve their efficacy. One approach is to make behavioral treatments as powerful as possible, so that when youth receive them, they have the greatest possibility for behavior change, defined here as clinically-significant reductions in binge drinking and related harms [6]. An intervention that is an ideal candidate for this context and age group is motivational interviewing (MI) [7]. While not initially developed for youth, this brief, empathic, and strength-based approach reaches and quickly facilitates therapeutic relationships, particularly with non-treatment seeking youth [8–10]. Qualitatively, adolescents report that the therapeutic style of MI resonates with them [11,12].

Despite its promise, MI is not universally effective. While one of the three strongest evidence-based addictions practices for this age group (http://www.nrepp.samhsa.gov), meta-analyses suggest that effect sizes for behavior change following MI are much less robust for adolescents ($d = 0.17$) [13] as compared with adults ($d = 0.77$) [14]. This may be because we do not fully understand how MI works, particularly with younger samples [15]. Thus, innovative approaches are needed to elucidate how MI operates.

One reason why MI might be less powerful with adolescents may stem from natural neurodevelopmental differences within this age group. Studies continue to highlight the unique structure and function of the brain during the adolescent years [16–18]. The field of developmental neuroscience is still unraveling the degree to which the adolescent brain is adaptive (i.e., enabling the drive to explore and gain new experiences) or overly disposed toward dangerous decision-making (i.e., an "immature" system programmed for risk) [19–21]. At this time, the prevailing theoretical frameworks [e.g., "dual process" [22]; "triadic" [23]; "imbalance" [24], highlight a developmental mismatch, particularly between the control and reward systems. In this respect, less developed control systems, including the medial frontal gyrus (MFG) and inferior frontal gyrus (IFG), may contribute to adolescents' difficulty inhibiting impulsive behaviors, and bias youths' selection toward riskier decisions across myriad contexts. In terms of the reward system, critical nodes include the dopaminergic (DA)-pathways of the orbitofrontal cortex (OFC), nucleus accumbens (NAc), ventral striatum (VS), and medial prefrontal cortex (mPFC). These areas are important for adolescents' evaluation of the magnitude and valence of rewards [25,26] [e.g., 25,26], along with processing social information [e.g.,27–29]. During adolescence, these regions show relatively greater activation than during other periods of development. This may be a reflection of substantive changes during this period, including the redistribution of DA receptor density in the PFC, striatum, and NAc, causing a greater release of DA in response to rewarding events during this timeframe [e.g.,30]. As a result, risk taking behaviors, such as drinking, which are inherently exciting, frightening, and fun, may indeed feel much more rewarding during adolescence [e.g.,31,32]. While well-established in the developmental neurocognitive literature, these differences are only beginning to be examined within the context of treatment [15,33].

In terms of compelling candidates for how and why addiction therapy works (and how and why it does not) [34], most process research in MI has relied upon examinining audio-recorded treatment sessions. This has revealed that certain client statements made within the course of treatment, such as those in favor of changing substance use (change talk; CT; e.g., "*I don't like who I become when I drink*") are strongly associated with successful behavior change [35,36]. In contrast, this has also shown that client statements in support of substance use (sustain talk; ST; e.g., "*Drinking is fun*") are associated with continued use [34]. Interestingly, most of this research has focused on the client side of this relationship. Yet, studies point to the critical role of *therapists* in this clinical exchange [37–39]. For instance, following the seminal work of Patterson and Forgatch [40], Glynn and Moyers [41] found that when therapists utilized more skillful techniques prescribed in MI practice, including complex reflections (e.g., *"You've seen what happens to people at parties when they have passed out")* young substance users provided significantly more CT, as compared with when therapists utilized approaches that are generally not recommended within MI practice and training [7], such as closed questions (e.g., "*Did you drink this weekend? How much?"; "Do your parents know?*"). This is clinically relevant because many addiction treatment efforts, particularly with youth, rely heavily on therapists' use of standard addictions approaches generally discouraged in MI, including use of closed questions.

In terms of the neural networks that might be relevant in this therapeutic exchange, adolescent studies have found greater brain response, measured by increases in blood oxygen level dependent (BOLD) activity during CT in self-reflection and contemplation regions including the posterior cingulate gyrus and precuneus [15]. Importantly, these increases in BOLD activity were associated with behavior change; youth who showed greater BOLD response showed greater reductions in cannabis use, dependence, and problems at the one-month follow-up [15]. Notably, other studies have also underscored the importance of using genuine therapeutic exchanges in youth brain response. Specifically, a separate study found significantly greater BOLD response among emerging adult drinkers when they were re-presented with their own in-session client language, as compared with youth who were re-presented with statements that "sounded like" client language but were not generated in a therapeutic session [42]. Further, studies continue to suggest that importance, readiness, and motivation to change may also be salient in the relationship between neural response and treatment outcome [43].

While adult behavioral studies have supported the causal chain from therapist behaviors to treatment outcomes [44,45], we still do not know how therapist behaviors influence treatment response for adolescent binge drinkers. Moreover, we do not know what neural mechanisms are relevant in this equation. Thus, in this study, we utilized a within-subjects design from a neurodevelopmental perspective to understand what happens to adolescents' brains during two types of therapist statements. We then evaluated how that brain response related to post-treatment behavior change (number of drinking days; importance of changing drinking). Based on prior studies [15], we hypothesized that we would observe greater BOLD response in youths' medial frontal gyrus (MFG), inferior frontal gyrus (IFG), and insula during therapist statements prescribed in MI (complex reflections) as opposed to the therapist statements that are more common in standard adolescent addiction treatment (closed questions). We also predicted that we would find an inverse association between youths' BOLD response (MFG, IFG, insula) and post-treatment substance use.

2. Material and methods

2.1. Participants: informed consent and description

Seventeen unique community-based youth participated in a translational study aimed at reducing adolescent health risk behaviors. Youth were recruited via local outreach methods (e.g., posted signs, word of mouth). All youth were required to be binge drinkers,