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Participant–Experimenter Rapport in Experimental Settings: A Test Case of Executive Functions Among Children With ADHD

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There is a growing interest in the effects of social engagement on cognition, yet, research on the effects of social engagement with the experimenter in empirical contexts has been sparse. During an experiment, the experimenter and participant form a dyad, establishing a certain level of rapport—a sense of a positive and congruent relationship. This rapport is thought to promote performance by providing a comfortable testing environment, thereby reducing resource demand, and enhancing participant engagement and willingness to exert effort to perform. The current study sought to better understand the role of rapport by examining the effects of perceived rapport on effortful control, that is, inhibition and shifting, in an experimental setting among children with and without attention-deficit/hyperactivity disorder (ADHD). Forty-nine children (9 to 12 years old) were divided into two groups based on ADHD classification (i.e., typically developing children, $n = 27$; children with ADHD, $n = 22$). Participants completed the day/night Stroop task and the Wisconsin Card Sorting Task following a short rapport-building conversation with the experimenter. Later, both participant and experimenter filled the CHARM questionnaire reporting the rapport constructed during the experiment. Results show moderating effects of ADHD on the relationship between perceived rapport quality and congruency, and participant's executive functions performance. Specifically, children with ADHD showed higher susceptibility to rapport quality and were impervious to the effects of rapport congruency. Results highlight the importance of rapport with the experimenter in experimental research and suggest incorporating considerations concerning rapport, both in designing the experimental paradigm as well as an independent factor affecting task performance and outcome.

Keywords: rapport, interpersonal interaction, executive functions, ADHD, empirical setting

Our brains are constantly influenced by our interactions with one another (Adolphs, 2010; Davidson & McEwen, 2012; Siegel, 1999). Whether by the mere presence of others (Bond & Titus, 1983), social roles (Terry, Hogg, & White, 1999), the mental representation of others (Shah, 2003), or the interaction with one another (Chartrand & Bargh, 1999), our social encounters affect the way we process and function in our daily lives (Levine, Resnick, & Higgins, 1993). There is an increasing interest in how we affect one another cognitively through social engagement. Despite this, social aspects of the interaction between the experimenter and their participant, a basic interpersonal interaction, which are present in most psychological experimenting, have been left somewhat unnoticed. This interaction may have a key influence on the performance of the participant. Awareness of the participant–experimenter interaction may facilitate engagement and optimal performance or provide a controllable measure of systematic variance. The current study, therefore, explores the effects of participant–experimenter rapport on cognitive performance.

In his writing on the role of the experimenter in behavioral research, Robert Rosenthal explained as follows: "[W]hatever we can learn about the experimenter and his interaction with his subject becomes uniquely important to the behavioral scientist" (Rosenthal, 1976).[1] Indeed, the role of the experimenter was of high importance and received great interest in the 1960s and 1970s, which was in conjunction with the boom of experimental and cognitive psychology (Higbee & Wells, 1972). Research on experimenters' roles focused thus far on how (1) the characteristics of the experimenter, such as gender or race and his or her congruence with the participants' characteristics, impacted both participant performance and experimenter rating (Rumenik, Capasso, & Hendrick, 1977; Sattler, 1970) and (2) studies examined the role of

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[1] This is written in masculine form, but it plausibly refers to both genders.

the experimenter's expectations and how the performance of different study groups changes accordingly (Rosenthal & Rubin, 1978). These findings were the basis of experimental practices used today, such as blind and double-blind experimenting, aimed to eliminate the role of the experimenters' expectancies on study results. It is important to note that literature has mostly focused on how to minimize experimenter bias because it enters artifacts into the experimental design. Yet, as the experimenter is such an inherent part of the experiment, the interpersonal effects may be viewed as inevitable and should be explored as a factor that can be controlled or even used. Moreover, as different populations arrive at experiments with different motivations, taking note and utilizing the interpersonal interaction may serve to moderate performance differences that are motivationally biased. However, experimental research on experimenter–participant interactions remains sparse.

During an experiment, the experimenter and participant form a dyad with a shared goal—the successful completion of the experimental procedure. Indeed, research has shown that among typically developing children, the presence of the experimenter improves performance (Chevallier, Parish-Morris, Tonge, Le, Miller, & Schultz, 2014). For this, the dyad must form some level of rapport which aids in fostering cooperation (Drolet & Morris, 2000). *Rapport* is characterized as an interpersonal interaction with a variety of positive and cooperative attributes; emphasizing sympathy, understanding, cooperation, pleasantness, engagement, and harmony (Bernieri, Davis, Rosenthal, & Knee, 1994; Bernieri, Gillis, Davis, & Grahe, 1996; Jap, Robertson, & Hamilton, 2011). In the clinical field, it is an axiom that creating a good rapport is vital for the success of assessment processes (Groth-Marnat, 2009; Sattler & Hoge, 2006). Indeed, rapport-constructing behaviors have been found to improve scores in cognitively demanding assessment tasks, such as arithmetic (Krämer et al., 2016) and IQ (Feldman & Sullivan, 1971). Hence, understanding rapport's role during experimental procedures is necessary, yet, research on the effects of experiencing rapport from the perspective of the dyadic partners is missing in the empirical arena.

In the field of investigational interviewing, there has been a rise in empirical testing of the role of rapport (Abbe & Brandon, 2013). During an investigation, it is important to develop rapport and an alliance with the interviewee to enable and elicit them to provide information (Walsh & Bull, 2011). Indeed studies have shown that rapport promoted responsiveness, cooperation and higher recall of correct information in both adults (Collins, Lincoln, & Frank, 2002; Kieckhaefer, Vallano, & Schreiber Compo, 2014; Vallano & Compo, 2011) and children (Almerigogna, Ost, Bull, & Akehurst, 2007; Davis & Bottoms, 2002). Two paths have been suggested for how rapport enables better outcomes—enlistment of greater effort and reduction of anxiety. The forming of rapport between investigator and interviewee increases the interviewee's motivation to be cooperative and forthcoming during the investigation (Abbe & Brandon, 2013). In addition, the investigative setting may be perceived as stressful and demanding—the interviewee is faced with a new environment that is different than the normal day-to-day setting and includes distracting stimuli that demand attentional resources and inhibitory control. The construction of good rapport may serve as a tool to form an alliance, reduce anxiety during the investigation, and diminish the demand on the interviewee's attentional resources (Almerigogna et al., 2007; Vallano & Schreiber Compo, 2015), thereby improving task performance. Applicable to experimental settings, with the experimenter blind to the test condition, creating a sense of rapport would similarly aid in engaging the participant, boosting exertion of effort to perform up to their potential abilities and have more resources for the task at hand in taxing environments. (see Figure 1; Feldman & Sullivan, 1971; Tickle-Degnen, 2006).

The formation of rapport is a dyadic process in which a mutual sense of bond is formed (Abbe & Brandon, 2013; Sharpley, Guidara, & Rowley, 1994) and is apparent in an increase of rapport-inducing behaviors and the synchronization in physiological markers within the dyad (Sharpley et al., 1994). In their characterization of rapport manifestation, Tickle-Degnen and Rosenthal (1990) offered three main observable components of rapport that are important: *Positivity* of the relationship, marked by friendliness and caring toward the other; *mutual attention* for which both agents attend and orient toward the other, showing interest in what the other is doing or saying; and *coordination* between the pair, creating a sense of synchrony. Indeed, a recent study showed that dyadic rapport is derived from increased coordinated expressivity and promotes a better mood (Nelson, Grahe, & Ramseyer, 2016). Moreover, research on the interaction between adult strangers has shown that synchrony (LaFrance, 1979; Vacharkulksemsuk & Fredrickson, 2012) and responsive positive reactions of one interacting agent create a sense of rapport and reliability in the other (Kleiman, Kashdan, Monfort, Machell, & Goodman, 2015). Tickle-Degnen and Rosenthal's observable rapport components serve both as behaviors that may induce rapport and as perceivable cues that the dyadic partners and their surroundings can use to understand the nature of the relationship formed. Importantly, it is the dyadic partner's perception of the relationship formed between them that is supposed to serve as the agent of change when eliciting motivation and reducing surrounding resource demand. Examining the perceived quality of rapport (expecting it to be correlated mostly with the observed positivity), and the congruence of the dyadic partners' report (being more related to the observed mutual attention and coordination they form) is necessary to identify what aspects of the interaction affect the participant's willingness to invest effort in the task and as a result their performance.

To test the effect of perceived rapport on participants' cognitive performance during an experiment, the current study explored performance in two primary executive functions (EF)—inhibitory control and shifting tasks. EF provides the cognitive basis for action needed during task performance (Zelazo & Müller, 2002). EF are cognitive processes that dynamically monitor and regulate human cognition and behavior (Miyake & Friedman, 2012; Miyake et al., 2000). Miyake et al. (2000) defined three foundational EFs—inhibition (i.e., the ability to inhibit a response or cognitive process), updating/working memory (i.e., the ability to monitor and update processed information), and shifting (i.e., the ability to shift between mental processes). These functions stand at the basis of cognition and action as they allow for task processing, planning, execution, and evaluation (Zelazo & Müller, 2002).

Although EFs are considered developmentally stable (Miyake & Friedman, 2012), they are still subject to situational effects, due to emotional content and motivation (Lindström & Bohlin, 2011; Mitchell & Phillips, 2007; Shields, Sazma, & Yonelinas, 2016). Impairment of EF due to emotional manipulations is mainly attributed to resource allocation, as EF capabilities decrease while

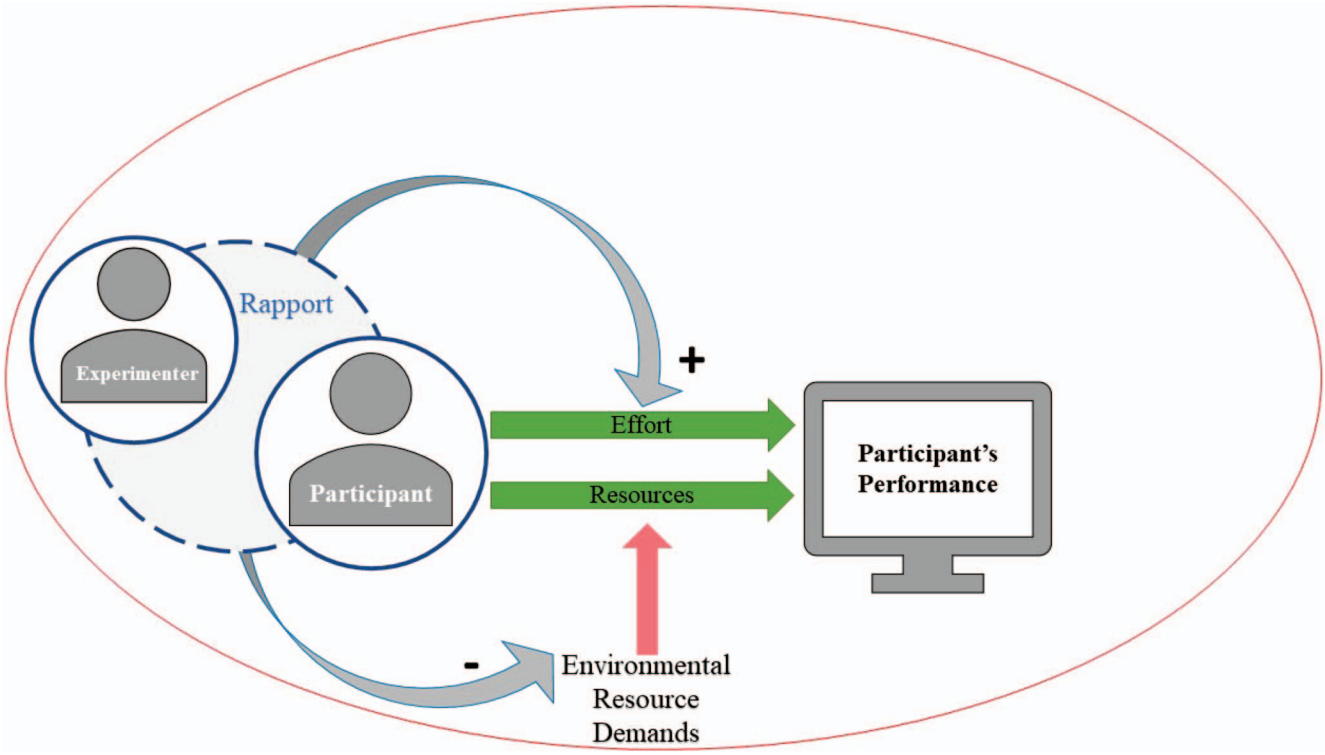

Figure 1. A theoretical model of the influence of rapport within the experimental procedure. See the online article for the color version of this figure.

resources are allocated to cope with the emotional stimuli (Lindström & Bohlin, 2012). Consequently, populations with reduced EF resources, such as the elderly (Phillips, Smith, & Gilhooly, 2002) and children with attention-deficit/hyperactivity disorder (ADHD; Yarmolovsky, Szwarc, Schwartz, Tirosh, & Geva, 2017), are plausibly more prone to EF impairment in regulating performance in emotional context, particularly such that are negative or ambiguous. Moreover, affectively related brain structures (e.g., the cingulate cortex, the amygdala, and the nucleus accumbens) are thought to be engaged with prefrontal function, thus indicating a link between affect-driven motivation and EF performance (Pessoa, 2009). Therefore, creating a testing situation that both reduces cognitive resource demand and elicits motivation for cognitive effort may be vital for successful performance.

When examining how rapport affects EF performance, the study population must be considered. ADHD is a neuropsychological disorder characterized by difficulties in maintaining attention, inhibitory control, and impulsivity (APA, 2013; Barkley, 1997). Children and adolescents with ADHD show more EF deficits compared with typically developed children (Biederman et al., 2004; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Yet, when motivated, these EF deficits lessen (Bioulac et al., 2014; Slusarek, Velling, Bunk, & Eggers, 2001). Further, children with ADHD are known to suffer from social difficulties (Wehmeier, Schacht, & Barkley, 2010), including social communication impairment (Geurts & Embrechts, 2008; Klimkeit et al., 2006) and emotion recognition deficits (Jusyte, Gulewitsch, & Schönenberg, 2017; Ludlow, Garrood, Lawrence, & Gutierrez, 2014). As the development of EF is considered crucial for school performance (Alloway & Alloway, 2010; Duckworth & Seligman, 2005), health (Miller, Barnes, & Beaver, 2011) and future life outcomes (Eakin et al., 2004), understanding how rapport may impact children's effortful control performance is therefore crucial. Children with ADHD exhibit both difficulty in resource allocation (Barkley, 1997; Dekkers et al., 2017; Gualtieri & Johnson, 2006)—showing deficiencies when confronted with multiple and incongruent stimuli—and motivational deficits (Dekkers et al., 2017; Haenlein & Caul, 1987; Volkow et al., 2011). As situational effects of resource demand and motivation are related to EF performance, examining the moderating role of ADHD classification on the relationship between perceived rapport and EF performance may highlight susceptibility or resilience to social effects during experiments.

The current study has two aims: (1) to explore the role of participant–experimenter perceived rapport in an experimental procedure and (2) to serve as an example of the differential effects of rapport as a function of the study population. First, we examined the independence of perceived rapport quality and rapport congruence from one another, expecting to find no correlation between them. In addition, perceived rapport quality was expected to relate to observed positivity of the interaction, and perceived rapport congruency to relate to observed mutual attention and coordination. Second, we examined how perceived and observed rapport affect executive functioning (EF) during an experimental situation (i.e., inhibition and shifting), postulating that both rapport quality and congruency will relate to improved EF. Last, we expected ADHD classification to interact with both perceived rapport di-

mensions in their relations to EF performance, such that the effects of rapport quality and rapport congruency on performance will be seen more prominently among children with ADHD.

Method

Participants

Participants were 53 children between the ages of 8 and 12 (M age = 10.50 ± 1.01; 46.9% girls). The participants were neurotypically developing children and those with ADHD who were recruited as a subsample of a larger study including other clinical populations. The sample size was similar to previous studies examining the effect of motivation on EF performance among children with ADHD (Bioulac et al., 2014; Slusarek et al., 2001). Recruitment was conducted using flyers posted in online groups of neighborhoods around the university. Eight children had incomplete questionnaire data. For four children with only one of the CHARM questionnaires missing, data were filled with the mean of the rest of the study population. The other four children, having completed neither of the rapport questionnaires, were removed from further analysis (the four children performed better in the Wisconsin Card Sorting Task [WCST; Mann–Whitney $\chi^2 = 2.45$, $p = .010$] but otherwise did not differ from the rest of the sample). Participants were classified as typically developing or with ADHD according to a parental *DSM*-based questionnaire of ADHD symptoms. Children with more than six symptoms in either hyperactivity or inattention were classified with ADHD ($n = 22$) and the rest were classified as typically developing children ($n = 27$). None of the typically developing children were previously clinically diagnosed with ADHD, compared with more than half of the study ADHD population with a previous ADHD diagnosis (for more demographic information see Table 1). Participants with prescribed medication for ADHD were instructed not to take the medication prescribed for the day of the experiment. All participants were offered monetary compensation, in the order of a $75 gift card to a toy store, for their participation in the large-scale study, irrespective of performance.

Materials

EF. EF was measured using two widely acceptable computerized tasks: a computerized version of the day/night Stroop task, measuring inhibitory control (Gerstadt, Hong, & Diamond, 1994; Ramon, Geva, & Goldstein, 2011), and the computerized Wisconsin Card Sorting Task measuring shifting capabilities (Heaton, 1981; Kongs, Thompson, Iverson, & Heaton, 2000). EF performance score was computed based on the following quotient:

$$EF\ performance = \frac{Z_{DayNight\_accuracy} - Z_{DayNight\_CorrectRT}}{2} + Z_{WCST\_perseverative\ errors\ t-score}.$$

Computerized day/night Stroop task. The day/night task is a commonly used Stroop-like task, that does not require any reading skills, and is used to assess inhibitory control among children from preschool age to young adults (Brocki & Bohlin, 2004; Gerstadt et al., 1994; Montgomery & Koeltzow, 2010; Ramon et al., 2011). Previous use of the task to examine emotional effects in children with ADHD has been fruitful (Yarmolovsky et al., 2017). Although considered an inhibitory task, the complex nature of the task also entails the use of working memory capacities (Garon, Bryson, & Smith, 2008; Nigg, 2000). As the accuracy in the original task is high (Lagattuta, Sayfan, & Monsour, 2011; Passler, Isaac, & Hynd, 1985), stimulus presentation time was reduced in the current study to a more demanding 120-ms presentation to increase task difficulty.

The task was designed using E-prime 2 software (Psychology Software Tools Inc. Pittsburgh, PA) and comprises two blocks. In the introductory block, participants are presented with eight 500-ms presentations of either a sun image or a moon image and are required to click on the corresponding mouse key. Subsequently, in the trial block, an inhibitory component is added as participants are instructed to press the opposite key than the image they are presented with. The trial procedure consists of a fixation cross presented for 800 ms, followed by a 100-ms pause and then a 120-ms stimulus presentation, all of which were followed by 1,000 ms for the participant to respond. This procedure is repeated for 16 trials (eight sun images and eight moon presented randomly). The participant may respond from the moment the stimulus appears and up to 1,120 ms after its appearance. Once a participant responds, the next trial begins. If no response is recorded during the allocated time frame, the next trial appears automatically. Measures of accuracy and response time (RT) in the

Table 1
Descriptive Statistics of Typically Developing Children and Children With ADHD

Variable	Typically developing children	Children with ADHD	Statistic
Gender	51.9% female	40.9% female	$\chi^2 = .58$, $p = .567$
Age	10.44 ± 1.03 years	10.58 ± 1.01 years	$t(47) = -0.46$, $p = .649$
ADHD inattentive symptoms	1.19 ± 1.67	6.91 ± 1.38	**$t(46) = -12.77$, $p < .001$**
ADHD hyperactive symptoms	2.23 ± 1.39	4.36 ± 2.50	**$t(31.68) = -3.56$, $p = .001$**
ADHD clinical diagnosis	0%	59.1%	**$\chi^2 = 21.72$, $p < .001$**
WISC-IV vocabulary[a]	11.22 ± 2.75	9.09 ± 2.79	**$t(47) = 2.68$, $p = .010$**
WISC-IV matrices[b]	10.41 ± 3.50	8.82 ± 3.83	$t(47) = 1.52$, $p = .140$
CHARM-A M	3.26 ± .19	3.29 ± .27	$t(46) = -0.49$, $p = .629$
CHARM-C M	2.23 ± 1.39	4.36 ± 2.50	$t(44) = 0.60$, $p = .553$

Note. ADHD = attention-deficit/hyperactivity disorder; WISC-IV = Wechsler Intelligence Scale for Children–Fourth Edition; CHARM-A = Child–Adult Rapport Measure–Adult report; CHARM-C = Child–Adult Rapport Measure–Child report. Bold = difference significance $p < .050$.
[a] Vocabulary subscale score of the WISC-IV (Hebrew version; Wechsler, 2003). [b] Matrices subscale score of the WISC-IV (Hebrew version).

"correct" trials were recorded (no correlation was found between the two measures: $p = .285$).

Wisconsin Card Sorting Test–64 Card Version (WCST-64 CV). An abbreviated computer-administered form (Kongs et al., 2000) of the original 128 card version of the Wisconsin Card Sorting Test (WCST; Heaton, 1981) was administered. In the task, participants are required to sort cards according to one of three different stimulus parameters (i.e., color, shape, and number) and alter their approach during test administration. Four response cards (one red triangle, two green stars, three yellow crosses, and four blue circles) constantly appear on the screen, and participants receive a set of 64 cards to sort according to one of the card's parameters. The sorting rule persists until the participant sorts 10 consecutive cards by the rule, then the rule changes, and the participant, required to recognize the rule switch, should alter his or her responses. Like other shifting tasks, the WCST entails a combination of EF skills as it requires the ability to maintain multiple sets of rules (working memory) and inhibit a predominant set (inhibition) so to allow the shift to the new rule (shifting).

The test was scored for the number of categories completed and perseverative errors (i.e., an error that repeats an error based on the same category; Kongs et al., 2000). As categories completed and perseverative errors were highly correlated ($r = .574$, $p < .001$), only perseverative errors were taken as a measure of shifting as they were standardized based on age-corrected norms (Kongs et al., 2000).

Perceived Rapport

When examining the quality of a relationship, it is key to understand it from the subjective perspective of all members (Cleary, Ray, LoBello, & Zachar, 2002; Furman, 1998). Rapport was thus evaluated using a form for the participants and a form for the experimenter.

Child–Adult Rapport Measure–Child report (CHARM-C). The CHARM-C is a self-report questionnaire made up of 20 items aimed at measuring the rapport the child feels with an adult interactor (Gurland & Grolnick, 2003, 2008). The 20 items are emotional sentences that describe the interaction (e.g., "She made me feel like trying hard" or "She gave me a relaxed feeling"). Children report how true the statements were for them using a four-point Likert scale, ranging from 1 (*not true at all*) to 4 (*very true*). The questionnaire has shown internal reliability for children between the ages of 9 and 13 (Cronbach's $\alpha = 0.94$; Gurland, Grolnick, & Friendly, 2012). In the current sample Cronbach's $\alpha = 0.76$.

Child–Adult Rapport Measure–Adult report (CHARM-A). The CHARM-A is the corresponding measure for the CHARM-C for adults. It is a 20-item self-report questionnaire filled out by the adult in the dyadic interaction. The items include sentences equivalent to those filled by the child but are from the perspective of the adult concerning the approach with which they interacted with the child. For example, while the child receives a sentence, such as "She made me feel relaxed," the adult receives a comparable sentence, such as "The approach I used made him/her feel relaxed" (S. Gurland, personal communication, June 2, 2014). Previous research with the CHARM-A reports a Cronbach's alpha of 0.69 (Merriman, 2013), and in the current study, Cronbach's alpha was 0.64. The correlation between the scores of the two CHARM questionnaires was insignificant ($r = .252$, $p = .095$).

Evaluation of perceived rapport quality allows to evaluate each partner's ratings and enables the evaluation of the relationship quality in two ways. First, it provides a rating of rapport quality perceived by each member of the dyad, and second, it offers a measure of congruency among the agents' rapport ratings derived from computing rating differences between experimenter and participant (Cleary et al., 2002; Iafrate, Bertoni, Margola, Cigoli, & Acitelli, 2012; Parker & Asher, 1993; Trafimow, 2015). The level of congruency indicates how coordinated and mutual the relationship is, and by that attests to the harmonious nature of the relationship. Combined, quality and congruency values give a representation of the dyad's perceived rapport.

CHARM-A and CHARM-C mean scores were combined to create a measure of rapport quality. Also, the absolute difference between the two measures was calculated and reversed as an indicator of rapport congruency so that higher values represent higher congruence.

Observed Rapport

The introductory conversation was taped and later rated by one of 3 independent observers on a six-point Likert-scale for positivity, mutual attention, and coordination. The intraclass correlation coefficient (ICC) was calculated for a single rating based on a two-way random-effects model of absolute agreement based on a subsample of interactions coded by all three observers (McGraw & Wong, 1996). Positivity was defined as how positive the interaction seemed, was there a sense of pleasantness, caring, and friendliness (ICC = .773). Mutual attention was defined by how attentive the participant and experimenter were toward one another and the invested interest in what the other said and did (ICC = .868). Coordination was defined by the degree to which the interaction was predictable and synced between participant and experimenter, as manifested by the adjustment of body posture to one another, shared and synced movements and coordinated conversation (ICC = .933).

ADHD Classification

With regard to ADHD symptoms, parents filled out a *DSM*-based symptoms report about their children (APA, 2013). The questionnaire described inattentive and hyperactive symptoms indicative of ADHD and parents were asked to indicate whether their child exhibits that symptom. In accordance with ADHD classification for children in *DSM–5*, children were classified as children with ADHD if they exhibited more than six symptoms of either inattention or hyperactivity (APA, 2013).

Procedure

The study was approved by Bar-Ilan University's Institutional Review Board. Parents of all participants signed informed-consent forms before the children's arrival at the research lab. Participants arrived at the research lab, where they met an experimenter. Experimenters were six psychology and neuroscience undergraduate students experienced with the administration of the testing battery and were instructed to construct a good rapport with the

participants. Instructions given to the experimenters were to be attentive and friendly with the participant throughout the experiment, make sure to notice the participant's needs and assist when needed. Aiming to establish a high sense of rapport, prior to the administration of the tasks, the experimenter and participant sat for an unstructured introductory conversation (*M* length = 7.5 ± 5.3 min) in which they both told one another a little about themselves and talked about their interests, family, school and other activities. At the end of which the experimenter explained the upcoming tasks. Experimenters were blind to the study's objective, the relevant tasks, and children's ADHD symptoms. Indeed, validation analysis indicated no experimenter bias on EF performance (median test: $\chi^2[5] = 6.79$, $p = .237$). Nevertheless, as intraclass correlation coefficient (ICC) analysis revealed that 8.6% of the variance in EF performance is related to the experimenter identity, analyses of rapport on EF performance were run while considering this random effect.

Following the short introductory conversation (which was video recorded), participants underwent the day/night Stroop task and the Wisconsin Card Sorting Task. Upon completion of all tasks, while alone in a room, participants filled out the CHARM-C questionnaire. At the same time, the experimenter filled the CHARM-A questionnaire in an adjacent room. At the end of the meeting, participants received a toy store gift-card. The introductory conversation was later rated by an independent rater for positivity, mutual attention, and synchronicity between the participant and the experimenter.

Results

Perceived and Observed Rapport

Mean perceived rapport quality was high (for means and correlations of perceived and observed rapport measures see Table 2), indicating that overall the quality of rapport established during the experiment was typically good. Mean rapport congruency score was close to zero, however, the participant's rating of the interaction was higher compared to the experimenters (Willks' $\lambda = .712$, $F[1, 48] = 19.41$, $p < .001$). Pearson's correlation between the perceived rapport estimates of rapport quality and congruency was found to be nonsignificant, indicating that rapport quality and congruency represent two distinct aspects of rapport. Comparatively, observed rapport scores were around the scale midpoint, thus, on average for an outside observer the interactions seemed neutral (i.e., neither negative nor positive). In addition, Correlations between the three observed measures were high indicating that the constructs were somewhat similar (see Table 2), especially mutual attention and coordination. Importantly, no correlations were found between the individual perceived rapport measures and the observed rapport measures, marking the importance of recording both observed and perceived rapport scores. There was a positive correlation between perceived rapport congruency and observed positivity, but no relations between perceived rapport quality and observed positivity, nor between perceived rapport congruency and observed mutual attention or coordination, suggesting that interactants use behavioral cues of positivity as markers of rapport.

Effects on Perceived and Observed Rapport

To examine the effects of ADHD classification on rapport a multivariate analysis of covariance was conducted controlling for WISC vocabulary scores and the five rapport measures as the dependent variables: perceived rapport quality and congruency and observed positivity, mutual attention and coordination. ADHD classification affected rapport, Willks' $\lambda = .691$, $F(5, 42) = 3.76$, $p = .007$. Following univariate tests showed that ADHD affected the observed ratings for mutual attention, $F(1, 46) = 10.69$, $p = .002$, partial $\eta^2 = .189$, and coordination, $F(1, 46) = 11.18$, $p = .002$, partial $\eta^2 = .196$, but not positivity, $F(1, 46) = 1.47$, $p = .232$, or the experimenter–participant perceived quality, $F(1, 46) = 1.28$, $p = .263$, or congruency, $F(1, 46) = 0.05$, $p = .831$. This indicates that although children with ADHD had more difficulty maintaining coordination ($M \pm SE = 2.70 \pm 0.24$) and mutual attention ($M = 3.03 \pm 0.26$) compared with the typically developing group ($M \pm SE$ coordination = 3.80 ± 0.21; $M \pm SE$ mutual attention = 4.23 ± 0.24), the interaction remained positive and was rated similarly regardless of ADHD classification. In addition, correlational analysis in the two groups revealed that while in the typically developing group correlation between positivity and perceived rapport congruency remained high ($r = .620$, $p < .001$) among children with ADHD the correlation was no longer significant ($r = .198$, $p = .376$).

A median test indicated that dyads had similar rapport quality, $\chi^2(5) = 8.70$, $p = .122$, and congruency, $\chi^2(5) = 7.84$, $p = .165$, regardless of who the experimenter was. Differences, however, were found for two of the observed measures (mutual attention $\chi^2[5] = 11.28$, $p = .046$; coordination $\chi^2[5] = 12.58$, $p = .028$) and a trend for positivity ($\chi^2[5] = 10.83$, $p = .055$). This indicates that while different experimenters interacted differently with the

Table 2
Correlations Between Perceived and Observed Rapport Measures

Variable	*M* (*SD*)	1	2	3	4	5	6	7
1. Participant perceived rapport quality	3.49 (0.32)	—	.228	.858***	−.361*	−.089	.258	.193
2. Experimenter perceived rapport quality	3.27 (0.22)		—	.696***	.549***	.214	.170	.220
3. Perceived rapport quality	6.76 (0.43)			—	.020	.029	.191	.178
4. Perceived rapport congruency	−0.32 (0.26)				—	.422**	.096	.151
5. Observed positivity	3.86 (1.15)					—	.556***	.546***
6. Observed mutual attention	3.69 (1.36)						—	.753***
7. Observed coordination	3.31 (1.12)							—

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

participants, the dyads' sense of rapport remained the same. Pearson's correlations between interaction length and the five measures of observed and perceived rapport indicated that the length of the interaction was solely related to observed positivity ($r = .292$, $p = .042$) and a trend was seen with observed coordination ($r = .262$, $p = .069$). Observed mutual attention and the perceived measures were unrelated to the interaction's length ($p < .212$, $p < .274$, $p < .537$, respectively).

Validity checks indicated that gender had no effect on the five measures: quality $t(47) = 1.30$, $p = .200$; congruency $t(47) = -0.70$, $p = .507$; positivity $t(47) = -1.32$, $p = .193$; mutual attention $t(47) = -1.73$, $p = .090$; coordination $t(47) = -0.95$, $p = .348$. No correlations were found between the five measures and the children's age (quality $p = .132$; congruency $p = .773$; positivity $p = .907$; mutual attention $p = .782$; coordination $p = .364$). Last, of the five measures only coordination was correlated with Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV) vocabulary ($r = .308$, $p = .031$) and none were related to WISC-IV matrices.

Effects of ADHD Classification on EF Performance

Overall performance in the day/night and WCST tasks was fair allowing sufficient variance to explore the proposed model. In the day/night task, participants had a mean accuracy of 61.08% ± 20.47% with a mean response time during correct response trials of 592.20 ± 195.48 ms. In the WCST, participants completed three categories on average and had a t score of 55.04 ± 15.54 for their perseverative errors, indicating that the current sample performed according to their age norm (Kongs et al., 2000). Correlational analysis between the performance measures of the two tasks revealed no correlations between the two tasks marking shifting and inhibitory control as two independent constructs (Miyake et al., 2000).

To examine the effects of ADHD classification (typically developing children compared with those with ADHD) on EF performance, a one-way analysis of covariance was conducted controlling for WISC vocabulary. A main effect $F(1, 46) = 6.08$, $p = .017$, partial $\eta^2 = .117$, indicated that typically developing children performed better in the EF tasks ($M \pm SE$ composite score = 0.19 ± 0.11) compared with children with ADHD ($M \pm SE$ composite score = −0.23 ± 0.12), indicating, as expected, that ADHD hinders EF capabilities.

Perceived Rapport as a Predictor of EF Performance

To examine the predictive value of the observed and perceived rapport measures on EF performance, backward elimination stepwise regression was conducted with EF performance as the dependent variable, while including the effect of ADHD classification and the random effect of experimenter identity, using the step function in the lmertest R package (Kuznetsova, Brockhoff, & Christensen, 2017; see Table 3 for original saturated model and elimination order) and the "lme4" (Bates, Mächler, Bolker, & Walker, 2014) and "r2glmm" (Jaeger, 2017) packages for computing the explained variance. Of all rapport measures, only perceived rapport congruency remained in the final model ($R^2 = .126$, 95% CI [.009, .327]) with the model explaining 32.4% (95% CI [14.9, 53.0]) of the variance in EF performance, indicating that the perceived sync created between experimenter and participant is important in the performance of EF during experimental tasks.

ADHD as a Moderator of the Relationship Between Perceived Rapport and EF Performance

To explore the hypotheses that ADHD classification moderates the relationship between experimenter-child perceived rapport and EF performance a mixed model regression was conducted using the "lmer" function in the "lme4" R package (Bates et al., 2014) with EF performance as the dependent variable. The predicting variables included perceived rapport quality, perceived rapport congruency, ADHD classification and the interaction variables of ADHD with the two rapport measures (ADHD × Rapport Quality and ADHD × Rapport Congruency). WISC vocabulary was entered as a controlled variable and experimenter as a random effect. To avoid matters of multicollinearity on the direct effects, the predictors were mean-centered (Shieh, 2011). ADHD classification ($R^2 = .203$, 95% CI [.046, .412]), rapport congruence ($R^2 =$

Table 3
Saturated Model of Perceived and Observed Rapport Measures Predicting EF Performance and Order of Elimination

Effect	Variance (*SE*)	*t*	*p*	Elimination order	*p*[a]
		Random effects			
Experimenter identity	0.22 (0.47)			Remained	.035*
		Fixed effects			
	Estimate (*SE*)				
Observed mutual attention	0.00 (0.09)	0.002	.998	1	.998
Observed positivity	0.01 (0.09)	0.15	.879	2	.873
Perceived rapport quality	0.16 (0.19)	0.86	.395	3	.360
Observed coordination	0.08 (0.09)	0.89	.380	4	.098†
Perceived rapport congruency	0.80 (0.33)	2.46	.018	Remained	.004**
Group	−0.56 (0.18)	−3.06	.004	Remained	<.001***

Note. EF = executive function.
[a] p value when variable was eliminated. If variable remained, p equals that in the final model.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

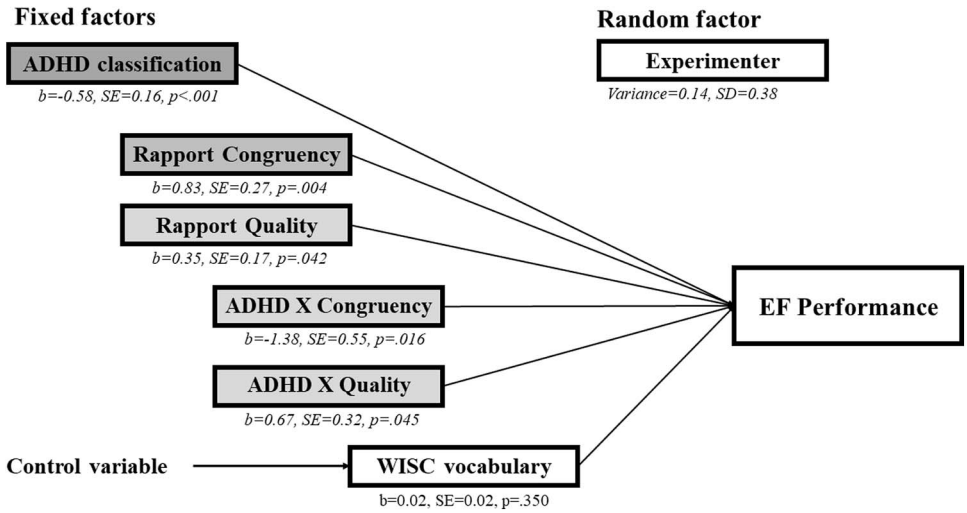

Figure 2. Coefficients of additive moderations model of attention-deficit/hyperactivity disorder (ADHD) classification moderating the relationship between both rapport congruency and rapport quality and executive function (EF) performance. legend. Dark gray marks = $p < .001$; medium gray marks = $p < .01$; light gray marks = $p < .05$. WISC = Wechsler Intelligence Scale for Children.

.129, 95% CI [.010, .331]) and rapport quality ($R^2 = .067$, 95% CI [.001, .249]) were all significant predictors of EF performance (see Figure 2). Additionally, the model showed that ADHD moderated the relationship of EF performance with both rapport congruency ($R^2 = .094$, 95% CI [.003, .287]) and rapport quality ($R^2 = .062$, 95% CI [.000, .241]) and the full regression model predicted 42.2% (95% CI [27.6, 62.6]) of the variance in EF performance. Among children with ADHD, the increase of perceived rapport quality resulted in improved EF performance (B = 0.72, 95% CI [0.21, 1.22]; see Figure 3, Panel a), whereas, among typically developing children such effect was not seen (B = 0.05, 95% CI [−0.36, 0.45]). In contrast, EF performance of children with ADHD was unaffected by rapport congruency (B = 0.07, 95% CI [−0.69, 0.83]; see Figure 3, Panel b), while typically developing children showed improved EF results as perceived rapport congruence grew (B = 1.46, 95% CI [0.71, 2.20]).

Discussion

The current study examined the role of participant–experimenter perceived rapport, showing that rapport plays a significant role in the outcome of the experiment. The rapport constructed during the experimental procedure, whether quality among children with ADHD or congruency among typically developing children, was found to be a predictor of the variance in EF performance during testing. The moderate–high relations of the rapport measures with performance, and how they act differently in the separate groups, substantiate the axiom not tackled in research thus far, on the importance of rapport during assessment processes (Groth-Marnat, 2009; Sattler & Hoge, 2006).

Perceived rapport quality and congruency were also not correlated to one another, signifying that sensing the interaction as positive and being synced represent two separate constructs and

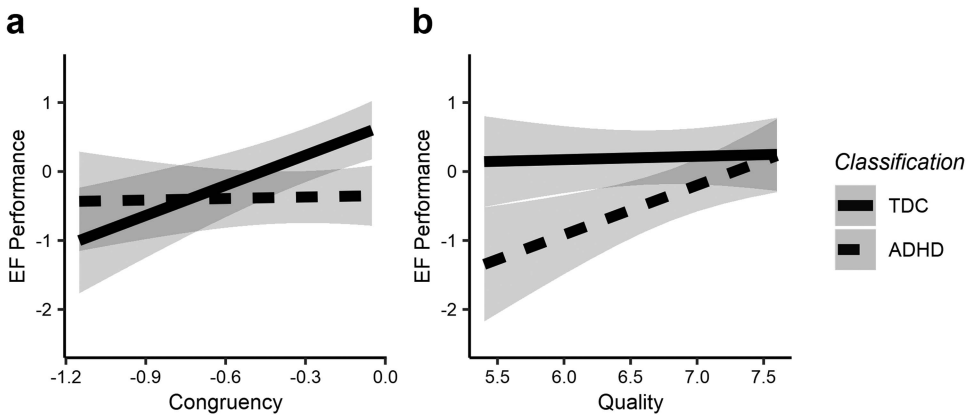

Figure 3. Panel a: Attention-deficit/hyperactivity disorder (ADHD) classification moderating the relationship between rapport quality and executive function (EF) performance. Panel b: ADHD classification moderating the relationship between rapport congruency and EF performance. TDC = typically developing children.

two separate needs of different populations during a testing situation. Partial relations between the perceived rapport measures and observed rapport measures indicate the importance of recording both. Current results indicated that perceived rapport quality was unrelated to the observed positivity of the initial interaction and perceived rapport congruency was unrelated to observed mutual attention or coordination. Congruency of perceived rapport, however, was positively related to observed positivity, signaling that when signs of positivity were clear to an outside observer, the interactants rated the interaction similarly to one another. Importantly, the effects of signs of rapport were not equal across groups. In the case of the current study, for example, this relationship only occurred among typically developing children, and not those with ADHD. Thus, results indicate that children with ADHD fail to utilize behavioral cues of positivity when assessing their rapport. The relations between and within observed and perceived rapport measures mark the need to examine the social relationship constructed in various tools and for various aspects. This understanding was further reinforced by the effects of rapport quality and congruency on EF performance among the two different populations.

ADHD sets an effective model to explore rapport in the experimental setting as children with ADHD often show impairments in social interactions (Wehmeier et al., 2010) and EF (Barkley, 1997; Willcutt et al., 2005). Regarding the interaction constructed between participant and experimenter, ADHD affected observed rapport behaviors, specifically mutual attention and coordination. Yet, it is important to note that both perceived rapport quality and congruency, were not affected by ADHD classification. Thus, findings signify that the experimenters managed to create a similar level of rapport with children regardless of attention deficit.

Differential effects of rapport were expected between groups, specifically expecting higher susceptibility to rapport among the ADHD group. Exploring the interaction between ADHD classification and rapport on test performance uncovered a double dissociation. Relationship between rapport congruency and EF performance was seen only among typically developing children, whereas the relationship between rapport quality and executive performance was noted only among children with ADHD. Specifically, among typically developing children, increased congruency in the ratings of rapport quality between child and experimenter was related to better EF scores. Children with ADHD, however, seemed unfazed by the discrepancy between their own sense of rapport quality and the experimenter. Even though one could expect that rapport congruency would facilitate performance among children with ADHD compared with typically developing children, the lack of effect of perceived rapport congruency on executive functioning among children with ADHD may be due to social attentional difficulties. For children with ADHD, who have difficulty maintaining attention on one task, the allocation of social attention needed to monitor the interpersonal interaction while they were engaged in the experimental task may be too taxing. Resorting to reduced social monitoring, together with difficulty in perceiving the emotional cues of the experimenter (Berggren, Engström, & Bölte, 2016; Boakes, Chapman, Houghton, & West, 2008; Da Fonseca, Seguier, Santos, Poinso, & Deruelle, 2009), result in the children's lack of awareness of the interactional incongruence, and therefore lack of effect on the task performance. Reminiscent of a difficulty faced by children with ADHD in utilizing social cues (Coutinho, Reis, da Silva, Miranda, & Malloy-Diniz, 2018), current findings of lack of correlation between observed positivity and perceived rapport congruency among children with ADHD, show their misuse of the positivity signals apparent in the interaction. In practice, this may be both a hardship and a defense mechanism among children with ADHD. On the one hand, the lack of awareness enables greater resilience to lack of congruency in the environment; while on the other hand, limiting opportunities for learning to modify the interaction with others and enhance engagement with the task at hand more adaptively.

Current results underscore this point by also showing that children with ADHD are contributed highly by a positive social interaction. High-quality rapport plausibly promotes motivation to invest the effort to succeed (Sattler & Hoge, 2006). This socially based drive seems to be especially effective among participants needing a boost in motivation, such as children with ADHD (Dekkers et al., 2017). This was apparent in the current study as ADHD moderated the relationship between rapport quality and executive functioning. A positive correlation, not seen among typically developing children, was noted between perceived rapport quality and EF performance among children with ADHD. This finding indicates that the construction of a good rapport as a dyad may have a protective influence on children with ADHD, acting as a stimulant of better performance. Positive social interaction enhances motivation and encourages exertion of executive abilities that children with ADHD otherwise fail to utilize. Therefore, emphasizing the need to promote the rapport in experimental designs seeking to examine the true potential of participants who are not necessarily driven to succeed or participants who are challenged by clinical or circumstantial demands, as was seen in the current design in children with ADHD.

Previous research has shown that children with ADHD suffer from depletion in both motivation and executive resources (Dekkers et al., 2017). Accordingly, results give further validation to the role of rapport as a facilitator of engagement and in maintaining a nonstressful or overbearing experimental setting. The children with ADHD showed increased executive performance as a function of rapport quality, indicating that the construction of a positive relationship may be a way to engage participants who lack inherent motivation or effortful control needed to sustain mental effort throughout the empirical task (Bioulac et al., 2014; Slusarek et al., 2001). Also, an incongruent setting is thought to increase the load on the participant, thereby depleting his cognitive resources needed for his performance during the task. As children with ADHD already show depleted attentional resources and difficulty with social cues, they, unlike the rest of the study population, were not afflicted by the dissonance between them and the experimenter. As such, results showcase the dual role of rapport, in promoting engagement and enabling resource use, and how different populations, in this case, children with and without ADHD, are differentially affected.

Given that the findings are primarily correlational an alternative interpretation may also apply. Results may indicate that those children with ADHD who have improved executive functioning also manage to construct better rapport with others, as foundational EF abilities have been found to mediate the relationship between ADHD and social competence (Tseng & Gau, 2013). Similarly, the link between EF and perceived rapport congruence among typically developing children may lay on the involvement of inhibition

and shifting in theory of mind needed to achieve congruent ratings between participant and experimenter (Leslie, Friedman, & German, 2004). Both accounts further substantiate the interrelations between experimenter-participant rapport and exerting motivation during experimental tasks.

To summarize, the current study underscores the role of perceived rapport and social interaction within experimental settings; and demonstrates how individual differences, such as ADHD, interact with rapport during experiments. Results indicate that rapport quality and congruency are directly related to EF performance and affect participants differentially. Typically developing children benefitted from congruent harmonious setting for optimal performance, while children with ADHD, who were impervious to the effects of rapport congruency benefitted from higher rapport quality. Results underscore the importance of rapport evaluation in experimental research and suggest incorporating considerations concerning rapport, both in designing the research paradigm as well as an independent factor affecting task performance and outcome.

Context

Social interactions are crucial to how we perform and develop. Our lab takes a multidimensional approach in search of ways to support social development and well-being. We incorporate developmental, clinical, neurobiological, and environmental aspects that shape the way social factors influence cognitive and emotional development in typical and clinical populations from infancy to adulthood. Our studies explore parents interacting with their newborn infants, infants and toddlers engaging in joint attention with their parents, friends affecting the way their mate plays, and the effects of social agents on behavior in children and adults in different clinical populations and ecological settings. This line of research explores social interaction effects on the development and application of cognitive and emotional abilities. The current research sought to explore for the first-time social support within the experimental setting. We examined the participant–experimenter interaction, aiming to understand how participant–experimenter perceived rapport contributes to performance on effortful tasks. We were particularly interested in exploring the interplay between rapport and attention. Results affirm that the rapport constructed during the experiment matters. Findings highlight the notion that social interactions are always at play and should be considered as an intervening factor in performance.

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