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Characterizing Mood States in Individuals Diagnosed with Bipolar Disorder and Intellectual Disability

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Abstract

Introduction: The purpose of this study was to gain additional insight on patterns of behavior of three individuals dually diagnosed with Intellectual disability (ID) and Bipolar disorder as they cycled between elevated and depressed mood states.

Methods: Data were collected from weekly, one hour observations across a period of several months. The total duration of time spent engaged in target responses (pacing, rocking, and talking), in addition to indirect measures of activity (irritability and hyperactivity subscale of the Aberrant Behavior Checklist-Community; ABC-C), were assessed to characterize and monitor changes in overall state.

Results: While observable behavior seemed to be a good indicator of overall state, ABC-C irritability and hyperactivity subscales were not. Additional analyses included lag sequential analyses of environmental stimuli and conditions potentially correlated with observed behavior.

Conclusions: Our findings suggest that observable behavior may be one way to monitor the progression of Bipolar disorder in those with ID; however, further research needs to be conducted.

Keywords

Intellectual disability; Bipolar disorder; mood states

Much of the research that exists on Bipolar disorders has focused on the typically developing population with limited research conducted on those with Intellectual disabilities (ID). This is a concern for those who work with individuals with ID as the prevalence of psychological disorders has been found to be higher for those diagnosed with ID than when compared to the typical population (Matson & Shoemaker, 2011). Differences in prevalence is of particular concern, as the presence of a dual diagnosis has been shown to predict sooner psychiatric intervention as well as earlier and recurrent hospitalization for those with a dual diagnosis (ID and psychological disorder) when compared to those diagnosed solely with a psychological disorder (Morgan, Leonard, Bourke, & Jablensky, 2008).

Evaluation of the prevalence of Bipolar disorders in those with ID is difficult to determine as patients' limited communication skills or health professionals' reliance on diagnostic tools

designed for use amongst a typically-developing population provides challenges in addressing the needs of the dual diagnosis population (Hurly, Folstein, & Lam 2003). Despite potential challenges that may exist in diagnosing psychological disorders in those with ID, research has found that those with ID can be identified with Bipolar disorder using the Diagnostic and Statistical Manual of Mental Disorders (APA, 2013; Cain et al., 2003) and that those diagnosed with Moderate to Profound ID are more likely to be diagnosed with Bipolar disorder than any other disorder (Hurley et al., 2003). Indeed, when compared to the general population, it appears that Bipolar disorder exists at double the rate in those diagnosed with ID (Cain et al., 2003; Cooper, Smiley, Allison, & Morrison, 2018; Cooper, Smiley, Morrison, Williamson, & Allan 2007). And although research has demonstrated that those with ID can be reliably identified and diagnosed with Bipolar disorder (Cooper et al., 2018), more information regarding the presentation and course of Bipolar disorder in individuals with ID is warranted.

Often, individuals with ID present with challenging behavior (e.g., aggression, self-injurious behavior; SIB) and these behaviors are sometimes indications of psychological disorders (Rojahn & Meier, 2009). Additionally, other variables such as agitation and irritability have been found to be associated with manic episodes in those with Bipolar disorder (Sturmey, Laud, Cooper, Matson, & Fodstad, 2010). For individuals dually diagnosed with ID and Bipolar disorder, aggression is a commonly observed behavior (Tsiouris, Kim, Brown, & Cohen, 2011). When challenging behaviors such as aggression present, these behaviors can be measured to monitor conditions such as Bipolar disorder.

To address challenging behaviors, often analysis of the antecedents that evoke, or the consequences that maintain behavior is conducted to determine behavior function (Dixon, Vogel, & Tarbox, 2012). There are occasions when the effectiveness or strength of a consequence varies given antecedent states or conditions. These states or conditions are referred to as motivating operations (Langthorne & McGill, 2009). For example, experiencing a manic state may serve to make access to highly preferred activities (e.g., smoking) more reinforcing. Thus an individual may be more likely to engage in behavior (e.g., aggression) that produces to access that activity.

Limited research, however, exists on the monitoring of symptoms associated with Bipolar disorder in those diagnosed with more severe ID who engage in limited aggressive behavior. Existing research suggests that monitoring observable behavior or activity may reliably indicate periods of mania (e.g., González & Matson, 2006; Sturmey et al., 2010) but research regarding the changes in these behaviors over time and their relation to changes in mood state is limited. The purpose of this study was to characterize observable, non-challenging in nature, behavior potentially associated with Bipolar disorder in individuals diagnosed with Moderate to Profound ID and to use those behaviors to monitor mood state. Additionally, we examined the association between perceived mood states and measures of irritability and hyperactivity and assessed if there were environmental variables that reliably co-occurred with those targeted behaviors.

Method

Participants and setting

Ross was a 49 year-old male diagnosed with Bipolar disorder not otherwise specified (NOS) and Profound ID. According to care provider reports, he cycled between elevated and depressed mood states every three to six weeks. Ross was prescribed Seroquel (quetiapine) 400 mg, Fanapt (loperidone) 6mg, and Lithobid (lithium) 1,650 mg (all daily dosing totals) at the start of the study. By the end of the study his daily regimen included quetiapine 500 mg and Ativan (lorazepam) 0.5 mg. Additionally, when Ross was identified by care providers to be experiencing elevated mood states, lorazepam was administered according to the following dosing regimen: 1mg daily for one week, then 0.5mg daily for a week, and then lorazepam was discontinued.

Ryan was a 28 year-old male diagnosed with Autistic disorder, Severe ID, and Bipolar Disorder Type I. At the beginning of the study, Ryan was prescribed the following daily doses: Depakote sprinkles (divalproex) 1000 mg, Mellaril (thioridazine) 200 mg, and Lexapro (escitalopram) 5 mg. Throughout the course of the study, thioridazine and escitalopram were discontinued, and Latuda (lurasidone) was initiated and titrated to 160mg daily.

Linda was a 53 year-old female diagnosed with Bipolar Disorder Type II and Moderate ID. She was prescribed divalproex 1000 mg and thioridazine 100 mg daily, and valproic acid liquid was administered as needed in the evenings if she refused other medications. Throughout the duration of the study divalproex was increased to 1250 mg, 1mg of Risperdal (risperidone) was initiated and then subsequently discontinued, Risperdal Consta injection (risperidone injection) 25 mg every two weeks was added and then increased to 37.5 mg every two weeks, and thioridazine was discontinued. After these changes, according to care provider reports, Linda was noted to be more cooperative and at a stable state. Each of the participants lived with seven roommates and four 24-hour, direct-care support staff support members in an intermediate-care facility.

This study was completed in compliance with the American Psychological Association ethical standards in the treatment of our participants and in obtaining informed consent.

Procedures

As part of a larger study (see Valdovinos et al., 2016), all participants were observed once a week with the day of week and time held constant. Ross was observed for a total of 46 observations over a 15-month period. Ryan was observed once a week with the day and time held constant, for a total of 25 observations over a 5-month period. Finally, Linda was observed once a week with the day of the week and time held at a constant for a total of 77 observations over the course of approximately a 25-month period. Breaks in observations were due to scheduled University breaks and a participant injury (Ross) unrelated to the study. All observations lasted approximately 60 minutes, or one hour, were conducted in participants' homes, and were video recorded. Videos were scored using Noldus Observer® XT. Informed consent was obtained from participants' legal guardians after the nature of the procedures had been thoroughly explained. Assent was ascertained prior to each observation.

Direct care staff completed the Aberrant Behavior Checklist – Community (ABC-C; Aman, Burrow, & Wolford, 1995) every week by direct-care staff when direct observations were conducted. This checklist includes 58 items categorized on a 4-point Likert scale (0=not at all a problem, 1=the behavior is a problem but slight in degree, 2=the problem is moderately serious, 3=the problem is severe in degree). The ABC-C also has five subscales, which include irritability, lethargy, stereotypy, hyperactivity, and inappropriate speech. Previous research has found that increased activity (Fidan, Kirpinar, Oral, & Koçak, 2011) and irritability (Cain et al., 2003) are closely correlated with Bipolar disorder diagnosis. Thus, the irritability and hyperactivity subscale scores were included in this analysis.

Data analysis

Three analyses were completed for this study. Given the identified relationship between observable activity and mania (e.g., González & Matson, 2006), the first analysis focused on activity that varied consistently (i.e., occurred a lot, occurred very little, did not occur at all) and mood state. Ross's primary activity was walking or pacing; thus, the number of rooms he entered during an observation period and the duration of pacing were measured for each observation. Ryan's activity consisted of body rocking. For, Linda the duration of talking and rate of verbal non-compliance or refusal of demands were assessed. Given that the diagnosis of a single current episode of hypomania or depression was not within the scope of this paper, three mood states were characterized as a way to simplify a complex disorder: elevated mood state, depressed mood state, or the absence of these states (referred henceforth as "stable" state). See Table 1 for operational definitions used to discriminate between elevated and depressed mood states versus stable states for each participant.

Measures of irritability and hyperactivity were examined using the results of the ABC-C as completed by direct-care staff. The final analysis assessed antecedent conditions or stimuli that were significantly associated with target behavior of each participant. Multiple-Option Observation System for Experimental studies (MOOSES; Tapp & Wehby 1995) software program was used to run sequential analyses of these behaviors in order to determine the operant contingency value (OCV) of antecedent conditions that preceded target behavior. OCV is a measure that calculates conditional probabilities while taking into account background probabilities and chance associations between events (Lloyd, Kennedy, & Yoder, 2013). This approach determines what stimuli and behavior(s) might comprise a contingency. The purpose of conducting this analysis was to determine if there were identifiable antecedent events in each participant's environment that seemed to reliably predict target behavior and if those potential contingencies varied depending upon mood state.

Interobserver agreement

Interobserver agreement (IOA) was calculated for all measures with the exception of the ABC-C, as only one caregiver completed the scale each observation. Two raters independently observed all of Ross's 46 observations with one rater identified as the primary rater and the other as the secondary rater (primary rater data were used for analysis). Using the aforementioned operational definitions, raters identified Ross as experiencing an "elevated mood", "stable", or "depressed mood" state. To determine IOA, the total number

of agreements were divided by the total number of agreements plus disagreements and multiplied by 100. Overall IOA for mood state was 95.65%. In determining IOA for pacing and room changes, 41% of observations were coded by a second independent observer. Overall mean IOA for pacing was 80.92% (range, 47.56%-100%) and overall mean IOA for room changes was 92.18% (range, 81.82%-100%).

For Ryan, two raters independently observed all of his 25 observations and, using the aforementioned operational definitions, identified Ryan as experiencing an “elevated mood”, “stable,” or “depressed mood” state. Overall IOA for mood state was 88.90%. In determining IOA for rocking, 40% of observations were coded by a second independent observer. Overall mean IOA for rocking was 87.24% (range, 76.12-100%).

Finally, for Linda, two raters independently observed 36% of the 77 of her observations and, using the aforementioned operational definitions, identified Linda as experiencing an “elevated mood”, “stable”, or “depressed mood” state. Overall IOA for mood state was 86%. In determining IOA for talking and verbal non-compliance, 38% of observations were coded by a second independent observer. Overall mean IOA for talking was 84.87% (range, 70.54-100%) and overall mean IOA for verbal non-compliance or refusal of demands was 99.51% (range, 85.71%-100%).

Results

The top panel of Figure 1 presents Ross’s total duration of pacing in seconds, while the bottom panel presents the number of room changes per one hour observation across 46 observations. During the observations in which Ross was observed to be experiencing an elevated mood state, the average duration of pacing was 46.15 min (range, 23.67 to 55 min). For the observations in which he was observed to be stable, the average duration of pacing was 33.38 min (range, 8.43 to 51.66 min). And finally, during the depressed mood state observations, Ross’s average duration of pacing was 4.9 min (range, 0 to 15.67 min). Correspondingly, the average number of room changes Ross experienced during his elevated mood state was 300 (range, 167 to 407). For the observations in which he was characterized as stable, he engaged in an average of 180 room changes (range, 52 to 303). During observations when he experienced depressed mood states, he changed rooms an average of 33 times (range, 1 to 86).

Table 2 presents the states Ross was identified to be experiencing for each observation, clinically significant ratings on the hyperactivity and irritability subscores of the ABC-C, significant antecedent associations detected between antecedent events and pacing for each of the observations, and his changes in medication. For the ABC-C, scores that are ranked at the 85th percentile or greater are considered to be clinically significant. With respect to the two subscales, scores reached significance for the irritability subscale for one observation (30), in which Ross was identified to be experiencing an elevated mood state. The hyperactivity subscale reached clinically significant scores throughout the course of the study; however, these high scores corresponded with an elevated mood state only four times.

Regarding significant associations between antecedent conditions and pacing for Ross, there were three variables that seemed to predict pacing: ambient noise, physical attention, and the availability of tangible items. Ambient noise was associated with pacing most often when Ross was experiencing an elevated mood state with associations found for 88% of observations, contrasted with associations found between ambient noises and pacing for 67% of the observations in which he was stable and 57% when he was experiencing a depressed mood state. Interestingly, physical attention was most often associated with pacing when Ross was observed to be stable (59% of the observations) or experiencing a depressed mood state (57% of the observations) compared to when he was experiencing an elevated mood state (25% of the observations). Finally, the availability of tangible items was more often predictive of pacing during his depressed mood state, occurring 45% of the observations rather than when experiencing an elevated mood state (13% of observations) or stable mood state (30% of observations).

Figure 2 presents Ryan's total duration of body rocking per one hour observation across 25 observations. During the observations in which Ryan was observed to be experiencing an elevated mood state, the average duration of body rocking was 48.7 min (range, 15 to 59.8 min). For the observations in which he was observed to be stable, the average duration of body rocking was 39.4 min (range, 1.2 to 55.1 min). And finally, during the depressed mood state observations, Ryan's average duration of body rocking was 15.6 min (range, 0 to 32.6 min).

Table 3 presents the states Ryan was identified to be experiencing for each observation, clinically significant ratings on the hyperactivity and irritability subscales of the ABC-C, significant antecedent associations detected between antecedent events and rocking for each observation, and his changes in medication. Clinically significant scores were obtained on the Irritability subscale for one observation (15) in which Ryan was identified to be in an elevated mood state – none of the scores on the Hyperactivity subscale reached clinical significance.

With respect to significant associations between antecedent conditions and body rocking for Ryan, there were ambient noise, standing, and other challenging behavior (aggression, self-injurious behavior). Half of the observations in which significant associations between antecedent conditions and rocking were found when he appeared to be experiencing an elevated mood state (50%) and 80% of those observations involved standing and/or walking as an antecedent to rocking. However, associations were also found when Ryan was observed to be in a stable state (40% of observations with associations), half of which involved self-injury.

The top panel of Figure 3 presents Linda's total duration of talking in seconds, while the bottom panel presents the number of refusals per one hour observation across 77 observations. During the observations in which Linda was observed to be experiencing an elevated mood state, the average duration of talking was 6.4 min (range, 1.59 to 12.66 min). For the observations in which he was observed to be stable, the average duration of talking was 4 min (range, 0 to 19.51 min). And finally, during the depressed mood state observations, Linda's average duration of talking was 1.16 min (range, 0 to 3.36 min).

Correspondingly, the average rate of refusals per minute Linda emitted during her elevated mood state was 0.02 (range, 0 to 0.12). For the observations in which she was characterized as stable, she engaged in an average rate of 0.01 refusals per minute (range, 0 to 0.12). During observations when she experienced depressed mood states, she engaged in an average rate of 0.005 refusals per minute (range, 0 to 0.03).

Table 4 presents the states Linda was identified to be experiencing for each observation, clinically significant ratings on the hyperactivity and irritability subscales of the ABC-C, significant antecedent associations detected between antecedent events and talking (there were no significant associations found between antecedent events and refusals) for each observation, and her changes in medication. Unlike Ross and Ryan, clinically significant scores were obtained on both the Hyperactivity and Irritability subscales during several observations (often both subscales reaching clinical significance); however, these scores were obtained during the initial observations and coincided with two observations (3 and 11) in which Linda was identified to be in an elevated mood state. Once the risperidone injection was initiated, the subscale scores did not reach clinical significance. With respect to antecedent conditions that predicted talking, most associations, 76%, were identified when she was observed to be experiencing stable mood state. Specifically, access to desirable items (which included food/drink) were found to predict talking in 50% of those observations and problem vocalizations predicted 31% followed by changes in ambient noise levels (25%) and access to attention from others (25%). There were no antecedent conditions that were associated with refusals.

Discussion

The focus of this study was the characterization of the observable behaviors thought to be associated with Bipolar disorder in adults also diagnosed with ID. Although prior analyses of clinical data suggest that detection and monitoring of this condition in those with ID could be reliable (e.g., Cain et al., 2003), we found that monitoring symptoms may be more challenging in an applied setting. Overall level of activity seemed to correspond with depressed mood states; however, activity level did not always correspond with elevated mood or stable states, even though average duration and number of behavior did reflect differences. For example, for Ross the duration of pacing and number of room changes could be high even though he did not appear to be agitated, similarly for Ryan and Linda and their target behavior. Additionally, indirect measures of symptoms previously found to track with Bipolar disorder (i.e., hyperactivity and irritability) did not correspond with identified mood states in this study. Finally, environmental events (e.g., accessibility to tangible items, noise level) associated with target behavior seemed to systematically vary with mood state.

One can hypothesize how individuals might respond differently to environmental stimuli given one's mood state. For example, when one is experiencing a heightened sense of agitation, an increase in the volume of ambient noise may be more of an aversive stimulus. Thus, mood state potentially functions as a motivating operation establishing noise as a stronger aversive stimulus. In this case, pacing and room changes may provide an individual access to negative reinforcement (e.g., escape from or avoidance of the loud noise, movement that might produce soothing proprioceptive feedback). Conversely, a depressed

mood state may serve to establish or abolish access to tangible items as reinforcing. Therefore, having access to an item or escaping an item may be more likely to reinforce pacing behavior. Much research has been conducted on the impact of motivating operations on challenging behavior (cf., Beavers, Iwata, & Lerman, 2013); however, very little has been done examining the potential role mood states play with respect to the function of behaviors associated with bipolar disorder (e.g., activity, challenging behavior).

We calculated OCV to determine variables that might predict behavior. Admittedly, this analysis is more commonly done to determine which environmental stimuli may be reinforcing behavior (i.e., assessing the relationship between behavior and stimuli that follow behavior; Martens, Digennaro, Reed, Szczech, & Rosenthal, 2008). In this study, when OCV was calculated for target behaviors and consequential events, there were very few observations in which significant relationships were identified (with the exception of Linda). One observation produced a significant relationship for Ross, three observations produced significant associations for Ryan; however, 17 observations (of 77) were found to have produced significant association between target behavior and environmental events for Linda albeit inconsistent. For example, consequences associated with talking were found for a total of five observations (access to attention when she experienced stable state were found in three observations and the other two were during observations where she was noted to be experiencing a depressed mood state). More significant associations were found between refusals and consequences during stable mood states (16% of total observations) versus depressed mood states (three observations; only one observation of elevated mood state was associated with significant OCV values for refusals) and were social in nature (i.e., verbal attention delivered). Conducting lag analyses of variables associated with target behavior resulted in differentiated probabilities associated with each mood state but more research is needed to determine if applying this method of analysis is appropriate for predicting stimuli that may evoke behavior associated with Bipolar disorder.

There are some limitations to this study. First, during the course of this study Ross experienced an injury, unrelated to our investigation. As a result, there was a two month period when Ross used a wheelchair to navigate his environment. His injury and recovery may have potentially impacted his pacing behavior in the observations conducted around this time. Another limitation was the lack of control over medication regimens as participant care providers determined changes made in medications. Thus, for Ross, although the lorazepam was administered to address heightened agitation and elevated mood state, the changes in medication did not necessarily correspond with our observations of mood state. As an aside, we obtained relatively low IOA for some of Ross's observations. The rule in place to determine when Ross stopped pacing was three seconds. During elevated mood phases, it was challenging to determine if Ross had indeed stopped long enough to discontinue measuring time or if pacing was continuous. Ryan experienced initial increases in lurasidone even though in our observation of his mood state he appeared to be stable; however, for Linda, the initiation of, and subsequent increase in, risperidone injection dose occurred when her mood state was observed to be elevated. Admittedly, Linda also engaged in aggression (which was rarely seen during our observations) which influenced decisions regarding medication. Information regarding sleep and eating patterns were not available and as such we do not have corroborating data for the mood states we identified. Finally, our sample size

was small with three participants and the descriptive nature of the study limits generalization. Future research should be conducted with a larger sample size in which correlations between the variables included in this study (i.e., irritability/hyperactivity, associated behavior, and mood states) can be explored more fully.

Despite these limitations, the results of this study are consistent with previous findings regarding the appropriateness of using overall activity for determining mood states in individuals diagnosed with Bipolar disorder and ID (Fidan et al., 2011). Thus, it may be prudent for those who care for and interact with individuals who are dually diagnosed with Bipolar disorder and ID to systematically monitor activity to determine when a person is experiencing a shift in mood states. Additionally, these results imply that there may be environmental antecedents that are more likely to evoke behavior when a person is experiencing a given mood state suggesting that environmental modifications may be necessary to address or prevent associated challenging behavior (e.g., aggression, self-injury) when an individual is noted to be experiencing mania or depression. Finally, our results suggest that direct measures of observable behavior may be more beneficial for tracking mood state than indirect measures.

Moving forward, monitoring overall activity and environmental arrangements might aid in promoting mood stability, managing symptoms, and directing treatment or medication adjustments for individuals with dual diagnosis. Given that medications are often used to manage Bipolar disorder, future research should also explore whether medication use and medication changes are additional variables that may impact the evocative effects of environmental stimuli on behaviors associated with mood states (e.g., activity, aggression). Determining if individuals are more sensitive to sensory or other stimuli when experiencing elevated or depressed mood states, and if medication impacts this sensitivity or reactivity could further facilitate more effective medication and environmental management of symptoms and enhanced quality of life.

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Figure 1.

Top panel: Duration in seconds Ross paced per observation. Bottom panel: Total number of rooms Ross crossed into during each observation. For both panels, breaks in observations are noted by double hash lines on the x-axis. Closed circles represent elevated mood state, closed squares stable mood state, and open circles depressed mood state. Phase lines indicate when lorazepam regimen was administered.

Figure 2.

Total duration in seconds that Ryan engaged in body rocking during each observation.

Breaks in observations are noted by double hash lines on the x-axis. Closed circles represent elevated mood state, closed squares stable mood state, and open circles depressed mood state. Phase lines indicate when medication regimens were altered.

Figure 3.

Top panel: Duration in seconds Linda talked per observation. Bottom panel: Refusals per minute made by Linda during each observation. For both panels, breaks in observations are noted by double hash lines on the x-axis. Closed circles represent elevated mood state, closed squares stable mood state, and open circles depressed mood state. Phase lines indicate when changes in medication regimen were made.

Table 1

Operational Definitions of Mood State for Each Participant

Participant	Mood State	Definition
Ross	Elevated	Participant paces quickly and near continuously, coming in and out of various rooms in his house while maintaining an upright posture; engaging in utterances although speech is unintelligible.
	Stable	Although participant paces during the observation, it is at a leisurely pace with fewer changes in rooms while maintaining a relaxed posture. He sits and stands in different locations of his house while sometimes engaging in utterances.
	Depressed	Participant is relatively immobile and rarely paces while engaging in limited utterances.
Ryan	Elevated	Participant rocks in chair, while forcefully flinging self against chair repeatedly. He engages in unintelligible utterances.
	Stable	Although participant rocks in chair, it is at a leisurely pace with fewer less forceful rocks. He has fewer occurrences of flinging himself against a chair, while sometimes engaging in utterances.
	Depressed	Participant rocks in chair at a leisurely pace, rarely flinging himself against chair. He rarely engages in utterances.
Linda	Elevated	Participant consistently moves extremities, engages in challenging behaviors with heightened vocalizations, and speaks more without being spoken to throughout the observation.
	Stable	Participant has limited movement of extremities, engages in fewer challenging behaviors, and speech is conversational (speaks when spoken to).
	Depressed	Participant sits or sleeps a majority of the observation without movement and engages in limited speech.

Table 2

Mood, ABC-C Scores, Antecedents to Target Behavior, and Medication Changes for Ross

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication changes
1/ E	H	Ambient noise present/absent (0.90/0.89) Self-injury (0.89)	Lorazepam started (1mg)
2/S	H	Ambient noise absent (0.87) Physical attention withdrawn (0.87)	Lorazepam reduced (0.5mg)
3/E	H	Ambient noise level absent (0.94) Physical attention delivered (0.94)	Lorazepam D/C
4/D	-	-	
5/D	N/A	-	
6/D	H	Ambient noise present (0.96) Tangible items withdrawn (0.96) Verbal attention withdrawn (0.96)	
7/E	-	Ambient noise absent (0.95)	
8/E	-	-	Lorazepam started (1mg)
9/S	H	Ambient noise absent (0.94)	Lorazepam reduced (0.5mg)
10/D	-	Ambient noise present (1) Physical attention withdrawn (1) Tangible items withdrawn (1)	Lorazepam D/C
11/S	H	Ambient noise present (0.86) Physical attention withdrawn (0.86) Tangible items withdrawn (0.86)	
12/S	-	Ambient noise present (0.94) Physical attention withdrawn (0.94) Tangible items withdrawn (0.94)	
13/S	-	Ambient noise present (0.86)	
14/E	H	Ambient noise present (0.88) Demand withdrawn (0.88)	
15/S	-	Ambient noise absent (0.83) Physical attention presented (0.83) Tangible items presented (0.83)	
16/S	-	Ambient noise present (0.87) Physical attention withdrawn (0.87) Tangible items withdrawn (0.87)	
17/D	-	Compliance with demand (0.94) Physical prompt (0.94) Self-injury (0.94)	
18/D	-	-	
19/E	-	Ambient noise present/absent (0.93/0.94) Self-injury (0.94)	
20/S	-	-	
21/S	-	Ambient noise absent (0.86) Physical attention presented (0.86)	
22/S	H	Physical attention withdrawn (0.86) Physical attention delivered (0.86)	
23/S	-	-	
24/E	-	Ambient noise absent/present (0.92/0.92) Tangible items withdrawn (0.92)	
25/S	H	Ambient noise present (0.87)	

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication changes
		Tangible items withdrawn (0.87) Physical attention delivered (0.88)	
26/S	-	Ambient noise present (0.85) Verbal prompt (0.86)	
27/S	N/A	-	Lorazepam started (1mg)
28/S	-	Tangible items presented (0.89)	Lorazepam reduced (0.5mg)
29/S	H	Ambient noise present (0.89) Physical attention withdrawn (0.89) Tangible items withdrawn (0.89)	Lorazepam D/C Quetiapine increased (400mg to 500mg)
30/E	H/I	Ambient noise absent/present (0.92/0.93) Physical attention delivered (0.93) Physical attention withdrawn (0.93)	
31/D	H	Demand withdrawn (0.96) Physical attention delivered (0.96)	
32/S	-	Physical prompt (0.92)	Lorazepam started (1mg)
33/S	H	Physical attention withdrawn (0.92)	Lorazepam reduced (0.5mg)
34/S	-	Ambient noise absent/present (0.87/0.87)	Lorazepam D/C
35/S	H	-	
36/D	-	-	
37/S	-	Ambient noise absent/present (0.88/0.88) Drink request (0.88)	Lorazepam started (0.5 mg)
38/S	-	Ambient noise absent/present (0.89/0.89) Other request (0.89) Physical prompt (0.89)	
39/S	H	Ambient noise absent (0.91) Demand withdrawn (0.91) Physical attention presented (0.91)	
40/S	H	Ambient noise present (0.89) Physical attention withdrawn (0.89)	
41/D	H	Ambient noise absent (0.85) Physical attention presented (0.85) Tangible items presented (0.85) Verbal attention presented (0.86) Verbal attention withdrawn (0.85)	
42/D	-	Ambient noise present (0.89) Physical attention withdrawn (0.98) Tangible items withdrawn (0.98) Verbal attention withdrawn (0.98)	
43/S	-	Ambient noise absent/present (0.90/0.90) Compliance with demand (0.90) Demand present (0.91) Physical prompt (0.90)	
44/D	H	-	
45/S	H	Physical attention withdrawn (0.84) Tangible item present (0.84)	
46/S	-	Ambient noise present (0.87)	

Note. In column one, “E” refers to elevated state, “S” to stable state, and “D” to depressed state. In column two, “H” denotes clinically significant hyperactivity subscale scores; “I” clinically significant irritability subscale scores; “N/A” scores not obtained; and “-” neither subscale was clinically significant. In column three, “-” indicates no significant associations found.

Table 3

Mood, ABC-C Scores, Antecedents to Target Behavior, and Medication Changes for Ryan

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication Changes
1/D	-	Ambient noise (0.98)	
2/S	-	Ambient noise (0.99) Proximity to others (0.99) Sitting (0.99) Standing (0.99)	
3/E	-	-	
4/S	-	-	
5/E	-	Standing (0.99)	
6/D	-	-	
7/E	-	Other precursor point (0.90) Walking (0.90)	
8/E	-	-	
9/S	-	-	
10/E	-	-	
11/S	-	Physical attention (0.95)	
12/S	N/A	-	Decreased thioridazine by 100mg to 100mg Decreased escitalopram by 2.5mg to 2.5mg Introduce lurasidone 20mg increased 40mg
13/E	-	Physical aggression (0.99)	
14/E	-	-	Decreased thioridazine by 50mg to 50mg Discontinue escitalopram Increased lurasidone by 20mg to 60mg
15/E	I	Walking (0.95)	Discontinue thioridazine Increased lurasidone by 20mg to 80mg
16/S	-	Self-hitting (0.94) Verbal Prompt (0.94)	
17/S	-	-	Increased lurasidone by 40mg to 120mg
18/S	-	-	Increased lurasidone by 40mg to 160mg
19/D	-	-	
20/E	-	-	
21/E	-	-	
22/E	-	-	
23/E	-	Physical aggression (1) Standing (0.99)	
24/S	-	Self-hitting (0.97)	
25/E	-	-	

Note. In column one, “E” refers to elevated state, “S” to stable state, and “D” to depressed state. In column two, “H” denotes clinically significant hyperactivity subscale scores; “I” clinically significant irritability subscale scores; “N/A” scores not obtained; and “-” neither subscale was clinically significant. In column three, “-” indicates no significant associations found.

Table 4

Mood, ABC-C Scores, Antecedents to Target Behavior, and Medication Changes for Linda

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication Changes
1/S	H/I		
2/S	-	Problem vocalization (0.93)	
3/E	H/I		
4/S	H/I		
5/S	-	Demand withdrawn (0.98) Drink & Food request (0.98/0.98)	
6/S	-	Sitting (0.97)	
7/D	H/I		
8/D	-		
9/S	I		Divalproex increased (1000mg to 1250mg)
10/D	H/I		
11/E	H/I	Self-biting (0.93)	
12/S	-	Ambient noise (0.97) Tangible item withdrawn (0.90)	
13/S	-	Ambient noise present (0.89) Demand withdrawn (0.90) Physical attention absent (0.89)	
14/S	I	Problem vocalization (0.90) Tangible item withdrawn (0.90)	
15/S	H/I	Ambient noise present (0.93) Physical attention absent (0.93) Problem vocalization (0.93) Proximity to others (0.93) Crawling (0.93)	
16/D	H/I	Problem vocalization (0.95) Sitting (0.95)	
17/S	H/I	Ambient noise present (0.95) Drink request (0.95) Physical attention absent (0.95) Tangible item present (0.95) Proximity to others (0.95)	
18/S	I		
19/S	H/I	Tangible item (0.97)	Risperidone started (1mg)
20/S	I		Thioridazine D/C Risperidone injection started (25mg)
21/S	-		
22/S	-		
23/S	-		Risperidone D/C
24/S	-	Tangible item present (0.96) Other request (0.99)	
25/D	-		
26/S	-	Physical attention (0.96)	
27/S	-		

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication Changes
28/D	-		
29/S	-		
30/S	-	Problem vocalization (0.96)	
31/S	-		
32/S	-		
33/D	-		Risperidone injection increased (37.5mg)
34/S	-		
35/S	-		
36/D	-		
37/S	-		
38/D	-		
39/S	-		
40/S	-		
41/S	-		
42/S	-		
43/D	-		
44/S	-		
45/S	-		
46/S	-		
47/E	-	Other request (0.98)	
48/S	-		
49/S	-	Tangible item present (0.97)	
50/S	-		
51/E	-	Tangible item present (0.96)	
52/D	-		
53/D	-		
54/S	-		
55/D	-		
56/E	-		
57/S	-		
58/S	-	Other request (0.96)	
59/D	-		
60/S	-		
61/D	-		
62/S	-	Problem vocalization (0.96)	
63/E	-		
64/S	-		
65/S	-		
66/S	-	Tangible item present (0.96)	

Observation/Mood State	ABC-C Subscales at Clinical Level	Antecedent Conditions (OCV value)	Medication Changes
67/D	-	Physical attention present (0.98)	
68/S	-		
69/E	-		
70/D	-		
71/S	-		
72/D	-		
73/E	-		
74/S	-		
75/S	-		
76/S	-		
77/E	-		

Note. In column one, “E” refers to elevated state, “S” to stable state, and “D” to depressed state. In column two, “H” denotes clinically significant hyperactivity subscale scores; “I” clinically significant irritability subscale scores; “N/A” scores not obtained; and “-” neither subscale was clinically significant. In column three, “-” indicates no significant associations found.