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A Preliminary Behavior Analytic Approach to "Sundowning" among Older Adults with Major Neurocognitive Disorder

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Abstract

Research has estimated that “sundowning”, an increase in confusion, agitation or challenging behavior later in the day, occurs in 20% to 40% of people with Alzheimer’s disease (AD). We conducted 8-hr continuous measurement of the sundowning behavior of two women with AD who were identified as ‘sundowners’ by staff in a care home. The distribution of behavior corresponded to the description of sundowning for one participant, but not the other. Functional analysis results suggested a possible social positive function for one participant, but were unclear for the other. We suggest that sundowning is better defined as a description of the distribution of behavior across a day rather than topographically, because topography and function differ across individuals. We recommend that environmental variables such as staff attention should be measured to determine their effect on behavior and to develop interventions. This study demonstrates an example of a behavior analytic approach to clinical practice in dementia settings, including potential limitations.

Key words: major neurocognitive disorder, dementia, observational recording, functional analysis, sundowning, older adults

A preliminary behavior analytic approach to “sundowning” among older adults with major neurocognitive disorder Between 50% and 80% of people with major neurocognitive disorder (called dementia prior to the most recent version of the Diagnostic and Statistical Manual of Mental Disorders: 5th ed.; DSM-5; American Psychological Association, 2013) are estimated to engage in challenging behavior such as aggression, wandering, and disruptive vocalizations (Allen-Burge, Stevens, & Burgio, 1999). Such challenging behaviors may contribute to caregiver burden. Caregiver burden and reduced independence are common reasons for admission to care homes across a range of countries, and challenging behavior as an independent factor is an important reason in some countries (Verbeek et al., 2015). It is therefore crucial that evidence-based interventions are made available to help improve the lives of people with major neurocognitive disorder (MCD). To date, the most common approach to decreasing challenging behavior in the elderly in care homes has been guided by the medical model and involves the administration of chemical restraints, such as sedatives, on a regular or as needed schedule. The medical model has been subject to criticism because often the pharmaceutical treatments are associated with negative side effects such as increased levels of confusion (Trahan, Kahng, Fisher, & Hausman, 2011). Other negative side effects include increased risk of medical complications such as stroke and many pharmacological treatments are ineffective (Sink, Holden, & Yaffe, 2005). Alternatively, non-pharmacological behavioral approaches, which involve analyzing and modifying antecedent and consequent environmental events, can be effective in decreasing challenging behavior in people with MCD. Similarly, the use of small-N designs in behavioral approaches for evaluating and intervening upon behaviors can be useful for working with people with MCD. Such an approach allows for differences in the operational definitions of behavior across individuals, and allows for functional relations to be demonstrated (Steingrimsdottir & Arntzen, 2015).

Functional analyses, in which antecedent and consequent events are systematically manipulated to determine the function of behavior (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994), have been used to determine the function of the challenging behavior of people with MCD. For example, Baker, Hanley, and Matthews (2006) assessed whether a staff-administered functional analysis would identify the function of aggression in an elderly woman with Alzheimer’s disease (AD), a subtype of MCD. They conducted a setting analysis in which they found that aggression occurred more often during bathroom routines than recreational routines. A subsequent functional analysis showed that aggression during bathroom routines occurred more often when escape from the toileting routine was made contingent on aggression than when attention was provided for aggression. Baker et al. were also able to demonstrate that non-contingent escape decreased the occurrence of aggression, and that staff could be trained to implement functional analyses. Consequently, function-based interventions that are more effective than arbitrarily-selected interventions can be implemented to successfully decrease challenging behaviors in this population. Similarly, Dwyer-Moore and Dixon (2007) used functional analyses to determine the function of inappropriate vocalizations or wandering behavior in people with AD or vascular dementia. They demonstrated the behaviors differed in function across participants, and that function-based interventions were effective in decreasing the behaviors. Buchanan and Fisher (2002) presented reinforcers identified as maintaining disruptive vocalizations in two people with MCD during functional analyses on a non-contingent schedule to effectively decrease vocalizations. Therefore, functional analyses and interventions based on the results of the analyses have been shown to be useful in assessing and decreasing challenging behavior of people with MCD.

“Sundowning” is commonly described as the occurrence of, or increase in, confusion, restlessness, agitation, and challenging behavior in people with MCD later in the day

(Exum, Phelps, Nabers, & Osbourne, 1993). However, the study of sundowning is adversely affected by inconsistencies in definitions, both in regards to the topography of the behavior and the time of day over which the behavior occurs. Bachman and Robins (2006) reported a number of definitions that included variations in behaviors such as sleep disturbances, wandering, and confusion, and variations in the time of day such as the including the afternoon and specifying that behavior occurs within an hour of darkness falling. From a behavioral perspective, sundowning definitions may encompass a number of behavioral topographies, the function of which may or may not be shared. Although sundowning may be considered an outdated term in some applied settings, it is still used and is therefore an important issue to be addressed from a behavior analytic perspective.

Research into the prevalence of sundowning has yielded inconsistent findings, perhaps due in part to inconsistencies in definitions (Bachman & Robins, 2006). Some studies have suggested that between 25% and 45% of individuals with MCD with display some form of sleep disturbance and sundowning (e.g., Volicer, Harper, Manning, Goldstein, & Satlin, 2001). However it should be noted that the prevalence of sleep disturbances and sundowning were reported together by Volicer et al., and the two behaviors may or may not occupy the same response class. Other studies have suggested that community-dwelling people with MCD are more likely to engage in sundowning (e.g., Gallagher-Thomas, Brooks, Bliwise, Leader, & Yesavage, 1992), and that the prevalence of sundowning increases in people with severe MCD (Bedrosian & Nelson, 2013). In addition to varying prevalence estimates and definitional issues, some studies have dismissed the concept of sundowning with evidence that suggests that some individuals display higher levels of agitation in the morning, and others continuously throughout the day (e.g., Bliwise, Carroll, Lee, Nekich, & Dement, 1993).

Several explanations for sundowning have been explored, but arguably the most researched area in the sundowning literature is the disruption of circadian rhythms. Circadian rhythms are bodily processes and functions such as core body temperature, sleep/awake cycles, and the secretion of hormones from the endocrine system that tend to oscillate on an approximately 24-hr cycle (Van Someren, 2000). It is estimated that up to 80% of individuals over the age of 65 are affected by disruptions to these circadian rhythms (Foley et al., 1995). Circadian rhythms are believed to be disrupted in individuals with AD due to lower levels of light exposure, which has been shown to occur in care homes(e.g., Bliwise et al., 1993; Stopa et al., 1999). Exum et al. (1993) suggested that environmental variables other than light may play a part in reported levels of sundowning. They examined the relationships between staff administration of pro re nata (PRN, given as needed) psychotropic medications, sunset times, staff-to-resident ratios, and changes in caregiver shifts in a care home for people with AD. Exum et al. found that medication was commonly administered in the early hours of the morning (e.g., 4 a.m.) before sunrise, and in the afternoons between 3 p.m. and 5 p.m. (which was usually prior to sunset). These findings may not support sundowning if it is defined as agitation after sunset, however Exum et al. found that medication was likely to be administered during changes in staff shifts and during self-care routines (e.g., dressing). Although medication administration was an indirect measure of increased agitation, their findings suggest that sundowning is likely to be related to changes in environmental variables such as the availability of staff attention. If sundowning is affected by changes in environmental antecedents and consequences, functional analyses could be used to determine the function of sundowning behavior, and therefore to design and implement effective interventions. We know of no studies that have conducted functional analyses of sundowning in people with MCD.

The majority of research assessing the prevalence of sundowning has involved indirect measures of behavior such as medication administration as used by Exum et al. (1993). Martin, Marler, Shochat, and Ancoli-Israel (2000) identified a need for research on sundowning that uses direct measurement of behavior. Direct measurement of the occurrence and distribution of sundowning behavior and environmental variables across the day may help to test hypotheses regarding so-called sundowning as a phenomenon, and would allow for the effect of environmental variables on sundowning to be evaluated empirically.

The purpose of our study was twofold: 1). to use direct behavioral measures to show that sundowning behaviors can be defined objectively and measured across a day; and, 2). to conduct functional analyses of sundowning to determine the function of the behavior in two people with AD. The overarching aim was to demonstrate a behavior analytic approach to evaluating issues for people with MCD that are yet to be conceptualized behaviorally but may arise for practitioners working in applied settings.

Method

Participants and Setting

Meryl and Gail, two women diagnosed with AD, were identified by staff in a care home for people with MCD as engaging in sundowning. Meryl was 87 years old and scored 9 out of 30 on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975), indicating severe cognitive impairment. Staff reported that Meryl engaged in frequent, disruptive vocalizations. Gail was 88 years old and although she completed the MMSE, she scored 0, indicating severe cognitive impairment. Staff reported that Gail often engaged in disruptive and repetitive behaviors such as banging and tapping surfaces, and clapping. Previously attempted interventions included medication and moving the women away from other residents.

All sessions were conducted in the care home, which was home to 24 residents. Eight-hr observations were conducted in all areas of the home. For Meryl, the functional analysis was conducted in the lounge. For Gail, functional analysis sessions were conducted wherever she was at the time of commencement (e.g., the lounge, dining room, hallway, or conservatory).

Measurement and interobserver agreement

For Meryl, sundowning was defined as any inappropriate vocalization that involved swear words or insults, such as “nurse, you’re being a b****” and “you’re bloody stupid”. Non-examples included functional speech such as manding for tangibles, information, or cessation of an activity. For Gail, sundowning was defined as repetitively banging or rubbing any object or person, pushing dining chairs around the dining room, and flapping or clapping hands. Non-examples included Gail rubbing any part of her own body, such as legs or arms. From this point forth, the target behaviors will continue to be referred to as ‘sundowning’ (despite the different topographies) to remain consistent with how these behaviors were conceptualized and described by staff in the setting in which the study was conducted.

A Samsung Galaxy S3 smart phone with Android technology was used for continuous recording of participants’ behavior during 8-hr observations. We used the ‘Time Motion Study’ application, which can record the frequency and duration of multiple behaviors simultaneously. We recorded the frequency of Meryl’s sundowning behavior and the duration of Gail’s sundowning behavior. Partial-interval recording with 10-s intervals was used to measure the participants’ behavior during functional analysis sessions and the brief non-contingent assessment.

Interobserver agreement. An independent observer recorded data for 14.3% of functional analysis sessions and 33% of the non-contingent assessment sessions. Interobserver agreement was calculated by dividing the number of intervals of agreements by

the total number of intervals and multiplying by 100. Mean IOA was 98.3% (range 96.7% - 100%).

Procedure

Indirect and descriptive assessment. Prior to the functional analyses, the Questions About Behavior Function (QABF; Paclawskyj, Matson, Rush, Smalls, & Vollmer, 2000) was used to interview the participants' caregivers and identify potential functions of sundowning behavior. The first author also conducted 60-min sessions of ABC narrative recording of sundowning behavior at varied times of the day twice for each participant.

Continuous observations. Four 8-hr observations (9 a.m. to 5 p.m.) were conducted one per week (on Wednesdays) for four weeks for each participant, during which all occurrences of sundowning behaviors were recorded.

Functional analysis. Standard functional analyses conditions were based on those outlined by Iwata et al. (1982/1994) with an ignore condition in place of an alone condition (for safety). The order of the conditions in each session was ignore, attention, control, demand. Each condition was 10 min in duration. For each participant, half of the functional analysis sessions were conducted in the morning (between 9 a.m. and 11 a.m.) and half in the afternoon (between 3 p.m. and 5 p.m.). We alternated the morning and afternoon sessions randomly.

During the *ignore condition*, staff were asked to avoid interacting with the participants, and the first author either pretended to read a book or be engaged in another activity. There were no programmed consequences for sundowning behavior. During the *attention condition*, the first author provided attention in the form of a brief statement contingent on each occurrence of sundowning behavior. For Meryl, the attention was displeased statements such as "please don't swear" or "that's not very nice". For Gail, attention was sympathetic statements such as "it's ok" or "I know, I know". The type of

attention was selected from the direct assessment data. During the *control condition*, leisure items such as magazines were made available, music was played, and attention in the form of neutral statements such as "it's a nice day today" were delivered on a 20-s fixed time schedule. If sundowning behavior occurred when attention was scheduled to be delivered, attention was delayed until 5 s had elapsed with no instances of the behavior. During the *demand condition*, each participant was presented with a task, engagement in which could not occur simultaneously with sundowning behavior (writing her name for Meryl; asked to walk with the first author for Gail). An instruction was delivered ("please write your name" or "please come with me") and if no response was emitted after 3 s, least-to-most prompting was delivered. Compliance with the task resulted in praise and the re-presentation of the task. In the absence of sundowning behavior, the next instruction was delivered 2 s after the praise. Task materials (for Meryl) were removed and the first author moved away for 30 s contingent on the occurrence of sundowning behavior. For each 30 s of demand removal, an extra 30 s was added to the session duration (maximum of an additional 5 min) to keep the duration of opportunities to engage in the behavior constant across all conditions.

Brief non-contingent attention assessment. For Meryl, a brief assessment of non-contingent attention (NCA) followed the functional analysis to confirm the suggested results of the functional analysis (i.e., that Meryl's behavior was maintained by access to attention). First, we conducted a baseline probe in which we recorded the occurrence of sundowning behavior. There were no programmed contingencies. Second, we conducted a session in which NCA was provided on a 10-s fixed time schedule by the first author. Attention consisted of statements such as "it's a nice day today" and "I like the jumper you're wearing". If Meryl engaged sundowning behavior when attention was due to be delivered, attention was delayed by 5 s. A second baseline session followed. Sessions were 10 min in duration.

Results

Continuous recordings of sundowning. Figures 1 and 2 show the distribution of sundowning behavior across 8 hrs as rate per hour (Meryl) and duration per hour (Gail). From the continuous recordings of sundowning behavior for Meryl, the rate per hour was calculated by dividing the total number of occurrences in each hour (e.g., 9 a.m. to 10 a.m.) by 60 min. Meryl engaged in higher rates of sundowning behavior in the morning (e.g., 82 occurrences per hour between 9 a.m. and 10 a.m. compared with three per hour between 4 p.m. and 5 p.m. on the first day) (Figure 1). A pattern of decreasing rate was observed across all four days of continuous observation, however overall rates of sundowning were lower on the second and third days. A higher rate of sundowning was observed between 12 p.m. and 1 p.m. on the first day (47 per hour) but not on any other day.

Duration per hour (Gail) was calculated by totaling the duration of all occurrences in each hour (Figure 2). In contrast to Meryl, Gail’s sundowning behavior increased in duration across the day on all four days of observation (e.g., from zero occurrences between 9 a.m. and 12 p.m. to 6.4 min of sundowning between 3 p.m. and 4 p.m.). Despite this, the highest durations of sundowning were observed between the hours of 12 p.m. and 4 p.m., with sundowning decreasing in the last hour of observation on each day. For example on the first day, the duration of sundowning decreased in the last hour of observation (4 p.m. to 5 p.m.) to 3 min from 6.8 min the previous hour. The highest duration of sundowning was observed on the fourth day of observation (3 p.m. to 4 p.m.); 9.4 min.

Indirect and descriptive assessment. ABC recordings showed that there was no consistent outcome for Gail’s behavior, and that approximately half of the occurrences of Meryl’s behavior were followed by attention from staff. The results of the QABF suggested automatic reinforcement as a maintaining consequence for Gail’s behavior, and attention as a maintaining consequence for Meryl’s behavior.

Functional analyses. The results of the functional analysis for Meryl showed some undifferentiated responding across conditions. The percentage of intervals in which sundowning occurred was highest during the attention condition with a mean of 19.2% across all six sessions (range, 0% to 46.7%) (Figure 3) but similarly was 17.5% during the control condition (range, 0% to 51.6%). The percentage of intervals in which sundowning occurred was 12.8% during the ignore condition (range, 0% to 38%). Sundowning behavior rarely occurred during the demand condition (mean of 2.9% of intervals, range, 0% to 5%). Responding was lower in all conditions in most of the sessions conducted in the afternoon (Sessions 1, 3, and 7). In the condition in which behavior occurred most (attention), the percentage of intervals in which sundowning occurred was higher in morning sessions (mean of 30.8%, range, 15% to 46.7%; Figure 3, left panel) than afternoon sessions (mean of 7.5%, range, 0% to 23.3%, Figure 3, right panel).

The results of the functional analysis for Gail showed undifferentiated responding across conditions (Figure 4). For example, the mean percentage of intervals in which the behavior occurred was 21.1% in the ignore condition (range, 0% to 40%), 20.5% in the control condition (range, 3% to 33.3%), 13.3% in the attention condition (range, 0% to 33.3%), and 22% in the escape condition (range, 0% to 38.9%). There was little difference in the percentage of intervals in which sundowning occurred across sessions conducted in the morning and sessions conducted in the afternoon.

Brief non-contingent attention (NCA) assessment. In the first baseline session, Meryl engaged in inappropriate vocalizations in 52.7% of intervals. During the NCA session, the percentage of intervals in which vocalizations occurred decreased to 18.3%. In the subsequent return to baseline session, the percentage of intervals with inappropriate vocalizations increased to 41.7%.

Discussion

We assessed whether sundowning behavior in two individuals with AD could be defined operationally and measured across a day. The purpose of measuring behavior across 8 hrs was to demonstrate a pattern of responding consistent with reports of sundowning (i.e., increased rates of behavior in the afternoon). Our results showed that although the distribution of behavior for one participant corresponded to the increased rates of behavior across a day consistent with sundowning, this was not the case for the other participant. The measurement of the distribution of sundowning behavior for the other participant showed that the behavior was more likely to occur in the morning. Furthermore, we found that functional analyses alone may not be sufficient to indicate the function of sundowning behavior.

Sundowning

Although sundowning is reported to occur in a large proportion of people with MCD, the existence of the phenomenon has been frequently questioned (Bliwise et al., 1993), and existing treatments are not well established (Van Someren, 2000). Our study represents the first attempt to operationally define sundowning behavior, and conduct direct observation and functional analyses. We suggest that the term ‘sundowning’ does not describe a behavior (due to differences in topography and function across people), but is a description of the changes in distribution of a behavior across a day. Furthermore, we showed that sundowning cannot be addressed based on staff report alone; of the two women identified as engaging in sundowning behavior, the distribution of behavior fit the description of sundowning for only one. For the second participant, the reverse distribution of behavior was found; more sundowning behavior in the morning than in the afternoon. Our results corroborate those of Cohen-Mansfield, Werner, and Marx (1989), who found that the patterns of behavior varied across all participants and subsequently suggested that individual repertoires be evaluated to inform intervention design. They also found that agitated behaviors occurred most often during the day than during the night, however we found that this was the case for only one of

our participants. We acknowledge that we may have discovered different patterns of sundowning behavior with longer observations (i.e., later than 5 p.m.). Longer observations would have been useful in particular due to the inconsistencies in which part of the day constitutes sundowning, however we were unable to conduct longer observations due to practicalities of the first author’s work in the setting.

Our results suggest that although informant methods may be useful to identify challenging behavior, they may not be useful for identifying patterns of behavior across the day (i.e., sundowning). Our finding that informant methods may not be reliable for determining dimensions of behavior such as distribution corroborate the literature showing that informant methods can produce inaccurate information about other dimensions of behavior. For example, Mesman, Buchanan, Husfeldt, and Berg (2011) found that staff and family predictions of preferences for people with MCD were inaccurate. Kazdin, Esveldt-Dawson, and Loar (1983) suggested that disruptive or discrete behaviors can be more salient. Behaviors that are more salient may be more likely to be noted and reported by staff, which may account for inaccurate estimations of sundowning. More research is needed to assess the involvement of staff in measurement and intervention in dementia settings, as the accuracy of staff information may affect intervention selection and intervention acceptability.

Exum et al. (1993) found that environmental factors such as changes in staffing were related to rates of medication administered for challenging behavior. Our study represents the first attempt to assess the hypothesis that sundowning behaviors are operant behaviors under environmental contingencies, however more studies are required to support this hypothesis. Further research is required to determine the effect of changes in light levels using objective direct measures of sundowning behavior, however further research is also needed to evaluate common environmental events that may occasion increased rates of challenging behavior at certain times of the day. For example, changes in the staff shift are

likely to be associated with decreased attention, increased noise, increased number of people present etc., which may occasion challenging behavior. Therefore, collecting data on the distribution of behavior and the co-occurring environmental changes is important to inform interventions and staff training to reduce challenging behavior. We suggest that some challenging behavior affected by such environmental changes is often labelled as sundowning and attributed to either internal factors such as disrupted circadian rhythms (e.g., Volicer et al., 2001), or considered to be an inherent part of the progression of MCD.

Functional analyses and subsequent NCA

Previous behavioral research in MCD has focused predominantly on antecedent manipulations. Only a small number of studies have assessed the utility of functional analyses for people with MCD, in spite of the high prevalence of challenging behavior in this population (Volicer et al., 2001). Studies that have included functional assessment or analyses have yielded promising findings for both the utility of functional analyses and function-based interventions such as non-contingent reinforcement and functional communication training (e.g., Baker et al., 2006; Buchanan & Fisher, 2002).

Although the results from our functional analyses suggested a possible function for the behavior of both participants, neither analysis clearly suggested a function of behavior. For Gail, the results of the functional analysis were undifferentiated, suggesting that automatic reinforcement was maintaining her behavior. Gail engaged in more sundowning behavior in the afternoons, which may have been a result of fewer available activities to provide competing reinforcers. Further measurement of environmental variables would be required to confirm our hypothesis. For example, we could have conducted an analysis such as the increased and decreased sensory conditions conducted by Buchanan and Fisher (2002). They demonstrated that disruptive vocalizations increased slightly when stimulation (television or music) was provided contingent on the vocalizations. An analysis of the

potential relation between a lack of environmental stimulation and Gail’s behavior may have further supported the hypothesis that her behavior was maintained by automatic reinforcement and suggested a potential intervention (i.e., environmental enrichment).

Meryl’s behavior occurred more frequently in the mornings, and occurred more often in the attention and control conditions, suggesting that her behavior was maintained by attention. We noted that in the control condition, Meryl often engaged in the behavior directly after NCA was provided. We hypothesize that her behavior functioned to prolong attention, and that the NCA was a discriminative stimulus for the availability of further interaction. Our hypothesis could have been strengthened by conducting a conditional probability analysis of the relation between attention and behavior in the control condition. For example, Roane, Lerman, Kelley, and Van Camp (1999) showed that within-session analyses of behavior during functional analyses can be conducted to clarify the function of behavior. Behavior also occurred in the ignore condition, possibly due to the presence of the discriminative stimulus for attention (i.e., the first author). Hanley, Piazza, Fisher, and Adelinis (1997) showed that attention-maintained behavior persisted in the presence of another person, despite the absence of attention provided contingent on behavior. Therefore, we can account for the occurrence of behavior in the attention, control, and alone conditions, and when combined with the data from the demand condition in which little behavior occurred, our data suggest that Meryl’s behavior was likely attention-maintained. Conducting an extended ignore condition would have supported our conclusion, as it would be expected that the behavior would decrease if socially-mediated and would persist if automatically-maintained (Vollmer, Marcus, Ringdahl, & Roane, 1995).

In addition, we could have used discriminative stimuli to facilitate differential responding across the conditions of the functional analysis. As we conducted the functional analyses in common areas of the home due to space availability, it may have been even more

important to facilitate discrimination between conditions due to the presence of many competing stimuli. Sidman (1960) suggested that schedule-correlated stimuli should be used in multi-element designs as it is a multiple schedule that is used. Furthermore, Conners et al. (2000) showed that discriminative stimuli produced differentiated responding in some people with intellectual disabilities during functional analyses due to facilitated discrimination between the conditions. Given that it has been suggested that people with MCD may experience in deficits in the antecedent control of stimuli (e.g., Gallagher & Keenan, 2006), facilitating stimulus control of responding should be considered during functional analysis with this population.

As there has been no previous research on functional analyses and sundowning, comparisons can only be drawn to previous research that has used functional analyses with people with MCD. Previous research has identified clear functions of behavior such as to access attention or to escape from demands (e.g., Baker et al., 2006; Buchanan & Fisher, 2002; Dwyer-Moore & Dixon, 2007). Although we did not attain clear results, we demonstrated that functional analyses can be conducted with behaviors that may be attributed to difficult-to-measure causes, and suggest that further research on the utility of functional analyses of the behavior of people with MCD should be conducted.

Although limited by the small number of sessions, we conducted an assessment to strengthen the conclusions drawn from the results of the functional analysis. The decrease in vocalizations during the provision of NCA strengthen our hypothesis that Meryl’s inappropriate vocalizations were maintained by attention, and are consistent with findings from Buchanan and Fisher (2002), who found that NCA reduced disruptive vocalizations in two participants with MCD. The results of brief additional analyses such as our NCA assessment can be used to develop function-based interventions by evaluating the potential effectiveness of changing the contingency for behavior (i.e., NCA was subsequently

incorporated into the clinical work conducted by the first author). Our results further support the need for function-based interventions for people with MCD, although it should be noted that the NCA did not decrease Meryl’s vocalizations to zero, even with a dense schedule (10-s intervals). Information such as this is vital for the design of effective, function-based interventions.

Conclusion

Our study further contributes to the growing body of literature on the utility of behavioral approaches to socially significant behaviors experienced by people with MCD. We showed that a common behavioral challenge, sundowning, can be conceptualized behaviorally, defined operationally, and measured objectively. In addition, we have provided evidence to support the notion that sundowning is affected by environmental variables, and is an operant behavior able to be changed by changing contingencies. The implication is therefore that sundowning can be assessed and intervened upon using methods that have been used to address challenging behaviors in other populations (e.g., functional analyses and function-based interventions). We also provided evidence that standard functional analyses may not always yield clear information regarding the function of behavior, but may be useful as a component of assessment methods.

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Figure captions

Figure 1. Rate per hour of Meryl’s sundowning behavior across four 8-hr observations.

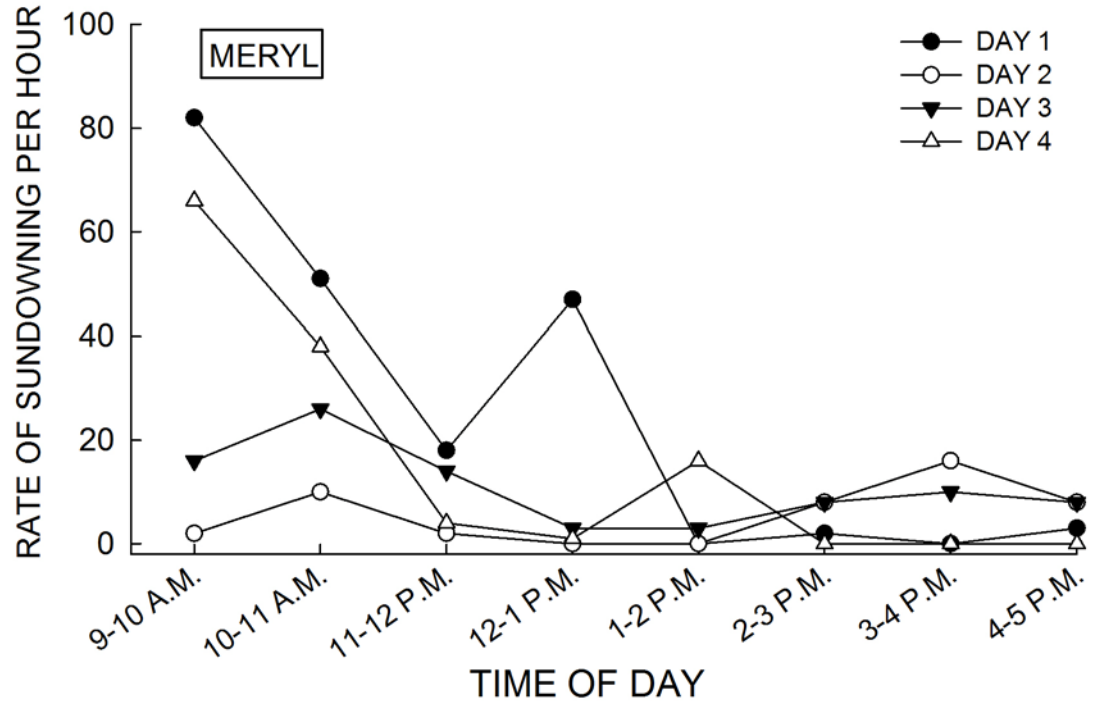
Figure 2. Total duration per hour of Gail’s sundowning behavior across four 8-hr observations.

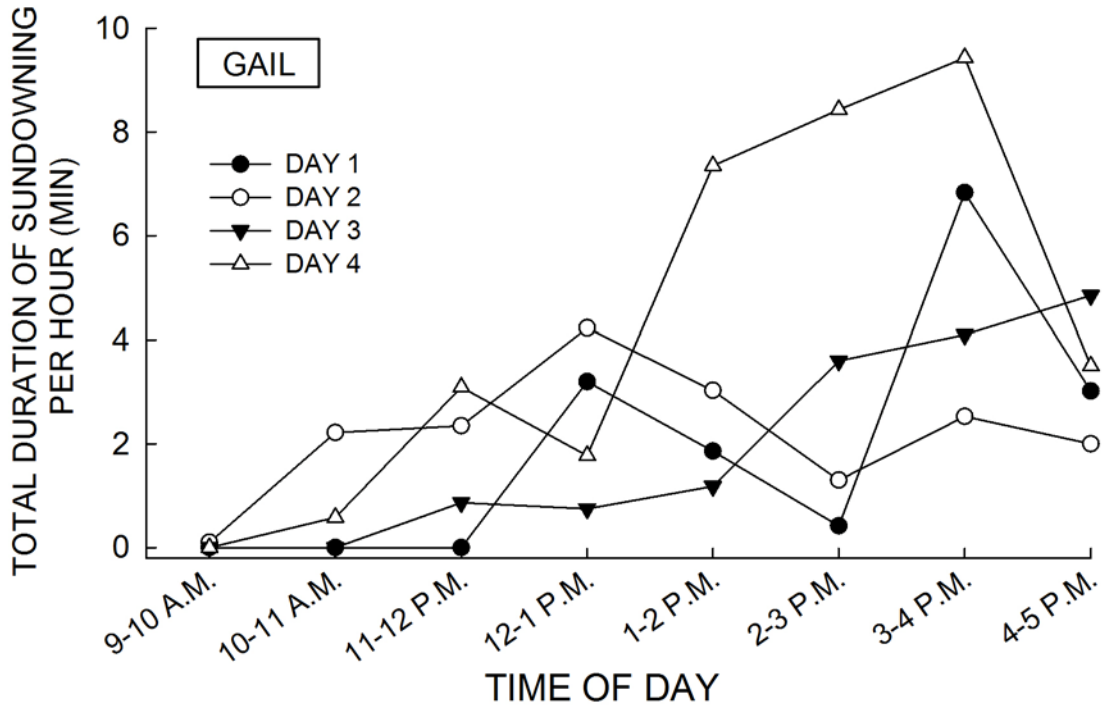
Figure 3. The percentage of 10-s intervals in which sundowning occurred in morning and afternoon functional analysis sessions for Meryl.

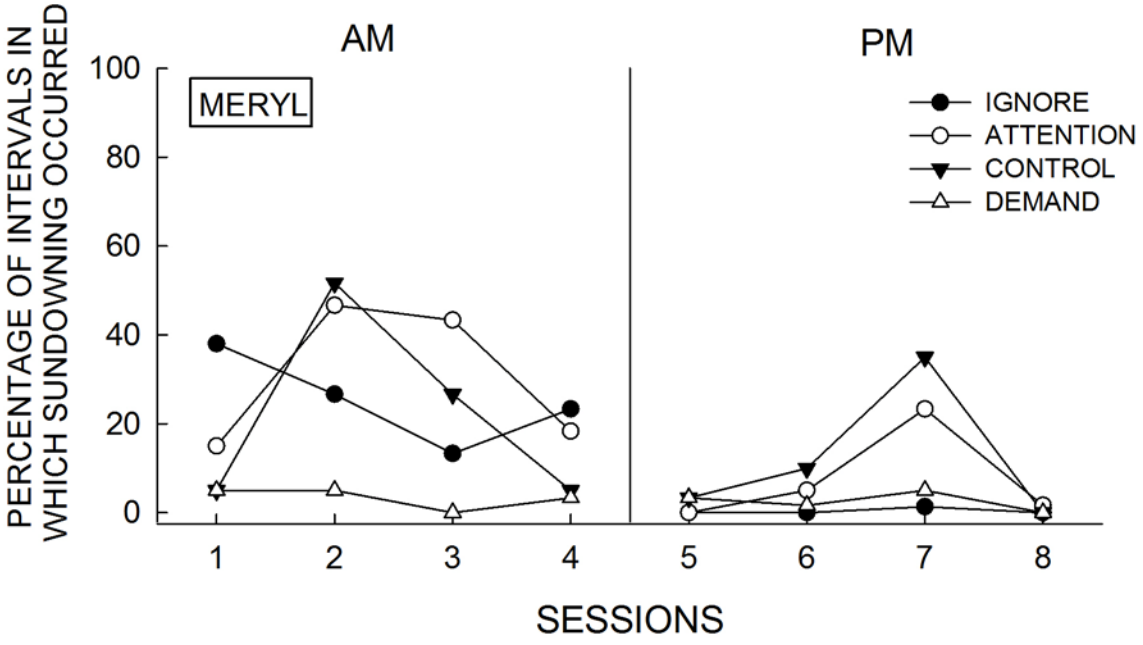
Figure 4. The percentage of 10-s intervals in which sundowning occurred in morning and afternoon functional analysis sessions for Gail.

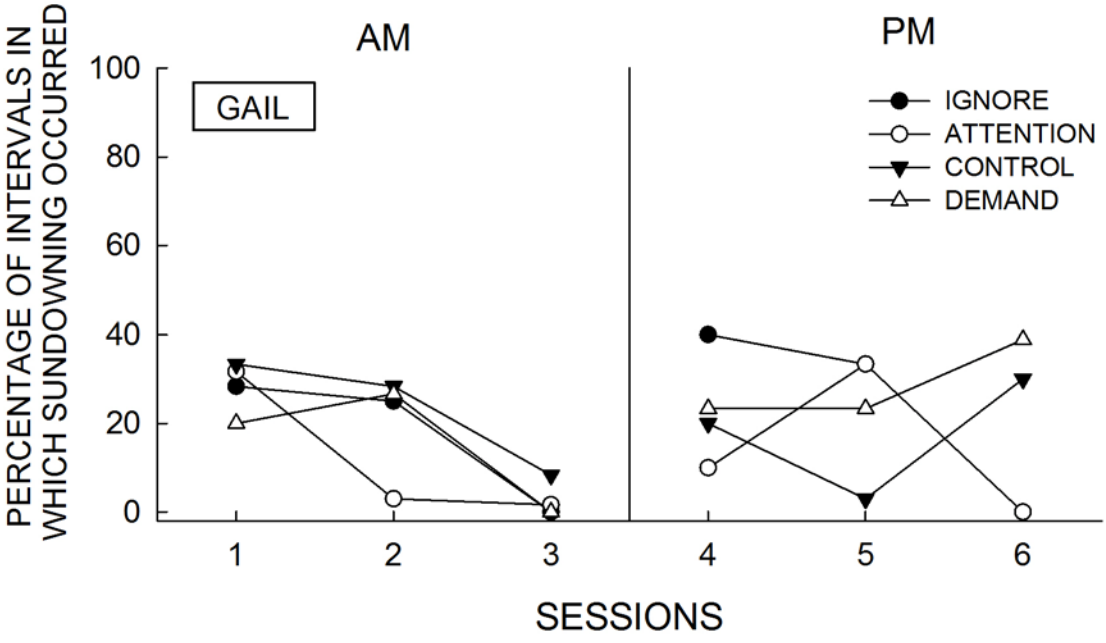
Figure 5. The percentage of 10-s intervals in which sundowning behavior occurred during baseline, non-contingent attention, and return-to-baseline sessions for Meryl.

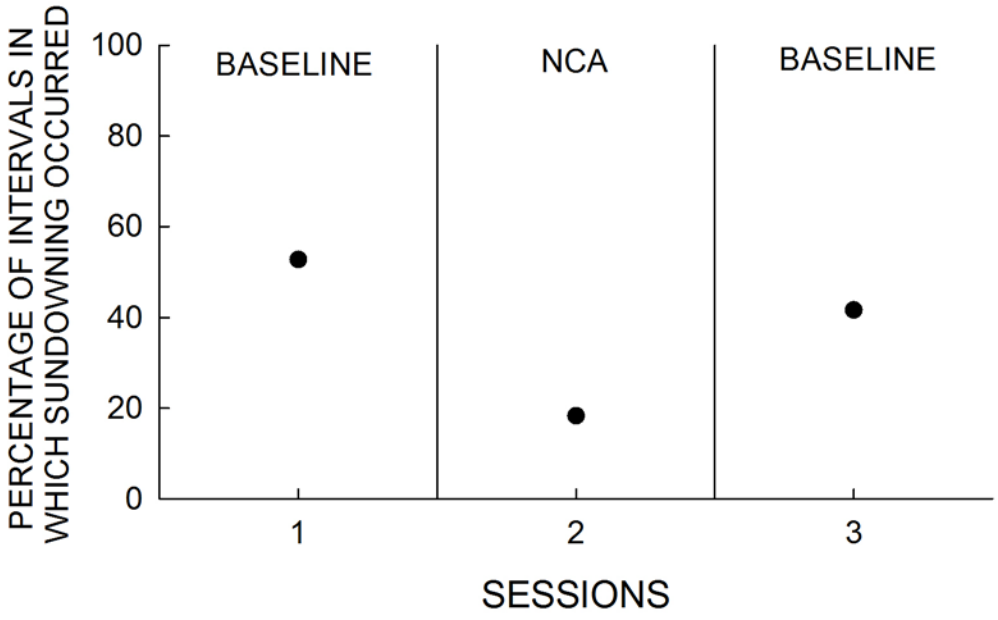
Figures


MERYL
DAY 1
DAY 2
DAY 3
DAY 4
RATE OF SUNDOWNING PER HOUR
100
80
60
40
20
0
9-10 A.M.
10-11 A.M.
11-12 P.M.
12-1 P.M.
1-2 P.M.
2-3 P.M.
3-4 P.M.
4-5 P.M.
TIME OF DAY


GAIL
DAY 1
DAY 2
DAY 3
DAY 4
TOTAL DURATION OF SUNDOWNING PER HOUR (MIN)
10
8
6
4
2
0
9-10 A.M.
10-11 A.M.
11-12 P.M.
12-1 P.M.
1-2 P.M.
2-3 P.M.
3-4 P.M.
4-5 P.M.
TIME OF DAY


AM
PM
MERYL
IGNORE
ATTENTION
CONTROL
DEMAND
PERCENTAGE OF INTERVALS IN WHICH SUNDOWNING OCCURRED
100
80
60
40
20
0
1
2
3
4
5
6
7
8
SESSIONS


AM
PM
GAIL
IGNORE
ATTENTION
CONTROL
DEMAND
PERCENTAGE OF INTERVALS IN WHICH SUNDOWNING OCCURRED
100
80
60
40
20
0
1
2
3
4
5
6
SESSIONS


PERCENTAGE OF INTERVALS IN WHICH SUNDOWNING OCCURRED
100
80
60
40
20
0
BASELINE
NCA
BASELINE
1
2
3
SESSIONS