Time-Event Sequential Analysis of Agitation in Nursing Home Residents During Personal Care Interactions With Nursing Assistants

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Computer-assisted behavioral observation data were collected from 66 nursing home residents while they received assistance during personal care routines from a certified nursing assistant (CNA). Data were collected both before and after a comprehensive behavior-management and communication-skills training program was delivered to the nursing staff. A total of 30 residents showed 6 or more episodes of disruptive vocalization or other forms of agitation during baseline observations, and time-event sequential analysis methods were used to test whether certain CNA behaviors either elicited or prevented onsets of agitation in these 30 residents. Simple verbal prompts used by CNAs during personal care routines before staff training were found to elicit agitation onset (p = .03), whereas positive statements to the resident were found to reduce the likelihood of agitation onset (p = .02). In a previous analysis of the effects of staff training, we found that rates of resident agitation were significantly lower after training compared with baseline and that CNAs increased their rates of positive statements to residents. In the present study, time-event sequential analyses indicated that the verbal prompts used by CNAs during personal care routines were no longer associated with an increased rate of resident agitation after staff training among the 20 residents who showed 6 or more episodes of agitation both before and after staff training. These findings suggest that the staff training program improved the quality of CNA verbal prompts. The sequential analysis of observational data provides an important method for studying interpersonal interactions, including those of nursing home residents and the nursing staff who care for them.

Concerns about the quality of care that nursing home residents receive often revolve around questions about the quality of nursing assistance for personal care activities (e.g., bathing, dressing, grooming) and the methods by which problem behaviors (e.g., disruptive vocalizations) are managed. These issues are especially critical in the care of the 50% to 80% of the current nursing home residents who have some form of dementia (Magaziner, Zimmerman, Fox, & Burns, 1998).

A common complication of dementia is the increased tendency to display behavior problems, with as many as 90% of nursing home residents with dementia showing some signs of behavioral disturbance (American Psychiatric Association, 1997). These behaviors include disruptive vocalizations, repetitive demands or complaints, wandering, psychomotor restlessness, and acts of physical aggression. Collectively, these behaviors have been labeled agitation (Cohen-Mansfield, 1986). Previous research has documented that agitation is a common problem in nursing home residents with dementia (Beck, Rossby, & Baldwin, 1991; Swearer, Drachman, O’Donnell, & Mitchell, 1988; Zimmer, Watson, & Treat, 1984). Clearly, the effective management of problem behaviors is a major challenge facing those who provide nursing home care to older adults.

Management of problem behaviors is complicated by functional limitations in the majority of nursing home residents. Needs for significant assistance with personal care activities such as dressing, toileting, grooming, and transferring require frequent interactions between residents and nursing home staff. Such interactions are often accompanied by agitation, which can disrupt personal care interactions and undermine the quality of care (Chalmers, Levy, Buckwalter, Ettinger, & Kambhu, 1996). In addition, the manner in which care is provided may elicit agitation in some residents. It is important, therefore, to study the quality of these care interactions. Optimal communication between nursing assistants and nursing home residents is essential for maintaining the residents’ overall quality of life.

Current guidelines in nursing home care call for the use of behavioral strategies in the management of disruptive behaviors. The keys to implementing and demonstrating successful behavior management strategies for agitation include effective training and sensitive outcome evaluation. Because certified nursing assistants (CNAs) provide up to 90% of resident care, they have been the focus of several educational and skills training programs (Cohn, Horgas, & Marsiske, 1990; Feldt & Ryden, 1992; Litchenburg, Strzepak, & Zeiss, 1990; Smith et al., 1994). Outcome data from most studies of CNA training programs rely primarily on knowledge tests of skill usage and retrospective reports of resident behavior from the CNAs. Retrospective reports are useful but limited sources of data. Nursing assistants may give inaccurate reports because of a variety of potential problems including biased reports designed to make the respondents appear more effective, poor memory for relevant events, or misunderstandings about the terms used on rating scale instruments (Burgio, 1996).

An alternative source of outcome data involves direct.
observation of resident and staff behaviors. Observed behaviors can be quantified objectively in terms of their frequency, duration, and sequential association. Direct observational data provide a rich source of information about the rates and duration of multiple behaviors, and the flow of events or behaviors across time can be studied in person-to-person interactions (Bakeman & Gottman, 1986). Computer-assisted behavioral observation systems have been used previously to record instances of disruptive vocalization by nursing home residents and skill use by nursing assistants (Burgio et al., 1994, 2000). Direct measures of resident and staff behaviors provide a powerful source of data for characterizing staff–resident interactions and the quality of nursing home care.

When analyzing continuous streams of behavioral data, investigators are able to specify hypotheses about antecedent and consequent events and to determine whether certain behaviors are more (or less) likely to precede other behaviors than would be expected on the basis of chance. Sequential analysis methods have been used for many years in research on interactions between parents and children (e.g., Brown et al., 1975) and spouses (e.g., Gottman, Markman, & Notarius, 1977). More recently, these methods have been applied to study interactions and test antecedent–consequent relationships between older adults and their professional caregivers in many settings (Baltes & Wahl, 1992; Burgio et al., 2000; Rose & Pruchno, 1999).

Computer-assisted real-time behavioral observations were made on CNA–resident interactions during personal care routines as part of a recent skill training study conducted by Burgio and colleagues (2002). Nursing staff from two large nursing homes were trained to use behavior management and communication skills while interacting with residents, and a staff motivational system was implemented to facilitate the long-term use of these skills. Direct observation of caregiving routines allowed an examination of specific behavior management skills used by CNAs and the residents’ responses to these CNA behaviors. Burgio and colleagues found that the staff training program resulted in a significant increase in the rate of positive statements made by CNAs and a significant decrease in the amount of time that agitated behaviors were displayed by residents during care interactions. Whereas these findings are suggestive of a relationship between CNA skill usage and resident agitation, changes in simple rates of behaviors do not fully consider the temporal relationships between behaviors that are available for study when multiple streams of behavioral data have been coded from continuously observed interactions.

In the present study, timed-event sequential analysis methods were applied to the care-interaction data collected by Burgio and colleagues (2002) to test hypotheses about possible antecedent–consequent sequential relationships between CNA behaviors and resident agitation. Four different CNA behaviors were examined as possible antecedents: providing physical assistance, verbally prompting the resident, making positive statements to the resident, and making negative statements to the resident. Measures of the strength of each sequential association were determined separately for each resident before and after staff training. This allowed us to determine whether staff training led to changes in the association between staff behaviors and resident agitation during personal care interactions.

**Methods**

**Participants and Setting**

The participants in this investigation were the residents and CNAs of two nursing homes in the Birmingham, AL, area. All participants were part of a larger study of the effects of a behavior management and communication skills training program for the CNAs (Burgio et al., 2002; Stevens et al., 1998). One facility was operated by the local county government and housed 238 residents. The other facility was a 100-bed private facility.

A total of 66 residents (52 women and 14 men) were observed during personal care interactions with nursing staff both before and after the staff training program was implemented. The mean age of these residents was 80.86 years. Twenty-two residents (33%) were African American and 44 (67%) were White. Most residents (92%) were diagnosed with dementia using physician-established diagnoses and the Clinical Dementia Rating Scale.

Of the 66 residents observed during personal care interactions with CNAs, 9 residents displayed no agitated behaviors and another 27 residents showed fewer than 6 onsets of agitated behavior during the four baseline observation sessions. Residents with fewer than 6 onsets of agitated behavior before staff training were excluded from the sequential analyses because a minimal number of agitation onsets must be observed to avoid excessive bias or unreliability when estimating the sequential associations (Bakeman & Gottman, 1986). In other words, these residents with fewer than 6 onsets of agitation at baseline did not show enough variability in agitation onset to study the predictors of agitation onset with a sequential analysis approach. Consequently, a total of 30 residents (24 women, 6 men) displayed a sufficient number of agitated behavior onsets during the baseline observation sessions to examine baseline sequential associations. These 30 residents had a mean age of 80.17 years and a mean Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) of 3.17 (range = 0–23).

Eighty-seven CNAs were observed to be providing personal care to the 66 residents during the behavioral observation sessions. The average age of the CNAs was 39.64 years, and 89% were African American. Each CNA had a minimum of 8 months of experience. The average experience level was 10.8 years. A total of 59 CNAs were observed providing care for the 30 residents who displayed 6 or more agitation onsets at baseline. These 59 CNAs did not differ from the other 28 CNAs on any demographic or work experience variable.

Written informed consent was obtained from the residents using proxy consent wherein the individual listed as the resident’s sponsor in the nursing home records was contacted, told about the study, and provided a written informed consent form. Written informed consent was obtained from 62% of the sponsors contacted. We also attempted to obtain assent from all resident participants. The CNAs participated in the training program and observation sessions as part of their regular employment duties; thus, consent for their
participation was obtained from the facility administrator and the Director of Nursing. Verbal consent was obtained from the CNAs before all observation sessions and for collection of demographic information. All informed consent procedures were regularly reviewed and approved by the Institutional Review Board of the University of Alabama at Birmingham.

Procedure and Measures

Behavioral observation methods.— Computer-assisted behavioral observation data were collected during personal care interactions between CNAs and residents before and after the nursing staff received training in behavior management and communication skills. Behavioral observation sessions were conducted during personal care interactions on four separate occasions before staff training and on four additional occasions after staff training. The average duration of the baseline and posttraining care interactions was approximately 10 min (M = 557 s and 603 s, respectively). In all, over 84 hr of staff–resident personal care interactions were observed in this study. Residents were observed for an average of 2,195 s (range = 858–4,895) during baseline observation sessions and 2,403 s (range = 1,394–3,950) during posttraining observation sessions. Each personal care interaction that was observed and coded focused on the behavior of a single CNA delivering care to one resident.

During these interactions, trained research assistants recorded behaviors and events using real-time computer-assisted behavioral observation methods (Burgio et al., 1994). Keys on lap-top computers were assigned to certain CNA and resident behaviors, and these keys were pressed whenever target behaviors were observed. Relatively brief behaviors (e.g., positive statements by the CNA) were designated as events and given an arbitrary duration of one second. For behaviors that could persist over several consecutive seconds (e.g., disruptive vocalizations by the resident), both the onset and offset of these events were recorded by the research assistants. Thus, these behaviors were coded as duration events, and their actual durations were recorded in the computer-assisted system. More specific and comprehensive information about the behavioral observations is presented elsewhere (Burgio et al., 2002).

The target behavior in the present investigation was agitation displayed by residents during personal care interactions. Agitation was defined as a general category of disruptive behaviors that included at least one of three more specific behaviors: disruptive vocalization, restlessness, or physical aggression (Cohen-Mansfield, Marx, & Rosenthal, 1989). Disruptive vocalization was the most common form of agitation. It was defined as any utterance that was repeated three or more times, judged to be excessively loud, and/or was unintelligible. This category included not only vulgar comments and repetitive requests but also groans, self-talk, and other utterances that met definitional criteria. Restlessness was defined as a psychomotor indication of agitation and included behaviors such as pounding with the hand, banging objects, or grinding one’s teeth. Inappropriate disrobing was also coded as restlessness. Physical aggression was defined as physically aggressive behaviors toward others such as hitting, grabbing, punching, or throwing objects. Physically aggressive acts were observed rarely. If one or more of these behaviors were observed for any particular second, then agitation was said to be occurring during that second. Agitation was coded as a duration event, meaning both the onset and offset of agitated behavior were recorded.

CNA behaviors that were coded and analyzed as possible antecedents of resident agitation included providing physical assistance to the resident, giving verbal prompts to the resident (verbal instructions concerning the personal care activity itself), making positive statements to the resident, and making negative statements to the resident. Verbal prompts, positive statements, and negative statements were coded as brief events with arbitrary durations of one second. Both the onset and offset of physical assistance were coded, rendering this behavior a duration event.

Type of personal care provided was also coded. Assistance with dressing was observed most often (30% of total observation time), followed by grooming/bed–bathing (25%), transferring from bed to chair (21%), and toileting (9%). The remaining observation time was coded as “no activity” (15%) and consisted of periods when the CNA left the resident momentarily or during transition periods from one personal care activity to another. Bathing in the shower or bathtub was not included in these observations because both nursing homes used “bath teams” of CNAs with specific training. Although the use of bath teams is becoming more common in nursing homes, it is not the norm, and we believed that data from these interactions might not be representative of the typical care interactions in most nursing homes.

Training program.— After the baseline observation period, all CNAs completed a comprehensive behavior-management and communication-skills training program. This program consisted of 5 hr of in-service training and 3 weeks of on-the-job training (Burgio et al., 2002; Stevens et al., 1998). The curriculum included four major skill areas: identifying factors in the environment that could affect resident behavior, communication skills, positive reinforcement procedures, and distraction and diversion techniques. The program emphasized improving both the verbal and nonverbal (e.g., smiling, gesturing) communication skills of the nursing staff. Specifically, CNAs were trained to use direct, one-step, verbal instructions and nonverbal cues when communicating with residents, and they were encouraged to make more positive statements and provide more positive reinforcement when interacting with residents. After these basic skills were discussed, the specific behavior problems of each resident under their care were reviewed, and an individualized behavioral program was written for each resident’s chart. Finally, a staff motivation system was used to enhance adherence and to maintain the long-term impact of the training program.

Comprehensive findings of the effects of the staff training program and the motivational system on rates of CNA and resident behaviors are presented elsewhere (Burgio et al., 2002). Included in those results are findings that staff training led to an increase in the rate of CNA positive statements per hour (M = 8.4 and 33.7, p < .001) and a decrease in the percentage of time that residents displayed some form of
agitation during personal care interactions (Ms = 12.4% and 10.0%, p < .05).

Sequential Analysis Procedures

The present article describes the results of the timed-event sequential analyses that were used to test hypotheses concerning possible antecedent–consequent sequential relationships between CNA and resident behaviors. These methods allowed us to determine whether certain CNA behaviors were associated with agitation onset by being either more likely or less likely to precede agitation onset than would otherwise be expected on the basis of chance. Using the methods developed by Bakeman and Quera (1995), second-by-second data from the observational records were tabulated into separate 2 × 3 contingency tables for the baseline and posttraining observation sessions for each resident.

Figure 1 illustrates a hypothetical data record from 60 s of observation for one CNA–resident interaction. Onsets and durations for one CNA behavior (X) and one resident behavior (Y) are depicted. The CNA behavior is modeled as the hypothesized antecedent, and the resident behavior is modeled as the hypothesized effect of this antecedent. For each second of observation, a code of 1 is entered for the variable if the behavior is occurring, and a code of 0 is entered if it is not occurring. Each second of this hypothetical 60-s record for these two behaviors is coded at the bottom of Figure 1 and in the 2 × 3 contingency table displayed in Figure 2. The two rows of the contingency table represent whether the CNA behavior (X) was present (1) or absent (0) during a particular second, and the three columns of the contingency table indicate whether the resident behavior, Y, was just beginning (1 = onset), continuing (1 = cont), or absent (0) for each second.

To determine whether the onset of resident agitation was more (or less) likely to occur than expected by chance when a particular CNA behavior was exhibited, we computed summary statistics from the 2 × 3 contingency table for each resident to index the strength of the antecedent–consequent sequential relationship. In these calculations, the middle column from the contingency table was excluded because once agitated behavior has begun, that episode of behavior must end before a new onset of agitated behavior can be observed. In other words, it is impossible to observe a new onset of agitation in a particular second if an ongoing episode of agitation is continuing from the previous second. If one collapses the first two columns of Figure 2 into a simple 2 × 2 contingency table, summary statistics for the simple co-occurrence of these two behaviors can be calculated, but these indices would not be informative for testing an hypothesized antecedent–consequent relationship between the two behaviors. By removing these data in the middle column of Figure 2 that tabulate the seconds during which agitation episodes were merely continuing, the summary statistics from the timed-event sequential analysis now index an antecedent–consequent relationship, namely whether the CNA behavior (X) is associated with the onset of resident agitation (Y).

Potential antecedent events such as CNA behaviors may have effects on consequent events such as resident behaviors that extend for a period of time after the offset of the antecedent condition. For this reason, a 10-s window was added to the offset of the CNA behaviors that were studied as possible antecedent events in this analysis. Thus, for the two incidents of the hypothetical antecedent depicted in Figure 1, durations of 15 s and 13 s, respectively, are indicated. These durations would have resulted from CNA behaviors (e.g., physical assistance) that continued for 5 s and 3 s, respectively, with 10-s windows appended to each occurrence. If the onset of resident agitation was observed during the CNA behavior

![Figure 1](https://academic.oup.com/psychsocgerontology/article-abstract/57/5/P461/609408/609408)
or within 10 s of the offset of the CNA behavior, then this onset of agitation was attributed to that CNA behavior in the sequential analysis (i.e., entered into the upper left corner of the contingency table). In the analysis of observational data from interactions between two people, multiple options are available concerning what is considered to be the unit of analysis. One possibility was to consider all staff–resident dyads separately and analyze the data at the level of the dyad. However, the multiple dyads in this study were not independent from each other, and many possible dyads were observed only rarely or not at all. Another possibility was to consider the CNA to be the unit of analysis. Even though the training program was administered to the CNAs, the emphasis when collecting behavioral observation data was on the quality of care provided to the residents and on the residents’ reactions to CNA behaviors. Therefore, each resident was observed for an equivalent amount of time (a total of four baseline and four post-training care interactions), and the data collected on each resident were assumed to be independent from the data collected on all other residents. These research design considerations led to a decision to designate the resident as the unit of analysis for all analyses that are reported in this article.

Residents with fewer than six onsets of agitated behavior across the four baseline observation sessions were excluded from the analysis. This was necessary because a minimal number of agitation onsets must be observed to avoid excessive bias or unreliability when estimating the sequential associations (Bakeman & Gottman, 1986). In addition, not all CNA behaviors were observed for all residents. This further reduced the sample size for the analysis of CNA positive statements and CNA negative statements. Although the statistical significance of each antecedent–consequent sequential association can be determined for each individual resident, significance level is affected by many factors including the strength of the effect, the percent of time each antecedent condition was observed, the number of consequent behaviors observed, and the total number of seconds of observation. Thus, a measure of effect size that is unaffected by total amount of observation time is often desired when averaging effects across multiple subjects. Several indexes are available for averaging effects, including the familiar odds ratio, phi coefficient, and Yule’s Q (Bakeman, McArthur, & Quera, 1996). Comparisons of the distributions for the different indexes revealed notable skewness for the odds ratio and for Yule’s Q. The phi coefficient tended to yield more symmetric distributions. Consequently, the phi coefficient was selected for use when examining effects across residents.

The Wilcoxon signed ranks test (Siegel & Castellan, 1988) was used to determine whether the median effect size for each sequential association between CNA behavior and resident agitation was significantly different from zero. Wilcoxon tests were also used to determine whether these effect-size estimates changed from baseline to posttraining. Although all statistical tests were performed on the phi coefficient, the median odds ratio is also reported to aid in the interpretation of the findings.

## Results

Of the 30 residents who showed six or more onsets of agitated behavior during the personal care observations before staff training, the percentage of total baseline observation time that these residents displayed agitation was 23.6%. Table 1 summarizes the results of the sequential analyses on the baseline data for the four CNA behaviors that were analyzed as possible antecedents of agitation onset for these 30 residents. The Wilcoxon signed ranks test indicated that agitation onset was significantly more likely than would be expected by chance following the verbal prompts of the CNAs before they received the training program ($p = .031$). The median odds ratio of 1.44 indicates that the odds of agitation onset during verbal prompting or within 10 s after a verbal prompt was 1.44 times higher than the odds of agitation onset at other times. After excluding another 8 residents who received no positive statements from CNAs during the baseline observations, we found that onsets of agitation among the remaining 22 residents were significantly less likely to occur than would be expected by chance following positive verbal prompts. Table 1. Sequential Analysis Results for Certified Nursing Assistant Behaviors as Antecedents of Resident Agitation During Baseline Observations

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Rate per Hour</th>
<th>Phi</th>
<th>OR</th>
<th>SR</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Assistance</td>
<td>34.7</td>
<td>.011</td>
<td>1.25</td>
<td>75.5</td>
<td>.122</td>
</tr>
<tr>
<td>Verbal Prompts</td>
<td>85.0</td>
<td>.018</td>
<td>1.44</td>
<td>103.5</td>
<td>.031</td>
</tr>
<tr>
<td>Positive Statements</td>
<td>8.5</td>
<td>.009</td>
<td>0.00</td>
<td>-69.5</td>
<td>.020</td>
</tr>
<tr>
<td>Negative Statements</td>
<td>4.7</td>
<td>.012</td>
<td>0.00</td>
<td>-60.0</td>
<td>.677</td>
</tr>
</tbody>
</table>

Note: OR = odds ratio; SR = signed ranks statistic for the Wilcoxon test. *OR = 0 for 15 residents, OR < 1 for 19 residents. **OR = 0 for 9 residents, OR < 1 for 9 residents.
statements by CNAs (\( p = .020 \)). In this analysis, 19 of the 22 residents had odds ratios less than 1.00, suggesting a uniform effect for positive statements to have protective or suppressive effects on resident agitation. Only 12 residents were subjected to negative statements by CNAs during baseline observations, and these relatively rare CNA behaviors were not found to have significant effects on the rates of agitation onset.

After staff training, 20 (17 women, 3 men) of the 30 residents who showed 6 or more onsets of agitation at baseline continued to show 6 or more agitation onsets during the post-training observations. These 20 residents provided an opportunity to test the effects of staff training on the strength of these sequential associations. Most of these residents had severe dementia (MMSE, \( M = 1.75 \), range = 0–10). Table 2 summarizes the baseline and posttraining sequential associations found for these 20 residents and reports the results of Wilcoxon signed ranks tests on the difference between the baseline and posttraining phi measures. Although CNA verbal prompting was sequentially associated with agitation onset before staff training for these 20 residents (median phi = .032, \( p = .01 \)), there was no such sequential relationship between these two behaviors after staff training (median phi = −.004, \( p = .91 \)). The Wilcoxon signed ranks test indicated that the phi coefficient for the CNA verbal prompt–resident agitation sequential association decreased significantly from baseline to posttraining for these 20 residents (\( p = .04 \)). The median odds ratio decreased from 1.82 at baseline to 0.92 after training, indicating that the odds of resident agitation beginning during verbal prompting or within 10 s after a verbal prompt by a CNA were reduced to approximately one half their size following staff training.

Although CNA positive statements had a suppressive effect on resident agitation onset for the 30 residents studied at baseline, this sequential association was not found for the 20 residents who continued to have six or more agitation onsets after staff training. A negative or suppressive effect was still found, but it was no longer statistically significant (baseline: median phi = −.013, median odds ratio = 0.0, \( p = .21 \); posttraining: median phi = −.012, median odds ratio = .72, \( p = .56 \)). No significant changes in sequential association were observed for CNA physical assistance, CNA positive statements, or CNA negative statements.

**Table 2. Changes in Sequential Association Between Nursing Staff Behavior and Resident Agitation After Staff Training**

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Pretraining phi</th>
<th>Pretraining OR</th>
<th>Posttraining phi</th>
<th>Posttraining OR</th>
<th>Change phi</th>
<th>Change OR</th>
<th>Change SR</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Assistance</td>
<td>0.032 1.82</td>
<td>0.00</td>
<td>0.020</td>
<td>0.092</td>
<td>−55.0</td>
<td>0.400</td>
<td>0.013</td>
<td>.736</td>
</tr>
<tr>
<td>Verbal Prompts</td>
<td>−0.043</td>
<td>5.57</td>
<td>−0.010</td>
<td>0.72</td>
<td>−8.0</td>
<td>0.679</td>
<td>0.012</td>
<td>.560</td>
</tr>
<tr>
<td>Positive Statements</td>
<td>0.043</td>
<td>0.00</td>
<td>0.010</td>
<td>0.00</td>
<td>−3.0</td>
<td>0.375</td>
<td>0.012</td>
<td>.560</td>
</tr>
</tbody>
</table>

*Note: OR = odds ratio; SR = signed ranks statistic for the Wilcoxon test on the change in phi coefficients.*

With nursing assistants can be sequentially related to the behaviors of those nursing assistants. The findings indicate that before behavior-management and communication-skills training, the verbal instructions of the CNAs during personal care interactions were more likely to elicit agitation in residents than would be expected by chance, whereas positive statements by CNAs were associated with a reduced likelihood of agitation onset. The quality of the verbal prompts used by CNAs before staff training appeared to create distress, discomfort, or displeasure in many residents. Conversely, positive statements had a calming effect that appeared to suppress or prevent resident agitation.

This study also provides evidence that the quality of the interactions between CNAs and residents was modified by the behavior-management and communication-skills training program. Sequential associations from behavioral observations made before and after staff training suggested that the training program significantly improved the quality of the CNAs’ verbal instructions during personal care routines. Although CNA verbal prompts were found to be associated with an increased probability of agitation onset in residents before staff training, no such sequential association was found after staff training. The statistical significance of this change in sequential association was confirmed for the 20 residents with six or more onsets of agitation during both baseline and posttraining observations. One of the primary goals of the communication-skills component of the training program was to teach the CNAs to give simple, one-step verbal instructions, rather than multiple-step instructions. Prompting in this way might reduce confusion or frustration for residents with dementia, making it less likely that these residents become disoriented or upset during personal care interactions.

Because the verbal prompts used by CNAs after training were less likely to elicit agitation, they may have also been more effective for assisting residents with their personal care activities. Although the rate of CNA verbal prompting was not significantly altered by the training program (Burgio et al., 2002), timed-event sequential analysis methods showed that after training, CNAs used prompts that were significantly less likely to elicit agitation in the residents for whom they provided care. Thus, CNAs were observed to interact with residents during personal care routines in more innocuous, calming, and less irritating ways after they completed the formal training program.

The results of the sequential analyses on the baseline data showed a link between CNA positive statements and resident agitation such that positive statements were associated with a reduced rate of agitation onset in the 30 residents with six or more agitation onsets across the four baseline observations. Previous analyses of pre- and posttraining data indicated that CNAs significantly increased their rate of positive statements following staff training (Burgio et al., 2002). Consequently, a corresponding decrease in the rate of resident agitation would be expected on the basis of this baseline sequential association between positive statements and agitation, and this is what was found by Burgio and colleagues (2002). Because positive statements by CNAs were much more common after training, this may have had more general effects such that all CNA verbal output, including
verbal prompts, was now responded to more favorably by residents. Taken together, these findings show that the staff training and motivational system did affect the quality of care provided to these nursing home residents. By increasing the rate of CNA positive statements and improving the quality of CNA verbal prompts, resident agitation was significantly reduced during personal care interactions.

As sequential analysis methods continue to be applied to research questions in aging and gerontology, the optimal methods for testing specific hypotheses are still being developed. Some approaches simply record the onset of behaviors, and information about the duration of those behaviors is not considered when examining sequential associations (e.g., Rose & Pruchno, 1999). Other investigators have recorded behaviors in 10-s blocks and examined the lagged responses of caregivers to dependent and independent behaviors of both institutionalized and community-dwelling older adults (Baltes & Wahl, 1992). In our timed-event sequential analysis method, we have implemented a second-by-second approach that allows us to measure the duration of hypothesized antecedent and consequent events and to calculate effect-size estimates specific to the onset of the consequent event. We have also added a 10-s window to the offset of possible antecedent conditions to allow for briefly delayed responses. Within this general analytic approach, we have tended to implement conservative statistical testing procedures that include deleting the data of participants with fewer than six onsets of the consequent behavior, using nonparametric statistical tests to examine overall group effects, and supplementing the phi coefficient with the odds ratio to interpret the magnitude of the sequential associations. The various behavioral coding and sequential analysis methods that are available for studying ongoing interpersonal interactions present a multitude of options to the applied investigator, and additional methodological studies are needed to more fully evaluate and compare the usefulness of these approaches (Bakeman et al., 1996).

Our methodological work has shown that the phi coefficient usually has reasonable psychometric properties for averaging effect sizes across residents. However, phi is limited in an interpretive sense because its possible range is markedly attenuated when analyzing rare events such as resident agitation or negative statements by CNAs. A phi coefficient of .02, for example, is a rather meaningless effect-size indicator unless one also has information about the base rates of the antecedent and consequent behaviors and makes adjustments accordingly. The distribution of the odds ratio is more likely to be skewed, but it is less affected by unbalanced base rates and provides more useful information for interpreting the strength of any significant effects.

There are limitations to this study and qualifications to the results that should be acknowledged. The computer-assisted, direct behavioral observation method requires much more effort and resources than using simple paper and pencil observation methods or staff-report questionnaires. The frequency and duration of events that satisfy definitional criteria are carefully recorded, but additional innovations are necessary if one also wishes to record the intensity or severity of specific problem behaviors. For example, one brief episode of physical aggression might be much more severe and more disruptive to the unit than longer and more frequent episodes of repetitive utterances. Both were simply analyzed as instances of agitation in the present analysis. Another limitation of the study is the relatively large number of residents who were excluded from the sequential analysis because they did not display a sufficient number of discrete onsets of agitation. Because of these exclusions, our findings may not generalize to nursing home residents who display agitation at low rates. Positive statements from CNAs, for example, appear to be effective for preventing agitation onset in residents who show a relatively high number of discrete agitation episodes during personal care interactions, but other factors may be more important for suppressing agitation in the residents who showed relatively few agitation episodes.

Data from retrospective staff survey instruments provide important information on resident problem behaviors. Behavioral observation techniques can be used to examine different aspects of problem behaviors such as possible causative factors. Behavioral observation techniques are also useful for collecting data directly from individuals for whom self-report data are simply not available (e.g., very young children, nursing home residents with severe dementia). Consequently, these methods can provide sensitive measures for assessing current functioning and changes that are due to treatment. The findings for CNA verbal prompts in the present investigation illustrate the contributions that behavioral observation and sequential analysis methods can make in the context of an intervention study. Even when survey data from the nursing staff are available, the sequential analysis of behavioral observations can address specific research questions about the flow of events in person-to-person interactions that might otherwise go unanswered.

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