A CONSECUTIVE CONTROLLED CASE SERIES OF SELF-INJURIOUS BEHAVIOR MAINTAINED BY AUTOMATIC REINFORCEMENT

by

ESTHER PARK

(Under the Direction of Kevin M. Ayres)

ABSTRACT

Self-injurious behavior (SIB) maintained by automatic reinforcement (i.e., ASIB) occur when SIB itself produces a reinforcing sensory consequence. Though SIB may be found to have an automatic function through a functional analysis, further assessments might be necessary to expose an additive social function. The current study included a consecutive controlled case series to identify the assessment and treatment procedures and outcomes for ASIB and SIB both automatically and socially reinforced for clients admitted to an intensive outpatient program for behavioral intervention. Of 267 clients, 25 were included in this study based on meeting the study's inclusion criteria. Overall, 28% of participants had an additive social function to their SIB, 88% of participants had a punishment component, and 72% had a successful discharge from the program. Differences of admission and treatment outcomes between ASIB and SIB maintained by both automatic and social reinforcement are also reported.

INDEX WORDS: Consecutive controlled case series, Retrospective analysis, Self-injurious behavior, Automatic reinforcement, Social reinforcement, Functional analysis

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ESTHER PARK

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by

ESTHER PARK

Major Professor:	Kevin M. Ayres
Committee:	Rachel R. Cagliani
	Alicia B. Davis

Electronic Version Approved:

Ron Walcott
Vice Provost for Graduate Education and Dean of the Graduate School
The University of Georgia
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CHAPTER 1

INTRODUCTION

Among children diagnosed with autism spectrum disorder (ASD), about 27% engage in self-injurious behavior (SIB; Soke et al., 2016). SIB varies based on its topography (e.g., skin scratching, head banging), magnitude (i.e., intensity), and rate, and can cause injury and distress to the individual and those around them (Craig et al., 2016; Taylor et al., 2011). SIB can also affect the individual's ability to socialize with peers and participate in academic activities (Richards et al., 2016). Given the impact SIB can have on the individual and others, understanding the etiology of the individual's SIB is important and the use of behavior-analytic treatments can be efficient and effective in behavior reduction (Reeves et al., 2013; Wood et al., 2011).

Functional Analysis

A functional analysis (FA) is a type of functional behavioral assessment that tests various antecedents that evoke and consequences that reinforce target challenging behavior (Iwata et al., 1994b). An FA is the only empirically supported approach to identify potential functions (i.e., causes) of behavior (Hanley et al., 2003). An FA typically includes test conditions (e.g., attention, tangible, escape) that test for social and automatic functions and are all compared to a control condition (e.g., toy play). Clear results can be determined from the FA; however, further assessment may be needed if results are inconclusive (e.g., variability in responding across conditions). An automatic function can affect the interpretation of responding in an FA if not controlled for (Scheithauer et al., 2017). To address this, previous studies have conducted

extended alone or ignore conditions either before or after the FA to rule in or out the automatic function (Vollmer et al., 1995; Querim et al., 2013). If high rates of SIB persist across test conditions or in the alone or ignore condition, then behavior may be maintained by automatic reinforcement (Iwata et al., 1994b).

Despite assessment results that suggest automatically reinforced SIB (ASIB), there is the potential that SIB is also reinforced by social variables (McKerchar et al., 2001). When SIB is undifferentiated across multiple conditions in the FA, it becomes difficult to determine a clear function (Hagopian et al., 2015). One way to test for an additive social function is to account for SIB maintained by automatic reinforcement (e.g., using protective equipment) and subsequently attempt to evoke SIB under social test conditions (Scheithauer et al., 2017). For example, Scheithauer et al. (2017) identified that the SIB of 2 children with ASD was maintained by automatic reinforcement. Hypothesizing that there also might be a social function maintaining SIB, the researchers implemented sensory extinction (i.e., protective equipment and blocking) after conducting a multielement FA without sensory extinction in place. By comparing the rates of SIB occurring during sessions with and without sensory extinction in place, they found that the implementation of sensory extinction helped to determine if SIB was maintained by automatic reinforcement alone or multiply maintained with another social function (Scheithauer et al., 2017). Through such assessments, a comprehensive understanding of the function of SIB can be obtained which will better guide treatment selection.

Treatment

Function-based treatments have shown that developing an intervention based on the function of behavior is highly effective in reducing the target challenging behavior (Wood et al., 2001). Following the guidelines made by the Behavior Analyst Certification Board (BACB) in

2014, reinforcement-based procedures are typically encouraged prior to incorporating punishment-based procedures. Noncontingent reinforcement (NCR) is a reinforcement-based procedure that involves having reinforcers accessible to the client regardless of the presence or absence of challenging behavior and has been found to be an effective treatment for ASIB (Rooker et al., 2018). Another common treatment procedure for ASIB is the use of competing items, using an item that competes with the function of the challenging behavior (Ahearn et al., 2003). Alternatively, providing reinforcement for the absence of challenging behavior (differential reinforcement of other behavior [DRO]) or for the presence of an alternative appropriate behavior (differential reinforcement of alternative behavior [DRA]) to the challenging behavior can be implemented (Hedquist & Roscoe 2019; Toussaint & Tiger, 2012).

Reinforcement-based procedures alone may be ineffective in the treatment of automatically reinforced challenging behavior, specifically ASIB (Hagopian et al., 2015). When reinforcement-based procedures do not result in reduction of the target challenging behavior, punishment-based procedures may be considered. Punishment-based procedures involve the use of negative or positive punishment components that are implemented to reduce challenging behavior (Cooper et al., 2007). Response interruption and redirection (RIRD) and response blocking (RB) are common procedures used to target ASIB and involve blocking or interrupting challenging behavior and redirecting to an appropriate behavior (Ahrens et al., 2011), and these are often conceptualized as punishment procedures based on the quick and sustained decrease in challenging behavior (Smith et al., 1999). Use of protective equipment as means of sensory extinction may also be implemented either contingently or noncontingently on the presence of SIB to restrict its occurrence and reduce the potential sensory stimulation it produces (Scheithauer et al., 2017).

The implementation of function-based interventions is important in addressing challenging behavior. When the initially identified ASIB has a potential social function, a treatment designed to target automatic reinforcement may not be effective in reducing the challenging behavior. If SIB is found to be multiply reinforced by automatic and social reinforcement, a procedure to target the social function may also be necessary. For example, functional communication training (FCT) uses differential reinforcement to teach an alternative response that delivers the same reinforcement as the challenging behavior (Carr & Durand, 1985). Rather than engaging in SIB to obtain a reinforcer, the client is taught an alternative communicative response (e.g., verbal request, picture card exchange, sign language) to request for what they want. This procedure can be combined with the previously mentioned procedures to establish a comprehensive treatment that targets multiply reinforced SIB.

CHAPTER 2

PURPOSE

To provide further information regarding the assessment and treatment of ASIB and SIB multiply maintained by automatic and social reinforcement, a retrospective consecutive controlled case series (CCCS) of clients admitted to an intensive outpatient program (IOP) for the reduction of SIB was conducted. The study aimed to evaluate the trajectory and outcomes of assessment and treatment from a clinical sample of participants with automatically reinforced SIB.

CHAPTER 3

METHOD

Clients and Setting

We reviewed the clinical records for clients admitted to an IOP for the assessment and treatment of severe challenging behavior between September 2018 and November 2019. The program was supported within a large autism center, and the autism center was a subsidiary of a comprehensive pediatric healthcare system. Clients attended the program for approximately 5 days per week, 6 hours per day, and for an average of 16 weeks (range, 12-30 weeks). Therapists generally implemented assessment and treatment procedures in individualized padded or unpadded rooms, which were equipped with a one-way mirror that allowed for inconspicuous data collection.

Master's- and doctoral-level Board Certified Behavior Analysts (BCBA/BCBA-Ds®) lead teams of Registered Behavior Technicians (RBTs®) in the implementation of all behavioral services. Upon admission, the clinical team conducted caregiver interviews and direct observations to identify primary concerns and target challenging behavior. The clinical team also conducted other assessments (e.g., preference assessments, demand-latency assessments), which helped inform the FA (Iwata et al., 1994) and subsequent treatment. Reinforcement-based procedures were initially implemented to decrease challenging behavior. However, if challenging behavior persisted, the clinical team considered the use of some type of punishment-based procedure depending on the rate, intensity, and severity of the challenging behavior.

Once treatment resulted in a reduction of challenging behavior, the clinical team worked towards generalizing treatment effects through caregiver training, home visits, and community outings. There were two main documents that were completed for each client which provided an overview of the admission and recommendations for treatment. The first document included an admission summary that outlined all the assessments and interventions that were implemented. The second document included behavioral recommendations following discharge from the program. These two documents were recorded and uploaded to the client's electronic record. For the current study, client admission data were extracted and reviewed from these clinical records up until the point of generalization. Clients were included in the current study if they met the following inclusion criteria: (a) SIB was targeted for reduction during the admission, (b) at least an automatic function for SIB was confirmed through an FA, and (c) assessment and treatment data were available in each client's electronic file. A total of 267 clients were reviewed from the program database. Of those, 154 were excluded for SIB not being a target behavior during the admission and 88 were excluded for not having SIB reinforced by automatic reinforcement, resulting in 25 participants (9%) that met inclusion criteria. Participants averaged 10.25 years of age (range, 4-18 years), with the majority being male (n = 25; 64%) and Black or African American (n = 11; 44%). All participants were diagnosed with some form of developmental disability, including, for example, autism, moderate to severe intellectual disability, or cerebral palsy. Refer to Table 1 for participant demographics and diagnoses.

Data Coding

The electronic records for all 25 participants who met the inclusion criteria were reviewed and coded for several variables related to the assessment and treatment of ASIB. Regarding the assessment of SIB, we coded for the *pattern of responding that indicated an*

automatic function during the FA. This was coded based on whether response rates of SIB were variable (a) across standard FA conditions (i.e., tangible, attention, escape, alone or ignore, and toy play) such that results were inconclusive, (b) during an extended alone context in which SIB occurred regardless of social contingencies, or (c) both across standard FA conditions and during an extended alone context. We also coded SIB into three subtypes of responding within the FA: higher levels of SIB in alone condition only (Type 1), variable or high levels of SIB in all conditions (Type 2), or presence of self-restraint behavior (e.g., crossing arms, tucking hands, or holding onto objects to restrict movement) within conditions (Type 3; Hagopian et al., 2015). We further coded whether an *additional assessment for a potential social function of SIB* was completed for the participants. This was done by coding the assessment procedures the clinical team employed to evaluate the potential social function.

Treatment progression and treatment components were analyzed for the 25 participants to assess the *types of treatment components that were implemented* and the *final treatment package the client discharged with*. Data were gathered on the use of protective equipment (e.g., protective gear to prevent injuries such as arm splints, helmets, mouth guards), final treatment components, and implementation of punishment-based interventions (e.g., RB/RIRD, NCR, response cost). Data on *final treatment outcomes* were gathered on the total reduction of challenging behavior as a percentage and admission outcome (i.e., successful vs. unsuccessful) as reported in the participant's behavioral recommendations. Assessment and treatment information for each participant can be found in Table 2.

Data Analysis

Data were analyzed by the first author and two BCBA-Ds employed at the autism center. The response rates of SIB from the FAs were visually analyzed by examining the clients' graphs

to determine the function of behavior. Several participants had multiple FAs, but those specific to the assessment of SIB were extracted and analyzed. The *pattern of responding that indicated an automatic function during the FA* was analyzed based on high response rates in the extended alone condition, across standard FA conditions (i.e., toy play, attention, escape, tangible), or high response rates in both the extended alone and standard FA conditions. A visual analysis of participants' FA graphs was done to also analyze the *additional assessment for a potential social function of SIB*. The type of assessment (e.g., sensory extinction to control for automatic reinforcement, alternative FA designs) that confirmed a social function was collected from this.

The *types of treatment components that were implemented* and the *final treatment package the clients discharged with* were identified by reports from the participants' admission summary and behavior recommendations documents. The information found from the reports were gathered and organized to each corresponding participant. This descriptive data was then analyzed into prevalence rates by dividing the number of participants with a certain treatment component (e.g., RB/RIRD, NCR, response cost) to the total number of participants and multiplying by 100 to get a percentage. *Final treatment outcomes* (i.e., successful vs. unsuccessful) were coded based on the percent reduction in SIB. Percent reduction for SIB was calculated by taking the average of SIB responses from baseline (i.e., total number of SIB responses during the FA divided by the number of total sessions conducted), the average of SIB responses from the last 3 days of treatment implementation in the clinic, and then subtracting those two values. The subtracted value was then divided by the average of SIB responses from baselines and multiplied by 100. A successful admission was defined as an 80% or greater reduction in SIB. An unsuccessful admission was defined as not having an 80% or greater reduction in SIB.

Inter-rater Agreement

Inter-rater agreement was collected to ensure accurate coding of clients in the database based on the study's inclusion criteria. Three RBTs® who were trained in data collection collected agreement for this study. The study's inclusion criteria were given to the RBTs® and coded based on this. Agreement was calculated by comparing two separate raters' records on a total count basis of scoring for whether a client met inclusion criteria or not. This was calculated by taking the smaller count and dividing that value by the larger count value and multiplying by 100 to get a total percentage of agreement. The clinical database of clients were randomly distributed with clients that met the inclusion criteria and clients that did not meet the inclusion criteria. The agreement data collected were based on the initial data collected by the primary experimenter and confirmed by BCBA-Ds®. Inter-rater agreement was collected for 25% of clients in the database and had an overall mean of 100% agreement.

CHAPTER 4

RESULTS

Assessment characteristics of participants with an automatic function only (Auto Only; *n* = 18) were compared to the data of participants with an automatic and social function (Auto + Social; *n* = 7), as shown in Table 2. For the assessment of an automatic function, 16 (64%) of the participants had increased levels of SIB within both the standard FA conditions and the extended alone condition that indicated an automatic function (Auto only: *n* = 12, 67%; Auto + Social: *n* = 4, 57%). There was no test for a social function following the identification of an automatic function for 24% (*n* = 6) of the participants; there was a test for a social function for 76% (*n* = 19) of the participants. A pairwise model of assessment was most used for 32% (*n* = 8) of the participants for whom a test for a social function was conducted (Auto only: *n* = 5, 28%; Auto + Social: *n* = 3, 43%).

Treatment characteristics of participants were also compared and shown in Table 3. Overall, the terminal treatment included a punishment component for 22 (88%) of all participants (Auto only: *n* = 16, 89%; Auto + Social: *n* = 6, 86%). The most common punishment component was RB/RIRD, which appeared in the terminal treatment plan for 18 (72%) participants (Auto only: *n* = 15, 83%; Auto + Social: *n* = 3, 43%).

Reduction in SIB following treatment and final admission outcomes of participants is provided in Table 4. SIB percent reductions were divided into categories of limited reduction (0%-60%) , moderate reduction (60%-80%), and successful reduction (80%-100%). For overall treatment and admission outcomes, 18 (72%) participants had a successful discharge (Auto only:

n = 14,78%; Auto + Social: *n* = 4, 57%). Overall percent reduction of SIB was high (*M* = 85%, *SD* = 15.54) and ranged from 34% to 100%.

CHAPTER 5

DISCUSSION

The current study evaluated the trajectory and outcomes of behavioral services for children with automatically reinforced SIB only versus automatically and socially reinforced SIB. Descriptive data on patterns of responding during the FA, assessments for potential social functions, treatment components, and admission outcomes were reported based on a clinical sample.

Initial data suggested that of 267 clients admitted to the autism center, 42% (n = 113) were found to have SIB as a target challenging behavior. Among the clients that had SIB as a target challenging behavior, 22% (n = 25) had SIB maintained by automatic reinforcement. And of those clients that had an automatic function, 28% (n = 7) had SIB maintained by both automatic and social reinforcement. Findings from this study are similar to those of reports from previous studies that showed the prevalence of ASIB within individual with SIB (Beavers et al., 2013; Hanley et al., 2003). For example, Iwata et al. (1994a) found that of 152 individual with SIB, 25.7% engaged in automatically reinforced SIB. In the same report of Iwata et al. (1994a), 2.6% of the 152 individuals engaged in SIB reinforced by automatic and social reinforcement. The slight difference in prevalence found in this study versus previous studies may be due to demographic differences. For example, the current study included individuals with an age range of 4-18 years whereas Iwata et al. (1994a) had an age range of 1- 51 and up. Overall, data from this study provide further insight on the prevalence rates of ASIB and SIB reinforced by both

automatic and social reinforcement based on a clinical sample. Further studies can examine the difference in prevalence rates of SIB based on function across clients, settings, and topographies.

This study provides further insight and implications on the assessment and treatment of SIB with an automatic function. First, the pattern of responding in the FA that indicated an automatic function was assessed and compared between participants with ASIB and SIB reinforced by both automatic and social reinforcement. For both groups, control was not obtained, and it was more likely that SIB was elevated and persisted in both the test conditions and the alone/ignore conditions which suggested an automatic function. Based on the subtypes mentioned by Hagopian et al. (2015), the data from this study suggest that participants fell into subtype 2 (low levels of differentiation across sessions). Analyzing the client's pattern of responding in the FA may help guide treatment decisions and improve treatment outcomes.

Next, the assessment procedure used to test for potential social functions was analyzed for both groups. The study's findings showed that further assessments to test for a social function were not done for all participants. This may be due to several variables such as clear assessment results from the initial FA indicating an automatic function, previous indirect assessment results, or severity of the challenging behavior and necessity for immediate treatment. However, there could have been participants whose SIB did have a social function but was not identified through assessment. This could be a potential reason for why some participants have a longer treatment progression or have an unsuccessful discharge from the program. Further assessment could still be beneficial in ensuring the implementation of effective treatment to address ASIB.

Treatment for automatically reinforced SIB is an area that receives continued research because it is difficult to identify and control for variables that are maintaining the challenging behavior (Hagopian et al., 2015). In a 2015 study by Hagopian and colleagues, findings

suggested the potential ineffectiveness of using only reinforcement-based interventions for automatically reinforced SIB that had low levels of differentiation across FA sessions. This is supported by the current study's findings that 88% of the participants had punishment within their final treatment package. Results of the current study also showed participants' overall reduction in SIB which was also used to indicate admission outcomes. Of the 25 participants, 72% (n = 18) had an 80%-100% reduction in behavior and a successful discharge from the program, while 28% (n = 7) had a behavior reduction less than 80% and an unsuccessful discharge from the program. Of the 18 participants with SIB maintained only by automatic reinforcement, 78% (n = 14) had an 80 %-100% reduction in behavior and a successful discharge from the program. Of the 7 participants with SIB maintained by both automatic and social reinforcement, 57% (n = 4) had an 80%-100% reduction in behavior and a successful discharge from the program. Of the 19 participants for whom a social test was completed following identification of an automatic function, 74% did not control for the automatic reinforcer. Therefore, it is likely that the prevalence of unsuccessful outcomes is due to including treatment components that do not target the function of challenging behavior. Overall, successful admission outcomes were observed more often for participants with SIB maintained by automatic reinforcement alone. Although both group of participants had similar implementations of punishment, differences in behavior reduction and admission outcome may be due to the complexity of treatment needed to address SIB maintained by both automatic and social reinforcement. Overall findings from this study highlight the difficulty in treating ASIB and the need for further research in identifying effective and efficient assessment and treatment implementation for ASIB and ASIB with an additive social function.

Limitations and Future Directions

There are some limitations of the present study that should be considered. First, the sample size of participants used for this study were small and participants were admitted to an intensive day treatment clinic based on challenging behavior that had immediate risk for severe harm to themselves and others. Thus, the sample of participants is from a particular and unique population of individuals in which the clinical practices may be specific to a single clinic. Further research should be done across other clinical setting and across different populations.

Second, this study is a retrospective review of clinical cases from a single clinic. Within this clinic, a test for social functions was not always done for all the clients with ASIB. Instead, additional assessments were done based on clinical judgment of the clinical team.. Likewise, as mentioned above, not all participants had the automatic function controlled for in subsequent tests for social functions. Although other FA designs can help remediate some of the undifferentiated responding, it could still be unclear what the precise reinforcer for responding was without controlling for the automatic reinforcer. This may be problematic when making treatment decisions and including treatment components that are unnecessary or target the incorrect function. Therefore, a study done by testing every client with SIB for a social function could offer a more accurate prevalence report and control for some of these limitations

Third, successful admission was based only on an arbitrary value of 80% of behavior reduction from baseline to final treatment. Although objective criteria for treatment effects are generally needed, an 80% response reduction may not be a socially valid measure for all individuals and challenging behavior, and the basis of a successful admission being confined only to treatment in the clinic (i.e., not accounting for generalization) also might limit the social validity of our outcomes (see Stokes & Baer, 1977). Generalization of appropriate behavior

from treatment context (e.g., session room) into other untrained contexts (i.e., across settings, people, responses, or time) improves the effectiveness of an intervention. The current study also did not include follow-up data of the participants after they have discharged. Future clinicians and researchers should consider a more restrictive definition of admission success, as well as including follow-up data of participants to ensure treatment effectiveness.

Finally, this study focused on the final treatment components that participants had discharged with rather than all treatment components that were implemented throughout the clients' admission. Therefore, there could have been interventions that were implemented and resulted in therapeutic effects (i.e., reduction of SIB), but not included in the terminal treatment package. For example, FCT was included in the final treatment for 16% (n = 4) of the 25 clients. However, FCT could have been implemented in the earlier stages of treatment and completed following mastery, in which case this would not be documented as part of the participant's final treatment package. Future studies could investigate all treatment components that were implemented within the participant's admission.

In conclusion, results of this study showed the prevalence of ASIB and SIB maintained by both automatic and social reinforcement within a clinical sample. The study further compared the trajectory and outcomes of assessment and treatment implementation based on the reported functions of SIB. The findings of this study support the research on the importance of conducting sufficient assessments to understand and identify the unique functions of SIB. Furthermore, using assessment results to guide the implementation of efficient and effective treatments can improve the overall outcomes of individuals with SIB.

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TABLES

Table 1

Participant Characteristics

Characteristics	*n*	%
Gender		
Male	16	64
Female	9	36
Age		
1–5	4	16
6–10	11	44
11–15	7	28
16–20	3	12
Race		
African American	11	44
Caucasian/White	9	36
Asian/Pacific Islander	4	16
Multiracial	1	4
Diagnosis [a]		
Autism spectrum disorder	21	84
Disruptive behavior disorder	5	20
Stereotypic movement disorder	3	12
Attention deficit hyperactivity disorder	2	8
Cerebral Palsy	2	8
Developmental Delay	2	8
Intellectual disability	5	20
Other	6	24

Note: Demographic and clinical data of the participants that met the inclusion criteria for the current study.

[a] Most participants had more than one diagnosis (n = 19, 76%).

Table 2

Assessment Characteristics of Participants

Characteristics	*Auto Only*		*Auto + Social*		*Combined*	
Assessment Results for Automatic Function						
Standard FA Conditions	2	11	2	29	4	16
Extended Alone	4	22	1	14	5	20
Combined	12	67	4	57	16	64
Assessment Results for Social Function						
Multi-Element	3	17	3	43	6	24
Pairwise	5	28	3	43	8	32
Sensory Extinction	4	22	1	14	5	20
N/A	6	33	0	0	6	24
Determined SIB Function						
Automatic Only					18	72
Automatic + Social					7	28

Note: The assessments conducted to determine an automatic or social function are shown in this table along with the respective outcomes. Data are organized into participants with ASIB, participants with SIB reinforced by automatic and social reinforcement, and a combined value of all the participants in the study.

Table 3

Final Treatment Components of Participants

Characteristics	*Auto Only*		*Auto + Social*		*Combined*	
	n	*%*	*n*	*%*	*n*	*%*
Final Treatment Components for SIB						
RB/RIRD	15	83	3	43	18	72
Competing Items	3	17	0	0	3	12
Protective Equipment	10	56	4	57	14	56
Response Cost	0	0	3	43	3	12
DRO	6	33	3	43	9	36
DRA	3	17	2	29	5	20
NCR	5	28	0	0	5	20
FCT	1	6	3	43	4	16
Punishment Based Treatment	16	89	6	86	22	88

Note: Final treatment components for participants in the study, dividing into Auto only, Auto + social, and combined group. *RB/RIRD* response blocking/response interruption and redirection, *DRO* differential reinforcement of other behavior, *DRA* differential reinforcement of alternative behavior, *NCR* non-contingent reinforcement, *FCR* functional communication response.

Table 4

Treatment and Admission Outcomes

Characteristics	*Auto Only*		*Auto + Social*		*Combined*	
	n	***%***	***n***	***%***	***n***	***%***
SIB Percent Reduction						
0% - 60%	1	6	0	0	2	8
60% - 80%	3	17	3	43	5	20
80% - 100%	14	78	4	57	18	72
Admission Outcome						
Successful	14	78	4	57	18	72
Unsuccessful	4	22	3	43	7	28

Note: The percent reduction of SIB responding and admission outcome for each participants included in the study is shown in this table.