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A Risk-Benefit Analysis of Antipsychotic Medication and Contingent Skin Shock for the Treatment of Destructive Behaviors

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Abstract

Antipsychotic medications are commonly used to address destructive behaviors in people with developmental disabilities. Contingent skin shock is less commonly employed. Here, the risks and the benefits of antipsychotic medications and contingent skin shock are enumerated and compared. First, the major untoward effects of antipsychotic medications and contingent skin shock are summarized. Second, an efficacy analysis was conducted consisting of the following components: a brief description of the conclusions of a 1991 review of antipsychotic medications; a complete analysis of the effect of first generation and second generation antipsychotics on the irritability subscale of the Aberrant Behavior Checklist; a complete analysis of first generation and second generation antipsychotics on the Clinical Global Impression – Improvement Scale; a complete analysis of the effect of first generation antipsychotics, second generation antipsychotics, and contingent skin shock on destructive behavior frequency. The results of the analysis suggest that contingent skin shock is by far the most effective procedure and has the most favorable side effect profile.

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Introduction

Clinical teams comprised of psychiatrists, behavior analysts, and other professionals strive to provide the least restrictive most effective treatment to those people with developmental disabilities who exhibit destructive behaviors. Each discipline has expertise in a range of interventions. For example, the behavior analyst may be skilled at assessment of behavior function, differential reinforcement, extinction, and punishment procedures. On the other hand, the psychiatrist brings a range of pharmaceutical interventions, the ability to sign off on the use of protective equipment or mechanical restraint, and the ability to recommend electroconvulsive therapy or psychosurgery.

Destructive behaviors generally include high intensity and/or high frequency aggression, self-injury, and/or property destruction, but may include other excessive topographies or idiosyncratic responses. High intensity means the behavior(s) result in injuries to the emitter, injuries to others, or requires emergency physical interventions or protective equipment. High frequency means the behavior occurs hundreds or thousands of times per day. Generally, these behaviors force the person to live away from their family home or ideal living situation, make it difficult or impossible for them to receive an education in a typical school setting or otherwise learn new skills, and result in frequent or long-term psychiatric hospitalization.

Differing opinions exists regarding how to employ the various interventions used to treat destructive behaviors. For example, Matson and LoVullo [1] suggest using positive reinforcement methods, then adding aversives first and psychotropic medications second if necessary when treating self-injury. Wachtel and Hagopian [2] suggested a cooperative approach between psychiatry and behavior analysis in treating destructive behaviors exhibited by those with intellectual disabilities. Others have demonstrated successful treatment of destructive behaviors using differential reinforcement and punishment and, in most cases, eliminating medication [3].

There is agreement that those treating people with destructive behaviors should provide the most effective and least restrictive treatment interventions available. Within behavior analysis and psychiatry, decision making models have been proposed to aid in clinical thinking regarding aversive interventions and psychotropic medications. For example, Meinhold and Mulick [4] provided an example of a decision analysis that separated value statements from the effectiveness of treatment options, side effects, and costs associated with various interventions.

Mikkelsen [5] proposed the following equation as a guide to clinical thinking regarding psychotropic medication and people with intellectual disabilities:

$$\frac{\text{Probability of Success} \times \text{Symptom Severity}}{\text{Side Effect Profile}} = \text{Hierarchy Quotient}$$

Mikklesen classified psychotropic medication side effect profiles into categories of severity based on extant literature, encouraged neutral data collection methods, and suggested examination of the literature and/or analysis of one's clinical experience to identify the probability of success of a particular drug intervention.

The models proposed by Meinhold and Mulick [4] and Mikklesen [5] have in common the need to identify the risks and benefits of treatment options. Treatment interventions that most would considerto possess minimal risk include pharmacological interventions with extremely mild side-effect profiles and function-based behavioral interventions such as functional communication training [6], differential reinforcement of alternative and differential reinforcement of incompatible behaviors [7], non-contingent reinforcement [8], antecedent manipulations [9], and extinction [10].

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Function-based behavioral treatments continue to be refined. However, the derived procedures are not universally effective. First, in a certain percentage of the published literature, assessment results show that some problem behaviors are maintained by multiple factors or by automatic or unknown reinforcers [11]. Second, even if the behavior function is identified, the prescribed function based intervention, even with the addition of punishment components, is not always effective [12]. If such procedures are ineffective, the next set of treatment/management options include the following: frequent physical restraint; continuous mechanical restraint/protective equipment; antipsychotic medication and polypharmacy; and contingent skin shock. In addition, psychosurgery [13] and electroconvulsive therapy [14] have been described.

In 1989, the National Institute of Health held a consensus development conference to examine destructive behaviors and associated treatments in people with developmental disabilities. The final report was controversial [15] and called for more research. Since 1989, new treatments and new information regarding existing treatments has been published. New atypical antipsychotic drugs including clozapine, risperidone, olanzapine, quetiapine, ziprasidone, aripiprazole, and paliperidone were introduced in the United States in 1989, 1994, 1996, 1997, 2001, 2002, and 2006 respectively. Increasingly, these medications have been prescribed to address destructive behaviors exhibited by people with developmental disabilities. New information about contingent skin shock is also available.

In this paper, the efficacy and side effect profiles of first generation antipsychotic medications (FGAs), second generation antipsychotic medications (SGAs), and contingent skin shock (CSS) are summarized and compared.

Side Effect Profiles

Side Effect Profile of First Generation Antipsychotic Medications

The side effects of FGAs include acute extrapyramidal syndromes, chronic extrapyramidal syndromes, neuroleptic malignant syndrome, weight gain, sexual dysfunction, seizure, prolactin level elevation, and sudden cardiac death, among other side effects.

Marder and van Kammen [16] describe acute extrapyramidal syndromes including akathisia, dystonia, and drug induced parkinsonism. Akathisia may be characterized by a feeling of inner restlessness, an inability to sit still, or an urge to walk or initiate movement. Akathisia has been reported to occur in 62% (41% - mild; 21% - moderate to severe) of those taking FGAs. Acute dystonias consists of muscle spasms of the head and neck and involuntary movements. These reactions occur in 40% of those treated with high potency FGAs (e.g. pimozide, fluphenazine, haloperidol) who do not also receive antiparkinsonian medications. Finally, drug induced parkinsonism, comprised of rigidity, bradykinesia, shuffling gait, and tremor, occur in approximately 30% of those chronically treated with FGAs. Anticholinergic medications are often effective in treating extrapyramidal side effects but are associated with an additional set of side effects. Extrapyramidal signs have been reported to occur in children treated with FGAs at percentages ranging from 25-73% [17]. Casey [186] summarized the clinical presentation of tardive dyskinesia (TD) in the following way:

Tardive dyskinesia is characterized by repetitive, involuntary, purposeless movements. The typical signs include chewing; tongue protrusion; vermicular tongue activity; lip smacking, puckering, and pursing; or paroxysms of rapid eye blinking. Choreoathetoid movements in the limbs and trunk can also occur. Dyskinesias in the fingers may look as if the patient is playing an invisible guitar or piano. Very rarely TD produces aerophagia, irregular respiratory rates, and grunting noises.

Generally, approximately 3% of those receiving typical antipsychotic drugs will develop persistent (lasting more than 3 months) cases of TD each year; approximately 2% per year will develop transient TD (lasting less than 3 months) [19]. Further, the cumulative incidence of TD has been reported at 5%, 27%, 43%, 52%, 56% at 1, 5, 10, 15, 20 years respectively [20]. If one does develop TD, recovery rates at 3 month have been reported at 24%, 40%, and 81% [21]. Generally, the probability of developing TD is related to age; with TD less common in children and adolescents and most common in the elderly.

Levenson [22] described major and minor features of neuroleptic malignant syndrome (NMS). Major features include fever, rigidity, and elevated creatine phosphokinase concentration (suggesting injury or stress to the heart, brain, or muscle tissue). Minor features include tachycardia, abnormal arterial pressure, tachypnoea, altered consciousness, diaphoresis, and leukocytosis. The probability of developing NMS is estimated to range from .07%[1] to 2.2% per year [23]. Marder and van Kammen [16] suggest that 20 to 30% (or more) of well-developed cases of NMS are fatal.

Allison et al. [24] estimated the effects of FGAs on weight gain in adults at 10 weeks of treatment. For the FGAs molindone, fluphenazine, haloperidol, chlorpromazine, and thioridazine, they found estimated mean weight changes of -.81, .43, .48, 2.10, and 3.49 kg respectively. Allison et al. noted that weight gain clearly increased with time and that patients taking the drugs for long periods of time would be expected to gain more weight. Aronson [17] noted significant weight gain in nearly 100% of children treated with FGAs. Obesity, of course, is associated cardiovascular diseases, diabetes, cancer, and other maladies [25].

FGAs affect sexual functioning. Erectile dysfunction has been reported in 23 to 54 percent of men receiving FGA treatment [16]. Sexual dysfunction varies among FGAs. For example, Serretti and Chiesa [26] found that perphenazine, haloperidol, and thioridazine were associated with sexual dysfunction in 25, 46, and 60 percent of patients respectively. They suggest that FGAs may affect sexual function by inhibiting motivation and reward, increasing sedation, and reducing peripheral vasodilation.

Seizures have been reported to be associated with FGAs. When examining incidence of seizures, Allredge [27] pointed out that seizures have been reported to occur in the general population at an annual incidence of .073 to .086%. Aronson [17] (2 reports seizures to occur in probably less than 1% of those prescribed these drugs (p. 203). Logothetis [28] compared seizure incidence in 859 patients treated with phenothiazines and 669 patients not so treated. Seizure incidence was equal to 1.2% for those treated with phenothiazines and 0.0% for those not treated with a phenothiazine. Seizures occurred in 9% of those prescribed a high dose (1000 mg/day or more of chlorpromazine or equivalent) compared to .3% prescribed a low dose (200 mg/day or less). On the other hand, Pauig, Deluca, and Osterheld [29] found that seizures rates improved or remained unchanged in 64 of 100 patients with epilepsy receiving thioridazine.

Prolactin levels can be affected by FGAs. Rosenbloom [30] summarized studies describing the effect of antipsychotic medication

on prolactin levels. A combination of 4 studies showed that of 56 children receiving a mean does of 14.2 mg/day of haloperidol, 90% had prolactin levels greater than the upper limit of what is consider to be normal. As a result 6.7% had gynecomastia and 15.4 had irregular menstrual cycles. A combination of 3 studies showed that of 46 children receiving 3.7 mg/day of pimozide, 80% had prolactin levels great than the upper limit of what is considered normal (reports regarding gynecomastia and menstrual cycles were absent). Madhusoodanan, Parida, and Jimenez [31] summarized two studies showing a dose dependent increase in prolactin in 40-90% of those treated with phenothiazines. Crawford, Beasley, and Tollefson [32] summarized the effect of haloperidol on prolactin levels of 69 adults and found 72% had elevated prolactin levels. In addition to contributing to galactorrhea, amenorrhea, gynecomastia, and sexual dysfunction, hyperprolactinemia may impact peak bone mass attainment and bone mineral density [30].

FGAs have been associated with sudden cardiac death. Recently, Ray, Chung, Murray, Hall, and Stein [33] summarized data associated with 90,307 (44,218 typical; 46,089 atypical) antipsychotic drug users and 186,600 matched nonusers of antipsychotic drugs between the ages of 30 and 74. They found higher rates of sudden cardiac death in users of FGAs when compared to nonusers and reported incident rate ratios of 1.99 (95% confidence interval [CI], 1.68 to 2.34). Put another way, over the course of 1 year approximately 1 in 700 nonusers died of sudden cardiac death. For those prescribed FGAs, over the course of 1 year, approximately 2 in 700 died of sudden cardiac death. In addition, the risks varied with respect to drug and dose. For example, those prescribed high doses of thioridazine over the course of 1 person year, approximately 5 in 700 died of sudden cardiac death. The risk of sudden cardiac death was dose dependent as those receiving higher doses died more frequently than those who received lower doses. In addition, sudden cardiac death was 10 times more likely in the 70-74 age group than the 30-34 age group.

Sedation is a common side effect of FGAs. Lehman et al. [34], in the American Psychiatric Association Practice Guidelines for the Treatment of Patients with Schizophrenia, suggest the following: "Most patients experience some sedation, particularly with the low-potency first-generation agents such as chlorpromazine, but it occurs to some extent with virtually all antipsychotic medications."

Finally, typical antipsychotic medications have been associated with venous thromboemolism [35], hypotension, and QT prolongation (especially thioridazine) which potentially could contribute to sudden death [17].

Side Effect Profile of Second Generation Antipsychotic Medications

The side effects of SGAs include acute extrapyramidal syndromes, chronic extrapyramidal syndromes, neuroleptic malignant syndrome, weight gain, sexual dysfunction, seizure, prolactin-level elevation, among other side effects. Generally, SGAs cause acute extrapyramidal side effects at similar rates when compared to low potency FGAs (e.g. chlorpromazine, thioridazine) [36]. Only case reports of acute dystonic reactions have been reported with SGAs [36]. Miller et al. [37] reported that 37 – 44% of people taking olanzapine, quetiapine, risperidone, or ziprasidone met at least one of three criteria for parkinsonism for 1 year or less. They also described akathisia occurring in 26 – 35% of those treated with SGAs.

In the past, SGAs, in relation to FGAs, were thought to be much less likely to cause TD. However, recent studies and reviews have not confirmed this assertion. In a recent review, Tarsy, Lungu, and Baldessarini [19] concluded the following:

The sparring of risk of TD with modern APDs [antipsychotic drugs] is surprisingly modest and less than is generally assumed. In fact, as reviewed above, TD risk may not be substantially lower than with some older APDs, especially those of low or moderate potency, including perphenazine, mesoridazine, molindone, and thioridazine. (pp 611-612; bracketed material supplied).

Correll and Shenk [38] found annual TD rates of 5.5 and 3.9% respectively for FGAs and SGAs respectively. Woods et al. [39] compared prevalence, incidence, and severity of TD in a 352 patient cohort who received treatment with antipsychotic medication between 2000 and 2005 with a 362 patient cohort who received treatment at the same mental health center in the 1980's (prior to the introduction of SGAs). Despite the fact that only 36% received FGAs in the 2000-2005 cohort, the prevalence, incidence, and incident case of severity of TD were equivalent.

Troller, Chen, and Sachdev [40] reviewed the literature related to SGAs and NMS. They described NMS associated with all SGAs and concluded that, with the exception of clozapine (which was less associated with rigidity), NMS induced by SGAs looked the same as NMS induced by FGAs. Finally, they noted that it was not clear whether any SGAs was more or less likely to cause NMS when compared to FGAs.

SGAs have been associated with significant weight gain. For example, Allison et al. [24] estimated that clozapine, olanzapine, risperidone, and ziprasidone were associated with weight increases of 3.99, 3.51, 2.00, and 0.04 kg respectively after 10 weeks of treatment. Correll et al. [41] evaluated the effects of first time SGAs treatment on weight gain in 272 children aged 4-19 years. After a median of 10.8 weeks of treatment, aripiprazole, risperidone, quetiapine, and olanzapine were associated with mean weight increases of 4.44, 5.34, 6.06, and 8.54 kg respectively. Those untreated gained a mean of 0.19 kg. Many of the drugs had a negative effect on metabolic parameters such as insulin, cholesterol, and triglycerides.

SGAs have been associated with sexual dysfunction. Serretti and Chiesa [26] summarized total sexual dysfunction reported in the literature regarding SGAs. They reported clozapine, risperidone, olanzapine, aripiprazole, ziprasidone, and quetiapine to be associated with sexual dysfunction in 52, 43, 40, 27, 19, and 16% of patients respectively. However, they pointed out that, with the exception of risperidone and clozapine, rates of sexual dysfunction were lower in studies where concomitant use of other drugs was prohibited.

This risk of seizure associated with SGAs is variable. Devinsky, Honigfeld, and Patin [42] reviewed 1418 people treated with clozapine and found that 2.8% experience seizures (4.4% of those prescribed 600 mg per day or more; 1% of those prescribed 300 mg per day or less). Alper, Schwartz, Kots, and Kahn [43] found clozapine and olanzapine to be associated with more frequent seizures upon examination of Phase II and III clinical trials.

Among SGAs, risperidone is most likely to cause increases in prolactin. Upon review of the literature, Roke, van Harten, Boot, and Buitelaar [44] found that risperidone, olanzapine, and quetiapine were

associated with hyperprolactinaemia in 62, 31, and 12% of children respectively. On the other hand, clozapine and ziprasidone did not increase prolactin levels.

Ray et al. [33] examined sudden cardiac death associated with clozapine, olanzapine, quetiapine, and risperidone. They found that these second generation drugs were associated with same degree of risk as first generation drugs and that risk was dose dependent. That is, within the sample of people aged 30-74, approximately 2 in every 700 people per year taking an SGA died of sudden cardiac death compared to 1 in 700 not taking an SGA or FGA.

Clozapine can cause agranulocytosis which is the suppression of bone marrow's production of infection fighting white blood cells (leaving the person vulnerable to infection) [45]. In Finland, clozapine was originally introduced in 1975 to 2260 people. During that year, 16 (.70%) experience agranulocytosis and 8 (.35%) died as a result. de la Chapelle, Kari, Numinen, and Hernberg [46] estimated the incidence rate at 2.1/1000 patient-months. Using their analysis, for every 80 people given clozapine for one year, 2 developed agranulocytosis and 1 in 80 died as a result. The introduction of regular blood tests and national patient registries significantly reduced the risk of agranulocytosis. Specifically, Honigfeld [47] found that of 99,502 people receiving clozapine in the US between 1990 and 1994, .38% (378 people) experienced agranulocytosis and .01% (12 people) died as a result.

SGAs have been associated with nocturnal enuresis. Harrison-Woolrych, Skegg, Ashton, Herbison, and Skegg [48] evaluated the associated between nocturnal enuresis and clozapine, olanzapine, quetiapine, and risperidone in people between the ages of 15 and 64. Enuresis occurred in 20.7 (17 of 82), 9.6 (11 of 115), 6.7 (7 of 105), and 6.2 (12 of 195) percent of those taking clozapine, olanzapine, quetiapine, and risperidone respectively. For 65% of the participants, nocturnal enuresis occurred on multiple occasions.

Additional side effects, save weight gain, associated with SGAs are presented in Tables 1-4 (Supplementary File). For all tables, only the name of the first author is listed for the sake of brevity. In Tables 1-4, the side effects reported in the studies examined for efficacy (described later in this paper) are summarized. In Table 1, the side effects, in the placebo controlled studies are presented. Every side effect, the number of times it was reported, the number of people in the group the side effect was reported in, and associated percentage are reported for drug and placebo groups. In Table 2 [49-57] side effects such as sedation, somnolence, fatigue, etc. are grouped together and presented adjacent to placebo groups. Table 2 shows that 52% of those who received an SGA experienced some sedation/somnolence/fatigue type effect compared to 13% who were given placebo. Table 3 summarizes the side effects reported in studies without a placebo control. Table 4 [53, 58-85], shows side effects such as sedation, fatigue, somnolence, etc. from studies without a control group grouped together. Table 4 shows that 40 percent of those given SGAs experienced some sedation/somnolence/fatigue type effect.

Side Effect Profile of Contingent Skin Shock

In order to properly compare the side effects of contingent skin shock with the side effects associated with antipsychotic medications, it is important to classify side effects. There seems to be two kinds of side effects. First, there are specific side effects to the body. Second, there are side effects associated with behavior that were unintentional but beneficial or unintentional and disruptive or harmful. Here, all of these effects are reviewed with respect to CSS. However, it is important to point out that problem behaviors such as crying, escape behaviors, and noncompliance surrounding the administration of oral and/or intramuscular antipsychotic medication are not described in the typical drug study. Nor is the pain one experiences when medication is injected or venipuncture is required to monitor drug levels or side effects. Indeed, some children consider needles to be extremely painful and fear inducing [86]. In addition, examination of positive/negative changes in mood, learning, affection, appropriate behavior, inappropriate behavior are not necessarily part of typical side effect detection net for medications. This is not to say that such effects do not occur. Indeed, some researchers have noted improved response to behavior intervention plans [87, 88] with the addition of antipsychotic medications.

Lichstein and Schreibman [89] reviewed the side effects described in studies employing CSS and noted that the majority of the reported effects were positive in nature. Matson and Taras [90] reviewed 382 applied studies related to punishment (including studies with CSS as an independent variable) between 1967 and 1989. They found positive side effects were reported 212 times while negative side effects were reported 16 times. In this paper the side effects found in CSS studies since 1989 are summarized.

The obvious effect of CSS is pain caused when the electrical current stimulates nociceptors and sensory receptors. The pain only lasts as long as the current is passing through the skin. Mudford, Boundy, and Murray [91] reported superficial pin-point burn marks from sparks arcing from a Hot Shot Sabre Six Device to the skin. This is the only device that is described to cause these tiny pinpoint burns. Mudford [91] also reported a slight local tremor in the thigh during activation of a CSS device (Therapuetic Shock Device). Israel et al. [3] reported the occasional discoloration of the skin remaining for a few minutes or days. Otherwise, no physical side effects have been reported. None of these side effects resulted in termination of treatment with CSS. However, Mudford [91] replaced the device that caused superficial pin-point burns with a device that did not cause such superficial pin-point burns.

Negative behavioral effects have been reported. Duker and Seys [92] described extreme anxiety (screaming, crying, attack, and escape) during the initial CSS treatment sessions in 5 of 12 participants. However, these responses subsided and only returned when the CSS device was removed from their body. They also described one participant who froze (made no responses) during the initial CSS treatment session. Duker and Seys [93] describe providing relaxation training in the presence of panic or anxiety during the initial CSS presentation. Israel, Blenkush, von Heyn, and Rivera [3] indicated some individuals emitted avoidance responses (such as removing the device or grabbing the transmitter). Other negative behaviors mentioned included temporary emotional behavior and tensing of the body. None of the negative behavioral side effects resulted in discontinuation of treatment with CSS.

The majority of the side effects reported in the literature associated with CSS are positive in nature. For example, Duker and Van den Munckhof [94] found those treated with CSS experienced increased stress when the CSS device was removed. Table 5 (Supplementary File) [91, 95-102] presents the positive behavioral effects derived from studies regarding CSS since 1989. Generally, decreases in problem

behaviors not treated with CSS, improvements in appropriate behaviors, overt happiness, and improvement in skill acquisition are commonly described.

Efficacy

Overview of dependent variables

A number of different dependent variables have been used to measure the effect of FGAs and SGAs on destructive behaviors exhibited by people with developmental disabilities. The most common dependent variables are subjective ratings scales. Among the rating scales, the Clinical Global Impression – Improvement (CGI-I) scale [103] and the irritability subscale of the Aberrant Behavior Checklist (ABC-I) [104] are often used to describe the effect of a drug on destructive behaviors of the developmentally disabled.

The CGI-I scale instructions ask the rater (the attending clinician) to "rate total improvement whether or not, in your judgment, it is due entirely to drug treatment. Compared to his condition at admission to the project, how much has he changed?" [103]. The rater selects from the following numbered options: (0) not assessed, (1) very much improved, (2) much improved, (3) minimally improved, (4) no change, (5) minimally worse, (6) much worse, (7) very much worse. Generally, those classified as very much improved or much improved are considered responders.

The ABC-I [104] is comprised of the following 15 items: injures self, aggressive to other patients and staff, screams inappropriately, temper tantrums, irritable, yells at inappropriate times, depressed mood, demands must be met immediately, cries over minor annoyances and hurts, mood changes quickly, cries and screams inappropriately, stamps feet while banging objects or slamming doors, deliberately hurts self, does physical violence to self, and throws temper tantrums when he/she does not get own way. The rater indicates whether a particular item is not a problem at all (0), a slight problem (1), a moderate problem (2), or a severe problem (3). Thus, the maximum score is 45 and the minimum score is 0. The rater is asked to consider the experiences of others caring for the person and whether the behavior interferes with development, functioning, or relationships. The rater is also asked to consider relative frequency. Specifically, the instructions state the following:

Take relative *frequency* into account for each behavior specified. For example if the client averages more temper outbursts than most other clients you know or most others in his/her class, it is probably moderately serious (2) or severe (3) even if these occur only once or twice a week. Other behaviors, such as noncompliance, would probably have to occur more frequently to merit an extreme rating. [105].

The reliability and validity of the complete Aberrant Behavior Checklist (ABC) (comprised of 58 total items, 15 of which make up the irritability subscale) are summarized in the ABC manual [104]. With respect to reliability, the scale has high internal consistency and test-retest reliability. The authors report mean Spearman correlations to be equal to .63 (.55 for the irritability subscale). Criterion group validity was demonstrated by showing that those with higher scores (indicating more problematic behaviors) were less likely to attend training facilities (because of the difficulty of their behavior). In addition, the authors showed that those people with down syndrome scored lower on the subscales of irritability, stereotypic behaviors, and hyperactivity than those without down syndrome confirming similar findings of past researchers. Convergent and discriminant validity were demonstrated by comparing ABC scores with scores on several other scales. Finally, the scale was found to correlate with behavioral observations on all scales save the irritability scale. Low rates of behavior and large amounts of variability in the behaviors associated with the irritability subscale did not produce a statistically significant difference.

The aforementioned scales are most often used to evaluate the effect of a drug on problem behaviors. However, there are a number studies where the frequency of a problem behavior is described during a control and drug condition. In the case of contingent skin shock, behavior problem frequency is, almost exclusively, used to evaluate efficacy. Frequency data, of course, is a superior dependent variable because it is a direct measurement thereby eliminating observer bias and test validity [106]. Johnston and Pennypacker [107] provide a complete description of the advantages of frequency as a dependent variable.

Studies were included for analysis if ABC-I, CGI-I, or frequency data were reported. If multiple doses of a drug were used or several baseline or placebo conditions were present, the placebo condition with the highest ABC-I score and the drug condition with the lowest ABC-I score or was utilized for the comparison. In most cases, CGI-I and frequency data was readily accessible. However, in a few cases, CGI-I and frequency data were estimated from a graphic because raw data were not reported. Those studies that utilized time sampling were also included. However, partial interval time samples were converted to frequency by assuming that only one behavior occurred within each interval. For example, if 10-second samples were taken for 60 minutes and the behavior occurred in 50% of the intervals, the response was described as occurring 180 times per hour. To allow for comparisons, all frequency data was converted to frequency per day. A day was considered to be composed of 16 waking hours. Therefore, responses per minute, hour, day, week, month, and year were converted to responses per day by respectively multiplying each by 960, 16, 1, 1/7, 1/30, 1/365. For CSS data, the mean baseline frequency was the mean of all baseline data points. Generally, the last three reported data points or data describing the end result of the treatment were used to calculate the mean treatment frequency.

Efficacy of First Generation Drugs

First generation antipsychotic study selection: Studies describing the efficacy of FGAs were obtained in two ways. First, all of the studies listed by Thompson, Hackenberg, and Schaal [108] in Table D-1 (p.374-375) were obtained. In addition, all single subject design studies they cited within the section on neuroleptics were obtained. Second, PubMed and PsychINFO searches (limited to the period between 1990 and 2011) were performed with search terms such as "neuroleptic", "antipsychotic", "developmental disability", "autism", "intellectual disability", as well as the brand and generic names of FGA. Finally, the reference sections of obtained articles were examined.

Review methodology: First, to describe the efficacy of FGAs in treating destructive behaviors the conclusions of a previous review are summarized. Second, because only six relevant studies since 1990 were found, each is briefly reviewed. Finally, ABC-I, CGI-I, and frequency data derived from the previous review and six studies since 1990 are described.

1991 Conclusions: Thompson, Hackenberg, and Schaal [108] summarized studies between 1971 and 1989 where FGAs were used to treat destructive behaviors in people with developmental disabilities.

After reviewing a series of studies related to chlorpromazine, they stated the following:

In summary, the literature concerning the therapeutic effects of chlorpromazine on the problem behaviors of people with mental retardation suggests that, although in some cases some therapeutic benefit has been observed, in most cases it was either (1) not observed, (2) observed, but at the expense of adverse side effects, (3) observed, but perhaps not to a clinically-relevant degree, (4) observed, but inferior to behavioral treatments, or (5) observed, but inferior to other drug treatments.

Regarding thioridazine, the authors again noted the variability in efficacy and concluded the drug was likely more effective than chlorpromazine, especially in reducing stereotypical behavior. Regarding haloperidol, the authors concluded the findings from the literature suggested a range of efficacy from ineffective to highly effective. The authors concluded these drugs can result in beneficial effects in addressing certain behavior disorders. However, because of issues associated with measurement, heterogeneity of participant samples, and absence of functional diagnosis of behavior problems, they noted it was difficult to state which individuals with which behavior disorders were likely to benefit.

1990-2011 review: Since 1990, it appears that no further research has been conducted specifically on the efficacy of chlorpromazine as a treatment for destructive behaviors. However, there have been a few new research studies addressing the efficacy of other FGAs.

Singh, Landrum, Ellis, and Donatelli [109] found that thioridizine at 1.25 mg/kg was effective in reducing stereotypy (measured by percentage of 10 second intervals of occurrence) in three participants with mental retardation. Specifically, during baseline, the participants engaged in stereotypy in 84.3, 87.4, and 63.3% of intervals respectively. During the last 5 days of treatment with thioridazine, the percent of intervals with stereotypy decreased to 51.4, 61.6, and 32.4% respectively. Treatment with thioridazine was also associated with increases in social behavior. However, a response contingent 10 second visual screening was more effective than thioridazine in reducing stereotypy and resulted in higher percentages of intervals with appropriate social behavior.

May et al. [110] described the effect of the gradual removal of thioridazine from 23 adults with developmental disabilities between 1989 and 1993. They found the participant could be classified into one of three groups. For 9 participants, problem behavior frequency increased and subsequently decreased. For 5 participants, problem behavior frequency progressively decreased. For the remaining 9 participants, problem behavior frequency steadily increased. Seven of 9 who experienced regression continued to require psychotropic medication.

Mace, Blum, Sierp, Delaney, and Mauk [111] contrasted the efficacy of haloperidol or placebo and behavior treatments based on function (e.g. extinction, differential reinforcement of alternative behavior, scheduled breaks) in treating self-injurious behaviors in 15 people with developmental disabilities. The functional analysis condition associated with the highest rate of self-injury served as the study baseline. Participants were randomly assigned to receive one of two treatments; haloperidol only or placebo plus behavioral treatment. If either treatment was unsuccessful in reducing self-injury by 75% or more, the other treatment was substituted. Two participants received haloperidol continuously (because of concerns about withdrawing the drug), 8 were assigned to haloperidol only, and 5 were assigned to placebo and behavior treatment. The haloperidol only intervention was successful in reducing self-injury in 2 of 8 participants by 98.9 and 100%. When behavioral procedures and placebo were substituted for haloperidol, the following percent reductions were observed: 100; 72.8; 11.4; 80.8; 90.3 (one participant dropped out before exposure to the behavioral procedure and placebo). All five participants assigned to receive behavioral treatment plus placebo achieved the following percent reductions in self-injury: 92.3; 98.7; 100; 100; 96.1. The two participants who received haloperidol continuously plus behavioral intervention experienced a 100% reduction. The researchers also contrasted scores on ABC at baseline and after haloperidol treatment. No significant differences were noted between any subscales.

Janowsky, Barnhill, Shetty, and Davis [112], in a retrospective chart review spanning 1990 – 1997, described the experience of FGA dose reduction or discontinuation in 136 adults with disabilities. Of the 136, 53 were withdrawn successfully; 18 were withdrawn but continued some non-antipsychotic medication; 31 continued on FGA or were switched to SGA; 34 people failed during a FGA reduction or discontinuation and required a resumption or increase of the reduced or discontinued drug.

Miral et al. [113] found that haloperidol reduced scores on the ABC from 67.1 to a statistically significant 45.8 after 12 weeks of treatment. In addition, those exposed to haloperidol showed statistically significant improvement in 4 of 5 subscales of the Ritvo-Freeman Real Life Rating Scale (RF-RLRS), Clinical Global Impression Scales, and Turgay DSM-IV PDD Rating Scale (TDPDD). In a related study, Gencer et al. [114] continued to follow the same participants for an additional 12 weeks, thus creating a 24 week evaluation period. All of the improvement in RF-RLRS and ABC scores reported by Miral et al. [113] were absent after 16 weeks in those treated with haloperidol. At 24 weeks, haloperidol reduced scores on the ABC from a mean of 67.1 to a mean of 58.1 and reduced scores on the TDPDD from 77.6 to 66.2. Only the change in TDPDD scores were statistically significant.

Tyrer et al. [115] randomly assigned 86 adults with developmental disabilities who exhibited aggressive behaviors to receive risperidone, haloperidol, or placebo. The bottom line finding was that there was no difference between the groups as measured by several rating scales (MOAS, ABC, CGI).

ABC-I: Three studies employing FGA as an independent variable and the ABC-I as a dependent variable have been conducted. White and Aman [116] used a double blind, placebo controlled, crossover design to examine the effect of pimozide on several dependent variables used to measure the behavior of 8 people with moderate to profound mental retardation. ABC-I scores during placebo and pimozide treatment were 24.2 and 18.93.

Aman and White [117] compared low, high, and individualized doses of thioridazine with placebo in 10 people with mental retardation. ABC-I scores associated with low, high, individualized, and placebo were 4.15, 5.18, 4.51, and 4.85 respectively.

Aman, Teehan, White, Turbott, and Vaithianathan [117] compared ABC-I scores of 20 mentally retarded people aged 12-35 years while receiving placebo, a low dose of haloperidol, or a high dose of haloperidol. ABC-I scores associated with placebo, low dose haloperidol, and high dose haloperidol were 7.02, 5.68, and 7.00 respectively.

However, when the participants were divided according to degree of stereotypy, ABC-I scores for those with low stereotypy classifications were 3.17, 3.71, and 5.42 for the placebo, low and high dose conditions. The ABC-I scores of those with high stereotypy classifications were 12.81, 8.62, and 9.38 for the placebo, low, and high dose conditions.

In summary, three studies show the mean ABC-I change from baseline/placebo to the FGA drug condition was 3.39 (range .7-5.27). This information was derived by comparing the highest baseline/placebo ABC-I score with the lowest ABC-I score in any drug condition.

CGI-I: Perry et al. [119] found that 33 of 59 participants with autism treated with haloperidol for 6 months were rated as much or very much improved on the CGI-I. However, participants were selected for the study because of previous positive responses to haloperidol.

Frequency Data. Four studies, describing the individual effect of FGAs on destructive behaviors of 13 individuals are summarized in Table 6 (Supplementary File) [109, 120-122]. In total, the effect of FGAs on 55 individual behaviors are summarized. Table 6 shows the converted frequency per day with placebo or the absence of a FGAs, the converted frequency per day with the FGAs, the percentage increase or decrease, as well as the multiply or divide by factor.

In the left hand third of Table 7 (Supplementary File) under FGAs, the number of behaviors reduced by various percentages is presented. Table 7 shows that 6 of 55 behaviors were reduced by 90% or more; 11 of 55 by 50% or more; and that 22 of 55 behaviors continued to occur at the same rate or increased in frequency. Of the 6 behaviors reduced by 90%, 4 were reduced by 100%.

Table 8 (Supplementary File) [110-111, 117-118, 123] shows the effect of FGAs on the destructive behaviors of 161 people across 5 studies. Only one of nine behaviors showed a >25% reduction in destructive behaviors.

Efficacy of Second Generation Drugs

Second generation antipsychotic study selection: PubMed and PsychINFO searches were performed with search terms such as "neuroleptic", "antipsychotic", "developmental disability", "autism", "intellectual disability", as well as the brand and generic names of each second generation antipsychotic medication. Finally, the reference sections of obtained articles were examined. Studies were included for analysis if any of the following dependent variables were used: ABC-I; CGI-I; or problem behavior frequency.

Review methodology: ABC-I, CGI-I, and frequency data were extracted and tabulated. The effect of SGA on each dependent variable is summarized below.

ABC-I: The ABC-I scores are summarized in Table 9 (Supplementary File) [49-81, 115, 124-127]. ABC-I scores taken before the administration of drug or placebo are listed in the baseline column. The last ABC-I score obtained in each study is listed in the endpoint column. For those studies with a placebo control, the mean baseline score in the drug groups was 23.69 while the mean score at endpoint was 11.39. For the placebo group, the mean score at baseline was 24.09 and the mean score at endpoint was 18.64. Thus, in the drug groups, the mean change from baseline to endpoint was 12.3 points on the ABC-I. In the placebo groups, the mean change from baseline to endpoint was 5.75. If the placebo effect is subtracted from the drug effect, 6.55 ABC-I points separated the drug and placebo groups.

For those studies without a placebo, the mean baseline ABC-I scores was 20.93 and the mean score at endpoint was 12.15, a difference of 8.78 points.

CGI-I: For those studies with a control group, of a possible 427 people, 230 were rated as much or very much improved (53.9%) on the CGI-I. For placebo, 54 or 329 (16.4%) were rated as much or very much improved.

For those studies without a control group, 246 of 429 (57.3%) were rated as much or very much improved.

Frequency Data: Eight studies, describing the individual effect of SGAs on destructive behaviors of 88 individuals are summarized in Table 10 [82-85, 128-130]. In total, the effect of SGAs on 136 individual behaviors is summarized. Table 10 (Supplementary File) shows the converted frequency per day with placebo or the absence of a SGAs, the converted frequency per day with the SGAs, the percent increase or decrease, as well as the multiply or divide by factor.

In the center third of Table 7 under SGAs, the number of behaviors reduced by various percentages is presented. Table 7 shows that 34 of 136 behaviors were reduced by 90% or more; 90 of 136 by 50% or more; and 20 of 136 behaviors continued to occur at the same rate or increased in frequency. Of the 34 behaviors reduced by 90% or more, 23 were reduced by 100%.

Table 11 [77, 131] summarizes group designs describing behavior frequency. Two studies, describing the effect of SGAs on 93 people across 11 behaviors are described. Table 11 (Supplementary File) shows that 8 of 11 behaviors were reduced by 59% or more.

Efficacy of Contingent Skin Shock

Contingent skin shock study selection: Peer reviewed studies were drawn from a list maintained at the follow web address: http://www.effectivetreatment.org/bibliography.html. Reference sections of obtained articles were also examined.

Review methodology: Frequency data were extracted and tabulated. The effect of CSS on problem behavior frequency is summarized below.

Frequency Data: Thirty-two studies, describing the individual effect of CSS on destructive behaviors of 114 individuals are summarized in Table 12 (Supplementary File) [3, 95, 97-100, 102, 132-155]. In total, the effect of CSS on 117 behaviors is summarized. Table 12 shows the converted frequency per day in the absence of CSS, the converted frequency per day with CSS, the percentage increase or decrease, as well as the multiply or divide by factor.

In the right hand third of Table 7 under CSS, the number of behaviors reduced by various percentages is presented. Table 7 shows that 110 of 117 behaviors were reduced by 90% or more; 112 of 117 by 50% ormore; and that 5 of 117 topographies continued to occur at the same rate or increased in frequency. Of the 110 topographies reduced by 90% more, 83 were reduced by 100%.

Frequency Comparisons across FGAs, SGAs, and CSS: The mean frequency of the behaviors treated with each CSS, FGAs, and SGAs are presented in Table 13 (Supplementary File). The table shows that those behaviors treated with CSS occurred at a far higher frequency than those treated with FGAs or SGAs. The table also shows that on the whole, CSS was far more effective in reducing destructive behavior than FGAs or SGAs.

Discussion

Comparison of Side Effects

Based upon the current review, the side effects associated with FGAs and SGAs appear to be greater in number, severity, and probability than those associated with CSS. Based upon the data reported by Ray et al. [33], current users of antipsychotic medications are twice as likely to die from sudden cardiac death when compared to non-users and former users. Death can also result from NMS. Both groups of drugs are likely to cause obesity and sexual dysfunction. Obesity, of course, is associated with a host of health risks such as diabetes, heart disease, and cancer. Giving a person with a developmental disability a drug that interferes with appropriate sexual expression adversely affects their quality of life. Generally, SGAs are only marginally safer than FGAs when it comes to the development of TD. Finally, both FGAs and SGAs can cause the person taking them to either be somnolent, sedated, or generally tired. In the placebo controlled studies reported here, this effect was reported in 52% of those given SGAs compared to 13% given placebo. In studies without a placebo control, this effect was reported in 40% of those given SGAs. Those with extremely dangerous or difficult behaviors are likely to be given high doses of FGAs or SGAs, further increasing the probability of sedation.

One advantage FGAs and SGAs appear to have over CSS is that they do not cause pain. However, the side effects, administration, and monitoring of these drugs can be painful. Dystonic reactions can be painful and distressing to person experiencing them [16, 157]. Drugs that are injected intramuscularly can cause acute pain. Venipuncture, necessary for monitoring adverse effects on the body caused by clozapine, also causes pain. Both intramuscular injections and venipuncture can cause panic, avoidance responses, and emotional behavior [158]. The frequency with which these procedures are required is similar to the frequency skin shock is applied after the initial deceleration of the treated behavior.

Across all the studies reviewed, CSS was once associated with tiny pinpoint burns. However, the device in questions was not designed for human use. No other CSS device has ever been reported to cause tissue damage. The other negative side effects described include pain, avoidance responses, and emotional reactions. When considering these side effects, it is important to consider the frequency of use. CSS is applied most frequently during first few days or weeks of treatment. Subsequently, the frequency of use most often decelerates or sometimes drops to zero.

Compared to SGAs and FGAs, the side effects of CSS have not been evaluated in the same depth or with as many participants. In addition, those studying the side effects of antipsychotic drugs generally utilize thorough protocols to assure all side effects are reported. However, because electricity has been applied to the body with therapeutic intensions for more than 100 years, there are well known sequelae of electrical stimulation [159]. These include muscular contraction, burns, seizures, and ventricular fibrillation and are described in detail by Bruner and Leonard [160]. CSS devices designed for humans are never placed over the major motor nerves, head, or chest and lack the power to cause burns, seizures, or ventricular fibrillation. Nevertheless, future research should focus on quantifying and developing standardized measures of negative behavioral side effects.

FGAs, SGAs, and CSS are often used over the long-term. Generally, CSS is used less often over time and therefore, any side effects should be expected to occur less frequently. However, sometimes, the intensity of the stimulus is increased to account for adaptation to a lower intensity. Conversely, many of the negative side effects of FGAs and SGAs are exacerbated with extended use. Specifically, the probability of TD increases approaching an asymptote the longer the exposure to the drug. In addition, SGAs and FGAs contribute to weight gain approaching an asymptote the longer the drug is administered [24].

In summary, based upon the information presented here, the side effects associated with FGAs and SGAs appear to be more numerous and more severe when compared to those associated with CSS.

FGA Efficacy

The data summarized in this paper show that FGAs are remarkably ineffective in treating destructive behaviors of people with developmental disabilities. The single subject frequency data clearly show that, for the 13 people across 55 topographies, FGAs are not effective in reducing problem behaviors. These findings could be easily dismissed because of the low number of individuals examined. However, the group frequency data in Table 8 confirm the ineffective nature of these drugs in reducing destructive behaviors in 161 people with developmental disabilities. Clearly, there are some cases where the addition of FGAs was extremely effective. For example, in the Mace et al. [111] report, the addition of haloperidol reduced self-injury by 99 and 100% in two individuals. However, in the literature, these findings seem to be the exception rather than the rule. The ABC-I data, CGI-I data, and the remaining papers reviewed suggest that FGAs have limited efficacy in treating destructive behaviors.

SGA Efficacy

ABC-I: ABC-I scores in conditions with SGAs were between 6.55 and 8.78 ABC-I points less than placebo or baseline conditions. In most cases, these changes were statistically significant. However, of what practical significance are these changes? In order to make such a determination, the properties of the ABC-I require examination.

One ABC-I point corresponds to a move from 3 to 2, 2 to 1, or 1 to 0 on one of 15 items between baseline and the endpoint measure (where 3 is severe problem, 2 is a moderate problem, 1 is a slight problem, and 0 is the absence of a problem). However, as described earlier, the ABC instructions advise the rater (typically a parent or primary care giver), using temper outbursts as an example, that behavior occurring more often than other class members, even only a few times per week could be rated as a severe problem. To describe severity, the rater also is asked to consider other clients in the class and other clients known by the rater. Thus, depending on the experience of the rater, behavior may be rated as severe, even if the behavior occurred relatively infrequently and regardless of intensity. The diversity of the items in the ABC-I allow for a change of 8 points to represent extraordinary treatment outcomes or simple reductions in verbal disruption. For example, a move from a baseline score of 2 to an endpoint score of 0 on items describing aggression and self-injury (items 2, 4, 50, 52) would represent an excellent outcome. On the other hand, a move from a baseline score of 2 to an endpoint score of 1 on items describing verbal disruption (items 8, 10, 14, 19, 29, 34, 36, 41), although beneficial, may obscure a lack of effect on items related to aggression and self-injury. The specificity described above could be interpreted as asking the ABC-I to do more than it was designed to be. However, unless a specific analysis is conducted to describe the effect of a particular drug on a particular item on the ABC-I, one cannot make conclusions about such effects.

In most cases, authors make concluding statements that reflect this problem. For example, Marcus et al. [57] reported "…aripiprazole was effective at reducing irritability in children and adolescents with autistic disorder who also demonstrate irritability, agitation, self-injurious behavior, or a combination of these symptoms." This statement reflects the fact that irritability is defined by the 15 items on the ABC-I. If the ABC-I scores decrease, one cannot say for certain that aggression, self-injury, yelling/screaming, or tantrums decreased. McCracken et al. [51] reported "risperidone was safe and effective for the short-term treatment of tantrums, aggression, and self-injurious behavior in children with autistic disorder." Although it may be the case that all of these behaviors as measured by the ABC-I improved as the result of risperidone administration, without a separate analysis, such conclusions cannot be made.

Recently, Aman et al. [161] described the effect of aripiprazole on individual items of the ABC-I. They found the most items were rated lower with aripiprazole when compared to placebo on the ABC-I scale with the exception of self-injury. More of these types of analyses would elucidate the effects of various SGAs on individual behaviors. In addition, it would be helpful to see *post hoc* data that first classified participants as responders or non-responders, and second described the magnitude of the response. For example, one could report of N participants receiving the drug, X showed no change in ABC-I score. Of the remaining Y participants, the ABC-I scores decreased by *Z*. This would allow statements like the following: If this drug is given to N similar people, it will be effective to *Z* degree for *Y* of them.

CGI-I: The shortcomings of the CGI-I have been described [162]. The CGI data show that 53.9 to 57.3 percent of the participants receiving SGA are rated as much or very much improved on the CGI-I. Although clearly there are differential responses to the various drugs, this suggests that just over half of those treated get better as a result of treatment. However, to what degree do they get better? What does much or very much improved on the CGI-I mean? The validity of the CGI-I is largely derived from the requirement that a trained clinician makes the judgment of improvement or deterioration [163]. The question is, then, what information does the clinician use to make their judgment? It would be interesting to determine if CGI-I ratings correlate with changes in behavior frequency or changes in the ABC-I. The CGI-I results are consistent with naturalistic results reported by Lemmon, Gregas, & Jeste [164] who found that of 80 patients treated with risperidone at a clinic for destructive behaviors, 53% of them showed some improvement at 1 year.

Frequency data: The frequency data suggest that SGAs are more effective than FGAs in reducing destructive behaviors. The single subject data show that 23 of 136 behaviors (exhibited by 88 different people) were completely eliminated by adding SGAs. In addition, 90 of the 136 behaviors were reduced by 50% or more. Data from the group studies showed that destructive behaviors were reduced by 59-78% for 8 of 11 behaviors. Whether this degree of reduction is sufficient depends on the nature of the behavior reduced. For example, if the behavior is sufficiently intense where the emission of only a few responses is likely to cause injury to the person or someone else, reducing a response by even 90% may not allow the person to enter the community or be free from restraint. In addition, for behavior occurring at high rates, a 50% reduction may be of little consequence. For example, if a destructive behavior is occurring 2000 times per day and reduced by 50% to 1000 times per day, we could expect little improvement in his or her living situation, quality of life, or access to the community. For a complete discussion of problems associated with employing percent increases and decreases, see Graf and Lindsley [165].

CSS Efficacy

This review and analysis suggests that CSS is extremely effective in addressing destructive behaviors. The single subject data show that 83 of 117 behaviors (exhibited by 114 different people) were completely eliminated by adding CSS. In addition, 110 of the 117 behaviors were reduced by 90% or more. However, it is important to point out that in order to be tolerable, CSS must work rapidly and maintain a low rate of problem behavior. For example, if a behavior occurs 10,000 times per day in the absence of treatment and is reduced by 98% by CSS, the person would be receiving 200 CSS applications per day; unlikely an acceptable result. Still, the results presented here suggest that indeed CSS is effective to such a degree that the destructive behavior is often completely eliminated.

The results are more remarkable when one considers that the behaviors treated with CSS are likely far more severe and certainly more frequent compared to the behaviors addressed in the medication studies. Specifically, mean daily rate of the behaviors treated with CSS summarized here was equal to 5300.23, nearly 19 times more frequent than those behaviors treated with SGAs.

Limitations

There are numerous limitations associated with the overall analysis. First, by limiting the review to only studies where frequency, ABC-I, and CGI-I scores are reported, information is neglected. Dependent variables such as the Children's Psychiatric Rating Scale, Clinical Global Impressions – Severity, and many others were excluded from analysis. Second, studies reporting frequency were included even if weak experimental designs were utilized and/or in the absence of interobserver reliability. Third, to aid in comparison, all frequency data were represented as responses per day. In many cases, frequency data were derived from experimental conditions where a response was measured for a short experimental condition. In some cases, the condition may have transiently increased the frequency of the behavior by presenting stimuli known to evoke problem behaviors or by reinforcing such behaviors. Transient increases in frequency may also have been caused by removing accustomed mechanical restraint. People with developmental disabilities often learn to restore restraint through the emission of high frequency aggressive or self-injurious behaviors. Thus, in some cases, it is unlikely the response would have continued at the same rate throughout the entire day. Converting from responses per week or month to responses per day is much less problematic. Fourth, the CGI-I and ABC-I were never used to assess the effects of CSS which make cross comparison between interventions impossible. The main advantage of the CGI-I and ABC-I is that they are easy to use and require only a few minutes to complete. Thus, they are much more appropriate for placebo controlled between group designs. Such designs have not been employed with CSS. Fifth, all individual FGAs, SGAs, and CSS interventions were grouped together with respect to side effects and efficacy. Clearly, side effects vary widely among the drugs. In addition, the intensity and severity of side effects associated with CSS could vary with respect to the type of CSS utilized, the behaviors treated, and the individual receiving treatment. Side effects associated with CSS were listed but were not evaluated with a comprehensive validated measure. With regard to efficacy, the tables provided allow readers to extract data with respect to any compound of interest. Regarding CSS, the magnitude and type of the CSS application (duration, intensity, and wave form) are important factors that dictate efficacy and side effects and are not discussed here. Sixth, in many cases, concurrent treatments were

involved. Many of the drug studies allowed the concurrent treatment with other classes of drugs and other antipsychotics in some cases. In addition, most CSS programs include, at the minimum, differential reinforcement. Finally, at least two studies [3, 50] involved some people that emitted destructive behaviors but were not classified as having a developmental disability.

The treatment of a person with destructive behaviors often involves many components including non-antipsychotic medication, a range of behavioral procedures, as well as other treatments. One might argue that medication is simply part of an overall treatment package that is usually successful and therefore CSS is unnecessary. Aman et al. [78], for example, demonstrated that risperidone or aripiprazole combined with simple parent training was more effective than drugs alone. Future research should be devoted to examine such interaction effects.

Mulick and Meinhold [4] point out that financial cost is an additional factor to be considered when choosing among treatments. In terms of labor and administrative costs, designing and implementing a CSS program is far more expensive than prescribing a medication. However, CSS is typically not considered a treatment option until a wide range of medications have failed to reduce the problem behavior(s) to acceptable levels. In addition, in the absence of an effective treatment, people with severe behavior disorders often require 24 hour per day 1:1, 2:1, or 3:1 staffing within a residential program. Alternatively, they may spend extended periods of time within psychiatric hospitals where costs are many times higher when compared to a residential or community based programs.

Another factor mentioned by Mulick and Meinhold [4] is social acceptability. They point out that most observers understand the need to treat destructive behaviors. However, Mulick and Meinhold also suggested that some believe using aversive procedures conflict with ideals such as community integration and individual dignity. The current analysis suggests that in many cases, adding CSS to a comprehensive behavior plan may enhance community integration, individual dignity, and improve quality of life. Future research could be devoted to specific questions regarding these factors.

Conclusions

The decision-making model described by Mikkelsen [5] asks one to consider the following three factors when examining treatment options: severity of symptoms, the probability the treatment will be successful, and the side effect profile of the treatment. Regarding symptom severity, the analysis presented here suggests that the behaviors treated with CSS in the literature are certainly more frequent than those treated with FGAs or SGAs. It is also likely the behaviors treated with CSS were generally more severe in degree. Regarding the probability of treatment success, the present analysis suggests that CSS is by far more effective than SGAs and FGAs in treating severely destructive behaviors. Finally, the negative side effects associated with SGAs and FGAs seem to be more serious, more probable, and more numerous than those associated with CSS. On the other hand, the positive side effects associated with CSS seem more probable and numerous than those associated with SGAs and FGAs.

Unfortunately, due to the ineffective nature of the procedures typically employed, the search for new procedures leads to interventions such as Electroconvulsive Therapy [14], psychosurgery [166], or the continued use of dangerous restraint procedures, as well as relatively ineffective, high risk drugs. As procedures based on behavior function and differential reinforcement continue to be refined, perhaps the need for interventions like CSS will decline. However, it is clear that such procedures are not able to treat all destructive behavior emitted by people with developmental disabilities. Perhaps research on and the development of using CSS treatment-delivery systems to make use of procedures known to be extremely effective for intractable destructive behaviors. The information obtained could be used to inform families with members who exhibit intractable destructive behaviors, lawmakers, and the general public.

Competing Interests

The author is employed by the Judge Rotenberg Educational Center which manufactures the Graduated Electronic Decelerator (GED). The author has not and does not receive compensation for use or sale of the GED.

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Supplementary Files

	Drug			Placebo		
Side Effect	Frequency	*N*	%	Frequency	*N*	%
Abdominal Pain	19	244	8	4	128	3
Abnormal Gate	1	15	7	0	16	0
Aggression	1	47	2	4	50	8
Aggressive reaction	1	39	3	4	38	11
Agitation	2	15	13	5	16	31
Akathisia	0	47	0	1	50	2
Anorexia	7	67	10	2	67	3
Anxiety	12	49	24	10	51	20
Apathy	5	40	13	0	39	0
Constipation	23	110	21	7	111	6
Coughing	22	232	9	9	118	8
Decreased Appetite	17	220	8	6	107	6
Diarrhea	14	111	13	16	117	14
Dizziness	8	49	16	2	51	4
Drooling	32	261	12	3	152	2
Drowsiness	24	49	49	6	51	12
Dry Mouth	10	64	16	5	67	7
Dyskinesia	7	76	9	3	51	6
Dyspepsia	9	70	13	4	79	5
Earache	2	49	4	4	51	8
Elevated serum prolactin	7	55	13	1	63	2
Enuresis	24	276	9	20	168	12
Epistaxis	5	165	3	0	51	0
Extrapyramidal Disorder	14	239	6	0	101	0
Fatigue	68	301	23	23	254	9
Fever	15	67	22	12	67	18
Gastroenteritis viral	5	165	3	0	51	0
Glazed Eyes	1	6	17	0	5	0
Headache	52	401	13	31	297	10
Hyperkinesia	2	74	3	1	50	2
Hypersomnia	5	165	3	0	51	0
Hypokinesia	2	74	3	0	50	0
Increased Thirst	11	220	5	7	107	7
Influenza-like symptoms	7	67	10	3	67	4
Injury	7	39	18	5	38	13
Insomnia	21	181	12	27	183	15
Inv, Muscle contraction	1	27	4	1	28	4
Lethargy	10	165	6	0	51	0
Muscle Rigidity	6	96	6	1	101	1
Muscle Spasms	0	47	0	1	50	2
Nasal Congestion	34	261	13	22	152	14
Nasopharyngitis	18	212	8	5	101	5
Nausea	12	214	6	6	102	6
Nervousness	0	6	0	1	5	20
Psychomotor hyperactivity	1	47	2	2	50	4
Pyrexia	19	212	9	1	101	1
Rash	4	165	2	1	51	2
Restlessness	3	49	6	3	51	6
Rhinitis	19	128	15	9	135	7
Rhinorrhea	8	165	5	1	51	2
Saliva Increased	19	232	8	3	118	3
Sedation	57	233	24	5	122	4
Siolorrhea	1	15	7	0	16	0
Skin Irritation	11	49	22	7	51	14
Sleep Problems	11	49	22	9	51	18
Somnolence	108	373	29	21		8
Sore Throat	5	49	10	1		2
Stomachache	5	49	10	9		18
Tachydardia	11	89	12	1		1
Tardive Dyskenisia	0	27	0	1		4
Tremor	34	328	10	1		1
Upper Respiratory Tract Inf.	37		11	18		8
Vomiting	65		17	34		12

Continue.....

Table 1: Placebo Controlled Studies Side Effect Summary.

		Drug		Placebo	
Study	Side Effect Label	Frequency	N	Frequency	N
McDougle (1998) [49]	Sedation	9	15	0	16
Aman (2002) [50]	Somnolence	28	55	6	63
McCracken (2002) [51]	Drowsiness	24	49	6	51
	Fatigue	29		14	
Shea (2004) [52]	Fatigue	4	40	1	39
	Somnolence	29		3	
Gagiano (2005) [53]	Somnolence	9	39	6	38
Hollander (2006) [54]	Sedation	4	6	1	5
Pandina (2007) [55]	Somnolence	20	27	2	28
Owen (2009) [56]	Fatigue	10	47	2	50
	Sedation	5		1	
	Somnolence	8		2	
Marcus (2009) [57]	Fatigue	25	165	0	51
	Lethargy	10		0	
	Sedation	39		3	
Totals		253	483	43	341

Table 2: Combined Sedation, Somnolence, Drowsiness, and Lethargy Side Effects from Placebo Controlled Studies.

Side Effect	Frequency	N	%	Side Effect	Frequency	N	%
Abdominal Pain	6	49	12	Increased Thirst	8	35	23
Abnormal EKG	2	62	3	Inflicted injury	7	58	12
Abnormal Gate	1	20	5	Injury	15	58	26
Abnormal Hepatic fx	10	62	16	Insomnia	47	225	21
Abnormal lipid profile	10	62	16	Irritability	3	26	12
Aggression	2	9	22	Knee pain	1	25	4
Aggressive reaction	11	58	19	Lethargy	3	33	9
Agitation	28	194	14	Leukopenia	1	6	17
Akathisia	8	141	6	Lip Biting	1	25	4
Anxiety	27	100	27	Listlessness	1	17	6
Apathy	6	58	10	Mouth Opening	1	54	2
Asthenia	15	37	41	Muscle Rigidity	2	34	6
Behavioral Activation	1	6	17	Nasal Congestion	9	83	11
Blood in Stool	1	25	4	Nausea	25	181	14
Blunted Affect	1	18	6	Nausea/vomiting	12	50	24
Cataplexy	1	6	17	Neck Stiffness	1	25	4
Constipation	35	145	24	Nervousness	6	25	24
Coughing	51	74	69	Ocul. dystonia	6	54	11
Cutaneous Rash	1	20	5	Oral dyskinesia	1	12	8
Decreased Appetite	11	123	9	Pain in extremities	1	13	8
Decreased Urination	1	25	4	Pedal edema	1	8	13
Diarrhea	38	165	23	Pharyngitis	9	49	18
Dizziness	7	142	5	Polydipsia	11	49	22
Drooling	4	49	8	Polyuria	3	49	6
Drowsiness	14	18	78	Polyuria/polydipsia	6	33	18
Dry Mouth	27	101	27	Protruding tongue	1	23	4
Dyskinesia	7	49	14	Pseudoparkinsonism	4	33	12
Dyskinetic Mov.	2	54	4	Pyrexia	8	49	16
Dyspepsia	17	74	23	Rash	16	74	22
Dystonia	4	89	4	Rhinitis	23	109	21
Dysuria	2	25	8	Rhinorrhea	39	49	80
Ear Infection	2	49	4	Rigidity or Tremor	5	54	9
Ejacuation Dysfx	1	12	8	Saliva Increased	22	76	29
Elevated prolactin	44	57	77	Sedation	108	457	24
Emo. Lability/Agg	6	17	35	Sedation/GI complaints	13	40	33
Enuresis	38	256	15	Seizure	5	97	5
Epilepsy	1	7	14	Sinusitis	1	25	4
Epistaxis	7	49	14	Siolorrhea	13	100	13
Exacerbation of pain	1	20	5	Somnolence	48	107	45
EPS	2	62	3	Stomachache	3	26	12
Fatigue	51	133	38	Sweats	1	9	11
Fever	1	25	4	Tachydardia	9	126	7
Galactorrhoea	1	54	2	Tardive Dyskinesia	1	20	5
Gross Motor Incoord.	1	18	6	Tearfulness	1	25	4
Headache	42	233	18	Tics	1	9	11
Hematuria	1	25	4	Tinnitus	1	25	4
Hyperglicemia	1	62	2	Tiredness	15	25	60
Hyperphagia	11	23	48	Transient Lisping	1	12	8
Hyperprolactinemia	52	62	84	Tremor	14	189	7
Hypertension	1	6	17	Trouble Falling Asleep	2	25	8
Increased Activity	1	22	5	Trouble Waking Up	8	25	32
liver enzymes	1	53	2	Vomiting	32	127	25
motor activity	3	52	6	Weight Loss	6	12	50

Table 3: Non-placebo Controlled Studies Side Effect Summary.

Study	Side Effect Label	Frequency	N	%
McDougle (1997) [58]	Sedation	6	18	33
Martin (1999) [59]	Sedation	3	6	50
Friedlander (2001) [60]	Sedation	10	54	19
Malone (2001) [61]	Drowsiness	5	6	83
Masi (2001) [62]	Sedation	1	24	4
Kemner (2002) [63]	Sedation	6	25	24
	Asthenia	14		56
Malone (2002) [64]	Sedation	15	22	68
McDougle (2002) [65]	Sedation	5	12	42
Masi (2003) [66]	Sedation	3	53	6
Gagliano (2004) [67]	Sedation	6	20	30
Stravrakaki (2004) [68]	Sedation	4	7	57
Stigler (2004) [69]	Sedation	2	5	40
Findling (2004) [70]	Sedation	7	9	78
Corson (2004) [71]	Sedation	2	20	10
Harden (2005) [72]	Sedation	3	10	30
Rugino (2005) [73]	Listlessness	1	17	6
Gagiano (2005) [53]	Fatigue	9	58	16
	Somnolence	24		50
Malone (2007) [74]	Asthenia	1	12	8
	Drowsiness	9		75
Capone (2008) [75]	Sedation	1	23	4
Stigler (2009) [76]	Tiredness	15	25	60
	Trouble Waking Up	8		32
Amore (2011) [77]	Sedation	12	62	19
Aman (2009) [78]	Somnolence	24	49	49
	Fatigue	33		67
Hellings (2006) [79]	Sedation/GI Complaints	13	40	33
Zarcone (2001) [80]	Sedation	10	20	50
Troost (2005) [81]	Fatigue	9	26	35
Cohen (1994) [82]	Sedation	4	6	67
Janowsky (2003) [83]	Sedation	4	20	20
Lott (1996) [84]	Lethargy	3	33	9
	Sedation	1		3
Cohen (1998) [85]	Sedation	3	8	38
Total		276	690	40

Table 5: Positive Side Effects of CSS Reported Since 1989.

Study	Participant	Positive Behavioral Side Effects
Linscheid (1990) [95]	Marie	Reductions in other problem behaviors (bites, hair pulls, hits to chair).
	Johnny	Increases in behaviors suggestive of relaxation and decreased distressed vocalizations.
	Donna	General improvement in adaptive functioning.
	Michael	Began attending to physical environment, more responsive to positive reinforcement, followed simple instructions, improved self-help skills.
	Diane	Improved response to instruction, improved waiting skills, improved general social interaction.
Ricketts (1992) [96]		Higher rates of smiling and happy vocalizations and lower rates of distressed vocalizations when CSS was present. (the addition of naltrexone caused distressed vocalization to increase in the presence of CSS)
Williams (1993) [97]		Regained total independence in self-feeding and improvement in other self-care skills, remission of selective mutism.
Linscheid (1994) [98]		Increases in laughing, smiling, uttering a word associated with happiness, self-initiated toy play.
Mudford (1995) [91]		"Richard appeared to prefer wearing the TSD, approaching any person who carried the equipment into his ward, and assisting in attaching it to himself. He never attempted to remove the device. Removal of the device provoked tantrum behaviors. He was judged by staff to be happier, calmer, and less clingy to people when wearing the TSD." (p. 264)
Linscheid (2002) [99]		Increase in smiles, laughs, self-initiated communication, self-initiated socialization, decrease in pinching.
Salvy (2004) [100]		Less distressed when upset, more responsive to reinforcement, emission of more appropriate behaviors.
van Oorsouw (2008) [101]		Improvement or no change in the following behaviors: positive verbal and nonverbal utterances (smiling, dancing, singing, talking); negative verbal and nonverbal utterances (crying, whining, spitting, stamping feet etc); socially appropriate behavior (raising hand, greeting others, asking for help); off task behavior (head down on table refusing academic tasks).
Israel (2010) [102]		Anecdotal reports of more family contact, skill acquisition, improved mood/outlook, and requests to have CSS added to behavioral program.

Table 5: Positive Side Effects of CSS Reported Since 1989

Study	Drug	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Drug Converted Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Millichamp (1987) [120]	Methotrimeprazine	Object stereotypy	Hugh	748.80	3070.08	310.00	x 4.1
	Methotrimeprazine	Body stereotypy		5374.08	3663.36	31.83	1.47
	Methotrimeprazine	Aggressive/destructive		5.76	270.72	4600.00	x 47
	Methotrimeprazine	Vocal sound		1054.08	1100.16	4.37	0.96
	Methotrimeprazine	Pica		5.76	5.76	0.00	1.00
	Methotrimeprazine	Self injury		0.00	5.76	476.00	x 5.76
	Methotrimeprazine	Object stereotypy	Richard	1296.00	950.40	26.67	1.36
	Methotrimeprazine	Body stereotypy		2672.64	1353.60	49.35	1.97
	Methotrimeprazine	Aggressive/destructive		11.52	11.52	0.00	1.00
	Methotrimeprazine	Vocal sound		1906.56	2217.60	16.31	0.86
	Methotrimeprazine	Pica		783.36	489.60	37.50	1.60
	Methotrimeprazine	Self injury		288.00	5.76	98.00	50.00
	Methotrimeprazine	Object stereotypy	Craig	362.88	5.76	98.41	63.00
	Methotrimeprazine	Body stereotypy		4527.36	5621.76	24.17	x 1.24
	Methotrimeprazine	Aggressive/destructive		0.00	0.00	0.00	0.00
	Methotrimeprazine	Vocal sound		783.36	86.40	88.97	9.07
	Methotrimeprazine	Pica		0.00	5.76	476.00	x 5.76
	Methotrimeprazine	Self injury		109.44	0.00	100.00	109.44
	Methotrimeprazine	Object stereotypy	Ian	3674.88	2275.20	38.09	1.62
	Methotrimeprazine	Body stereotypy		3669.12	2926.08	20.25	1.25
	Methotrimeprazine	Aggressive/destructive		0.00	0.00	0.00	0.00
	Methotrimeprazine	Vocal sound		276.48	161.28	41.67	1.71
	Methotrimeprazine	Pica		282.24	345.60	22.45	x 1.22
	Methotrimeprazine	Self injury		0.00	0.00	0.00	0.00
	Chlorpromazine	Object stereotypy	Dennis	3888.00	3317.76	14.67	1.17
	Chlorpromazine	Body stereotypy		5443.20	5656.32	3.92	x 1.04
	Chlorpromazine	Aggressive/destructive		0.00	0.00	0.00	0.00
	Chlorpromazine	Vocal sound		374.40	305.28	18.46	1.23
	Chlorpromazine	Pica		5.76	0.00	100.00	5.76
	Chlorpromazine	Self injury		17.28	17.28	0.00	1.00
	Chlorpromazine	Object stereotypy	Kevin	604.80	529. 92	12.38	1.14
	Chlorpromazine	Body stereotypy		4838.40	4970.88	2.74	x 1.03
	Chlorpromazine	Aggressive/destructive		0.00	0.00	0.00	0.00
	Chlorpromazine	Vocal sound		97.92	0.00	100.00	97.92
	Chlorpromazine	Pica		0.00	0.00	0.00	0.00
	Chlorpromazine	Self injury		5.76	0.00	100.00	5.76
Burgio (1985) [121]	Thioridazine	Aggression (play)	Doug	768.00	307.20	60.00	2.50
	Thioridazine	Disruption (play)		307.20	230.40	25.00	1.33
	Thioridazine	Self Stim (play)		3939.84	2995.20	23.98	1.32
	Thioridazine	Mouthing (play)		4147.20	3609.60	12.96	1.15
	Thioridazine	Aggression (academic)		76.80	23.04	70.00	3.33
	Thioridazine	Disruption (academic)		281.86	153.60	45.50	1.84
	Thioridazine	Self Stim (academic)		3018.24	1612.80	46.56	1.87
	Thioridazine	Mouthing (academic)		3532.80	2764.80	21.74	1.28
	Thioridazine	Aggression (play)	Terry	215.04	691.20	221.43	x 3.21
	Thioridazine	Disruption (play)		944.64	3609.60	282.11	x 3.82
	Thioridazine	Self Stim (play)		5015.04	6528.00	30.17	x 1.3
	Thioridazine	Aggression (academic)		7.68	2.30	70.00	3.33
	Thioridazine	Disruption (academic)		230.40	691.20	200.00	x 3
	Thioridazine	Self Stim (academic)		3632.64	3609.60	0.63	1.01
Luiselli (1986) [122]	Haloperidol	Face striking	Anne	1248	1824	46.15	x 1.46
	Thioridazine	Self injury	Frank	248	377	52.02	x 1.52
Singh (1993) [109]	Thioridazine	Stereotypy	Subject 1	4856.68	2776.32	42.84	1.75
	Thioridazine	Stereotypy	Subject 2	5034.24	3548.16	29.52	1.42
	Thioridazine	Stereotypy	Subject 3	3646.08	1866.24	48.82	1.95

Table 6: Converted Frequency Data From First Generation Single Subject Design Studies.

	FGAs		SGAs		CSS	
Percent Reduction	Number of Behaviors	Percent of Sample	Number of Behaviors	Percent of Sample	Number of Behaviors	Percent of Sample
90	6[a]	10.9	34[b]	25.0	110[c]	94
80	1	1.8	14	10.3	2	1.7
70	2	3.6	16	11.8	0	0
60	1	1.8	12	8.8	0	0
50	1	1.8	14	10.3	0	0
40						
	7	12.7	9	6.6	0	0
30	4	7.3	7	5.2	0	0
20	6	10.9	4	2.9	0	0
10	4	7.3	4	2.9	0	0
.01	1	1.8	2	1.5	0	0
No change or increase	22	40	20	14.7	5	4.3

Table 7: Behaviors Treated with First Generation Antipsychotic Medication Classified According to Percent Reduction.

[a]4 behavior were reduced by 100%
[b]23 behaviors or groups of behaviors were reduced by 100%
[c]83 behaviors or groups of behaviors were reduced by 100%

Study	Drug	Behavior	N	Baseline Converted Mean Frequency Per Day	Drug Converted Mean Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Heistad (1982) [123]	Thioridazine	Self stimulatory Behavior	100	5193.60	4387.20	15.53	1.18
		Active Negative - Pacing, injury to self, misappropriate, objectionable behavior, humiliate, tease, command negative, physical negative, yell, disapproval, and destructiveness.		988.80	816.00	17.48	1.21
		Passive negative - Inactivity, error, vanish from assigned place, whine, cry, dependency, noncompliance, ignore.		1065.60	1046.40	1.80	1.02
Aman (1988) [117]	Thioridazine	Self stimulatory beh. including self-injury	10	1884.00	1416.00	24.84	1.33
	Thioridazine	Any rule violation		199.00	80.00	59.80	2.49
Aman (1989) [118]	Haloperidol	Self stimulatory beh. including self-injury	20	1381.00	1450.00	5.00	x 1.05
	Haloperidol	Any rule violation		285.00	231.00	18.95	1.23
May (1995) [110]	Thioridazine	Destructive Behaviors	23	746.00	882.00	18.23	x 1.18
Mace (2001)a [111]	Haloperidol	Self-injury	8		2000		1580.80

Table 8 : Converted Frequency Data From First Generation Group Design Studies

[a] In this study, the effect of the presence and absence of haloperidol was compared with the presence and absence of placebo. The baseline converted mean per day was 2342.4 the placebo converted mean per day was 2969.6; and the percent increase was equal to 21.

					ABC-I					
					Drug		Placebo		CGI-I	
Study	Drug	N	Participants	Age	Baseline	Endpoint	Baseline	Endpoint	Drug	Placebo
Perry (1997) [124]	Risperidone	6	PDD	7-14	-	-	-	-	4/6	-
McDougle (1997) [58]	Risperidone	18	PDD	5-18	-	-	-	-	12/18	-
McDougle (1998) [49]	Risperidone	31	Autism PDD	18-43	-	-	-	-	8/14	0/16
Nicolson (1998) [125]	Risperidone	10	Autism	4 -10	-	-	-	-	8/10	-
Martin (1999) [59]	Quetiapine	6	Autism	6-15	15.67	22.3	-	-	2/6	-
Friedlander (2001) [60]	Risperidone	40	DD	13-24	-	-	-	-	23/40	-
Malone (2001) [61]	Olanzapine	6	Autism	4-12	-	-	-	-	5/6	-
Masi (2001) [62]	Risperidone	24	Autism	3-6	-	-	-	-	8/22	-
Zarcone (2001) [80]	Risperidone	20	Autism; DD	6-65	17.9	10.6	-	-	-	-
Aman (2002) [50]	Risperidone	118	IQ 36-84	5-12	23.5	13.5	23.6	19.2	28/52	5/63
McCracken (2002) [51]	Risperidone	101	Autism	5-17	26.2	11.3	25.5	21.9	38/49	6/52
Kemner (2002) [63]	Olanzapine	23	Autism	6-16	11.1	8.1	-	-	3/23	-
Malone (2002) [64]	Risperidone	22	Autism	2-16	-	-	-	-	17/22	-
McDougle (2002) [65]	Ziprasidone	10	Autism; PDD	8-20	-	-	-	-	6/12	-
Masi (2003) [66]	Risperidone	47	Autism; PDD	3-6	-	-	-	-	22/47	-
Shea (2004) [52]	Risperidone	79	Autism	5-12	18.9	6.8	21.2	14.7	21/40	7/38
Gagliano (2004) [67]	Risperidone	20	Autism	3-10	-	-	-	-	8/20	-
Stravrakaki (2004) [68]	Olanzapine	7	Autism; PDD	8-52	-	-	-	-	6/7	-
Stigler (2004) [69]	Aripiprizole	5	PDD-NOS	5-18	-	-	-	-	5/5	-
Findling (2004) [70]	Quetiapine	9	Autism	10-17	19	9	-	-	2/9	-
Corson (2004) [71]	Quetiapine	20	Autism; PDD	5-28	-	-	-	-	8/20	-
Harden (2005) [72]	Quetiapine	10	Autism PDD	5-19	-	-	-	-	6/10	-
Rugino (2005) [73]	Risperidone	7	Autism; PDD	5-17	-	-	-	-	2/7	-
Gagiano (2005) [53]	Risperidone		Adults with MR	18-65	18.4	8	17.9	12.1	-	-
					31.2	22.2	-	-	-	-
Troost (2005) [81]	Risperidone	36	Autism	5-17	23.1	12	-	-	-	-
Hellings (2006) [79]	Risperidone	40	DD	5-56	19.15	11.15	-	-	-	-
Hollander (2006) [54]	Olanzapine	11	Autism PDD	6-14	-	-	-	-	3/6	1/5
Malone (2007) [74]	Ziprasidone	12	Autism	12-18	1.5	1.1	-	-	9/12	-
Pandina (2007) [55]	Risperidone	55	Autism	5-12	20.6	7.2	21.6	14.1	14/27	6/28
Fido (2008) [126]	Olanzapine	40	Autism	7-17	20	6.2	-	-	12/40	-
Tyrer (2008) [115]	Risperidone	86	Adults with MR	28-55	-	-	-	-	7/29	5/29
Capone (2008) [75]	Risperidone	23	Autism; DD	3-13	15.8	10.7	-	-	-	-
Aman (2009) [78]	Risperidonea	47	Autism; PDD	4-13	29.69	14.53	-	-	-	-
Stigler (2009) [76]	Aripiprizole	25	PDD-NOS	5-17	29.6	8.1	-	-	22/25	-
Marcus (2009) [57]	Aripiprizole	213	Autism	6-17	28.6	16.2	28	19.6	87/164	17/49
					28.2	15	-	-	-	-
					28.9	14.5	-	-	-	-
Owen (2009) [56]	Aripiprizole	98	Autism	6-17	29.6	16.7	30.8	26.8	24/46	7/49
Amore (2011) [77]	Risperidone	31	MR	-	-	-	-	-	29/31	-
	Olanzapine	31	MR	-	-	-	-	-	21/31	-
Marcus (2011) [127]	Aripiprizole	48b	Autism	6-17	23.1	16.7	-	-	-	-

Table 6: Converted Frequency Data From First Generation Single Subject Design Studies.

Study	Drug	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Drug Converted Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Cohen (1994) [82]	Clozapine and Valproic Acid	Episodes of Agitation	Case 1	15.50	4.10	74	3.8
	Clozapine	Aggression	Case 2	0.60	0.17	72	3.6
	Clozapine	Self -injury	Case 2	1.37	0.47	66	2.9
	Clozapine	Verbal Aggression	Case 3	1.23	0.57	54	2.2
	Clozapine	Physical Aggression	Case 3	0.53	0.50	6	1.1
	Clozapine and Valproic Acid	Self -injury	Case 4	1.73	0.77	56	2.3
	Clozapine and Valproic Acid	Tantrums	Case 4	2.27	1.03	54	2.2
	Clozapine	Aggression	Case 5	0.40	0.00	100	12.0
	Clozapine and Valproic Acid	Aggression	Case 6	0.77	0.00	100	23.0
Lott (1996) [84]	Risperidone	Aggression	1	0.08	0.28	240	x 3.5
	Risperidone	Self-injury	2	0.07	0.35	425	x 5.0
	Risperidone	Aggression	3	3.38	2.60	23	1.3
	Risperidone	Aggression	4	2.14	0.48	77	4.4
	Risperidone	Self-injury	4	10.20	3.76	63	2.7
	Risperidone	Self-injury	5	0.05	0.08	67	x 1.6
	Risperidone	Self-injury	6	0.01	0.10	850	x 10.0
	Risperidone	Aggression	7	2.24	0.31	86	7.1
	Risperidone	Self-injury	7	0.25	0.19	22	1.3
	Risperidone	Self-injury	8	0.02	0.00	100	0.02
	Risperidone	Aggression	9	25.12	11.74	53	2.1
	Risperidone	Self-injury	9	0.25	0.07	73	3.8
	Risperidone	Destruction	9	0.43	0.19	57	2.3
	Risperidone	Self-injury	10	4.89	1.16	76	4.2
	Risperidone	Aggression	11	0.12	0.02	81	5.3
	Risperidone	Aggression	12	0.03	0.01	60	2.5
	Risperidone	Self-injury	12	1.05	0.15	86	7.1
	Risperidone	Destruction	12	0.03	0.08	200	x 2.7
	Risperidone	Aggression	13	0.55	0.04	93	14.3
	Risperidone	Self-injury	13	1.38	0.02	98	62.8
	Risperidone	Self-injury	14	0.24	0.43	84	0.5
	Risperidone	Aggression	15	1.40	0.38	73	3.7
	Risperidone	Self-injury	16	0.35	0.28	19	1.2
	Risperidone	Aggression	17	0.55	1.38	151	x 2.5
	Risperidone	Self-injury	18	1.19	0.84	30	1.4
	Risperidone	Aggression	19	2.12	0.76	64	2.8
	Risperidone	Self-injury	19	3.76	2.41	36	1.7
	Risperidone	Aggression	20	0.08	0.02	71	3.5
	Risperidone	Aggression	21	0.08	0.80	873	x 10.0
	Risperidone	Self-injury	21	0.23	3.47	1405	x 15.1
	Risperidone	Destruction	21	0.02	0.00	100	0.02
	Risperidone	Self-injury	22	3.63	1.15	68	3.1
	Risperidone	Destruction	22	0.30	0.03	89	9.2
	Risperidone	Aggression	23	2.95	1.87	36	1.6
	Risperidone	Self-injury	23	0.59	0.31	47	1.9

Continue...

Study	Drug	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Drug Converted Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
	Risperidone	Aggression	24	0.03	0.00	100	0.03
	Risperidone	Self-injury	24	0.87	0.10	88	8.4
	Risperidone	Destruction	24	0.29	0.13	57	2.3
	Risperidone	Self-injury	25	0.80	0.13	84	6.0
	Risperidone	Aggression	26	0.31	0.20	36	1.6
	Risperidone	Self-injury	26	0.27	0.31	14	1.2
	Risperidone	Aggression	27	0.10	0.00	100	0.1
	Risperidone	Aggression	28	3.31	0.32	90	10.2
	Risperidone	Self-injury	28	0.91	0.17	81	5.4
	Risperidone	Aggression	29	1.22	0.04	96	27.8
	Risperidone	Aggression	30	0.09	0.03	69	3.2
	Risperidone	Self-injury	30	0.37	0.16	57	2.3
	Risperidone	Aggression	31	0.41	0.24	42	1.7
	Risperidone	Self-injury	31	0.75	0.56	26	1.3
	Risperidone	Aggression	32	0.57	0.37	35	1.5
	Risperidone	Self-injury	32	0.29	0.30	4	x 1.0
	Risperidone	Destruction	32	0.34	0.51	51	x 1.5
Cohen (1998) [85]	Risperidone	Assault	1	0.01	0.00	100	0.01
	Risperidone	Self-injury	1	0.66	0.13	80	4.9
	Risperidone	Assault	2	2.57	0.13	95	19.3
	Risperidone	Disruption	2	2.53	0.03	99	76.0
	Risperidone	Assault	3	0.19	0.10	47	1.9
	Risperidone	Self-injury	3	0.36	0.30	16	1.2
	Risperidone	Assault	4	2.37	0.37	85	6.5
	Risperidone	Self-injury	4	16.64	3.87	77	4.3
	Risperidone	Assault	5	2.30	3.30	44	x 0.7
	Risperidone	Self-injury	6	2.09	0.00	100	2.1
	Risperidone	Assault	7	40.04	7.40	82	5.4
	Risperidone	Property Destruction	7	0.47	0.27	43	1.8
	Risperidone	Assault	8	0.06	0.00	100	0.06
	Risperidone	Self-injury	8	2.27	0.70	69	3.2
Cohen (1998) [85]	Risperidone	Assault	1	0.01	0.00	100	0.01
	Risperidone	Self-injury	1	0.66	0.13	80	4.9
	Risperidone	Assault	2	2.57	0.13	95	19.3
	Risperidone	Disruption	2	2.53	0.03	99	76.0
Dartnall (1999) [128]	Risperidone	Self-injury	1	1.22	0.00	100	1.2
	Risperidone	Aggression toward en.	1	0.23	0.00	100	0.2
	Risperidone	Noncompliance	2	1.40	0.00	100	1.4
	Risperidone	Hiding	2	0.47	0.01	98	42.7
	Risperidone	Assault	3	0.19	0.10	47	1.9
Crosland (2003) [129]	Risperidone	Demand Destructive	Reggie	672.00	201.60	70	3.3
	Risperidone	Tangible Destructive	Reggie	1920.00	979.20	49	2.0
	Risperidone	Attention Destructive	Sean	14592.00	5664.00	61	2.6
	Risperidone	Tangible Destructive	Sean	2208.00	768.00	65	2.9
	Risperidone	Demand Destructive	Sean	1824.00	768.00	58	2.4

Continue...

Study	Drug	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Drug Converted Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Janowsky (2003) [83]	Antipsychotic Plus Olanzapine	Aggression	A	0.04	0.02	63	2.7
	Antipsychotic Plus Olanzapine	Aggression	B	0.07	0.07	8	1.1
	Antipsychotic Plus Olanzapine	Aggression	E	0.71	0.33	54	2.2
	Olanzapine	Aggression	F	0.09	0.09	0	1.0
	Antipsychotic Plus Olanzapine	Aggression	I	0.10	0.01	95	19.0
	Antipsychotic Plus Olanzapine	Aggression	J	0.03	0.02	50	2.0
	Antipsychotic Plus Olanzapine	Aggression	K	0.04	0.01	88	8.0
	Antipsychotic Plus Olanzapine	Aggression	M	0.04	0.00	100	1.3
	Antipsychotic Plus Olanzapine	Aggression	O	0.44	0.10	78	4.4
	Antipsychotic Plus Olanzapine	Aggression	P	0.08	0.04	53	2.1
	Antipsychotic Plus Olanzapine	Aggression	Q	0.71	0.38	46	1.9
	Antipsychotic Plus Olanzapine	Aggression	R	0.03	0.02	40	1.7
	Antipsychotic Plus Olanzapine	Aggression	S	0.13	0.00	100	4.0
	Antipsychotic Plus Olanzapine	Aggression	T	0.09	0.03	71	3.4
	Antipsychotic Plus Olanzapine	Self -injury	F	0.08	0.08	0	1.0
	Antipsychotic Plus Olanzapine	Self -injury	G	0.02	0.01	33	1.5
	Antipsychotic Plus Olanzapine	Self -injury	K	0.15	0.02	85	6.8
	Antipsychotic Plus Olanzapine	Self -injury	L	0.33	0.27	17	1.2
	Antipsychotic Plus Olanzapine	Self -injury	P	0.03	0.02	33	1.5
	Antipsychotic Plus Olanzapine	Self -injury	R	0.08	0.05	40	1.7
	Antipsychotic Plus Olanzapine	Self -injury	S	0.08	0.00	100	2.3
	Antipsychotic Plus Olanzapine	Disruptive	A	0.01	0.02	100	x 2.0
	Antipsychotic Plus Olanzapine	Disruptive	C	0.26	0.05	81	5.2
	Olanzapine	Disruptive	D	0.52	0.07	87	7.3
	Antipsychotic Plus Olanzapine	Disruptive	E	0.55	0.05	91	11.1
	Antipsychotic Plus Olanzapine	Disruptive	H	0.01	0.02	100	x 2.0
	Antipsychotic Plus Olanzapine	Disruptive	J	0.20	0.23	14	x 1.2
	Antipsychotic Plus Olanzapine	Disruptive	N	0.08	0.05	33	1.5
	Antipsychotic Plus Olanzapine	Disruptive	O	0.11	0.05	50	2.0
	Antipsychotic Plus Olanzapine	Disruptive	P	0.28	0.12	59	2.4
	Antipsychotic Plus Olanzapine	Disruptive	S	0.36	0.03	91	10.8
	Antipsychotic Plus Olanzapine	Disruptive	T	0.11	0.07	40	1.7
Zarcone (2004) [130]	Risperidone	Destructive	Jack	940.8	0	100	940.8
	Risperidone	Destructive	Skip	1094.4	0.00	100	1094.4
	Risperidone	Destructive	Martin	192	19.2	90	10.0
	Risperidone	Destructive	Rose	336	0	100	336.0
	Risperidone	Destructive	Alice	120	0.00	100	120.0
	Risperidone	Destructive	Sam	4185.6	1267.2	70	3.3
	Risperidone	Destructive	Reggie	1032	264	74	3.9
	Risperidone	Destructive	Dolores	192	0.00	100	192.0
	Risperidone	Destructive	Carol	633.6	115.2	82	5.5
	Risperidone	Destructive	Mary	652.8	0.00	100	652.8
	Risperidone	Destructive	Simon	1324.8	1113.6	16	1.2
	Risperidone	Destructive	Aaron	3744	1440	62	2.6
	Risperidone	Destructive	Caleb	288	144	50	2.0

Table 10: Converted Frequency Data From Second Generation Single Subject Design Studies.

Study	Drug	Behavior	N	Baseline Converted Mean Frequency Per Day	Drug Converted Mean Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Ruedrich (2008) [131]	Atypical	Aggression and Self-injury	12	2.90	2.20	24	1.32
	Atypical	Aggression	14	0.94	0.64	32	1.47
	Atypical	Self -injury	5	0.70	0.78	11	x 1.11
Amore (2011) [77]	Olanzapine	Verbal Aggression	31	1.54	0.34	78	4.53
	Olanzapine	Object aggression		0.79	0.24	70	3.30
	Olanzapine	Self aggression		1.35	0.32	76	4.21
	Olanzapine	Aggression toward others		0.53	0.22	59	2.41
	Risperidone	Verbal Aggression	31	1.18	0.33	72	3.60
	Risperidone	Object aggression		0.77	0.21	73	3.69
	Risperidone	Self aggression		1.15	0.34	71	3.39
	Risperidone	Aggression toward others		0.38	0.13	65	2.86

Table 11: Converted Frequency Data From Second Generation Group Design Studies

Study	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Treatment Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Tate (1966) [132]	Hit self, self injury		6336.00	0.00	100	6336.00
Baroff (1968) [133]	Head hitting		1920.00	0.04	100	46080.74
Risley (1968) [134]	Dangerous climbing		107.20	0.00	100	107.20
Whaley (1968) [135]	Hand to head		76128.00	0.00	100	76128.00
Kushner (1969) [136]	Hand biting	Case 4	4.29	0.00	100	4.29
Lovaas (1969) [137]	Self destructive responses	John	42128.00	0.00	100	42128.00
	Self destructive responses	Linda	29779.00	0.00	100	29779.00
	Self destructive responses	Greg	4818.00	0.00	100	4818.00
Ludwig (1969) [138]	Aggression (hits, kicks, bites, spits)		259.00	0.00	100	259.00
Kohlenberg (1970) [139]	Stomach tensions leading to vomiting		2028.00	0.00	100	2028.00
Bucher (1971) [140]	Touching electrical appliances		1354.00	26.00	98	52.08
Corte (1971) [141]	Hand to face	Subject 1	1600.00	0.00	100	1600.00
	Face slapping, eye/tongue poking, hitting face on floor	Subject 2	8240.00	0.00	100	8240.00
	Pull out strands of hair, skin picking	Subject 3	4032.00	0.00	100	4032.00
	Hand biting, eating inedible objects	Subject 4	1895.00	0.00	100	1895.00
Baumeister (1972) [142]	Rocking	Subject 1	34464	0	100	34464.00
	Rocking	Subject 2	33888	1120	97	30.26
	Rocking	Subject 3	21792	96	100	21792.00
Tate (1972) [143]	Self injury, head banging, kicking, hitting self, biting self, cut self with fingernail		12859.00	3.39	100	3793.22
Brandsma (1973) [144]	Aggression		1795.00	0.00	100	1795.00
Hall (1973) [145]	Self-mutilation		25.00	0.00	100	25.00
Merbaum (1973) [146]	Face hitting		21216.00	0.00	100	21216.00
Wright (1973) [173]	Waving hand to induce seizures		848.00	0.00	100	848.00
Prochaska (1974) [148]	Head banging		3360.00	0.00	100	3360.00
Ramey (1974) [149]	Head hitting		3008.00	0.00	100	3008.00
Young (1974) [150]	Head to rail		2304.00	130.56	94	17.65
Ball (1975) [151]	Pinching, biting, hitting self	Case 1	29520.00	0.91	100	32439.56
	Throat hitting	Case 3	255.00	0.00	100	255.00
	Aggression	Case 4	3.90	0.05	99	79.30
	Aggression, food throwing, aggression toward objects	Case 5	5.13	0.79	85	6.46
Romanczyk (1975) [152]	Self hitting		86400.00	1099.00	99	78.62
Duker (1976) [153]	Head banging		640.00	0.00	100	640.00
	Hitting head with fists		713.00	8.00	99	89.13
Anderson (1978) [154]	Finger to mouth	CS	2880.00	5664.00	97	x 1.97
	Finger to mouth	PB	960.00	4800.00	400	x 5
	Finger to mouth	CW	4800.00	5760.00	20	x 1.2
	Finger to mouth	RK	2880.00	11520.00	300	x 4
	Head banging including attempts	JA	5760.00	11520.00	100	x 2

Continue...

Study	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Treatment Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Foxx (1989) [155]	Hair pulling		1.20	0.02	98	60.00
	Aggression		4.53	0.02	100	226.50
Linscheid (1990) [95]	Head hits	Marie	10752.00	19.20	100	560.00
	Head hits	Johnny	6176.00	2.67	100	2313.11
	Head hits	Donna	48192.00	76.80	100	627.50
	Head hits	Michael	45600.00	10.72	100	4253.73
	Head hits	Diane	15936.00	96.00	99	166.00
Williams (1993) [97]	Biting and self injury		7680.00	0.00	100	7680.00
Linscheid (1994) [98]	Head hits		3390.00	33.00	99	102.73
Mudford (1995) [91]	Hits		9043.20	1.78	100	5086.80
Linscheid (2002) [99]	Head hits		20736.00	128.00	99	162.00
Salvy (2004) [100]	Head banging, hitting self		117.00	0.00	100	117.00
Israel (2008) [3]	Aggression	Student 1	6.88	0.00	100	6.88
	Aggression	Student 2	2.43	0.00	100	2.43
	Aggression	Student 3	9.80	0.00	100	9.80
	Aggression	Student 4	0.73	0.00	100	0.73
	Aggression	Student 5	2.51	0.00	100	2.51
	Aggression	Student 6	31.82	1.19	96	26.72
	Aggression	Student 7	1.77	0.00	100	1.77
	Aggression	Student 8	12.97	0.00	100	12.97
	Aggression	Student 9	3.83	0.00	100	3.83
	Aggression	Student 10	4.91	0.00	100	4.91
	Aggression	Student 11	2.76	0.00	100	2.76
	Aggression	Student 12	23.94	0.00	100	23.94
	Aggression	Student 13	7.63	0.00	100	7.63
	Aggression	Student 14	2.83	0.00	100	2.83
	Aggression	Student 15	31.56	0.00	100	31.56
	Aggression	Student 16	10.44	0.95	91	10.97
	Aggression	Student 17	0.43	0.05	89	9.00
	Aggression	Student 18	34.22	0.00	100	34.22
	Aggression	Student 19	11.01	0.00	100	11.01
	Aggression	Student 20	3.81	0.00	100	3.81
	Aggression	Student 21	11.52	0.05	100	241.99
	Aggression	Student 22	4.83	0.00	100	4.83
	Aggression	Student 23	0.77	0.05	94	16.27
	Aggression	Student 24	1.65	0.95	94	17.3
	Aggression	Student 25	3.51	0.00	100	3.51
	Aggression	Student 26	3.67	0.00	100	3.67
	Aggression	Student 27	14.57	0.24	98	61.22
	Aggression	Student 28	29.18	0.57	98	51.07
	Aggression	Student 29	13.53	0.00	100	13.53
	Aggression	Student 30	20.08	0.52	97	38.33
	Aggression	Student 31	8.67	0.00	100	8.67

Continue...

Study	Behavior	Identifying Label From Original Study	Baseline Converted Frequency Per Day	Treatment Frequency Per Day	Percent Increase or Decrease	Multiply/ Divide By Factor
Israel (2008) [3]	Aggression	Student 32	19.49	0.00	100	19.49
	Aggression	Student 33	29.73	0.00	100	29.73
	Aggression	Student 34	12.19	0.05	100	256.18
	Aggression	Student 35	0.67	0.00	100	0.67
	Aggression	Student 36	13.57	0.38	97	35.61
	Aggression	Student 37	24.92	0.38	98	65.40
	Aggression	Student 38	3.47	0.00	100	3.47
	Aggression	Student 39	17.92	0.00	100	17.92
	Aggression	Student 40	4.89	0.00	100	4.89
	Aggression	Student 41	2.98	0.00	100	2.98
	Aggression	Student 42	1.19	0.00	100	1.19
	Aggression	Student 43	17.54	0.00	100	17.54
	Aggression	Student 44	14.56	0.00	100	14.56
	Aggression	Student 45	2.51	0.05	98	52.82
	Aggression	Student 46	17.34	0.10	99	182.13
	Aggression	Student 47	6.85	0.05	99	143.85
	Aggression	Student 48	30.44	0.05	100	639.44
	Aggression	Student 49	2.39	0.00	100	2.39
	Aggression	Student 50	11.41	0.62	95	18.44
	Aggression	Student 51	30.84	0.00	100	30.84
	Aggression	Student 52	10.94	0.00	100	10.94
	Aggression	Student 53	1.83	0.19	90	9.58
	Aggression	Student 54	1.78	0.00	100	1.78
	Aggression	Student 55	4.33	0.00	100	4.33
	Aggression	Student 56	11.60	0.00	100	11.60
	Aggression	Student 57	24.71	0.00	100	24.71
	Aggression	Student 58	1.60	0.10	94	16.79
	Aggression	Student 59	146.79	1.33	99	110.37
	Aggression	Student 60	2.41	0.00	100	2.41
Israel (2010) [102]	Aggression, health dangerous, destructive, major disruptive, noncompliance	Student 1	116.77	0.43	100	273.23
	Aggression, health dangerous, and noncompliance	Student 2	65.55	0.02	100	2989.51
	Aggression, health dangerous, destructive, major disruptive, noncompliance	Student 3	125.83	0.12	100	1043.82
	Aggression and health dangerous	Student 4	34.12	0.52	98	66.25
	Aggression, health dangerous, destructive, major disruptive, noncompliance	Student 5	213.74	0.03	100	6502.00
	Aggression and health dangerous	Student 6	91.60	0.13	100	696.62
	Aggression, health dangerous, destructive, major disruptive, noncompliance	Student 7	57.63	0.28	100	206.24

Table 12: Converted Frequency Data From Contingent Skin Shock Single Subject Design Studies

	Baseline or Placebo Frequency Per Day	Treatment Frequency Per Day
CSS	5300.23	360.05
FGA	1531.97	1382.91
SGA	282.31	98.10

Table 13: Mean Frequency Per Day During Baseline/Placebo Conditions and Treatment With Contingent Skin Shock, First, and Second Generation Antipsychotic Medications.