A|B|A|I
Association for Behavior Analysis International

RESEARCH ARTICLE

CrossMark

Classroom Management in Self-Contained Classrooms for Children with Autism: Extending Research on the Color Wheel System

Kathleen B. Aspiranti [1] · Alanna Bebech [1] · Brittany Ruffo [1] · Christopher H. Skinner [2]

Abstract

The color wheel is an evidence-based classroom management system that has been used to decrease inappropriate behaviors and increase on-task behaviors in general education elementary classrooms but not in classrooms for students with autism spectrum disorder (ASD). A multiple-baseline design was used to evaluate the effects of the color wheel system (CWS) on disruptive behaviors (being out of seat for one classroom, inappropriate vocalizations for two classrooms) in three self-contained elementary classrooms for students with ASD. Partial-interval time sampling was used to record class-wide disruptive behaviors. Visual analysis of a time-series graph suggests that the CWS decreased disruptive behaviors across all three classrooms. Discussion focuses on limitations of the study and directions for researchers interested in modifying, applying, and evaluating the effects of the CWS in settings for children with ASD.

Keywords Classroom management · Color wheel system · Autism spectrum disorder · Reducing inappropriate behaviors

Effective classroom management is dependent on several factors, including classroom rules that establish behavioral expectations designed to prevent inappropriate behaviors while enhancing the classroom climate and desired behaviors (Buck, 1999; Doyle, 2006; Jones & Jones, 2012; Mastropieri & Scruggs, 2014). Researchers have indicated that a single and generalized (e.g., broad) set of approximately three to five rules is a sufficient and effective method for managing the classroom (Malone & Tietjens, 2000). Several systems that incorporate a single set of rules and contingencies for rule breaking or following include the Good Behavior Game, the Caught Being Good Game, the ADHD Classroom Kit, and the Caterpillar Game (e.g., Filcheck, McNeil, Greco, & Bernard, 2004; Floress, Rock, & Hailemariam, 2017; Wright & McCurdy, 2011).

Although one set of three to five rules may be easy to learn, behavior expectations change as students switch from one activity to another (Skinner & Skinner, 2007). Consequently, a single set of three to five rules rarely provides clear and specific expectations for all activities across the school day, leaving students and teachers unsure of what rules are in place during specific activities (Fudge, Reece, Skinner, & Cowden, 2007). Students cannot be expected to follow unknown rules, and teachers cannot support student rule following unless the teachers know what rules are in place at all times (Fudge et al., 2008).

To address problems associated with unclear classroom rules, educators developed a classroom management strategy known as the color wheel system (CWS; Skinner, Scala, Dendas, & Lentz, 2007). The CWS incorporates multiple sets of classroom rules (i.e., green rules, yellow rules, and red rules) designed to provide specific behavioral expectations for different classroom activities. For example, yellow rules are designed for academic activities (e.g., teacher-led instruction) and include rules such as to remain in your seat, raise your hand to speak, and keep your eyes on your work or the speaker. Green rules are used for other activities designed to allow for more free communication and may include rules such as use your inside voice and keep your hands and feet to yourself. Visual prompts (e.g., a physical color wheel and rule posters) are publicly displayed so that at any given moment in time, everyone in the class can know which set of rules is in place.

✉ Kathleen B. Aspiranti
kaspiranti@ysu.edu

[1] Counseling, School Psychology, and Educational Leadership, Youngstown State University, One University Plaza, Youngstown, OH 44555, USA

[2] Educational Psychology and Counseling Department, University of Tennessee, Knoxville, TN, USA

Even experienced educators have difficulty managing student behavior during transitions (Codding & Smyth, 2008; Hine, Ardoin, & Foster, 2015). The CWS allows educators to consistently apply procedures designed to transition the class from one set of rules to another as it transitions from one activity to another (Skinner et al., 2007). The red rules are designed for transition and include keep your desk cleared, keep your eyes on the speaker, and no talking. When changing from one activity to another, teachers provide temporal warnings (e.g., "The color wheel will be turned to red in 2 minutes."), which cues students to stop what they are doing and put materials away before receiving directions and instructions for the next activity (Skinner et al., 2007). If students are following red rules, they will be attending to teacher-delivered directions for the next activity, allowing the teacher to quickly introduce the next activity and turn the color wheel to the appropriate color to begin this activity. For example, when transitioning from reading to spelling, the teacher may turn the wheel to red and inform the class that for their next activity they are to take out a pencil and their spelling workbook and turn to page 21. When the teacher turns the wheel to yellow, a student may raise his hand to have needs addressed (e.g., state, "I forgot a pencil."). Addressing such needs before beginning the lesson should allow the lesson to proceed with fewer disruptions (Saecker et al., 2008).

Evidence suggests that the CWS is effective and modifiable across settings, teachers, and general education classrooms (Skinner & Skinner, 2007). A number of consultants evaluated the CWS using procedures (e.g., A-B designs) that did not control for threats to internal validity (e.g., Below, Skinner, Skinner, Sorrell, & Irwin, 2008; Choate, Skinner, Fearrington, Kohler, & Skolits, 2008; Hautau, Skinner, Pfaffman, Foster, & Clark, 2008; Saecker et al., 2008). Others applied procedures that allowed them to draw stronger cause-and-effect conclusions. Researchers used A-B-A-B withdrawal designs to decrease inappropriate vocalizations (Fudge et al., 2007) and enhance on-task behavior (Fudge et al., 2008) in elementary classrooms. Watson et al. (2016) used a multiple-baseline design to evaluate the CWS in three kindergarten classrooms. For each class, results showed meaningful reductions in inappropriate vocalizations after the CWS was applied. Blondin, Skinner, Parkhurst, Wood, and Snyder (2012) evaluated a modified CWS system that included a fourth set of blue rules designed for collaborative learning activities (i.e., quiet voices, talk about work only, ask three before me, hands and feet to self, follow directions) and found increases in on-task behavior in a fourth-grade classroom.

Several factors suggest that the CWS may be effective when working with students with autism spectrum disorder (ASD). Many students with ASD engage in high rates of disruptive behavior, including out-of-seat behavior and inappropriate comments or noises (Conroy, Asmus, Boyd, Ladwig, & Sellers, 2007; Machalicek, O'Reilly, Beretvas, Sigafoos, &

Lancioni, 2007; Reese, Richman, Belmont, & Morse, 2005). These behaviors often distract classmates, disrupt educators who are trying to teach, and are incompatible with desired behaviors, such as attending to teacher instruction (Scattone, Wilczynski, Edwards, & Rabian, 2002). Additionally, students with ASD may be more likely to engage in undesired behaviors during transitions (McCoy, Mathur, & Czoka, 2010). As the CWS has reduced general education students' inappropriate behaviors during transitions, it may also be effective with students with ASD.

Some students with ASD are easily distracted, have difficulty ceasing or stopping specific activities, and have difficulty attending (Chien et al., 2015; Goldstein, Johnson, & Minshew, 2001; Kleinhans, Akshoomoff, & Delis, 2005; Lequia, Wilkerson, Kim, & Lyons, 2015; Mostert-Kerckhoffs, Staal, Houben, & Jonge, 2015; Occelli, Esposito, Venuti, Arduino, & Zampini, 2013; Rydzewska, 2016). These students may benefit from the consistent procedures (e.g., temporal warnings that the color wheel will be turned to red in 2 min) used to elicit stopping one activity and to enhance attending (e.g., having desks cleared and eyes on the teacher as she introduces the next activity). Students with ASD have responded well to visual stimuli (Bedford, Pellicano, Mareschal, & Nardini, 2016; Cihak, 2011; Ganz & Flores, 2010; Pierce, Spriggs, Gast, & Luscre, 2013). The CWS provides a visual indicator of behavioral expectation at all times (i.e., the displayed color), as well as verbal prompts (e.g., temporal warnings when switching to red) that allow students to participate regularly in routine transitions.

In previous studies, researchers used description and demonstration (e.g., role-play with different scenarios) to teach students CWS procedures. For some students with ASD, additional strategies may be needed (Gray, 2000). Researchers investigating other complex behaviors have found evidence that social stories, when used with other research-supported behavioral procedures, may be an effective tool for teaching students with ASD how to behave in social situations (Karkhaneh et al., 2010; Rhodes, 2014). Social stories are short stories, which may also incorporate pictorial cues, designed to enhance students' ability to interpret complex social situations and understand the appropriate behavioral response (Sansosti, Powell-Smith, & Kincaid, 2004).

Although researchers have evaluated the CWS across general education elementary school classrooms, this system has not been evaluated in classrooms serving students with ASD. The current study was designed to extend research on the CWS to students with ASD while using social stories to teach students CWS procedures. Specifically, a multiple-baseline design across self-contained elementary school classrooms was used to evaluate the effects of the CWS on inappropriate behaviors. In one classroom, the primary inappropriate behavior measured was out-of-seat behavior; in the other two classrooms, it was inappropriate vocalizations.

Method

Participants and Setting

The study was conducted in two kindergarten through second-grade (K–2) classrooms and one third- through fifth-grade (3–5) classroom in a self-contained school for students with ASD. Participants were 21 students who were placed in the school based on their current individualized education programs (IEPs). The school provided more intensive services than available at the home district. All students had a diagnosis of ASD and could follow one-step directions. Classroom A, a K–2 room, included six students, four boys and two girls, aged 5–8. All Classroom A students were considered nonvocal, as they did not communicate verbally through words. Classroom B, a room with grades 3–5, included five boys and three girls, aged 8–11. Classroom C, a K–2 room, had five boys and two girls, aged 5–8. All students in Classrooms B and C communicated their needs vocally through words.

Each classroom had one lead teacher and at least one teaching assistant. Other teaching assistants rotated between the classrooms as needed. All teachers possessed at least a bachelor's degree in special education, early education, psychology, or a related field. Academic programming in each classroom was similar to that of same-aged peers; students were exposed to the Common Core Curriculum with extended standards. All students received daily individual behavior-analytic instruction and some had individual behavior management plans. Procedures used in the classrooms included structured and incidental teaching during formal group activities and play times, discrete trial training, working walks, token systems, visual supports, consistent reinforcement, prompting hierarchies, shaping and chaining of complex behaviors, ongoing data collection, and formal behavior plans to address severe challenging behaviors.

Materials

As opposed to the traditional pie-shaped paper-wedge color wheel, we chose to use preconstructed plastic traffic lights purchased through Italtrike® to serve as the color wheel (see Below et al., 2008). The traffic light had three colors (red, yellow, and green) and the teacher changed the color by turning the top clockwise until the desired color was reached. In Classrooms B and C, the teachers chose to mount the traffic light on the 3-ft pole included with the traffic light, but the teacher in Classroom A chose not to use the pole and instead mounted the traffic light directly onto the stand.

Red, yellow, and green colored poster boards were created with the corresponding rules written on each poster board. Accompanying the written rules was a photograph of students responding to each set of rules. The teachers were encouraged

to adapt the rules for their classrooms. Table 1 displays the rules for each classroom. Teachers from Classroom A chose slightly different rules for yellow as their children were considered nonvocal.

Design and Dependent Variables

A multiple-baseline across-classrooms design was used to evaluate the effects of the CWS on disruptive behavior. For all experimental phases, data were collected by trained graduate students using 20-s partial-interval time-sampling procedures. Each graduate student entered the classroom and sat in a designated area. During the 20-min session, 20-s intervals were signaled using a smartphone app with attached earbud headphones. Data were recorded by writing a slash over each interval in which any student engaged in the disruptive behavior during that interval.

During a modified problem-identification interview (Bergan, 1977), each teacher selected which disruptive behavior was measured in her classroom. Classroom B and C teachers selected inappropriate vocalizations. Inappropriate vocalizations were defined as talking or making noises (e.g., humming, singing, and grunting) without permission. Examples of inappropriate vocalizations included talking while the teacher was talking, talking during independent seatwork, or calling out an answer. Nonexamples included answering a question after being called on by the teacher or talking quietly when placed in small groups to work.

Classroom A contained only students considered nonvocal. Because the teacher did not want to reduce student talking, she selected out-of-seat behavior. Out-of-seat behavior was defined as the student's bottom off his or her assigned chair or area (e.g., carpet) when the student was not given permission to move. Some examples of out-of-seat behavior include walking around the classroom, crawling on the floor, and taking another student's chair. A nonexample was moving from the table to the carpet area when instructed to do so by the teacher.

Procedures

Soliciting Participants and Training Observers At the end of the previous school year, the primary researcher conducted a 60-min workshop describing CWS procedures and results from studies evaluating the CWS. All three participating teachers attended the workshop and expressed interest in applying CWS procedures the following school year. Approximately six weeks into the school year, researchers observed each classroom and developed operational definitions and data-recording systems. Data were collected by the primary researcher and a secondary researcher who collected interobserver agreement data during 29% of the sessions. The data collectors were graduate students with experience

Table 1 CWS Rules for each classroom

Classroom	Red Rules	Yellow Rules	Green Rules
Classroom A	Eyes on teacher	Inside voices	Hands and feet to self
	In seat	Hands and feet to self	Use inside/quiet voices
	No talking	Eyes on teacher	Follow directions
		Follow directions	
Classrooms B & C	Eyes on teacher	Raise your hand and wait to speak	Hands and feet to self
	In seat	Hands and feet to self	Use inside/quiet voices
	No talking	Eyes on teacher	Follow directions
		Follow directions	

collecting direct-observation data in classrooms. The data collectors were systematically trained on the CWS using the implementation guide developed by Skinner et al. (2007), as well as on the definition of the dependent variables and how to collect data using the time-sampling procedure. Data collectors practiced recording data during two 20-min in vivo sessions and were provided feedback. Practice ceased when interobserver agreement between the observers exceeded 90%; the observers were then cleared to collect data used for the current study.

Baseline During 20-min sessions, researchers used 20-s partial-interval time sampling to record disruptive behaviors. In each classroom, data were collected between 8:30 a.m. and 10:30 a.m. on Mondays, Wednesdays, and Thursdays. For each classroom, specific 20-min sessions were selected because academic activities were scheduled during those sessions, and approximately 10 min into each session, the classroom typically transitioned from one activity to another. Activities typically observed during these sessions were whole-group and small-group academic tasks. The observer(s) sat at the back of the classroom with a data-collection sheet on a clipboard and a smartphone with an earpiece used to signal each 20-s interval.

An interval was scored if the disruptive behavior (out-of-seat behavior or inappropriate vocalizations) was observed at any time during that 20-s interval. This phase lasted a minimum of four sessions per class. The primary dependent variable was the percentage of intervals where any student in the class engaged in the inappropriate behavior. Class-wide data were plotted on a repeated-measures graph, and visual analysis of trends, levels, and variability was used to decide when to apply the intervention to each class.

Teacher and Student Training For each classroom, after the baseline phase ended, the researcher implemented teacher training (one 60-min session), student training (one 45-min session), and 1 practice day over 3 consecutive school days. Teacher training was staggered across classrooms, was conducted during planning time, and included the teacher and assigned teaching assistant(s). The primary researcher

described and demonstrated how to apply CWS procedures. Next, the teachers and researcher reviewed daily schedules and discussed what rules (colors) were appropriate for what activities. Finally, the teacher and teaching assistants practiced using the CWS procedures in different scenarios while others (e.g., researchers, teaching assistants) played the role of students.

Several key concepts were emphasized during the training (Skinner & Fudge, 2006), which had already been introduced during the initial workshop. Teachers were reminded to consistently use red when transitioning and to always provide 2-min and 30-s warnings before changing the traffic light to red. The researcher also indicated that red rules were the most difficult to follow; consequently, time on red to should be kept to a minimum (e.g., after moving to red, quickly introduce the next activity and move the wheel to yellow or green). The researcher emphasized that yellow rules are often used for teaching and learning time: when students attend to teacher instruction, complete individual assignments, write or read, and raise their hands to ask or answer questions. They were reminded that green rules were designed to set behavior expectations for free time or group activities.

Teachers were reminded that the CWS is designed to enhance rule following, not improve their ability to detect and punish rule breaking (Fudge et al., 2008). Thus, teachers were encouraged to frequently praise rule following with verbal praise and tangible rewards; when students were not following rules, teachers were encouraged to gently prompt rule following (e.g., remind students of the rules for yellow, or point to the traffic light). Teachers were told that time on red should never be used for punishment, but time on green could be used as a group reward. Finally, the teachers were reminded that although the CWS is a group intervention, individual behavior plans should always be followed when necessary. Teacher mastery of the training was completed when the teachers and assistants could accurately identify all components of the CWS procedure, answer scenario questions posed by the researchers, and accurately role-play using the CWS in two classroom situations.

During the first 45 min of the following day, the researcher and teachers introduced the CWS to the students. A social

story (see Appendix), supplemented with colored photographs of the traffic light, was used to assist in introducing the CWS to the students. Each page of the social story was accompanied by a photograph to help students visually understand the story. The researcher and teacher then helped the class practice examples and nonexamples of rules for each color. For instance, the class showed the teacher how to behave during red rules and then how not to behave during red rules. When prompted, all students demonstrated appropriate behavior for each set of rules. Next, the class practiced transitions from each color. Training was complete once the class could successfully transition from one activity to another using each transition combination available (i.e., yellow to red, green to red, red to yellow, and red to green) as the teacher implemented CWS procedures correctly.

For each class, the researcher returned the following day to observe the CWS being implemented, to answer any questions from teachers or assistants, and to provide feedback and prompts as the teachers applied CWS procedures. At the end of this practice day, all students were able to follow the procedures without much additional prompting and the student training was concluded.

Implementation and Maintenance The following day, researchers continued to collect intervention-phase data using procedures identical to baseline data-collection procedures. Teachers and teaching assistants were responsible for implementing CWS procedures in their classrooms. At the beginning of each intervention day, the teacher read the social story to the class and then the teacher and assistants followed the CWS procedures during all daily routines while in the classroom. Throughout the intervention phase, the primary researcher provided ongoing feedback to teachers and gave suggestions of how to increase correct use of the CWS. The researcher talked to the teachers after approximately 60% of the sessions to provide reminders such as to always go to red before yellow or green, to remember to use the 2-min and 30-s warnings, and to keep time on red brief. Several times, the researcher and teacher discussed periods during the observed class session that could have been conducted differently to adhere to the CWS. Following the last intervention-phase session, the researcher asked the teachers to continue using the CWS in their classrooms, and all agreed to keep the system in place. Researchers returned twice per week for the next 4 weeks to collect maintenance data on disruptive behaviors. During maintenance, no additional prompting or feedback was provided to the teachers. Data-collection procedures were identical to those used during baseline.

Analysis

For each session, the percentage of intervals in which the primary observer scored any occurrence of the problem

behavior across the entire class was divided by the number of intervals observed and was displayed on a repeated-measures graph. Visual analysis of this graph was used to determine when to change phases during the study and to interpret results after the study was completed. Analysis of treatment effects were based on within-classroom, across-phase comparisons and focused on changes in level, variability, and trends. Across-classroom and across-phase comparisons were used to evaluate the influence of threats to internal validity (Kazdin, 2011).

Visual analysis of the repeated-measures graph was supplemented with statistical analysis including effect size calculations. Specifically, for each classroom, percentage of data points exceeding the median (PEM) was calculated by determining the percentage of data points in the intervention and maintenance phases exceeding the median data point in the baseline phase and then dividing by 100 (Ma, 2006). Although Ma (2006) suggested PEM interpretation guidelines, more conservative guidelines for nonparametric effect size values were applied (Bruni et al., 2017; Parker & Vannest, 2009).

Interobserver Agreement and Acceptability

For each class, two observers scored inappropriate behaviors, and interobserver agreement was calculated for 20% or more sessions per phase. In total, 29% of all sessions were checked for interobserver agreement, not including training sessions for the observers. Interobserver agreement was calculated on an interval-by-interval basis by dividing the number of agreements per session by the number of disagreements plus agreements and then multiplying by 100. Average interobserver agreement scores for Classrooms A, B, and C were 99.7% (range 96.7%–100%), 99.2% (range 95%–100%), and 98.3% (range 90%–100%).

After all data were collected, each teacher completed an 11-item acceptability measure that was created in conjunction with the teachers and principal at the school. The principal participated because she wanted data that would assist her in determining if the CWS should be used in other classrooms. Additionally, a four-item student acceptability measure was read to all students. This form used a smiley face and a frowny face to indicate responses of "yes" and "no," respectively, to the questions. Two students from Classroom B did not complete the student acceptability form.

Results

For each classroom, Table 2 provides descriptive statistics for inappropriate behaviors by phases. Figure 1 provides the percentage of intervals scored for disruptive behaviors for each session. Baseline data for Classroom A were variable and showed an increasing trend in out-of-seat behavior ranging

Table 2 Percentage of intervals with inappropriate behaviors per phase and effect size measures between phases

Classroom	BL M (SD) Range	INT M (SD) Range	MTN M (SD) Range	BL to INT PEM	BL to INT PEM
Classroom A	23.8% (11.1) *13%–33%*	15.4% (7.0) *6%–31%*	11.4% (5.4) *1%–15%*	.85	1
Classroom B	80.2% (6.6) *71%–90%*	70.2% (16.9) *43%–90%*	50.3% (15.2) *33%–75%*	.67	1
Classroom C	68.2% (9.7) *55%–81%*	45.3% (9.1) *30%–53%*	29.7% (4.2) *23%–36%*	1	1

BL baseline-phase data; *INT* intervention-phase data; *MTN* maintenance-phase data; *PEM* percentage of data points exceeding the median

from 13% to 33% (*M* = 23.8%). The percentage of intervals scored with out-of-seat behavior decreased immediately after the intervention phase began and showed a steadily decreasing trend, followed by eight sessions of increased variability. During the intervention phase, class-wide out-of-seat behavior ranged from 6% to 31% (*M* = 15.4%). Maintenance data were generally lower and more stable than baseline- or intervention-phase data and ranged from 1% to 15% (*M* = 11.4%).

In Classroom B, percentage of intervals with inappropriate vocalizations during baseline ranged from 71% to 90% (*M* = 80.2%). Initial baseline data were variable, followed by an increasing trend in class-wide inappropriate vocalization. During the intervention phase, there was a gradual, but fairly

consistent (the exceptions were Sessions 12 and 13) decline in inappropriate vocalizations. During the intervention phase, inappropriate vocalizations ranged from 43% to 91% (*M* = 70.2%). Although the first maintenance session was higher than the last three intervention-phase data points, other maintenance-phase data were consistent with intervention-phase data and showed a decreasing trend in inappropriate vocalizations. Maintenance-phase data ranged from 33% to 75% (*M* = 50.3%).

Classroom C baseline data were variable (*M* = 68.2%; range 55%–81%), with an increasing trend. Intervals with inappropriate vocalizations immediately decreased after the CWS intervention was implemented and remained lower than all baseline data. Intervention-phase data were variable (*M* =

Fig. 1 Percentage of intervals where disruptive behaviors occurred during baseline, intervention, and maintenance phases
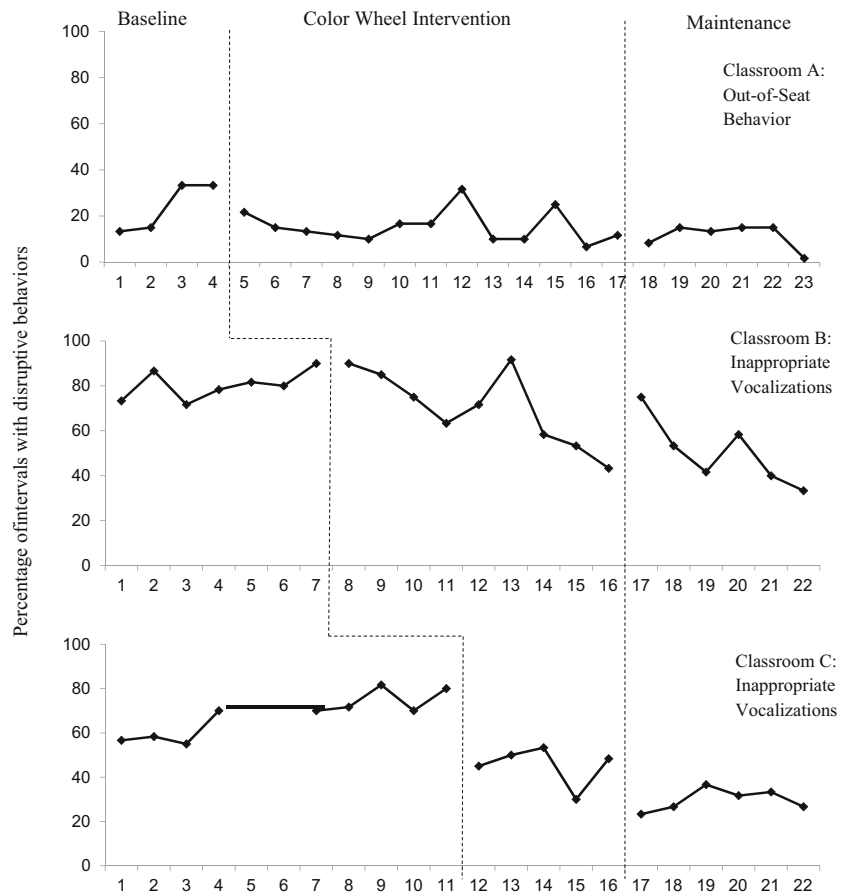
45.3%; range 30%–53%), with no consistent trend. Maintenance-phase data showed the least amount of variability, ranging from 23% to 36% ($M = 29.7\%$), and all sessions were lower than the lowest baseline session. Visual analysis of Fig. 1 shows that after the CWS was applied to one classroom, other classrooms showed no concomitant decreases in inappropriate behavior.

Statistical Analysis

Table 2 displays descriptive data for each phase across classrooms. Analysis of mean data across all three classrooms shows a consistent pattern. For each classroom, average inappropriate behaviors decreased during the intervention phase and were lowest during the maintenance phase, which indicates a general decline in inappropriate behaviors over time after the CWS was implemented. Generally, out-of-seat behavior in Classroom A was lower than inappropriate vocalizations in Classrooms B and C. When comparing percentage change from baseline to intervention phases and from baseline to maintenance phases, Classroom B showed the smallest changes.

For each classroom, effect size estimates (i.e., PEM) were calculated comparing baseline-phase data to both intervention- and maintenance-phase data (see Table 2). PEM values from .93 to 1 were considered large, from .66 to .92 were medium, and below .65 were small (Bruni et al., 2017; Parker & Vannest, 2009). When comparing baseline phases to intervention phases, effect sizes for Classrooms A and B were medium and the effect size for Classroom C was large. Baseline to maintenance comparisons for all three classrooms indicated large effect sizes (PEM = 1) with no maintenance points for any classroom exceeding the median baseline point.

Student and Teacher Acceptability

All teachers and students were given acceptability measures at the completion of maintenance data collection. Table 3 displays the ratio of students agreeing with each statement. The four questions were administered by paper with each question typed, and then smiley and frowny faces below each question, and "Yes" or "No" typed below the corresponding face. After

Table 3 Ratio of student agreement per classroom for statements measuring student acceptability of intervention

Statement	A	B	C
Using the CW is fun.	4/6	5/6	6/7
I like using the CW.	5/6	4/6	6/7
The CW helped me with class rules.	5/6	5/6	6/7
I would like to keep using the CW.	3/6	5/6	6/7

the teacher explained the task to the students, the primary researcher read each question while the teacher walked around the room helping the students complete the measure. In all classrooms, the majority of students liked using the CWS, thought the CWS was fun, and felt the CWS helped with class rules. In Classrooms B and C, the majority of students wanted to keep using the CWS, but in Classroom A, only half of the students wanted to keep using the CWS.

The teacher acceptability data were more variable than the student acceptability data. Table 4 displays the number of teachers in each classroom agreeing with statements measuring teacher acceptability of the intervention. In Classrooms A and C, the teachers rated all items as either "Yes" or "Maybe." All teachers in Classrooms A and C indicated that they noticed positive changes in their students' behaviors and would recommend the CWS to other teachers. Teachers in Classroom B generally rated the CWS negatively. Both teachers rated many items as "No" and did not feel that the CWS was beneficial to their students.

Discussion

The current study was designed to replicate CWS research and extend this research to students with ASD. Visual analysis of our repeated-measures graph shows immediate decreases and/ or decreasing trends in inappropriate behavior after CWS procedures were applied to each class and no concomitant decreases in classrooms still in baseline. This pattern suggests that the CWS, as opposed to other confounding variables, caused decreases in disruptive behavior in all three self-contained classrooms (Kazdin, 2011). These results support previous findings, which suggested that the CWS reduced inappropriate behaviors in general education classrooms (e.g., Fudge et al., 2007; Watson et al., 2016).

PEM suggests that the decreases in inappropriate behavior from baseline phase to intervention phase were medium for Classrooms A and B and large for Classroom C. More support for meaningful effects was found when comparing baseline-phase data to maintenance-phase data, which revealed large effects (PEM = 1) for each classroom. Additionally, when comparing phase means, a consistent pattern emerged; for each classroom, the highest phase means occurred during baseline, intervention means were lower than baseline, and maintenance means were the lowest. These data, along with visual analysis of Fig. 1, which suggests that the CWS was more effective as the study progressed, provide directions for future researchers.

Researchers should determine if the CWS is more effective or more consistently effective when students become more experienced and familiar with CWS routine and rules (Fudge et al., 2008). An alternative explanation is that teachers became more skilled at applying CWS procedures (e.g.,

Table 4 Tally of teacher agreement for statements measuring teacher acceptability of intervention

Statement	Yes	Maybe	No
1. The CW was an acceptable way to increase good student behavior.	A, A, A, C	B	B
2. I would recommend the CW to other teachers.	A, A, A, C	B	B
3. I noticed a positive change in my students' behavior.	A, A, A, C		B, B
4. I would be willing to use the CW again in the future.	A, C	A, A, B, B	
5. The CW is appropriate for a variety of students.	A	A, A, C	B, B
6. I liked the procedures used in the CW.	A, A, A, B, C	B	
7. The CW will produce lasting improvements in the students' behavior.		A, A, A, C	B, B
8. The students enjoyed the CW.	A, A, C	A	B, B
9. The CW will not result in negative side effects for the students' performance.	A, A, A, B, C		B
10. Overall, the CW was beneficial to the students.	A, A, A, C		B, B
11. The CW is a time-efficient way to work on behaviors.	A, A, A, C	B	B

A Classroom A teacher or assistant teacher; *B* Classroom B teacher or assistant teacher; *C* Classroom C teacher

applying procedures more consistently and with more integrity). In the current study, after the CWS was implemented, researchers failed to collect treatment integrity data; rather, during the intervention phase, they provided regular feedback regarding treatment integrity and suggestions on how to enhance integrity. This need for additional prompts and feedback suggests that future researchers should conduct more intensive training sessions and include more in vivo training opportunities before beginning to collect intervention-phase data (Fudge et al., 2007). Additionally, future researchers should collect treatment integrity data so that the relationships between treatment integrity and other factors (e.g., teacher training, treatment effectiveness, treatment acceptability) can be explored. Although students were reminded of the rules and praised or rewarded for rule following, the rate of praise was not specified and the consistency of praise was not measured. The medium effects of the CWS in Classroom B may be due to using reminders that functioned as unintended reinforcement for breaking the rules, giving praise to the students that was not reinforcing the rule following, or praising inconsistently.

Other limitations and directions for future researchers should be addressed. In the current study, the dependent variable for Classrooms B and C was inappropriate vocalization, and for Classroom A, whose students were considered nonvocal, the dependent variable was out-of-seat behavior. Future researchers should consider measuring the same inappropriate behaviors across classrooms. Also, researchers should consider measuring appropriate behaviors associated with learning, including on-task behavior (Fudge et al., 2008) and attending to and following teacher directions and instruction (Saecker et al., 2008).

Researchers have demonstrated how the CWS could be modified by using different rules, more rules, different stimuli, and the application of group contingencies (Below et al., 2008; Blondin et al., 2012; Hautau et al., 2008; Skinner & Skinner, 2007). In the current study, the procedures were modified to include the use of a social story to introduce the intervention to students. Although using social stories to teach CWS procedures was unique, this component was not formally evaluated. Researchers should determine if social stories can help students with ASD and other disabilities learn the rules and routines associated with the CWS.

Researchers should consider evaluating other components of the CWS. Previous researchers found that students with ASD often respond well to visual prompts (Ganz & Flores, 2010; Pierce et al., 2013). Thus, researchers could determine if having the behavioral expectations displayed at all times (i.e., the color displayed on the traffic light indicating behavioral expectations) enhanced students' knowledge of behavioral expectations and consequently their rule-following behaviors. Perhaps the visual presence of the color on the traffic light serving as a visual-discriminative stimulus was related to the specific behavioral contingency in place, thus improving discriminability and stimulus control. Also, researchers should determine if having the light displayed enhanced teachers' ability to consistently support desired behaviors (Fudge et al., 2007). As students with ASD often respond well to routine transitions (Cihak, 2011), researchers may want to evaluate the consistent application of transition procedures. Students with ASD often have difficulty attending (Chien et al., 2015). As the rules for red are designed to enhance attention to directions and instructions for the next activity (e.g., keep your desk cleared, keep your eyes on the speaker), researchers could determine if the temporal warnings and red rules enhanced students' direction following and reduced the need for teachers to repeat directions (Saecker et al., 2008).

The teachers in the current study indicated other directions for future research. Several teachers queried whether a visual timer, such as a SMART board countdown clock, could be used in addition to a verbal temporal warning. Teachers also indicated that during class time the students appeared to respond to the physical presence of the stop light. Researchers

may want to determine if enhancing the conspicuousness of the rule indicator (e.g., a wheel or, in this case, a traffic light) or the temporal cues (e.g., a countdown clock) enhances the effectiveness of the CWS. Interestingly, Teacher A may have successfully enhanced the conspicuousness of the traffic light by carrying it with her.

Across participants, acceptability measures showed that students and teachers generally rated the CWS positively; however, Classroom B teacher ratings were negative. During intervention and maintenance phases, Classrooms A and C showed larger average percentage decreases in inappropriate behaviors relative to baseline than did Classroom B. Thus, the lower acceptability rating may be related to effectiveness. However, no causal relationships can be drawn because other unmeasured factors may explain this relationship. For example, weak treatment integrity may have caused low effectiveness and acceptability. Additional research designed to evaluate these relationships must include treatment fidelity measures. The CWS has been shown to reduce undesired behavior in general education kindergarten students and enhance on-task behavior in general education elementary students (e.g., Fudge et al., 2008; Watson et al., 2016). The participating students with ASD also appeared to learn and respond to the three sets of rules, and the authors found evidence of treatment effects. These findings suggest the need for additional studies designed to enhance the effectiveness of CWS procedures when working with students with ASD. More longitudinal studies should be conducted to determine if the CWS accelerates learning by preventing behavior problems that reduce teaching and learning time while enhancing behaviors (e.g., direction following, academic engagement) associated with learning (Watson et al., 2016). Finally, researchers should continue to adapt and evaluate CWS procedures and determine if these procedures could be effective in inclusive classrooms and with students with other disabilities.

Implications for Practice

- Applies the CWS for use with students with ASD;
- Investigates the use of the CWS for both nonvocal and vocal students;
- Describes how teachers/researchers can implement the CWS in other classrooms;
- Incorporates social stories into the student training procedures.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained for all individual participants included in the study.

Appendix

Color Wheel System Social Story Text for Classroom A

This is the Color Wheel. We are going to use the Color Wheel to help us know what we are supposed to do during class.

The Color Wheel has three colors: Red, Yellow, and Green. Each color has different rules.

Red is for when I need to be very quiet and listen to the teacher's instructions.

My Red rules are: Eyes on Teacher, In Seat or Spot, and No Talking.

When on Red, I will have my eyes on the teacher, be in my seat, and not talk.

Yellow is for when I am doing my work or learning from my teacher.

My Yellow rules are: Inside Voices, Hands and Feet to Self, Eyes on Teacher, and Follow Directions.

When on Yellow, I will use my inside voice, keep my hands and feet to myself, keep my eyes on my teacher or work, and follow directions.

Green is for when I am working in a group or have free time.

My Green rules are: Hands and Feet to Self, Inside Voices, and Follow Directions.

When on Green, I will keep my hands and feet to myself, use my inside voice, and follow directions.

My teacher will tell me when we will move to a different color.

My teacher will change the color on the Color Wheel so I will know what rules to follow.

If I forget the rules, I can look at the posters on the wall. They will tell me what to do.

I like using the Color Wheel.

References

Bedford, R., Pellicano, E., Mareschal, D., & Nardini, M. (2016). Flexible integration of visual cues in adolescents with autism spectrum disorder. *Autism Research, 9*, 272–281.

Below, J. L., Skinner, A. L., Skinner, C. H., Sorrell, C. A., & Irwin, A. (2008). Decreasing out-of-seat behavior in a kindergarten classroom: Supplementing the color wheel with interdependent group-oriented rewards. *Journal of Evidence-Based Practices for Schools, 9*, 33–46.

Bergan, J. R. (1977). *Behavioral consultation*. Columbus: Charles E. Merrill.

Blondin, C., Skinner, C., Parkhurst, J., Wood, A., & Snyder, J. (2012). Enhancing on-task behavior in fourth-grade students using a modified color wheel system. *Journal of Applied School Psychology, 28*, 37–58.

Bruni, T. P., Drevon, D., Hixon, M., Wyse, R., Corcoran, S., & Fursa, S. (2017). The effect of functional behavior assessment on school-based interventions: A meta-analysis of single-case research. *Psychology in the Schools, 54*, 351–369.

Buck, G. H. (1999). Smoothing the rough edges of classroom transitions. *Intervention in School and Clinic, 34*, 224–235.

Chien, Y., Gau, S. S., Shang, C., Chiu, Y., Tsai, W., & Wu, Y. (2015). Visual memory and sustained attention impairment in youths with autism spectrum disorders. *Psychological Medicine, 45*, 2263–2273.

Choate, S., Skinner, C., Fearrington, J., Kohler, B., & Skolits, G. (2008). Extending the external validity of the color wheel procedures: Decreasing out-of-seat behavior in an intact, rural, 1st-grade classroom. *Journal of Evidence-Base Practices for Schools, 8*, 120–133.

Cihak, D. F. (2011). Comparing pictorial and video modeling activity schedules during transitions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*, 433–441.

Codding, R. S., & Smyth, C. A. (2008). Using performance feedback to decrease classroom transition time and examine collateral effects on academic engagement. *Journal of Educational and Psychological Consultation, 18*, 325–345.

Conroy, M. A., Asmus, J. M., Boyd, B. A., Ladwig, C. N., & Sellers, J. A. (2007). Antecedent classroom factors and disruptive behaviors of children with autism spectrum disorders. *Journal of Early Intervention, 30*, 19–35.

Doyle, W. (2006). Classroom organization and management. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.). New York: Simon and Schuster.

Filcheck, H. A., McNeil, C. B., Greco, L. A., & Bernard, R. S. (2004). Using a whole-class token economy and coaching of teacher skills in a preschool classroom to manage disruptive behavior. *Psychology in the Schools, 41*, 351–361.

Floress, M. T., Rock, A. L., & Hailemariam, A. (2017). The caterpillar game: A classroom management system. *Psychology in the Schools, 54*, 385–403.

Fudge, D., Skinner, C., Williams, J., Cowden, D., Clark, J., & Bliss, S. (2008). Increasing on-task behavior in every student in a second-grade classroom during transitions: Validating the color wheel system. *Journal of School Psychology, 46*, 575–592.

Fudge, D. L., Reece, L., Skinner, C. H., & Cowden, D. (2007). Using multiple classroom rules, public cues, and consistent transition strategies to reduce inappropriate vocalization: An investigation of the color wheel. *Journal of Evidence-Based Practices for School, 8*, 102–119.

Ganz, J. B., & Flores, M. M. (2010). Implementing visual cues for young children with autism spectrum disorders and their classmates. *Young Children, 65*(3), 78–83.

Goldstein, G., Johnson, C. R., & Minshew, N. J. (2001). Attentional processes in autism. *Journal of Autism and Developmental Disorders, 31*, 433–440.

Gray, C. A. (2000). Writing *social stories with Carol Gray* [Videotape and workbook]. Arlington: Future Horizons.

Hautau, B. L., Skinner, C. H., Pfaffman, J., Foster, S., & Clark, J. C. (2008). Extending the external validity of the color wheel: Increasing on-task behavior in an urban, kindergarten classroom. *Journal of Evidence-Based Practices for Schools, 9*, 3–17.

Hine, J. F., Ardoin, S. P., & Foster, T. E. (2015). Decreasing transition times in elementary school classrooms: Using computer-assisted instruction to automate intervention components. *Journal of Applied Behavior Analysis, 48*, 495–510.

Jones, V. F., & Jones, L. S. (2012). *Comprehensive classroom management: Creating communities of support and solving problems* (10th ed.). Boston: Allyn & Bacon.

Karkhaneh, M., Clark, B., Ospina, M. B., Seida, J. C., Smith, V., & Hartling, L. (2010). Social stories to improve social skills in children with autism spectrum disorder: A systematic review. *Autism: The International Journal of Research and Practice, 14*, 641–662.

Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings*. New York: Oxford University Press.

Kleinhans, N., Akshoomoff, N., & Delis, D. C. (2005). Executive functions in autism and Asperger's disorder: Flexibility, fluency, and inhibition. *Developmental Neuropsychology, 27*, 379–401.

Lequia, J., Wilkerson, K. L., Kim, S., & Lyons, G. L. (2015). Improving transition behaviors in students with autism spectrum disorders: A comprehensive evaluation of interventions in educational settings. *Journal of Positive Behavioral Intervention, 17*, 146–158.

Ma, H. H. (2006). An alternative method for quantitative synthesis of single-subject researches: Percentage of data points exceeding the median. *Behavior Modification, 30*, 598–617.

Machalicek, W., O'Reilly, M. F., Beretvas, N., Sigafoos, J., & Lancioni, G. E. (2007). A review of interventions to reduce challenging behavior in school settings for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*, 229–246.

Malone, B. G., & Tietjens, C. L. (2000). Re-examination of classroom rules: The need for clarity and specified behavior. *Special Services in the Schools, 16*, 159–170.

Mastropieri, M., & Scruggs, T. (2014). *The inclusive classroom: Strategies for effective differentiated instruction* (5th ed.). Boston: Pearson.

McCoy, K. M., Mathur, S. R., & Czoka, A. (2010). Guidelines for creating a transition routine: Changing from one room to another. *Beyond Behavior, 19*, 22–29.

Mostert-Kerckhoffs, M. L., Staal, W. G., Houben, R. H., & Jonge, M. V. (2015). Stop and change: Inhibition and flexibility skills are related to repetitive behavior in children and young adults with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 45*, 3148–3158.

Occelli, V., Esposito, G., Venuti, P., Arduino, G., & Zampini, M. (2013). Attentional shifts between audition and vision in autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*, 517–525.

Parker, R. I., & Vannest, K. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy, 40*, 357–367.

Pierce, J. M., Spriggs, A. D., Gast, D. L., & Luscre, D. (2013). Effects of visual activity schedules on independent classroom transitions for students with autism. *International Journal of Disability, Development and Education, 60*, 253–269.

Reese, R. N., Richman, D. M., Belmont, J. M., & Morse, P. (2005). Functional characteristics of disruptive behavior in developmentally disabled children with and without autism. *Journal of Autism and Developmental Disorders, 35*, 419–428.

Rhodes, C. (2014). Do social stories help to decrease disruptive behavior in children with autistic spectrum disorders? A review of the published literature. *Journal of Intellectual Disabilities, 18*, 35–50.

Rydzewska, E. (2016). Unexpected changes of itinerary–adaptive functioning difficulties in daily transitions for adults with autism spectrum disorder. *European Journal of Special Needs Education, 31*, 330–343.

Saecker, L., Sager, K., Williams, J. L., Skinner, C. H., Spurgeon, S., & Luna, E. (2008). Decreasing teacher's repeated directions and students' inappropriate talking in an urban, fifth-grade classroom using the color wheel procedures. *Journal of Evidence-Based Practices for Schools, 9*, 18–32.

Sansosti, F. J., Powell-Smith, K. A., & Kincaid, D. (2004). A research synthesis of social story interventions for children with autism

spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 19*, 194–204.

Scattone, D., Wilczynski, S. M., Edwards, R. P., & Rabian, B. (2002). Decreasing disruptive behaviors of children with autism using social stories. *Journal of Autism and Developmental Disorders, 32*, 535–543.

Skinner, C. H., & Fudge, D. (2006). *The color wheel: Better classroom management via better stimulus control.* Invited workshop presented at the annual meeting of the Tennessee Association of Behavior Analysis, Nashville, TN.

Skinner, C. H., Scala, G., Dendas, D., & Lentz, F. E. (2007). The color wheel: Implementation guidelines. *Journal of Evidence-Based Practices for Schools, 8*, 134–140.

Skinner, C. H., & Skinner, A. L. (2007). Establishing an evidence base for a classroom management procedure with a series of studies: Evaluating the color wheel. *Journal of Evidence-Based Practices for Schools, 8*, 88–101.

Watson, T. L., Skinner, C. H., Skinner, A. L., Cazzell, S., Aspiranti, K., Moore, T., & Coleman, M. (2016). Preventing disruptive behavior via classroom management: Validating the color wheel system in kindergarten classrooms. *Behavior Modification, 40*, 1–23.

Wright, R. A., & McCurdy, B. L. (2011). Class-wide positive behavior support and group contingencies: Examining a positive variation of the good behavior game. *Journal of Positive Behavior Interventions, 14*, 173–180.