Behavior Analysis in Practice (2023) 16:1047–1060
https://doi.org/10.1007/s40617-023-00774-4

RESEARCH ARTICLE

Using an App-Based Token Economy to Increase Engagement in Daily Living and Vocational Tasks with Adults with Developmental Disabilities

Lydia A. Beahm[1] · Einar T. Ingvarsson[1,2] · Noelle Funk[2] · Lauren Haskins[2] · Jake Frazier[2]

Accepted: 6 January 2023 / Published online: 25 January 2023

Abstract

The token economy is an evidence-based practice that improves outcomes across populations, settings, and behaviors. Nonetheless, their complex nature frequently leads to ineffective implementation. In addition, little is known about the extent to which token economies are effective for increasing engagement in adults with disabilities. Therefore, we conducted a multiple probe across participants to evaluate the effectiveness of a token economy using an app (i.e., Class Dojo) to increase engagement with daily living and vocational tasks in adults with disabilities. All participants increased their engagement with tasks following the introduction of the intervention and maintained higher than baseline levels of engagement up to 6 weeks after the intervention ended. Staff members completed an anonymous survey to indicate their perception of the feasibility and effectiveness of the intervention. Social validity results indicated that some staff members found the intervention effective, but time-consuming and challenging.

Keywords Token economy · Adults with disabilities · Engagement · Daily living skills · Vocational skills · Class Dojo

The token economy is a frequently used behavioral intervention that has been shown to increase appropriate behavior across multiple populations in various settings (Hackenberg, 2018; Kazdin, 1982; Nastasi et al., 2020). Token economies are defined by the accumulation of tokens, which are exchanged for a backup reinforcer preferred by the individual (Soares et al., 2016). Token economies have been widely studied across a variety of populations, including adults with intellectual disabilities (Krentz et al., 2016), individuals with attention-deficit hyperactivity disorder (Ayllon et al.,1975; Hupp & Reitman, 1999; Robinson et al., 1981), individuals with emotional and/or behavioral disorders (EBD; Alter, 2012; Drege & Beare, 1991), and individuals with autism spectrum disorder (ASD; Carnett et al., 2014; Fiske et al., 2015; Matson & Booisjoli, 2009); and have been shown to increase multiple behaviors such as verbal interactions in students with ASD (McDonald & Hemmes, 2003), social behaviors in adolescents with EBD (Wolfe et al., 2003), appropriate classroom behavior (Reitman et al., 2004), and academic engagement (Shogren et al., 2011).

Soares et al. (2016) found that token economies meet the What Works Clearinghouse standards to be considered an evidence-based practice (EBP). EBPs provide instructors with highly effective, research-based approaches that improve individual outcomes. EBPs are crucial for professionals working with individuals with disabilities, because this population is at risk for academic failure and social rejection (Bradley et al., 2008; Odom et al., 2006). Nevertheless, some professionals are hesitant to implement token economies because their complex nature is a potential barrier to effective implementation (Ivy et al., 2017).

Effective implementation of token economies requires monitoring an individual's behavior closely, delivering consequences consistently, having access to tokens and (often) a token board, regularly modifying contingencies, and identifying and controlling access to motivating backup reinforcers (Kazdin, 2012). Some service providers lament that token economies are too complicated and time-consuming to implement effectively in real-world settings (Cooper et al., 2020; Reitman et al., 2004). Thus, it is crucial to explore

✉ Lydia A. Beahm
lar3h@virginia.edu

[1] University of Virginia, 405 Emmet Street South, Charlottesville, VA 22904, USA

[2] Virginia Institute of Autism, Charlottesville, VA, USA

procedures to facilitate the implementation of token economies. One potential approach is to use software applications.

ClassDojo is a free classroom management application (app) that at least one teacher in a third of schools in the United States uses (Friedemann et al., 2015; Singer, 2014). The app can be accessed on phones, tablets, and computers and contains different sections or classrooms where students' data can be stored and easily accessed. Each student has a profile and is represented by an avatar. Instructors click their avatar to deliver a reward to a student, and the number next to the individual's avatar increases. This method may ameliorate the cumbersome nature of having to carry tokens and a token board. When an individual uses points to access a reinforcer, the instructor can easily deduct points from the individual's avatar. This eliminates some of the difficulty involved in keeping track of tokens for multiple students. These points can function as conditioned reinforcers that can be exchanged for backup reinforcers. To increase the effectiveness of the conditioned reinforcer, the individual should have access to multiple high-quality backup reinforcers (Fiske et al., 2020; Russell et al., 2018). Practitioners may consider using a "store" where individuals can spend their Dojo points to purchase backup reinforcers. For example, an individual could spend 10 points in exchange for a cookie.

Several scholars have highlighted ways to use ClassDojo to increase effective implementation of different EBPs (e.g., Cetin & Cetin, 2018; Cumming, 2013; Hirsch et al., 2016; Lynne et al., 2017; Maclean-Blevins & Muilenburg, 2013; Robacker et al., 2016). Although some of these articles have provided strategies on how to use ClassDojo with a token economy, none have experimentally evaluated the effectiveness of this approach. Only two studies (i.e., Lynne et al., 2017; Krach et al., 2017) have assessed the effectiveness of ClassDojo for other behavior management strategies (i.e., Good Behavior Game and data collection). Both studies found that these strategies were effective when implemented using ClassDojo and that teachers responded positively to the app. In addition, teachers reported that the app made implementing the practice manageable. This evidence supports the notion that the use of ClassDojo may increase the feasibility of implementing token economies.

To date, most studies on token economies studies have included school-age students, with limited research with adults over the age of 22 (Maggin et al., 2011; Soares et al., 2016). This is consistent with the relative dearth of evidence-based interventions for adults with disabilities compared to younger age groups (Taylor et al., 2012). This is concerning given that, for example, family members of individuals with autism have expressed concern over their adult children's abilities to perform daily living skills (e.g., folding and putting away clothes, sorting silverware) and vocational skills (i.e., work-related tasks; Jacobson et al., 1980; Gotham et al., 2015). Difficulties performing vocational tasks deters employers from hiring individuals with disabilities (Taylor et al., 2015). In fact, only about 25% of individuals with disabilities have some level of employment, and only 9.6% work 30 hr or more per week (Taylor et al., 2015). Therefore, it is crucial to continue to evaluate effective practices that increase engagement in vocational and daily living tasks for adults with disabilities to increase independence and opportunities for employment.

A handful of studies have shown promising results of token economy interventions with adults with disabilities. For example, Krentz et al. (2016) used a reversal design to and evaluate the effects of token economies on increasing walking in adults with intellectual disabilities. Nastasi et al. (2020) conducted a similar study using a changing criterion design. The participants in both Nastasi et al.'s study and Krentz et al.'s study were mostly sedentary and did not meet the guidelines for recommended daily activity. The authors of both studies found that the token economy interventions increased walking distance for most of the participants. These results suggest that token economies might also be effective in increasing engagement with vocational and daily living skills in adults with disabilities.

The current study was designed to evaluate whether a token economy implemented using the ClassDojo app increased engagement in daily living and vocational tasks in individuals with disabilities (including ASD and ID). A secondary aim was to collect social validity data to evaluate whether instructors found the token economy implemented using ClassDojo feasible and manageable.

Method

Participants and Settings

The participants in the current study were six adults with developmental disabilities who attended a day support program at an autism services center (at the center, the adults were referred to as *consumers* of services). Staff members nominated the participants for the study because they were reported to be prompt dependent and had insufficient participation in daily living and vocational training tasks. Unfortunately, the center had not retained specific diagnostic information for the consumers; therefore, we were unable to include this information. At first, nine participants agreed to be in the study; however, three did not meet the inclusion criteria and were therefore excused. In addition to lack of independent engagement in tasks, the inclusion criteria included attending the center regularly (i.e., multiple days per week) and absence of severe challenging behavior that would interfere with participation.

Clint was a 32-year-old male with autism who spoke in three- to five-word sentences and could communicate his

basic wants and needs. He had been reported to actively avoid nonpreferred tasks and often did not respond (i.e., did not answer or participate) when asked to engage in such tasks. Stephen was a 30-year-old male with autism who spoke in two- to three-word sentences but did not always reliably communicate his needs. He displayed occasional mild disruptive behavior (vocalizations) that had been reported to serve as precursors to more severe problem behavior in the past (i.e., self-injurious behavior). He required one-to-one assistance. Nick was a 27-year-old male with autism who spoke in complete sentences but was reported to display repetitive behaviors (e.g., verbal perseverations) that sometimes interfered with his ability to accomplish tasks or follow directions. Peter was a 42-year-old male with Down syndrome who spoke in one- to two-word sentences and could communicate some of his wants and needs. He occasionally engaged in self-injurious behavior and vocal protests when asked to complete a nonpreferred task. Tony was a 27-year-old male with ASD who spoke in three- to four-word sentences. He was able to communicate his wants and needs, but also displayed a moderate level of verbal perseverations. Bruce was a 24-year-old male with autism who was visually impaired and spoke in complete sentences. He could communicate his wants and needs and frequently sought to engage in discussions about his preferred topics. In addition, Bruce occasionally engaged in self-injurious behavior when he was unable to engage in preferred activities.

Due to the COVID-19 pandemic, the schedule for the center changed several times throughout the study. At the start of the study, participants attended the center in person 2 days a week for 3 hr each day. During the study, the participants transitioned to attending the center in person 5 days a week for 3 hr each day. However, two participants only attended the center 3 days a week after the 5-day schedule was initiated. In addition, the program moved to a new building during the intervention phase for all participants (the week of May 10). Two weeks after the move to the new building, the general schedule changed to 7 hr a day, 5 days a week (two participants continued to attend 3 days a week). Although five participants did not seem to be affected by the change, Clint's most preferred reinforcer was dependent on a location in the original building. After the move, Clint's engagement decreased; therefore, we conducted a new preference assessment to find a preferred location in the new building. Following the updated preference assessment, Clint was able to access a highly preferred reinforcer. In addition, there were times during the study when participants were not able to attend the center in person due to illness or vacation.

Prior to the move, sessions took place in an open 4.55 m^2 area at the end of a hallway immediately outside the participants' classroom. The area contained a shelf that held the study materials (i.e., task boxes, see below) and provided a space for stocking grocery items, a 1.4 m^2 long table and a chair, a laundry rack for hanging clothes, and a set of lockers. After the move, we conducted sessions in available settings that minimized consumer distraction. Sometimes sessions occurred at a table in the kitchen, other times they occurred at a table in the corner of the main classroom, and other times in an office with a table, chairs, and an office desk.

Materials

Task Boxes

The tasks were presented using 11 task boxes that focused on developing daily living skills and vocational training tasks (see Table 1 for a list of task boxes and the reinforcement schedule). Examples of task boxes are sorting silverware, folding towels, and folding shirts. The materials for each task were in a seven-quart clear plastic tub (i.e., the task box). For sorting silverware, the task box materials consisted of a plastic basket with three smaller baskets. In each basket was a picture of the individual silverware piece (i.e., fork, spoon, and knife) to indicate what silverware went into which basket. Participants were given 30 pieces of silverware mixed together and told to "sort them into their baskets." The task was to put all the spoons in the basket with the picture of the spoons, all the forks in the fork basket, and all the knives in the knife basket.

For folding towels, the task box contained six dishcloths. Participants were handed the box and instructed to "fold the towels." The task was to fold the towel in half three times and stack each folded towel on top of the other one. For folding shirts, the task box contained a folding board and six t-shirts in various adult sizes (i.e., medium, large, and extra-large). Participants were instructed to "fold the shirts." The task was to place a shirt on the folding board and fold the shirt.

ClassDojo

ClassDojo is a free software application that can be downloaded on any tablet or computer. Accounts are password protected. Multiple classes can be created under one account. In each class, individuals are assigned an avatar that is represented by an icon (e.g., monster, alien, skeleton). Points can then be awarded to each person by selecting an individual's avatar and adding a point. When points are awarded, a chiming sound indicates a point has been earned. Points can then be redeemed by clicking on an individual's avatar and subtracting the points (there is no noise to indicate that points have been subtracted). Redeeming points refers to "spending" the points to earn a backup reinforcer (e.g., time on an exercise ball, crackers, cookies, puzzles, iPad time).

Table 1 Description of Task Boxes

Task Box	Materials	Expected Response	Reinforcement Schedule
Filling salt and pepper shakers	6 salt and pepper shakers, scoop, large black and white beads to represent salt and pepper	Participants should scoop white beads into the shakers labeled salt and black beads into the shakers labeled pepper until the beads reach a line at the top	FR2 per scoop
Folding paper in thirds	Blank paper, envelopes	Participants should fold the paper into thirds and put it into the envelope	FR1
Folding shirts using a folding board	Cotton t-shirts, folding board	Participants should use the folding board to fold the shirts so they can be put away	FR1
Folding hand towels	Cotton hand towels	Participants should fold the hand towels in half 3 times	FR1
Hanging t-shirts	Clothing rack, closed shirts of various sizes (i.e., not button-up shirts), hangers	Participants should put the shirts on the hanger and place the hanger on the clothing rack	FR1
Matching and folding socks	Socks with various patterns	Participants should match the socks and folding them by putting the socks together and pushing them inside of each other	FR1
Restocking sugar caddies	Splenda, sugar, sweet and low, 6 sugar caddies	Participants should put all of the sweet and low, Splenda, and sugar into the 6 sugar caddies	FR6 per sugar packet
Sorting mail based on name and address	Envelopes labeled with different names and addresses, a mail sorter with the corresponding names and addresses on it	Participants should put the envelopes in the corresponding mail sorter	FR1
Sorting silverware (spoons, knives, forks)	15 plastic spoons, knives, forks, the baskets with the corresponding picture and label for spoons, knives, and forks	Participants should sort the utensils into the appropriate tray	FR6 per piece of silverware
Stocking grocery items	Various food cans and boxes (e.g., canned vegetables, crackers, spaghetti), shelves with corresponding pictures and labels for each grocery item, dividers to indicate where to place the item	Participants should sort the grocery items and place them in their labeled area on the shelf	FR1
Stuffing and sealing envelopes	Prefolded pieces of paper, envelopes	Participants should place the paper in the envelope and be able to close the envelope flap	FR1

Measurement

The dependent variable was engagement in activities of daily living (ADL) skills or vocational training tasks. Engagement was defined as any responses that were agreed-upon components of specified vocational and ADL tasks, including but not limited to placing utensils, folding shirts, towels, and socks, sorting sugar packets, and shredding paper. For example, picking up a utensil and placing it into the appropriate bin within 5 s would be considered engagement in the task of placing utensils. Nonexamples included doing something else with the materials that was unrelated to the task, such as picking up a utensil and hitting the table with it or waving it in the air, or not doing anything with the materials.

All sessions were video-recorded on a password-protected computer that was only accessible to the research team. The primary observer (i.e., the first author) manually scored engagement during live sessions using a data collection sheet (available upon request) by applying 15-s momentary time sampling (MTS). MTS was chosen as a discontinuous measurement strategy due to its utility in estimating duration of engagement (e.g., Hanley et al., 2007), whereas partial interval recording is likely to overestimate duration and whole interval recording is likely to underestimate duration (Kahng et al., 2021). Originally, the RBTs were going to collect data, so we chose 15 s to ensure they had adequate time to provide reinforcement, collect the data, and keep track of the time. However, we discovered that data collection would be more accurate if one person delivered the points and the first author collected data. We estimated engagement for each session by the percentage of intervals scored (i.e., instances of target behavior divided by all the intervals multiplied by 100). The observer scored engagement if the participant was engaged in any part of the assigned vocational or ADL task at the moment each interval ended. A second observer independently scored 30% of baseline, intervention, and maintenance sessions from videos using the same 15-s MTS procedure. Prior to collecting interobserver agreement (IOA) data, the two observers coded a subset of video-recorded sessions for training purposes until they reached 100% agreement. The IOA coder subsequently independently scored 30% of the videos. IOA was calculated on a session-by-session basis using point-to-point agreement by determining agreement and disagreement between the two observers for each MTS interval and dividing the number of agreements by the sum of agreements and disagreements for each session. Mean session IOA for Clint was 93% (session range: 83%–98%), 91% for Peter (session range: 88%–98%), 94% for Stephen (session range: 85%–98%), 85% for Tony (session range: 75%–98%), 91% for Nick (session range: 80%–100%), and 88% for Bruce (session range: 73%–98%). Disagreements were discussed and reconciled following each session.

Procedure

Before the study began, the first and second author met with the staff in the classroom to assess the needs of the participants and discuss what skills should be targeted. In addition, key staff participated in the development of the intervention procedures.

Instructor Training

The lead author was an elementary school special education teacher for 7 years before becoming a doctoral student in special education with an emphasis on applied behavior analysis. The second author has been a board-certified behavior analyst (BCBA) for over 10 years and has previously conducted studies on token economies and related instructional procedures. The instructors who implemented the token economy had worked at the school for six months to over 4 years. The instructors were all registered behavior technicians (RBTs) and held bachelor's degrees.

Prior to baseline, the instructors attended two 45-min behavior skills training (BST) sessions (Miltenberger, 2015) led by the first author. During the first session, the first author presented information about the purpose of the study, described the procedures, and modeled how to conduct baseline sessions. The instructors then had an opportunity to ask questions about the study before engaging in role-plays with the first author. During role-plays, the instructors received immediate positive and constructive feedback and continued practicing with the first author until they could correctly implement the procedures independently. Another 45-min BST session was conducted when the first group of participants was ready to start intervention. The procedures for the second BST session were identical to the first BST session, except the first author taught the instructors how to condition the Dojo points so they would function as reinforcers (see below) and how to implement the token economy. The same BST format was used (i.e., rationale, model, role-play practice, feedback) in both sessions (Miltenberger, 2015).

Baseline

Task boxes were designed to teach functional living skills to participants. Prior to baseline, participants were evaluated on their completion of each task box to ensure that the participants had the capability to perform the necessary skills to complete the task box independently. Once a participant could complete a task box with 90% accuracy independently, the task box was then used during baseline.

During baseline sessions, participants were asked to complete three task boxes in 10 min. The first author monitored sessions until each instructor implemented baseline procedures with 100% fidelity across two consecutive sessions.

The instructors placed three task boxes in front of the participant (e.g., sorting silverware, folding towels, folding shirts) and instructed the participants to complete each one by delivering instructions that took the form or, "First you will [task], then you will [task], then you will [task]. Go ahead and get started!" Then, the instructors modeled the first task for the participant. After modeling the first task, the instructors asked the participant to begin working and started the 10-min timer. The instructors did not provide any prompting following the initial instruction.

If a participant did not engage with the task box after 1 min (i.e., 60 consecutive s), the instructor removed the first task box and pushed the second task box in front of the participant. If the participant did not engage with the second task box after 1 min, the instructor removed that task box and pushed the third box in front of the participant. If a consumer did not engage with the third task box after 1 min, the instructor re-presented all three task boxes by placing them in front of the participant and asking them to work on each task box. If applicable, the cycle of removing a task box after 1 min of no engagement started again at this point. After 10 min, the instructor removed all three task boxes, thanked the participant for working, and informed them that break time was available. In the event that a participant finished the first task box, but stalled on the second or third task box, the instructor did not re-present the first task box, but would only present the task box(es) that were not completed. In addition, if a participant requested help, the instructor would ask them what they needed and provide help when requested. However, neither of these situations occurred during any sessions.

If a participant was engaged for the duration of the tasks, the instructor did not interact with the participant. When the participant finished all three task boxes, the instructor removed the materials, thanked them for working, and told them they could do something else. In addition, if a participant engaged in challenging behavior that was a potential danger to themselves or others, the session was terminated. For example, if a participant engaged in self-injurious behavior (SIB), the session was terminated, and the instructors followed the procedures specified in the participant's behavior support plan. When a participant finished early, total engagement was divided by the total number of observed intervals for the purposes of data analysis. For example, if the participant finished in 8 min instead of 10, then the number of engaged intervals was divided by 32 instead of 40.

Conditioning the Tokens

Following baseline but before the intervention, the first author conducted three rounds of a multiple-stimulus-without-replacement preference assessments for each participant across 3 different days (Conine et al., 2021) except for the visually impaired participant (Bruce) with whom the last author completed a single paired-choice preference assessment (Fisher et al., 1992). After conducting the preference assessments, the instructors conditioned the Dojo points as reinforcers.

To condition the tokens (i.e., points), the instructors used photos taken by the first author, representing the highest-ranked reinforcer for each participant from the preference assessment (e.g., a person sitting on their favorite bench or a picture of their favorite cookie). The instructor showed participants their avatars on ClassDojo and explained that the numbers represented points. Then, they showed the participant a picture card indicating the reinforcer's current price (i.e., 3 = [preferred reinforcer]) and told them that once they got three points, they would earn the reinforcer. The instructor then showed the participant their avatar displaying two points, touched the avatar to reward the third point, and immediately said, "You have three points! You get [reinforcer]!" and gave them the backup reinforcer. This process was repeated until the participant indicated (e.g., pointed to the picture, verbally stated) they had three points and earned their reinforcer.

After participants indicated they had earned their reinforcer, the participant started a task with zero points and was shown the same picture card (with 3 = [picture of reinforcer]). They were directed to complete simple tasks (e.g., putting an egg in a basket) and received a point each time they completed the task. When they received a point, the instructor would deliver behavior-specific praise and award a point (e.g., "Great job putting the egg in the basket! You earned a point!"). This process was repeated until the participant indicated (e.g., pointed to the picture, verbally stated) they had three points and earned their reinforcer. After they were able to indicate they had earned their reinforcer, the "cost" of the reinforcer (i.e., the token-exchange schedule) increased to five points. This was done to prepare the participants for the intervention phase, in which reinforcers were worth a different amount of points depending on the results of the preference assessment (as is typical in token economies). When they were able to earn five points and indicate they earned the reinforcer, the intervention began. Most participants completed the conditioning process within 15–20 trials.

Intervention

The intervention was a token economy implemented through a software application (i.e., ClassDojo). Similar to baseline sessions, the instructors placed three task boxes in front of each participant and asked them to complete them. Before the task boxes were presented to the participants, they were shown a visual menu (i.e., a picture of each reinforcer with their associated cost next to it) to remind the participants of

the available rewards (e.g., 5 points for cookies, 10 points for sour cream and onion chips, and 15 points for cheese puffs). Each participant had their own backup reinforcer "menu" based on their preference assessment. The token-exchange schedule (i.e., the cost) was set as 5 points to access a moderately preferred reinforcer, 10 points to access a more highly preferred reinforcer, and 15 points to access the most preferred reinforcer. The procedures for removing and presenting the task boxes in case of nonengagement were the same as baseline. During intervention sessions, the instructors rewarded points to the participants on a fixed-ratio reinforcement schedule (i.e., the token-production schedule) paired with behavior-specific praise for each task box (e.g., FR1 for folding towels; FR6 for sorting silverware; see Table 1). Whenever a participant earned a point, the instructor would say "You earned a point," click the avatar to reward one point, and the app would make a chiming sound. When 10 min had lapsed, the participants were given the opportunity to exchange their points to immediately receive the backup reinforcer (i.e., the exchange-production schedule). The instructor would show the participant their avatar that displayed their first name and how many points they had earned. The participant would then choose their backup reinforcer, the instructor would click on their avatar, click on "redeem points" and subtract the spent points. The avatar now had a new number of points. For example, Clint earned 15 points during the session, he wanted access to a cookie that cost 15 points. The instructor would click on Clint's avatar, click redeem points, subtract 15 points, and give Clint the cookie. Clint's avatar would now have the number 0 next to his name. For the purposes of the study, the participant started each session with zero points.

Some participants were able to finish all three task boxes before the 10 min had concluded. When this occurred, the session ended, and the participant was given the opportunity to exchange their points at that time.

Maintenance

Three maintenance sessions were conducted after stability was observed in the participants' data. Three maintenance sessions occurred 2–8 weeks after the final intervention session. Maintenance sessions were identical to intervention sessions.

Experimental Design

We used two consecutive concurrent multiple probe across participants designs to evaluate the effects of the app-based token economy on task engagement. We divided participants into two groups of three based on concurrent availability: Clint, Stephen, and Bruce were placed in the first multiple probe design, and Peter, Tony, and Nick were placed in the second group. We conducted a minimum of five baseline sessions for the first tier of each design, a minimum of eight for the second tier, and at least nine for the third tier. We conducted at least five intervention sessions for each participant and continued running intervention sessions until the first two authors agreed that the data were sufficiently stable based on visual analysis. When visual analysis indicated stable data for five consecutive sessions, Clint and Peter started the intervention phase while the other four participants remained in baseline. The same decision process was used for initiating intervention with Stephen and Tony, and finally Bruce and Nick.

Procedural Fidelity

To assess procedural fidelity, the first author created a checklist based on the steps required to implement the procedure (data sheet available upon request). Fidelity was assessed using a checklist divided into 1-min intervals for the instructor following the prompting procedures, a task box being removed, and another task box being presented (when necessary), and points being given on the appropriate reinforcement schedule. Before the instructor started the 10-min timer, fidelity was collected to evaluate if the instructor presented three task boxes, modeled the task when appropriate, presented appropriate instructions (i.e., complete these tasks within 10 min), started the timer after presenting the instructions, and stopped the timer after 10 min and ended the session. Procedural fidelity data were collected for at least the first five sessions or until the data were stable and high implementation fidelity was reached. Thereafter, procedural fidelity was assessed and coded for 30% of sessions across each phase (i.e., baseline, intervention, and maintenance). Procedural fidelity for Bruce was 97%, 97% for Peter, 98% for Stephen, 100% for Tony, 98% for Nick, and 94% for Bruce.

Social Validity

To assess the social validity of the intervention, the first and second authors developed a survey on Qualtrics. To ensure anonymity and increase the likelihood of honest responses from the instructors, the survey did not ask for any demographic information. The survey asked instructors to rate on a 1–5 (strongly disagree to strongly agree) scale whether they found the dependent variable (i.e., independent engagement) to be an important behavior to focus on, if the intervention was effective, if they would use a token economy in the future, if the app made it easier to implement the token economy, if the participants benefited from the intervention, and if they needed more support. In addition, we asked them to rate the training on a scale from 1 to 5 (i.e., very unhelpful to very helpful) and rate the ease of implementation on a

scale from 1 to 5 (i.e., very easy to very difficult). We asked them to compare using an app-based versus a traditional token economy on a scale from 1 to 5 (i.e., much easier to much more difficult) and how likely they would be to use the app again (1 = very likely to 5 = very unlikely). We asked four open-ended questions: what they liked about the token economy intervention using ClassDojo, what they disliked about the token economy intervention, what they would change about the intervention, and, finally, to share any additional comments about it.

Results

All participants displayed relatively low levels of engagement with ADL and vocational skills during baseline, with increased engagement following the introduction of the independent variable, thus demonstrating a functional relationship (see Figs. 1 and 2). Note that Figs. 1 and 2 contain occasional gaps in the calendar time when data were collected due to the center being closed for COVID, spring break, or when participants were absent for personal reasons. We included the calendar dates on the abscissa to increase transparency regarding the relative and absolute timing of sessions in the concurrent multiple baseline design.

Clint

During baseline, Clint's level of engagement averaged 19% (*SD* = 12%; see Fig. 1). Following the introduction of the token economy, visual analysis indicated an increase in his engagement starting with the second session of intervention (*M* = 55%, *SD* = 18%). During the intervention phase, the classroom moved to a new building, which coincided with a decrease in Clint's engagement. A new preference assessment was conducted, and following the introduction of new reinforcers, Clint's engagement increased and remained above baseline levels. Clint was engaged, on average, during 56% (*SD* = 13%) of intervals during maintenance probes.

Stephen

During baseline, Stephen's level of engagement averaged 23% (*SD* = 11%) of intervals (see Fig. 1). Following the introduction of the token economy, an immediate increase in Stephen's engagement was apparent through visual analysis (*M* = 58%, *SD* = 18%). There was a slight decrease in engagement following the move to a new building, which was immediately followed by an increase. During maintenance, Stephen's engagement was of 53% in each session.

Bruce

During baseline, Bruce's level of engagement averaged 44% (*SD* = 16%; see Fig. 1). Bruce had a sudden spike in engagement (20% to 70%) during baseline due to accidental reinforcement from another instructor. Immediately before the session, the instructor told Bruce that he could have access to a highly preferred reinforcer if he worked hard with the experimenter. However, Bruce's engagement decreased in subsequent baseline sessions in which this contingency was not stated. After the token economy was introduced, an immediate increase in Bruce's engagement was apparent through visual analysis (*M* = 79%, *SD* = 19%) and averaged around 80% (*SD* = 25%) during maintenance probes.

Peter

Peter's engagement during baseline averaged 31% (*SD* = 7%) of intervals (see Fig. 2). Following the introduction of the token economy, visual analysis indicated an increase in his engagement to an average of 51% (*SD* = 15%). On April 5, 2021, Peter engaged in multiple self-injurious behaviors, and the session ended early. Because Peter engaged in SIB almost immediately following the introduction of the task, no data were collected for that session. During maintenance, Peter's engagement averaged 57% of intervals (*SD* = 9%).

Tony

During baseline, Tony's engagement averaged 34% (*SD* = 19%) of intervals (see Fig. 2). Following the introduction of the token economy, visual analysis indicated that Tony's engagement increased to an average of 65% (*SD* = 18%). During maintenance, Tony's engagement was an average of 72% (*SD* = 1%).

Nick

During baseline, Nick's level of engagement averaged 34% (*SD* = 12%; see Fig. 2). Following the introduction of the token economy, visual analysis indicated an increase in his engagement to an average of 73% (*SD* = 9%). Nick's engagement remained above baseline during maintenance and averaged 39% (*SD* = 1%).

Social Validity

All seven instructors responded to the social validity survey (100% participation; full survey available upon request; see Supplemental Material Table S1). Five instructors strongly agreed that independent engagement was an important behavior to focus on and two instructors agreed it was important (*M* = 4.71, *SD* = 0.45). Instructors were asked if they

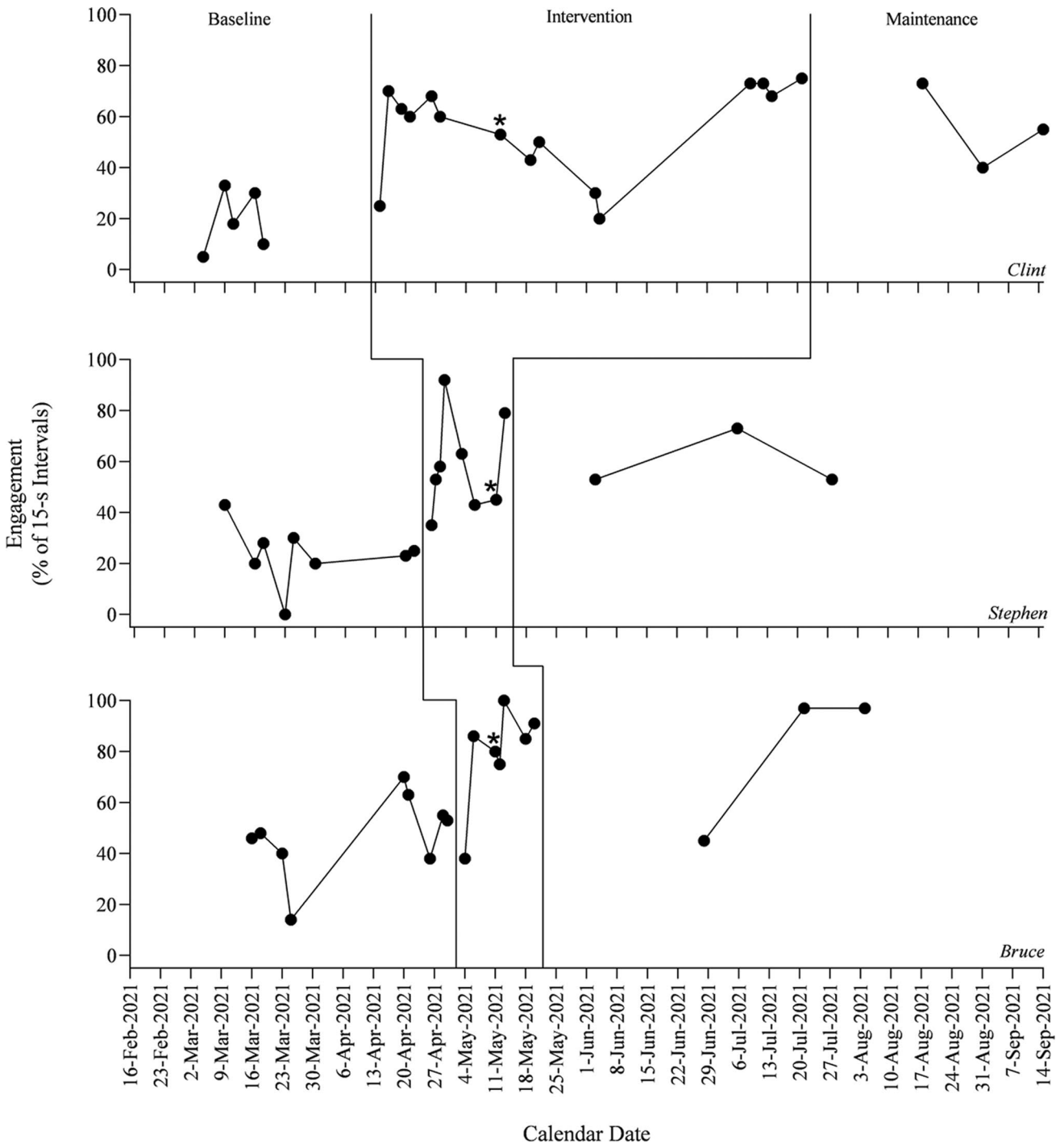

Fig. 1 Percentage of Engagement for Clint, Stephen, and Bruce. *Note*. The asterisk indicates change of study location, which occurred simultaneously for all participants

thought the intervention was effective and two did not think it was effective, two were neutral, one thought it was effective, and two thought it was very effective ($M = 3.43$, $SD = 1.18$). Four instructors indicated they would use a token economy in the future, two were very likely, and one was neutral on using a token economy ($M = 4.14$, $SD = 0.64$). When asked if the Class Dojo app made it easier to implement the token economy, one instructor strongly disagreed, two disagreed, one was neutral, and three agreed ($M = 2.86$, $SD = 1.12$). Instructors were asked if they thought the participants benefitted from the intervention one disagreed, two were neutral, and four agreed that participants benefitted (*M*

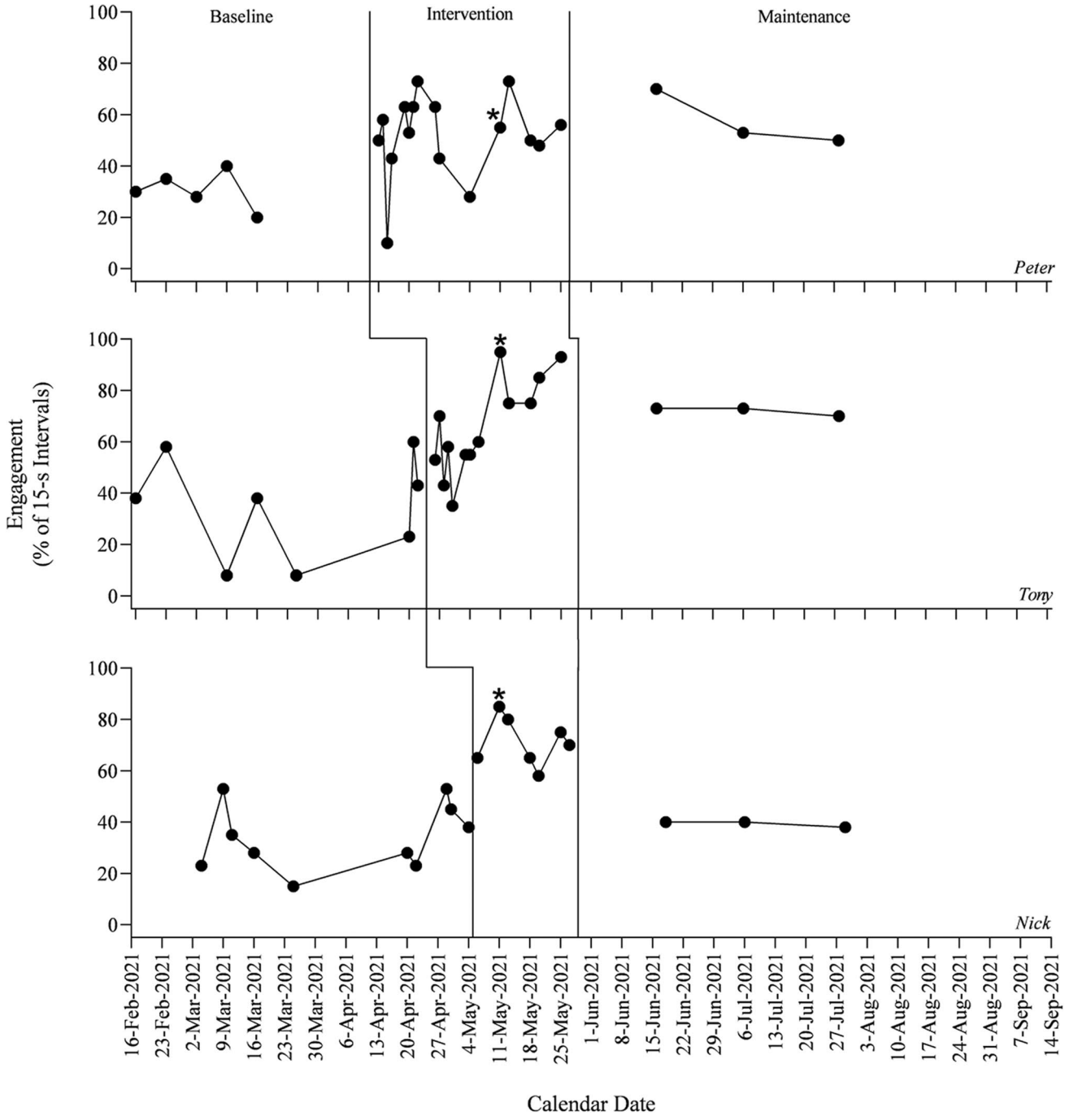

Fig. 2 Percentage of Engagement for Peter, Tony, and Nick. *Note.* The asterisk indicates change of study location, which occurred simultaneously for all participants

= 3.43, *SD* = 0.73). We also asked if the instructors needed more support and two did not think they needed more support, two were neutral, and three wanted more support (*M* = 3.14, *SD* = 0.83).

Two instructors found the intervention training neither helpful or unhelpful, four found it mostly helpful, and one found it very helpful. Two instructors found the token economy intervention difficult to implement, four stated it was mostly easy, and one indicated that it was very easy to implement. When asked if Class Dojo made it easier or more difficult than using traditional tokens, three instructors stated it was more difficult, two were neutral, and two thought it was mostly easier (*M* = 3.86, *SD* = 0.64). Two instructors said they were somewhat unlikely to use Class Dojo to

implement a token economy in the future, one was neutral, three were somewhat likely, and one instructors was very likely to use the app in the future ($M = 3.43$, $SD = 1.05$).

Following the survey questions, we asked three open-ended questions: (1) What did you like about the token economy intervention using Class Dojo?; (2) What did you dislike about the token economy intervention using Class Dojo?; and (3) What would you change about the token economy intervention? Five instructors indicated that the intervention was time-consuming and overwhelming. One instructor stated, "It seemed like a lot of work on the instructor to redeem points in large groups." Another one stated, "[The token economy] can be overwhelming with several consumers simultaneously, some did not understand the contingency."

In addition, four instructors stated that the app was difficult to use. One noted, "the system was clunky and difficult to implement," and two other instructors mentioned that ClassDojo frequently did not sync across devices, making it difficult to know how many points a consumer had. Another instructor stated that giving out points constantly seemed to distract the participants and take away from the lesson. One respondent suggested that it would be beneficial to find a way to make it easier to give out and redeem points to reduce the amount of time spent.

Finally, instructors commented on the use of task boxes to teach vocational and daily living tasks. One stated, "[The intervention] was kind of stale and remained mostly around task boxes." Another mentioned, "Switching out or adding novel task boxes would have been beneficial as I think some of our learners mastered all tasks quickly."

On a more positive note, the instructors also stated that they thought the token economy "helped motivate consumers" and it "provided quick and immediate reinforcement throughout the work session." One instructor mentioned that they liked that all the participants were on one app and "it was much easier to give every learner a token simultaneously."

Discussion

The purpose of the current study was to evaluate the effectiveness and feasibility of using an app-based token economy system to increase engagement in ADL and vocational tasks. In this study, six adults with disabilities were tasked with completing ADLs (e.g., matching and folding socks) and vocational tasks (e.g., sorting silverware). Each participant received points through a software application (i.e., ClassDojo) for independently engaging in the relevant tasks. All six participants increased their engagement in the tasks following the introduction of the intervention (i.e., the token economy). All of the participants maintained higher than baseline engagement levels during maintenance probes, and three out of six participants had higher levels of engagement during maintenance than during intervention sessions. Based on visual analysis, these data indicate that the app-based token economy effectively increased independent engagement in vocational and ADL tasks.

Previous research suggests that when tokens are systematically paired with highly preferred backup reinforcers, they may come to function as generalized conditioned reinforcers (Russell et al., 2018). Although we did not systematically evaluate whether the tokens in the current study functioned as generalized conditioned reinforcers, it is possible that the conditioning procedure contributed to the success of the system in increasing task engagement. In addition, the staff members ensured the participants had the necessary skills to complete the tasks before reinforcing independent engagement with the activity. These aspects of the intervention, in addition to using highly preferred backup reinforcers and training staff to implement the token economy may have contributed to the effectiveness of the intervention. This is consistent with general recommendations for implementing token economies (e.g., Cooper et al., 2020).

It should be noted that the ClassDojo application produced a distinctive "ding" sound when a point was rewarded. It is possible that this sound also became a generalized conditioned reinforcer that contributed to the effectiveness of the intervention. This may be especially beneficial to individuals with visual impairments. Indeed, Bruce would hear the app "ding" when others received points and commented that people were getting points.

The findings from this study are similar to Krentz et al. (2016), May et al. (2021), and Nastasi et al. (2020). In all three studies, the majority of the adult participants with disabilities increased their physical activity or improved their health choices (i.e., chose water over soda) following the implementation of a token economy. These results suggest that token economies are a viable option in increasing appropriate behavior in adults with disabilities.

Despite the success of the intervention, instructor social validity results indicate that the procedure may need to be refined to improve implementation fidelity and increase the likelihood that the intervention will survive within the setting (Welsh et al., 1994). The social validity results suggested that the staff might not continue implementing the token economy unless changes are made to the software application and other aspects of the intervention. Given the positive effects of the intervention on task engagement, this would be unfortunate. Some instructors stated that the app (i.e., ClassDojo) was challenging to use and time-consuming. This finding contradicts the results in Lynne et al. (2017) and Krach et al. (2017). The results from both studies indicated that ClassDojo made behavior management systems (i.e., Good Behavior Game and behavioral management charts) easier to implement,

and the teachers preferred the app-based interventions. During the intervention, instructors were tasked with rewarding points and then immediately providing the backup reinforcer to the participants as they redeemed their points. It is possible that if the time between rewarding the points and providing the backup reinforcer was extended, the instructors would not have found the intervention as time-consuming. Future studies may want to examine using the Class Dojo token economy with delayed access to the backup reinforcer. In addition, because we used fixed-ratio schedules in this study, the instructors had to continuously observe the participants' behavior during sessions in order to deliver points following the specified number of responses. This can be effortful, but research has shown that momentary differential reinforcement schedules, in which instructors "check in" during fixed or variable intervals and deliver reinforcers contingent on momentary engagement or response products, can also be effective in maintaining task engagement (e.g., Jessel et al., 2017). Future research could evaluate the use of such schedules in the context of an app-based token economy.

In addition, the current results are inconsistent with the recommendations of Robacker et al. (2016), who suggested that ClassDojo could increase the feasibility of a token economy intervention. However, it should be noted that in the current study, the staff members did not have a direct comparison with traditional (i.e., non-app-based) token economies nor other reinforcement systems within that setting. Therefore, their comments might reflect the difficulty inherent in implementing any new system when added to their already busy schedules. Non-app-based token economy systems require the same process as an app-based token economy for effective implementation. They may be even more difficult to implement than the app-based token economy we used in this study. Nevertheless, based on the comments from the survey, the app design may benefit from some adjustments to make it more user-friendly. For example, modifications could be made to make it easier to give and redeem points for multiple participants at a time and ensure the app updates across devices rapidly. In addition, more extensive training and supervision might have made implementation easier, which could have resulted in more confidence in the app-based token economy system. Despite the mixed findings of the social validity survey, some of the instructors anecdotally reported that after the study was over, they used the token economy system to increase participation in answering questions during group activities and completing fine and gross motor activities (e.g., painting and exercise). The instructors mentioned that extending the token economy seemed helpful because the participants were able to contact the contingencies more frequently. Although anecdotal reports indicate that the instructors were still using the token economy, the social validity results suggest that more work remains to be done for the intervention to be sustainable. Therefore, more research is needed to evaluate if the intervention can be altered to meet both the instructors' and the participants' needs.

The findings should be considered in light of the following limitations. First, we did not systematically evaluate if the points functioned as conditioned or generalized reinforcers. However, it has been shown by previous research that conditioning procedures, similar to the ones used in the current study, typically result in points functioning as conditioned and generalized reinforcers (Hackenberg, 2018; Russell et al., 2018). Second, there were several schedule changes and a significant relocation that occurred during the intervention. It is difficult to know how these changes affected the participants' engagement, but the experimental design did not reveal any lasting changes as a result of these events. Third, behavior-specific praise and the token economy were introduced simultaneously. We made this decision based on recommendations in the literature (Cooper et al., 2020). However, it is possible that engagement would have increased by only using behavior-specific praise. Fourth, we did not set formal mastery criteria before transitioning from one condition to another. Because the participants differed substantially in their abilities, it was difficult to determine ahead of time what would be an optimal level of engagement for each individual. Therefore, we evaluated each participant's level, trend, and variability and ended intervention when sufficient stability was obtained. Fifth, we did not collect generalization probes to assess whether or not the token economy increased engagement across different activities or settings. Finally, we used only fixed ratio-schedules during the intervention, which increases the risk of pausing and challenging behavior with increasing ratio values (Glodowski et al., 2020). Given the relatively low ratios used in the current study (i.e., FR1 to FR6), this may not have been a likely outcome. Nevertheless, future studies should consider programming token delivery using variable ratio schedules.

Despite the limitations listed above, this study demonstrates the effectiveness of using a token economy as one intervention component to increase independent engagement in adults with disabilities. In addition, this study contributes to the literature by assessing if a token economy increases engagement in completing vocational and ADL tasks, the social validity of the token economy, and if the effects of the intervention were maintained. As previously noted, employment outcomes for individuals with disabilities are poor and it is important to increase engagement with vocational and daily living tasks. Family members of individuals with disabilities express concern over their son or daughter's ability to perform daily living skills (e.g., folding and putting away clothes, sorting silverware) and vocational skills (i.e., work-related tasks; Jacobson et al., 1980; Gotham et al., 2015). In addition, these skills are necessary for individuals to obtain and maintain employment. The low levels of employment for this population were

already noted in the introduction, and difficulties performing vocational tasks frequently deter employers from hiring individuals with disabilities (Taylor et al., 2015). As such, it is imperative that staff members implement effective systems that increase daily living and vocational skill acquisition. Future studies may want to evaluate a token economy using a more diverse adult population, a different token delivery system, and examine effects on other behaviors. In addition, future studies could examine if increased engagement leads to increased skill acquisition, resulting in a higher level of independence in adults with disabilities.

Token economies are an evidence-based practice that improves behavior across participants (Soares et al., 2016); however, it can be challenging to implement token economies with high integrity (Ivy et al., 2017). In addition, little is known about the social validity of token economies, and the current results demonstrate the importance of studying this aspect more thoroughly. Thus, it is imperative to evaluate feasible and effective delivery methods for a token economy. Our results suggest that an app-based token economy results in increased engagement in adults with disabilities, but it should be emphasized that additional intervention components are needed in a comprehensive approach to vocational and adaptive skills training for this population (e.g., behavioral skills training, effective prompting and prompt fading procedures, consideration of individual choice and preference, and so on). Despite the promising results of the current study, some instructors expressed hesitancy to continue the intervention because using the app was challenging. Therefore, more research is needed to evaluate ways to facilitate the implementation of token economies in various contexts.

Declarations

Ethics Approval All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional review board of the University of Virginia.

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

Conflict of Interest On behalf of all authors, the corresponding author states there is no conflict of interest.

References

Alter, P. (2012). Helping students with emotional and behavioral disorders solve mathematics word problems. *Preventing School Failure: Alternative Education for Children and Youth, 56*(1), 55–64. https://doi.org/10.1080/1045988X.2011.565283

Ayllon, T., Layman, D., & Kandel, H. J. (1975). A behavioral-educational alternative to drug control of hyperactive children. *Journal of Applied Behavior Analysis*, 8(2), 137–146. https://doi.org/10.1901/jaba.1975.8-137

Bradley, R., Doolittle, J., & Bartolotta, R. (2008). Building on the data and adding to the discussion: The experiences and outcomes of students with emotional disturbance. *Journal of Behavioral Education, 17*(1), 4–23. https://doi.org/10.1007/s10864-007-9058-6

Carnett, A., Raulston, T., Lang, R., Tostanoski, A., Lee, A., Sigafoos, J., & Machalicek, W. (2014). Effects of a perseverative interest-based token economy on challenging and on-task behavior in a child with autism. *Journal of Behavioral Education, 23*(3), 368–377. https://doi.org/10.1007/s10864-014-9195-7

Cetin, H., & Cetin, I. (2018). Views of middle school students about ClassDojo education technology. *Acta Didactica Napocensia, 11*(3–4), 89–97. https://doi.org/10.24193/adn.11.3-4.7

Conine, D. E., Morris, S. L., Kronfli, F. R., Slanzi, C. M., Petronelli, A. K., Kalick, L., & Vollmer, T. R. (2021). Comparing the results of one-session, two-session, and three-session MSWO preference assessments. *Journal of Applied Behavior Analysis, 54*(2), 700–712. https://doi.org/10.1002/jaba.808

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis*. *Pearson.* 10.26741/abaespana/2020.cooper3e.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis.* Hoboken. NJ: Pearson.

Cumming, T. M. (2013). Mobile learning as a tool for students with emotional and behavioral disorders: Combining evidence-based practice with new technology. *Beyond Behavior, 23*(1), 23–29. https://doi.org/10.1177/107429561302300104

Drege, P., & Beare, P. L. (1991). The effect of a token reinforcement system with a time-out backup consequence on the classroom behavior of E/BD students. *BC Journal of Special Education, 15*(1), 39–46.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491–498. https://doi.org/10.1901/jaba.1992.25-491

Fiske, K. E., Isenhower, R. W., Bamond, M. J., Delmolino, L., Sloman, K. N., & LaRue, R. H. (2015). Assessing the value of token reinforcement for individuals with autism. *Journal of Applied Behavior Analysis, 48*(2), 448–453. https://doi.org/10.1002/jaba.207

Fiske, K. E., Isenhower, R. W., Bamond, M. J., & Lauderdale-Littin, S. (2020). An analysis of the value of token reinforcement using a multiple-schedule assessment. *Journal of Applied Behavior Analysis, 53*(1), 563–571. https://doi.org/10.1002/jaba.613

Friedemann, S., Baumbach, L., & Jantke, K. P. (2015). Textbook exercises into playful quests by using webble technology. CSEDU 2015, 7th International Conference On Computer Supported Education.

Glodowski, K. R., Bourret, J., Ivy, J. W., Seaver, J. P., Jackson, J., Stine, J. M., & Nuzzolilli, A. E. (2020). A comparison of token and tandem schedules of reinforcement on response patterns for adolescents with autism. *Behavioral Interventions, 35*, 25–37. https://doi.org/10.1002/bin.1704

Gotham, K., Marvin, A. R., Taylor, J. L., Warren, Z., Anderson, C. M., Law, P. A., Law, J. K., & Lipkin, P. H. (2015). Characterizing the daily life, needs, and priorities of adults with autism spectrum disorder from Interactive Autism Network data. *Autism, 19*(7), 794–804. https://doi.org/10.1177/1362361315583818

Hackenberg, T. D. (2018). Token reinforcement: Translational research and application. *Journal of Applied Behavior Analysis, 51*(2), 393–435. https://doi.org/10.1002/jaba.439

Hanley, G. P., Cammilleri, A. P., Tiger, J. H., & Ingvarsson, E. T. (2007). A method for describing preschoolers' activity preferences. *Journal of Applied Behavior Analysis, 40*, 603–618. https://doi.org/10.1901/jaba.2007.603-618

Hirsch, S. E., Macsuga-Gage, A., Park, F. K., & Dillon, S. (2016). A road map to systemically setting up a group contingency. *Beyond*

Behavior, 25(2), 21–29. https://doi.org/10.1177/107429561602500204

Hupp, S. D., & Reitman, D. (1999). Improving sports skills and sportsmanship in children diagnosed with attention-deficit/hyperactivity disorder. *Child & Family Behavior Therapy, 21*(3), 35–51. https://doi.org/10.1300/J019v21n03_03

Ivy, J. W., Meindl, J. N., Overley, E., & Robson, K. M. (2017). Token economy: A systematic review of procedural descriptions. *Behavior Modification, 41*(5), 708–737. https://doi.org/10.1177/0145445517699559

Jacobson, J. W., Tennov, D., & Vittucci, M. (1980). Token economies and unpredictable reward in family settings: A descriptive report. *Psychotherapy: Theory, Research & Practice*, 17(2), 220–226. https://doi.org/10.1037/h0085915

Jessel, J., Ingvarsson, E. T., Whipple, R., & Kirk, H. (2017). Increasing on-task behavior of an adolescent with autism using momentary differential reinforcement. *Behavioral Interventions, 32*, 248–254. https://doi.org/10.1002/bin.1480

Kahng, S., Ingvarsson, E. T., Quigg, A. M., Seckinger, K. E., Teichman, H. M., & Clay, C. J. (2021). Defining and measuring behavior. In W. W. Fisher, C. C. Piazza, & H. S. Roane (Eds.), *Handbook of applied behavior analysis* (2nd ed., pp. 135–154). Guilford Press.

Kazdin, A. E. (1982). The token economy: A decade later. *Journal of Applied Behavior Analysis, 15*(3), 431–445. https://doi.org/10.1901/jaba.1982.15-431

Kazdin, A. (2012). *The token economy: A review and evaluation*. Springer.

Krach, S. K., McCreery, M. P., & Rimel, H. (2017). Examining teachers' behavioral management charts: A comparison of ClassDojo and paper-pencil methods. *Contemporary School Psychology, 21*(3), 267–275. https://doi.org/10.1007/s40688-016-0111-0

Krentz, H., Miltenberger, R., & Valbuena, D. (2016). Using token reinforcement to increase walking for adults with intellectual disabilities. *Journal of Applied Behavior Analysis, 49*(4), 745–750. https://doi.org/10.1002/jaba.326

Lynne, S., Radley, K. C., Dart, E. H., Tingstrom, D. H., Barry, C. T., & Lum, J. D. K. (2017). Use of a technology-enhanced version of the good behavior game in an elementary school setting. *Psychology in the Schools, 54*(9), 1049–1063. https://doi.org/10.1002/pits.22043

Maclean-Blevins, A., & Muilenburg, L. (2013). *Using ClassDojo to support student self-regulation* (pp. 1684–1689). *EdMedia+ Innovate Learning*.

Maggin, D. M., Chafouleas, S. M., Goddard, K. M., & Johnson, A. H. (2011). A systematic evaluation of token economies as a classroom management tool for students with challenging behavior. *Journal of School Psychology, 49*(5), 529–554. https://doi.org/10.1016/j.jsp.2011.05.001

Matson, J. L., & Boisjoli, J. A. (2009). The token economy for children with intellectual disability and/or autism: A review. *Research in Developmental Disabilities, 30*(2), 240–248. https://doi.org/10.1016/j.ridd.2008.04.001

May, B. K., Britwum, K., & Nicol, G. E. (2021). Improving beverage choice in adults with developmental disabilities: Implementation of a token reinforcement system in a community residential setting. *Journal of Autism and Developmental Disorders*, 1–13.

McDonald, M. E., & Hemmes, N. S. (2003). Increases in social initiation toward an adolescent with autism: Reciprocity effects. *Research in Developmental Disabilities, 24*(6), 453–465. https://doi.org/10.1016/j.ridd.2003.04.001

Miltenberger, R. G. (2015). *Behavior modification: Principles and procedures*. Cengage Learning.

Nastasi, J. A., Sheppard, R. D., & Raiff, B. R. (2020). Token-economy-based contingency management increases daily steps in adults with developmental disabilities. *Behavioral Interventions, 35*(2), 315–324. https://doi.org/10.1002/bin.1711

Odom, S. L., Zercher, C., Li, S., Marquart, J. M., Sandall, S., & Brown, W. H. (2006). Social acceptance and rejection of preschool children with disabilities: A mixed-method analysis. *Journal of Educational Psychology, 98*(4), 807. https://doi.org/10.1037/0022-0663.98.4.807

Reitman, D., Murphy, M. A., Hupp, S. D., & O'Callaghan, P. M. (2004). Behavior change and perceptions of change: Evaluating the effectiveness of a token economy. *Child & Family Behavior Therapy, 26*(2), 17–36. https://doi.org/10.1300/J019v26n02_02

Robacker, C. M., Rivera, C. J., & Warren, S. H. (2016). A token economy made easy through ClassDojo. *Intervention in School & Clinic, 52*(1), 39–43. https://doi.org/10.1177/1053451216630279

Robinson, P. W., Newby, T. J., & Ganzell, S. L. (1981). A token system for a class of underachieving hyperactive children. *Journal of Applied Behavior Analysis, 14*(3), 307–315. https://doi.org/10.1901/jaba.1981.14-307

Russell, D., Ingvarsson, E. T., Haggar, J. L., & Jessel, J. (2018). Using progressive ratio schedules to evaluate tokens as generalized conditioned reinforcers. *Journal of Applied Behavior Analysis, 51*, 40–52. https://doi.org/10.1002/jaba.424

Shogren, K. A., Lang, R., Machalicek, W., Rispoli, M. J., & O'Reilly, M. (2011). Self-versus teacher management of behavior for elementary school students with Asperger syndrome: Impact on classroom behavior. *Journal of Positive Behavior Interventions, 13*(2), 87–96. https://doi.org/10.1177/1098300710384508

Singer, N. (2014). School tracking app won't keep data. *New York Times, B, 6*.

Soares, D. A., Harrison, J. R., Vannest, K. J., & McClelland, S. S. (2016). Effect size for token economy use in contemporary classroom settings: A meta-analysis of single-case research. *School Psychology Review, 45*(4), 379–399. https://doi.org/10.17105/SPR45-4.379-399

Taylor, J. L., Dove, D., Veenstra-VanderWeele, J., Sathe, N. A., McPheeters, M. L., Jerome, R. N., & Warren, Z. (2012). *Interventions for adolescents and young adults with autism spectrum disorders*. https://doi.org/10.1542/peds.2012-0682

Taylor, J. L., Henninger, N. A., & Mailick, M. R. (2015). Longitudinal patterns of employment and postsecondary education for adults with autism and average-range IQ. *Autism, 19*(7), 785–793. https://doi.org/10.1177/1362361315585643

Welsh, T. M., Miller, L. K., & Altus, D. E. (1994). Programming for survival: A meeting system that survives 8 years later. *Journal of Applied Behavior Analysis, 27*, 423–433. https://doi.org/10.1901/jaba.1994.27-423

Wolfe, B. D., Dattilo, J., & Gast, D. L. (2003). Effects of a token economy system within the context of cooperative games on social behaviors of adolescents with emotional and behavioral disorders. *Therapeutic Recreation Journal, 37*(2), 124.