Teaching an Adult With Autism Spectrum Disorder to Use an Activity Schedule During a Vocational Beekeeping Task

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Abstract

Recent federal legislation passed supports investment in sustainable green jobs. Beekeeping is one type of sustainable vocation. Activity schedules have shown effectiveness in increasing the independence of children with autism engaged in various tasks. This study investigated the effects of a treatment package consisting of an activity schedule plus contingent reinforcement on increasing the number of steps completed independently by an adult with autism employed at an apiary. The data demonstrate that the treatment package led to a higher percentage of steps completed correctly.

Keywords Vocational training · Activity schedules · Autism · Green jobs

Scientists in the field of applied behavior analysis have recommended that behavior analysts apply their attention to the field of sustainability (Chance & Heward, 2010). Recent federal legislation passed by the Obama administration also supports investment in sustainable green jobs (American Recovery & Reinvestment Act, 2009). Thus, there is a compelling rationale to increase training opportunities in sustainable green jobs. That is to say, behavior analysts should be encouraged to focus their attention on this green job market. An article published in the *International Journal of Green Economics* asserts that

as employment options arise to provide green goods and services, . . . those with disabilities should have equitable employment opportunities in this growth sector of the US economy. Therefore, a focused effort [by behavior analysts] to train and engage people with disabilities in the green economy will provide a greater opportunity to participate in this growing employment sector. (Bruyère & Filiberto, 2013, p. 1)

One green vocation is beekeeping. Beekeeping provides an alternative training setting to those traditionally available. For example, beekeeping takes place outdoors. Beekeeping is within a life sciences discipline and is rarely a vocational opportunity available to those individuals on the autism spectrum. Furthermore, restricted interests have been reported as a hallmark symptom of autism spectrum disorder (ASD). And finally, Hendricks (2010) suggests that for those with a specific, restricted interest, the appropriate job placement may produce successful employment outcomes, such as consistent employment and competitive pay. In cases in which insects and beekeeping are of high interest to individuals on the autism spectrum, a beekeeping vocation may increase their engagement and appeal to their strengths rather than their deficit areas. Finally, there are no known vocational training studies demonstrating the use of behavioral technology on beekeeping tasks. The purpose of the present study was to investigate the extent to which an activity schedule increased independent beekeeping-task completion in an adult with ASD.

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Method

Participant

The primary participant in this study, Joey, was a male diagnosed with ASD. At the time of this study, Joey worked as a beekeeper maintaining several hives in a cemetery in southeastern Pennsylvania. During two to

three 3-h shifts per week, Joey completed several beekeeping tasks with the support of a job coach.

Joey expressed a general interest in insects with a concentrated focus on bees. Joey preferred to discuss physiological similarities and differences across species of bees and the role of pheromones with his job coach. He had participated in the installation of bees into hives and hive observations for 3 years at the time of the study. However, these skills had not been completed accurately or independently. Joey had no history of using activity schedules prior to the study.

Setting and Materials

Two job coaches from the supported employment agency implemented treatment sessions, and two research assistants collected data. All sessions took place at an outdoor apiary (i.e., small cluster of 12 beehives) situated in a wooded area of a cemetery. The hives were wooden boxes of varying sizes, with the deep hive measuring 19 7/8 in. × 16 1/4 in. × 9 7/16 in. (50.48 cm × 41.28 cm × 23.97 cm) and the medium hive measuring 19 7/8 in. × 16 1/4 in. × 6 3/8 in. (50.48 cm × 41.28 cm × 16.19 cm). Inside the hive, 10 wooden frames, measuring either 17 3/4 in. × 9 1/8 in. (45.09 cm × 23.18 cm; deep hive frame) or 17 3/4 in. × 6 3/8 in. (45.09 cm × 16.19 cm; medium hive frame), housed approximately 30,000 honeybees and contained honey, larvae, and eggs.

Joey wore a beekeeping uniform composed of rubber knee-high boots, a zip-up jacket with elasticized wrists, a hat and veil that covered his entire head and neck, and heavy-duty gloves that reached up to the elbow. Joey used several beekeeping tools throughout his shift. A bee brush was used to brush bees from the frames when necessary. A hive tool, consisting of a plastic handle and a steel plate, was used to separate hive boxes and pry out frames from the hive. A wire hive-frame holder could be affixed to the side of a hive and held the frames once they were removed. Finally, Joey used a smoker that emitted smoke that would reduce the activity of the honeybees. The smoker was a canister within which materials could be burned, including newspaper, grass, and twigs. A bellows attached to the smoker generated smoke when pressed, which calmed bees and enabled the beekeepers to safely inspect the hive.

During treatment, the participant used a picture activity schedule. The activity schedule was composed of laminated pictures of each step in the task and was affixed to a whiteboard, measuring 36 in. × 24 in. (91.44 cm × 60.97 cm), by magnets. A whiteboard was chosen due to its durability and ability to withstand harsh conditions, including honey drippings, grass, and dirt. On the right side of the whiteboard, a box was drawn that was divided into 10 smaller, equally sized squares. Each square was labeled 1 through 10, corresponding

to each frame in the box. Round, blue magnets were placed on the bottom of the whiteboard, as well as a yellow break card.

Dependent Variable and Measure

The dependent variable was the completion of a beehive inspection according to the picture task analysis. The task analysis included steps such as individually removing the 10 frames from each hive and inspecting them on both sides to identify the queen bee, eggs, swarm patterns, and/or mites. The research assistant observed the primary job coach, an experienced beekeeper, completing the task and took photos of each component in order to create the activity schedule and to create the task analysis.

The dependent variable was summarized as the percentage of steps completed correctly and independently per session. Each session corresponded to inspection of one hive. The task analysis identified 11 steps to be completed for a successful hive inspection; 8 out of the 11 steps were composite steps, which were steps that were required to be completed for each of the 10 frames (i.e., smoke the bees, remove the frame). The remaining three steps included steps that were only required to be completed once per hive (i.e., remove the lid, replace the lid). Put together, a successful hive inspection consisted of 83 steps. During treatment, an additional step was added for the participant to mark off each of the 10 frames once completed, for a total of 93 steps. Responses were scored by an observer during sessions. The percentage of steps completed correctly and independently was calculated by dividing the number of steps by the total number of possible steps and multiplying that number by 100 to obtain a percentage. Experimenters used datasheets to record a + or a – for each step completed independently. Independent step completion was defined as completion in the absence of prompting (i.e., gestural, verbal, or manual) from the job coach and within 10 s of completion of the previous step or within 10 s of an initial direction to begin. The data sheets consisted of the steps required to complete a hive inspection, as well as columns representing each frame (10 columns in total).

Interobserver Agreement and Procedural Fidelity

Interobserver agreement (IOA) on the dependent measure was scored by two independent observers (i.e., the researchers) during 5% of sessions across both baseline and treatment conditions. IOA was calculated by dividing the total number of agreements by the sum of the agreements plus disagreements, which was then multiplied by 100. IOA data were a mean of 72.7% agreement across all sessions. Procedural fidelity was scored for 5% of sessions from a checklist of sequential tasks the researcher should complete in each session. The mean procedural integrity score was 100%.

Design and Procedure

This study was implemented as an A-B1-B2-A reversal design. Treatment included two variations, followed by a reversal to baseline.

Baseline During baseline, the activity schedule was not present. The job coach said, “It’s time to inspect a hive. You will get a break when you’re finished. I will not be able to speak to you until you are on a break. Let me know when you’re done.” No verbal praise was delivered for appropriate task completion, and no breaks were programmed into the sessions. If Joey took an unauthorized break (i.e., one not prompted by the job coach), the job coach gesturally prompted Joey to return to the hive.

Activity Schedule without Instruction This phase was identical to baseline with the exception of adding the activity schedule to the environment. No prompts were provided to assist the participant in using the activity schedule and/or following the steps. The purpose of this phase was to determine if presentation of the schedule alone, without teaching how to use the schedule, would result in acquisition of the task. Criteria to move onto teaching was three sessions with 80% accuracy or less.

Activity Schedule with Instruction Treatment sessions began with the job coach saying,

Follow the steps in the activity schedule to inspect a hive. You will get a break when you’re finished. I will not be able to speak to you until you are on a break. Let me know when you’re done.

On the first session of teaching, the job coach modeled how to refer to each step in the activity schedule, as well as how to cross off when a frame is finished. This was done by placing a blue magnet in one of the 10 small squares on the whiteboard. The job coach then said, “This is what you do when you’re done with a frame. Now you can see how many are left.”

If the participant did not initiate the first step of the schedule within 10 s of initial instruction or engaged in an incorrect response (e.g., started at a step other than the first step), the job coach initiated a least-to-most prompt hierarchy. First, he used a gestural (i.e., pointing) prompt to the first step depicted on the schedule. If the participant did not initiate the task within 10 s of being prompted to the step, the job coach guided the participant by the shoulders to the materials depicted in the first step. If a correct response did not follow, a manual prompt or additional gestural prompt was delivered specific to the step (e.g., a manual prompt to hold the frame horizontally for visual inspection, or an additional gestural prompt to indicate the location of the queen bee). If a correct response followed a

prompt, praise was withheld for that step. Verbal praise was delivered contingent upon steps that were completed independently (i.e., differential reinforcement). Attention was withheld from verbal statements of refusal, questions, or verbal initiations unrelated to the task of inspecting beehives with one exception: Per session, on the first instance of the participant requesting a break before the task is completed, the job coach said, “Once you have inspected this hive, you can take a break,” and pointed to the yellow break icon on the schedule. After this verbal prompt, all subsequent requests for a break or repetitive questions were redirected with a gestural prompt to the schedule and to the task materials. If the participant did not move the magnet over each frame after completion, the research assistant used a gestural prompt to redirect the participant to do so.

Results and Discussion

Figure 1 shows the percentage of steps completed in the beekeeping task during baseline, which ranged from 30% to 51% correct with a mean of 40% correct. During the activity schedule without instruction phase, treatment scores ranged from 20% to 29% correct with a mean of 23% correct. Although data in this phase suggest an upward trend, the overall level in the phase had a countertherapeutic change, which encouraged the authors to introduce instruction with the activity schedule, despite weakening experimental control. During the activity schedule with instruction phase, the percentage of steps completed correctly ranged from 49% to 87% with a mean of 70% correct. Once the activity schedule was removed and a return to baseline was implemented, the percentage of steps completed dropped to a range of 50%–52% correct and a mean of 51% correct. The percentage of nonoverlapping data points across baseline and treatment for the participant was 100%. The effect size across baseline and treatment was $r = .926$.

The participant consistently did not reach mastery criterion on Steps 6, 7, and 9 of the task analysis. These steps were (a) vertically pulling the frame out of the hive, (b) verbally identifying the presence or absence of the queen bee and egg cells on one side of the frame, and (c) verbally identifying the presence or absence of the queen bee and egg cells on the other side of the frame, respectively. The errors made on these steps prevented the participant from reaching 100% accuracy on the hive inspection task. The researchers hypothesized that the participant had difficulty discriminating the queen bee from other bees, as well as the presence of egg cells from the rest of the cells in the hive. This task was a complex discrimination of one single queen in a field of 100–1,500 honeybees and required conditional discrimination training that was beyond the scope of this study, as the beekeeping season came to an end due to a drop in temperature (i.e., below 65°F/18°C during the day) before the additional training could

Fig. 1 Percentage of steps completed accurately during each session. One session corresponds to one hive inspection

take place. Therefore, a return to baseline was implemented before the participant met the mastery criterion. The early drop in temperature also eliminated the possibility to reintroduce the treatment. Additionally, the time constraints limited the ability of the researchers to fade the contingent reinforcement schedule. Future research should consider the time constraints of seasonal green jobs when designing an experiment and ensure that time is available to provide further intervention (e.g., planning alternative training tasks for weather-prohibiting days), as well as use a reversal design in an A-B-A-B format to demonstrate experimental control.

This study extended the existing research in two ways. First, the literature supporting the use of activity schedules was extended to a young adult population, though it must be noted that the activity schedule was combined with contingent feedback and reinforcement, and the success of using an activity schedule alone was not demonstrated. As young adults with ASD struggle to maintain employment, and job coaches cannot provide continuous supervision of their clients for an indefinite amount of time, activity schedules may be used to increase independent task completion, even for complex tasks such as beekeeping. This may be particularly relevant in settings where high-tech solutions (video modeling) are not readily available or affordable. Second, this study extended the literature on vocational trainings for adults with ASD to a new employment sector: green jobs, and in particular beekeeping. The green job sector offers opportunities for job developers to carve individualized positions, a key component of supported employment. Presently, there is a paucity of research describing effective vocational training in these green jobs.

In addition to including sustainable (i.e., green) jobs when customizing employment, consideration of an individual's interests should be taken into account, as this can lead to more successful employment outcomes (Hendricks, 2010). In cases in which insects and beekeeping are of high interest, as was the case in the present study, providing empirically supported supports (i.e., activity schedules) can lead to an increase in task

completion. Increased task completion may produce additional opportunities for reinforcement, thus leading to preference for one's job and maintenance of competitive employment. Additionally, incorporation of a high-interest area may be conceptualized as selection of a high-preference activity. Incorporation of preference and preference assessments has high social validity and an abundance of support in the literature.

Many additional challenges arose from training in the natural environment. The weather frequently reached 90°F/32°C, a temperature at which beekeeping in full gear might lead to complications stemming from heat-related illnesses. The heat may have increased establishing operations for escape-maintained behavior, compromising task completion according to the task analysis. Additionally, sessions were often canceled due to extreme heat and humidity. For example, Joey was scheduled to work two to three times per week for 3 h per shift, though at times a week went by when no shifts were scheduled. The experimenters often incurred bee stings due to inconsistent availability of extra protective equipment for the researchers. As a result, a single beesting often required the researcher to walk away from the apiary to avoid additional stings (i.e., due to pheromone signal) and discontinue data collection, creating a unique challenge in obtaining sufficient and accurate data. This was especially true in the frequency of IOA and treatment integrity data. Data for IOA and treatment integrity were below the frequency considered adequate for research. Therefore, the reader should interpret the reliability of data collected on the dependent variable and the implementation of the independent variable with caution. Additionally, variability in the participant's performance, as represented in Fig. 1, could be explained by inconsistent reliability and treatment integrity data collection. Bee stings and uncomfortable heat may have also affected Joey's performance. In the future, researchers could investigate the effects of training in an analogue environment with beekeeping materials before generalizing to a natural setting.

This study offers practitioners a preliminary model for incorporating a learner's special interest area into a vocational task, specifically a task that promotes engagement (i.e., as measured by on-task behavior). Though previous researchers have called to incorporate one's interests when considering a vocational placement, this study is the first to specifically select a restricted, preservative interest, which is a hallmark diagnostic feature for individuals with autism, and incorporate that interest to produce sustained task engagement on a vocational task. Future researchers should implement a more rigorous experimental design, consider training in an analogue environment prior to generalizing to the natural environment, implement discrimination-training procedures to ensure that the participant is able to identify important hive features (queen bee and egg cells), and consider seasonal time constraints when incorporating activity schedules into complex, outdoor green jobs.

Compliance with Ethical Standards

Conflict of Interest Jessica Sances declares that she has no conflict of interest. Jessica Day-Watkins declares that she has no conflict of interest. James E. Connell declares that he has no conflict 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 from all individual participants included in the study.

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