Journal of Behavioral Education (2023) 32:64–75
https://doi.org/10.1007/s10864-021-09438-1

ORIGINAL PAPER

Emergent Entailed Analogical Reasoning of "Same," "Different," and "Opposite" in Children with Disabilities

Jordan Belisle[1] · **Dana Paliliunas**[1] · **Mark R. Dixon**[2]

Accepted: 27 March 2021 / Published online: 20 April 2021
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract
We sought to evaluate a set of procedures based on Relational Frame Theory in teaching children with disabilities to reason analogically using relations between the contextual cues "same," "opposite," and "different." Two children were first taught to respond to the relational cues using common pictures and were subsequently trained through an exemplar to correctly respond to analogies presented in an analogy matrix, based on the prior established relations. Two other children were exclusively trained to respond to analogies in the matrix without prior relational training. The children that received relational and analogy training could correctly respond analogically and the skill transferred to untrained analogies. Mastery was not observed in the control participants.

Keywords Analogy · RFT · PEAK · Disabilities

Introduction

Analogical reasoning requires an individual to respond to one set of events in terms of another set of unrelated events, based on a common relationship. For example, if a child has been previously taught that a solar system contains planets and that an atom contains electrons, the child may derive that a solar system is to planets in the same way that an atom is to electrons. Reasoning analogically is critical to

✉ Jordan Belisle
jbelisle@missouristate.edu

Dana Paliliunas
dana.paliliunas@missouristate.edu

Mark R. Dixon
mdixon@siu.edu

[1] Applied Behavior Analysis, Psychology Department, Missouri State University, Springfield, USA

[2] Southern Illinois University, Carbondale, USA

succeeding in educational settings (Vendetti et al., 2015), as well as in the development complex social behaviors such as argumentation, perception, prediction, and communication (Goswami, 1992).

Relational Frame Theory (RFT; Hayes et al., 2001) is an approach to complex language and cognitive development that describes analogical reasoning as an equivalence between relations in at least two relational networks (i.e., relations among relations; Stewart et al., 2002). For example, if an individual is taught that *Joe* is taller than *Susy*, the individual may derive that *Susy* is shorter than *Joe*, without direct instruction. The derived relation is described in RFT as a mutually entailed relationship between Susy and Joe. This is similar to "symmetry" within a stimulus equivalence model, except that the relations are not necessarily equivalent or "sameness." If a third person was included, such as Tom is shorter than Susy, the derived relationships among all three stimuli would described as combinatorially entailed. This is similar to "transitivity" within a stimulus equivalence model, except that not all relations are equivalent or "sameness." An analogy may therefore occur if the participant is subsequently told that *Susy* is to *Joe* as the *C.N. Tower* is to the *Empire State Building*, allowing for the derivation that the *C.N Tower* is taller than the *Empire State Building* and that the *Empire State Building* is shorter than the *C.N. Tower*.

This basic relational model has been used to explore the development of analogical reasoning in childhood (Carpentier et al., 2002, 2003) and the emergence of complex analogical structures required in solving intricate relational problems (Stewart, 2004). Studies conducted with typically developing children have shown that children can learn analogies at age 5, but that this skill may not emerge naturally until approximately age 9 (Carpentier et al., 2002), and this skill is likely delayed in children with developmental disabilities corresponding with other deficits in relational learning (Rehfledt & Barnes-Holmes, 2009). Thus, technologies are needed that promote the development of analogical reasoning when this pivotal skill does not emerge naturally.

In the present study, we sought to evaluate a set of procedures based on RFT to promote the emergence of analogical reasoning in young children with disabilities. Procedures were adapted from the PEAK Relational Training System (PEAK; Dixon, 2016), a language development curriculum designed for use with this population. Prior research has supported the procedures contained in PEAK in establishing several foundational relational skills, such as basic perspective taking (Belisle et al., 2016), naming (Dixon et al., 2016), and categorization (Dixon et al., 2016). Although the procedures described in the present study can be used in isolation, adapting the procedures from PEAK was intended to aid in clinical replication and in research.

Methods

Participants

Participants were four children between the ages of 5 and 7 with disabilities who attended a university ABA clinic in the Midwestern United States. John was a 6-year-old male with a diagnosis of autism, Eric was a 5-year-old male with a diagnosis of sensory processing disorder, Tom was a 7-year-old male with a diagnosis of autism, and Tucker was a 6-year-old male with a diagnosis of autism. Two of the participants, John and Eric, underwent relational training as well as exemplar analogy matrix training in the current study. The remaining two participants, Tom and Tucker, served as a control, undergoing analogy matrix training alone.

The clinic that all participants attended provided ABA-based language instruction for the participants based on advances in RFT and guided by all four modules in the PEAK system. The modules emphasize language learning through direct reinforcement (Dixon, 2014a), generalization (Dixon, 2014b), equivalence (Dixon, 2015), and relational learning (Dixon, 2016). The participants all attended the clinic 4h per week. Although the participants were actively receiving therapy guided by PEAK, none of the participants had prior exposure to the program used in the current study.

Several assessments were completed with the participants prior to the study to provide a metric of language and cognitive functioning to aid in replication in future research. The assessments included: the *PEAK-Direct Training Pre-Assessment (PEAK-DT-PA)*, *PEAK-Generalization Pre-Assessment (PEAK-G-PA)*, *PEAK-Equivalence Pre-Assessment (PEAK-E-PA)*, *PEAK-Transformation Pre-Assessment (PEAK-T-PA)*, and the *Wechsler Intelligence Test for Children— Fifth Edition (WISC-V)*. Each of the assessments was completed within two weeks, and up to a maximum of one month prior to the onset of the baseline phase in the study. The PEAK assessment battery, including each of the PEAK pre-assessments, provide criterion-referenced assessments of language abilities that are used to guide language development training, and each assessment corresponds to one of the four PEAK modules (see Dixon, Belisle, et al., in press, for a comprehensive overview of the assessments and supporting psychometric analyses). Assessment results for each of the participants are shown in Table 1 and demonstrate that the participants were a relatively homogenous sample. John demonstrated consistent scores with Tom and Eric demonstrated consistent scores with Tucker. Although IQ scores varied, these scores are scaled based on age, whereas the PEAK assessment battery is criterion-referenced assessments. Taken together, results suggested that participants had a well-established directly trained verbal behavior repertoire and could to demonstrate basic mutual and combinatorially entailed relations across several relational frame families. Finally, the *Challenging Behavior Index* (CBI; Dixon, 2017) was completed by assessors during the PEAK pre-assessments as a measure of the severity of challenging behavior and the probability that challenging behavior would reduce the validity of assessment results or therapeutic intervention. Results suggested that the participants did not engage in challenging behavior during the assessments.

Table 1 Participant scores on an assessment battery at the onset of the current study

Participant	Assessment	Total Score (%)
John	PEAK-Direct Training Pre-Assessment (PEAK-DT-PA)	56 (88%)
	PEAK-Generalization Pre-Assessment (PEAK-DT-PA)	32 (50%)
	PEAK-Equivalence Pre-Assessment (PEAK-DT-PA)	15 (31%)
	PEAK-Transformation Pre-Assessment (PEAK-DT-PA)	51 (27%)
	Wechsler Intelligence Scales for Children—V (WISC-V)	99
	Challenging Behavior Index (CBI)	0 (0%)
Eric	PEAK-Direct Training Pre-Assessment (PEAK-DT-PA)	63 (98%)
	PEAK-Generalization Pre-Assessment (PEAK-DT-PA)	54 (84%)
	PEAK-Equivalence Pre-Assessment (PEAK-DT-PA)	16 (33%)
	PEAK-Transformation Pre-Assessment (PEAK-DT-PA)	104 (54%)
	Wechsler Intelligence Scales for Children—V (WISC-V)	122
	Challenging Behavior Index (CBI)	11 (22%)
Tom	PEAK-Direct Training Pre-Assessment (PEAK-DT-PA)	57 (89%)
	PEAK-Generalization Pre-Assessment (PEAK-DT-PA)	33 (52%)
	PEAK-Equivalence Pre-Assessment (PEAK-DT-PA)	13 (27%)
	PEAK-Transformation Pre-Assessment (PEAK-DT-PA)	63 (32%)
	Wechsler Intelligence Scales for Children—V (WISC-V)	77
	Challenging Behavior Index (CBI)	4 (2%)
Tucker	PEAK-Direct Training Pre-Assessment (PEAK-DT-PA)	63 (98%)
	PEAK-Generalization Pre-Assessment (PEAK-DT-PA)	50 (78%)
	PEAK-Equivalence Pre-Assessment (PEAK-DT-PA)	29 (60%)
	PEAK-Transformation Pre-Assessment (PEAK-DT-PA)	106 (55%)
	Wechsler Intelligence Scales for Children—V (WISC-V)	105
	Challenging Behavior Index (CBI)	6 (12%)

Setting and Materials

The study was conducted at the clinic and in the same location as the participants regularly received ABA therapy. Therapy rooms contained two chairs, a table, and preferred items. Materials for the study were those specified in PEAK-Transformation module. The program emphasized derived comparative relational frames, and the transformation of stimulus function involved responding correctly to analogous stimulus arrangements in a matrix reasoning task.

Stimuli included in the program were pictures of related common objects and three analogical matrix reasoning grids. The pictures and stimulus coding conventions for pictures in the study are shown in Fig. 1. The letter denotes the stimulus property and the number denotes the stimulus class. A stimuli were pictures of common objects (e.g., a boy), B stimuli were different pictures that were functionally the same as A (e.g., a different boy; A is the same as B), C stimuli were different pictures that were functionally the opposite of A (e.g., a girl; A is the opposite of C), and D stimuli were different pictures that were functionally

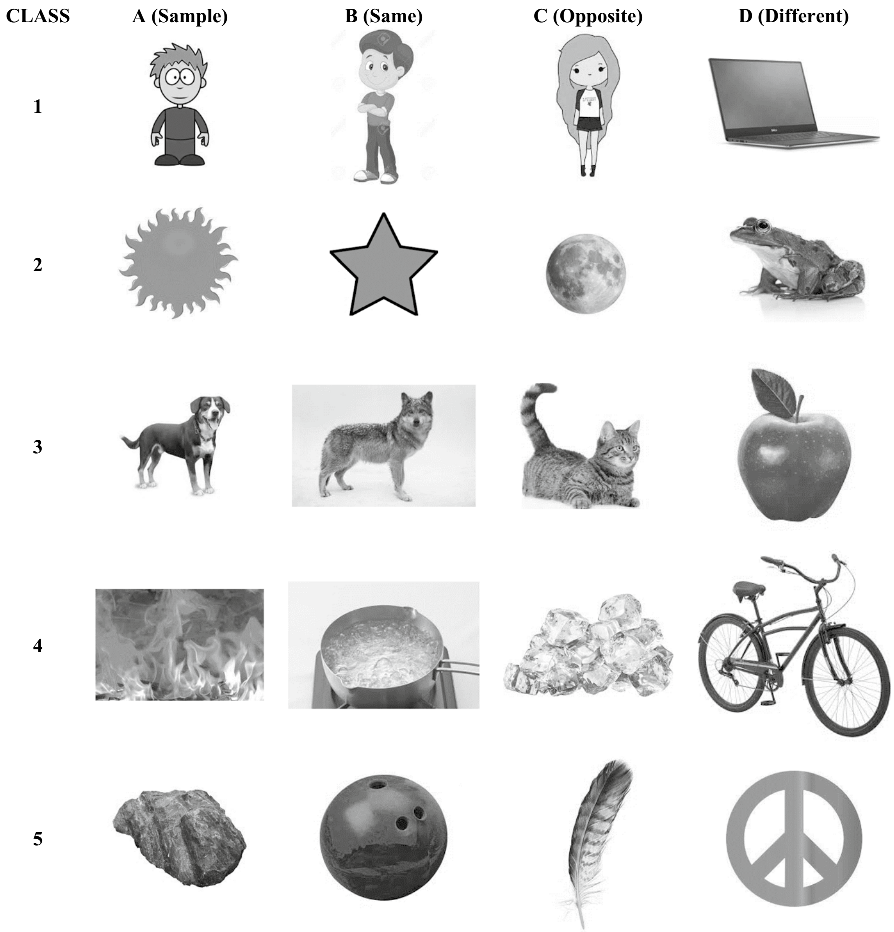

Fig. 1 Picture stimuli used in the study. Letters denote type of relation and numbers denote the class membership. Actual images were in color

different from A, B, and C (e.g., a marble; A is different from C). The analogy matrix reasoning grids are shown in Fig. 2. The top two cells contained images of shapes that were non-arbitrarily the same, opposite, and different. The bottom two panels were empty.

A token system was used with each of the participants, where 5 tokens could be exchanged for 5-min of break / access to preferred stimuli in the room. All participants had prior exposure to token systems. Examples of such stimuli that were regularly selected included: iPad, bubbles, toy cars, and putty.

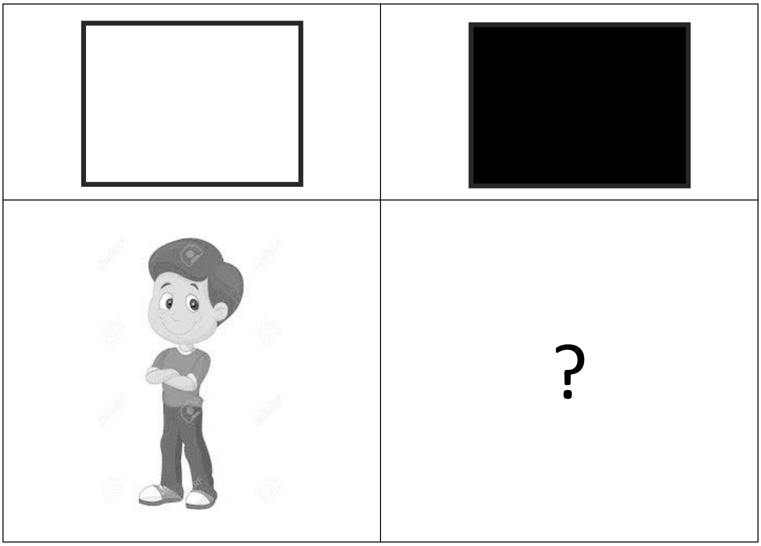

Fig. 2 Exemplar matrix grid. The upper left cell always contained a white square, and the upper left cell contained either a white square (same), a black square (opposite), or a blue circle (different)

Dependent Variables and Interobserver Agreement

There were four dependent variables recorded during the present study. Correct responding for same (A-B), opposite (A-C) and different (A-D) relations were reported as a percentage of correct responding within a 5-trial block (i.e., correct responses / 5, multiplied by 100). A correct response involved selecting the appropriate stimulus (B, C, or D) when presented with the corresponding A stimulus (A1, A2,…, A5) and the contextual cue *same* (A1-B1, A2-B2,…, A5-B5), *opposite* (A1-C1, A1-C2,…, A5-C5), or *different* (A1-D1, A2-D2,…, A5-D5). Correct responding for analogical reasoning was evaluated as a percentage of correct responding within a 15-trial block (i.e., correct responses / 15, multiplied by 100). A correct response involved selecting the appropriate stimulus (A, C, or D) when presented with the corresponding B stimulus (B1, B2,…, B5) and the non-arbitrary stimuli in the upper cells of the analogy matrix that was the same (B1-A1, B2-A2,…, B5-A5), different (B1-C1, B2-C2,…, B5-C5), or opposite (B1-D1, B2-D2,…, B5-D5). Therefore, correct responses for the same relation for analogical reasoning were mutually entailed (i.e., Train A = B; Test B = A), and correct responses for the opposite and different relations were combinatorially entailed (i.e., Train A = B, A = C, A = D; Test B = C, B = D). For all dependent variables, correct responding was calculated by dividing correct responses by total responses in a block, multiplied by 100. Interobserver agreement (IOA) was obtained for 46% of trials by having a second observer record correct and incorrect responses within a block. Calculating IOA involved dividing the number of agreements for each trial by the total number of trials, multiplied by 100. IOA was 100%.

Procedures

Non-Arbitrary Pre-Testing/Training

To ensure that the participants could identify the relationship between non-arbitrary stimuli presented in the upper cells of the matrix, a testing/training phase was conducted at the onset of the study with each participant. First, participants were presented with a white square and an array containing a white square, a black square, and a blue circle. The participants were asked to identify the "same," "opposite," or "different" shape from the array. Each contextual cue was presented twice within a 6-trial block. If participants scored above 80% (i.e., 5/6), then they progressed to the baseline phase. If participants did not achieve 80%, then trials were continuously presented randomizing the contextual cue until the participants demonstrated 12 consecutive correct responses. Then, another 6-trial block was conducted without reinforcement. All participants demonstrated 80% correct responding in one of the two testing phases, progressing to the baseline phase.

Baseline

All participants underwent a baseline phase that was extended for Tom and Tucker. The baseline phase involved testing of the same, different, and opposite relations. To test for the same relations, participants were presented with a sample A stimulus (e.g., A1) and three comparison stimuli (e.g., B1, C1, and D1). The experimenter then ran one finger across the three comparison stimuli, and said "Which of these…," then pointed to the sample stimulus, and said "… is the *same* as this?" The participant was given 5-s to respond, where a correct response involved touching the corresponding B stimulus. To test for opposite relations, the same sample and comparison stimuli were presented, and the same movements were made by the experimenter. The experimenter said, "Which of these… is the *opposite* of this?" where a correct response involved touching the corresponding C stimulus. Finally, the same stimuli and movements were used to test for different relations, and the experimenter said, "Which of these… is *different* from this?" where a correct response involved touching the corresponding D stimulus. All stimulus classes were presented once within each block, and the order of the stimuli was randomized. No prompts or tokens were delivered during the baseline phase. John was exposed to each relational type once, Eric was exposed to each relational type twice for replication of the baseline condition, and Tom and Tucker were exposed to each relational type on four occasions to test for stability. Additional A-D test blocks were conducted with Tucker to establish stability for this relation due to increasing levels of correct responding for A-D initially in the phase.

Analogical Matrix Testing (1)

Analogical matrix testing involved presenting the participants with either the same, different, or opposite non-arbitrary picture stimuli in the upper two cells of the analogy matrix. For each trial, participants were presented with one of the arrangements in the upper cells, a B stimulus as sample in the bottom left cell (e.g., B1), and three comparison stimuli below the matrix (e.g., A1, C1, and D1). The experimenter then pointed to the each of the upper cells in succession, and said "this is to this as…," then pointed at the bottom left cell, and said "…this is to what?" Again, the participant was given 5-s to demonstrate a correct response, where a correct response involved selecting the corresponding A, C, or D stimulus. In this phase, the progression of 5 same, 5 opposite, and 5 different trials was followed for each block, where the stimulus class presented within each set of 5 was randomized. Therefore, the block contained 15 trials. Again, no prompts or praise were delivered during this phase. This phase was conducted before- and after- relational training for John and Eric, and before- and after- exemplar analogy training for all four participants.

Same, Opposite, Different Relational Training

Relational training for the contextual cues *same, opposite,* and *different* was identical to the baseline phase, except that participants were provided reinforcement following each correct response (i.e., one token). If participants did not demonstrate the correct response within 5-s, the experimenter said, "Try again," and modeled the correct response. The participant was then required to demonstrate the correct response before progressing to the next trial in the block.

Exemplar Analogical Matrix Training (2)

Exemplar analogical matrix training was conducted to establish correct responding to the analogy task. Stimulus presentation and arrangement during this phase were identical to the Analogical Matrix Testing phase. The phase differed in that the experimenter began each trial by saying, "Look at the top row." In addition, correct responding to class 1 relations (B1-A1, B1-C1, B1-D1) were reinforced and incorrect responses were prompted using the same procedure as in the Relational Training phase. Reinforcement and prompts were not presented for any of the stimulus presentations contained in classes 2–5.

Mixed Analogical Matrix Testing (3)

The phase was identical to the Analogy Matrix Testing phase except that the stimulus presentation sequence was re-arranged to control for potential sequence effects. In this phase, the progression of class 1, class 2, class 3, class 4, and class 5 was followed, and the non-arbitrary pictures contained in the upper two cells were presented once and randomized within each of the 5 sets.

Results and Discussion

The present study sought to evaluate the efficacy of a set of procedures for promoting emergent mutually and combinatorially entailed analogical reasoning skills in children with disabilities. The results of the study are summarized in Fig. 3. A

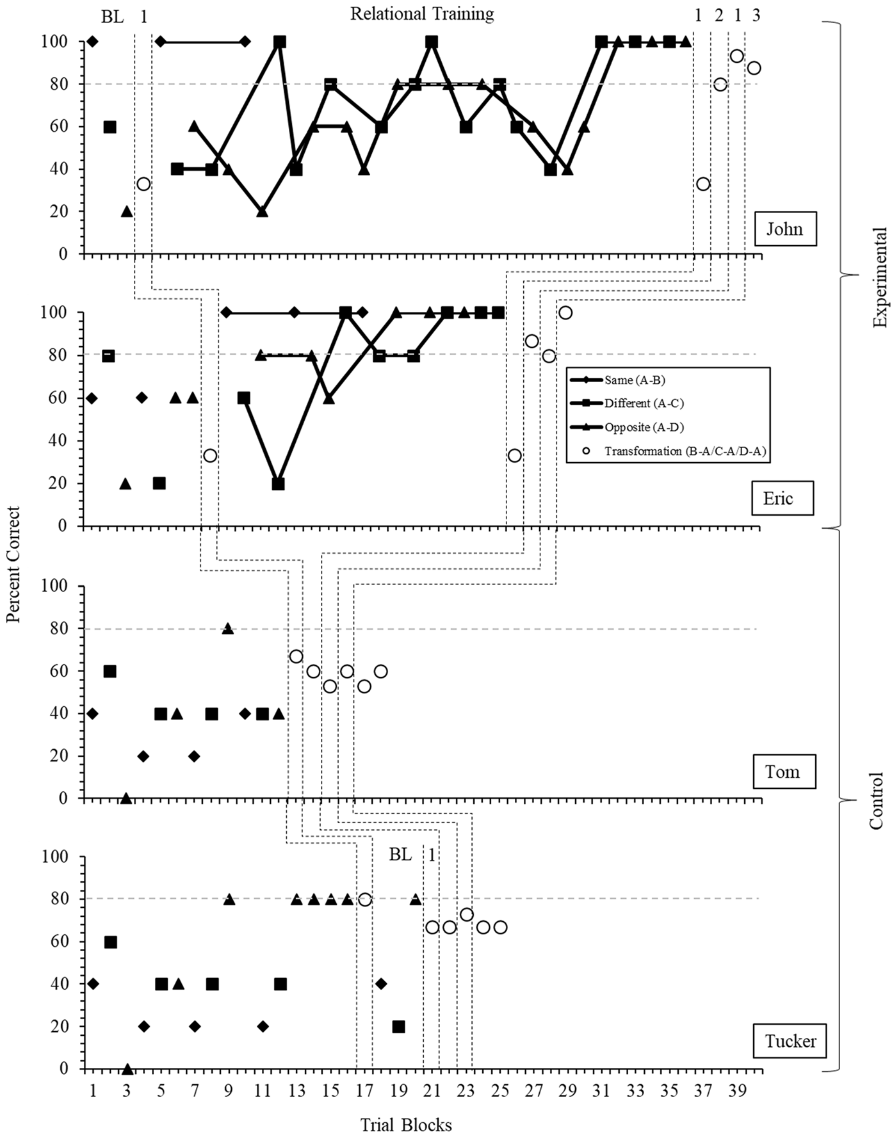

Fig. 3 Multiple baseline across subjects. Data points represent trial blocks, data paths indicate where training occurred, and the horizontal dashed line shows the mastery criterion of 80% correct responding. Phases were BL = Baseline, 1 = Analogical Matrix Testing, 2 = Exemplar Analogical Matrix Training, 3 = Mixed Analogical Matrix Testing. The control participants did not undergo relational training to establish the contextual relationships

mastery criterion of 80% correct responding was set for all trial blocks. Baseline results were varied across the four participants; however, 78% of the total baseline trial blocks produced scores below the mastery criterion. Each of the participants did demonstrate mastery of one type of relational response. John demonstrated mastery of the same relation, Eric demonstrates mastery of the different relation, and Tom and Tucker demonstrated mastery of the opposite relation. None of the participants demonstrated mastery of more than one relation in baseline, suggesting that they could not respond differentially in terms of the contextual cues *same, opposite,* and *different.* Analogical matrix testing was then conducted for each participant. John, Eric, and Tom responded below the mastery criterion, suggesting that these participants could not correctly respond analogically in this task. Tucker met the mastery criterion on the first matrix testing trial block. To determine if Tucker had acquired the relations, relational testing was reconducted, and the results suggested that he did not improve from the prior baseline phase across the three types of relations. Re-administration of the analogical matrix test suggested produced percent correct responding below the mastery criteria, suggesting that Tucker also could not demonstrate analogical reasoning.

In the relational training phase for John and Eric, both participants met the mastery criteria for all relations, and maintained correct responding of 100% across three consecutive trial blocks. Tom and Tucker did not undergo relational training. Analogical matrix testing conducted following relational training for John and Eric suggested that neither participant showed improvements in correct responding during this phase. In addition, neither Tome nor Tucker demonstrated greater correct responding in the re-administration of analogical matrix testing. In the exemplar analogical matrix training phase, John and Eric achieved the mastery criterion, suggesting that these participants were not only able to correctly identify the trained class 1 stimuli, but that this skill transferred to the remaining classes 2–5. Conversely, Tom and Tucker did not achieve the mastery criterion, demonstrating correct responding within 5% of the prior testing phase. The baseline phase was then replicated, where reinforcement and prompting were not provided for class 1, and results for John and Eric suggested that the skill maintained. Finally, the order of the stimuli was mixed in the mixed analogical matrix testing phase to control for sequence effects, and both participants remained above the mastery criterion. Throughout all subsequent analogical matrix testing phases, Tom and Tucker, who did not undergo relational training, also failed to achieve the mastery criterion.

Taken together, the results suggest that successful analogical reasoning in the matrix task used in the current investigation requires: (1) That participants can relate the same stimuli in different ways given established contextual cues (e.g., same, opposite, different) and (2) that participants can relate relations between two sets of stimuli. Beyond supporting the use of a technology in establishing both skills, the results support prior research evaluating how analogical reasoning develops in children from an RFT perspective (Carpentier et al., 2002, 2003). The matrix-reasoning task used in the current study is common in several tests of adaptive and intellectual functioning (e.g., WISC-V), highlighting the importance of analogical reasoning in problem solving and development (Goswami, 1992). The utility of an RFT approach is that analogical reasoning is not merely a product of neural pathways or cognitive models, rather is a skill repertoire that can be developed using behavioral scientific technologies. Consistent with this implication, exemplar training of only a single stimulus class for the analogical reasoning task may provide preliminary evidence suggesting that analogical reasoning, like other complex events described in RFT, may be a generalized higher-order form of operant behavior (Healy et al., 2000). That, multiple exemplar training can establish skills that are topographically boundless and can therefore be applied to any stimulus arrangement without direct instruction. Approaching complex problem-solving tasks as a generalized operant has been efficacious in teaching word-solving tasks (Dixon et al., 2018) and foundational perspective taking (Belisle et al., 2016), and the results reported here add to this growing body of the literature. Finally, by utilizing procedures from the PEAK curriculum, the results may be easily replicated by clinicians and researchers as part of a comprehensive language training curriculum for children with disabilities.

A limitation of the current findings is that relational training combined with analogical matrix training was only replicated across two participants. Therefore, future replications of the results are needed. Similarly, a lack of efficacy of the matrix training for the control participants may require further replication to improve certainty of this result. Because the present study establishes the technology in a controlled, multiple-baseline design, a more systematic group-design may be adequate to address this limitation. A second limitation is that treatment fidelity was not evaluated, potentially decreasing confidence that the procedures were implemented as intended. Procedures were, however, carried out by the authors of the current study, who have extensive experience with the procedures described in the PEAK system. We do not know the degree to which the same results would be obtained if individuals with less experience, such as direct care staff in a therapy setting. Finally, the experimental participants received additional training and reinforcement that could alternatively account for the results in the current study. Future research should address these limitations and extend upon the results presented here. One potential avenue for future research may involve training analogical reasoning in one context (e.g., analogy matrix) and testing for a transfer of function in another (e.g., vocal description). Such a demonstration would be required to support that analogical reasoning and more complex responses described in RFT are generalized operant behaviors that can be established in individuals with disabilities.

Funding The author(s) received no financial support for the research, authorship, and/or publication of this article.

Declarations

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

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

Informed Consent Informed consent was obtained from all participants prior to the present study.

References

Belisle, J., Dixon, M. R., Stanley, C., Munoz, B., & Daar, J. H. (2016). Teaching foundational perspective-taking skills to children with autism using the PEAK-T curriculum: Single-reversal "I-You" deictic frames. *Journal of Applied Behavior Analysis, 49*, 965–969. https://doi.org/10.1002/jaba.324.

Carpentier, F., Smeets, P. M., & Barnes-Holmes, D. (2002). Matching functionally same relations: Implications for equivalence-equivalence as a model for analogical reasoning. *The Psychological Record, 52*, 351–370.

Carpentier, F., Smeets, P. M., & Barnes-Holmes, D. (2003). Equivalence-equivalence as a model of analogy: Further analyses. *The Psychological Record, 53*, 349–371.

Dixon, M. R. (2014a). *The PEAK relational training system: Direct training module*. Shawnee Scientific Press.

Dixon, M. R. (2014b). *The PEAK relational training system: Generalization module*. Shawnee Scientific Press.

Dixon, M. R. (2015). *The PEAK relational training system: Equivalence module*. Shawnee Scientific Press.

Dixon, M. R. (2016). *The PEAK relational training system: Transformation module*. Shawnee Scientific Press.

Dixon, M. R. (2017). *Challenging Behavior Index*. Shawnee Scientific Press.

Dixon, M. R., Belisle, J., McKeel, A., Whiting, S., Speelman, R., Daar, J. H., & Rowsey, K. (in press). An internal and critical review of the PEAK Relational Training System for children with autism and related intellectual disabilities: 2014–2017. *The Behavior Analyst.*

Dixon, M. R., Belisle, J., Rowsey, K. E., Speelman, R., Stanley, C., & Kime, D. (2016c). Evaluating emergent naming relations through representational drawing in individuals with developmental disabilities using the PEAK-E curriculum. *Behavior Analysis: Research and Practice*. https://doi.org/10.1037/bar0000055.

Dixon, M. R., Belisle, J., Stanley, C., Speelman, R., Rowsey, K. E., & Daar, J. H. (2016d). Establishing derived categorical responding in children with disabilities using the PEAK-E curriculum. *Journal of Applied Behavior Analysis, 50*, 134–145. https://doi.org/10.1002/jaba.355.

Dixon, M. R., McCord, B. E., & Belisle, J. (2018). A demonstration of higher-order response class development in children. *Journal of Applied Behavior Analysis, 51*, 590–595. https://doi.org/10.1002/jaba.456.

Goswami, U. (1992). *Analogical reasoning in children*. . Psychology Press.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (Eds.). (2001). *Relational frame theory: A post-Skinnerian account of language and cognition*. . Plenum Press.

Healy, O., Barnes-Holmes, D., & Smeets, P. M. (2000). Derived relational responding as generalized operant behavior. *Journal of the Experimental Analysis of Behavior, 74*, 207–227. https://doi.org/10.1901/jeab.2000.74-207.

Rehfeldt, R. A., & Barnes-Holmes, D. (2009). *Derived relational responding: Applications for learning with autism and other developmental disabilities*. . New Harbinger Publications Inc.

Stewart, I., & Barnes-Holmes, D. (2004). Relational frame theory and analogical reasoning: Empirical investigations. *Revista Internacional de Psicología y Terapia Psicológica, 4*, 241–262.

Stewart, I., Barnes-Holmes, D., Roche, B., & Smeets, P. M. (2002). A functional-analytic model of analogy: A relational frame analysis. *Journal of the Experimental Analysis of Behavior, 78*, 375–396. https://doi.org/10.1901/jeab.2002.78-375.

Vendetti, M. S., Matlen, B. J., Richland, L. E., & Bunge, S. A. (2015). Analogical reasoning in the classroom: Insights from cognitive science. *Mind, Brain, and Education, 9*, 100–106. https://doi.org/10.1111/mbe.12080.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.