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Motivation and Attitude in a Computer-Aided Personalized System of Instruction Course on Discrete-Trials Teaching

Abstract

This study examined the differences in motivation levels and attitude valences produced by two different learning methods in a "mini-course" on discrete-trials teaching. One method was computer-aided personalized system of instruction (CAPSI) in combination with a discrete-trials teaching (DTT) self-instructional manual. The second method was the DTT manual alone. In addition, correlations between performance scores, motivation, and attitudes were explored. Participants were randomly assigned to one of the two conditions (CAPSI + DTT manual or DTT manual only). The main hypotheses tested were that: (a) participants using CAPSI + DTT manual would show higher levels of motivation and attitude valences compared to participants using only the DTT self-instructional manual, and (b) there would be positive correlations between the participants' overall performance, motivation level, and attitude valence. Predictions were partially supported: participants using CAPSI + DTT manual reported higher levels of motivation, whereas there was no significant difference in self-reporting of attitude. Furthermore, only the participants in the CAPSI condition demonstrated a significant positive correlation between performance scores, and motivation levels. These results aid in the confidence of using CAPSI as an effective and favourable teaching method for DTT.

Individuals today encounter a variety of different methods for knowledge uptake whether it is required for university courses or training for a job position. Both attitude valences (i.e., degree of positive or negative feeling) and motivation levels concerning those methods are of interest because such variables may ultimately influence performance (Sankaran & Bui, 2001; Sankaran, Sankaran, & Bui, 2000). For the purpose of this paper, motivation is defined as the self-reported general desire of an individual to perform well. Attitude valence is described as an individual's self-reported feeling about or evaluation of the learning method used in a particular course, in this case a "mini-course" on discrete-trials teaching (DTT).

The present study investigated how two different methods of knowledge uptake can affect a student's level of motivation and/or attitude valence, and whether either motivation or attitude would be related to students' overall performance in a "mini course" on DTT. These two learning methods were (a) a web-based online instructional method called computer-aided personalized system of instruction (CAPSI; Pear & Kinsner, 1988; Pear, Schnerch, Silva, Svenningsen, & Lambert, 2011) in combination with a self-instructional

manual on DTT, and (b) the DTT self-instructional manual alone. DTT is an effective and commonly used method in applied behavior analysis in early intensive behavioral intervention (EIBI) programs (Lovaas, 1987) for children with autism spectrum disorders (ASD). In this study participants learned how to conduct DTT sessions using CAPSI. There were two major questions in this study:

1. Will participants who learn using CAPSI with the DTT manual show higher levels of motivation and attitude valences compared to those using only the DTT manual?

2. Is there a correlation between the participants' overall performance, their motivation level, and their attitude valence?

Exploring these two questions may validate CAPSI as a more favourable and motivating learning method and thus the use of this instructional method as potentially producing higher performance scores. Given the rise in prevalence of ASD and government funded EIBI programs, there is an ongoing need for tutors and therapists to perform behavioural interventions (Fombonne, 2003; Jacobson & Mulick, 2000; Thomson, Martin, Arnal, Fazzio, & Yu, 2009). DTT training may be more accessible, convenient, and effective when using CAPSI as a learning method. In previous studies both CAPSI and the DTT manual have been demonstrated as effective learning methods (Fazzio, Martin, & Yu, 2009; Martin, Pear, & Martin, 2002a; Martin, Pear, & Martin, 2002b; Pear, 2002).

Computer-Aided Personalized System of Instruction

CAPSI, a computer-aided version of Keller's (1968) personalized system of instruction (PSI), has been used on various platforms since 1984. The basis of PSI involves students completing small units of material at a time and at their desired pace. CAPSI and PSI are both mastery-learning methods in which students must demonstrate mastery of a given unit before they're able to proceed to the next unit. PSI uses proctors who typically are students that have completed the course and have mastered the course material. A typical CAPSI course utilizes peer reviewers similar to the way that

PSI uses proctors. Peer reviewers are students in the same course as the students whose assignments they assess whereas proctors are students in a higher-level course. It should be noted that peer reviewers were not used in this study, so that the course was more like traditional PSI. PSI and other mastery-learning programs have been shown to have positive effects on students' performance (Kulik, Kulik, & Bangert-Drowns, 1990; Kulik, Kulik, & Cohen, 1979). In this study, participants used CAPSI to learn and apply the method of DTT.

DTT Self-Instructional Manual

The DTT manual is a self-instructional manual (Fazzio & Martin, 2011) designed as an early intensive behavioral intervention for children with ASD and other developmental disabilities. This method of teaching includes the instructor providing an instruction with a prompt for the child to respond, and then following the response with an immediate consequence. If the child makes an error, an error correction trial is applied in order to increase the likelihood of a correct response. Major components of DTT include: reinforcement procedures, prompt fading, breaking tasks into smaller parts, and requiring mastery of each task. The self-instructional component requires that the individuals' reading the manual teach themselves the procedures of DTT with help of detailed instructions and practice questions provided in the manual. In order to meet the high demand of trained individuals to perform behavioral interventions, research has been done to evaluate CAPSI as an appropriate training method for teaching DTT.

Motivation and Attitude Valence

Two core features of CAPSI, web-based instruction and mastery learning, have demonstrated relationships with motivation and attitude in students. Previous literature indicates that mastery learning is more likely to produce higher motivation levels in students compared to traditional learning methods (Ironsmith & Eppler, 2007), and that it ultimately results in positive effects on students' academic attitude and performance scores (Kulik et al., 1990). However, Sankaran and Bui (2001) demonstrate that not all students benefit from higher motivation

in web-based courses and show mixed attitude valences towards the learning method (Sankaran et al., 2000). In sum, mastery-learning methods tend to produce higher levels of motivation and attitude valences compared to traditional learning methods; however, findings in web-based courses are mixed.

It is important to measure what variables contribute to students' performance in courses because this allows us to create teaching strategies that enhance variables that are going to produce the most positive results in regards to students' performance. In the present study, if CAPSI is shown to enhance the motivation and attitude valences of participants completing the course on DTT, this will be specifically useful in several ways. First, it can lead to more individuals aspiring to receive training and jobs using procedures such as DTT. This is particularly important because of the ongoing need for more trained individuals to perform behavioural interventions. Second, because CAPSI is self-paced and online it is a more accessible, convenient, and low-cost training approach. Finally, more children with ASD and other developmental disabilities might be able to receive appropriate early behavioural interventions.

Method

This research investigated learning method (CAPSI + DTT manual or DTT manual alone) as the independent variable, and measures of motivation level and attitude valences as dependent variables. Levene's test of equality of variances was significant ($p < .05$) for motivation measures and insignificant for attitude valence. An independent-samples 2-tailed *t*-test was used in which self-ratings of motivation (unequal variances assumed) and attitude (equal variances assumed) were compared between learning methods. In addition, the Pearson correlation coefficient was used in exploring the relationship between performance levels, motivation, and attitude self-ratings.

Participants

Participants consisted of 42 students from the University of Manitoba, and interested individuals from around Winnipeg. The study was advertised though flyers posted at community centres and the University of Manitoba, newspaper and radio advertisements, a web advertisement on the St.Amant Centre website, and in-class presentations at the University of Manitoba. Prior to the start of the research, ethics approval was granted from the University of Manitoba Psychology/Sociology Research Ethics Board. Individuals who met the elimination criteria were those who already had access to the DTT manual or scored higher than 60% on the baseline assessment. The baseline assessment and post-test took place in assigned rooms at the University of Manitoba and St.Amant(see below). Before they were able to proceed in the project, participants signed a consent form agreeing that their results may be included in publications, reports, and talks without their identity being disclosed. A code was assigned to each participant so his or her identity was kept anonymous. The participants were made aware of when they were being recorded on video and that they could drop out of the study at any point.

Materials

Materials for use by the participants in the manual only condition consisted of a one-page summary of the DTT manual, brief instructions for the tasks participants were to engage in, three different data sheets (one for each task) allowing the participant to record relevant data from a role-playing confederate, picture flash cards to teach the tasks, edibles for reinforcement, a 65-page self-instructional manual on conducting DTT, blank paper, a pen, and a pencil. Materials for the participants in the manual + CAPSI condition consisted of the foregoing plus a computer in the experimental room the participants could access. Materials for use by the experimenter consisted of a camera to record application assessments, a DTT Evaluation Form (DTTEF; Babel, Martin, Fazzio, Arnal, & Thomson, 2008) to record the performance of the participants, and an evaluation questionnaire to administer to the participants that included self-rating measures of motivation, motivation change, and attitude valence. Motivation and motivation change, and attitude valence were each measured by a questionnaire which consisted of Likert scale-type questions, indicating the participant's motivation to perform well (1 = *very unmotivat-*

ed and 5 = *very motivated),* any change in motivation throughout the project (1 = *motivation decreased* and 5 = *motivation increased*), and the participants attitude valences (1 = *very poor* and 5 = *excellent*).

Experimental Design

The experimental design was a randomized groups comparison design consisting of two groups. The participants were randomly assigned to either the CAPSI + DTT manual condition (*n* = 20) or the DTT manual alone condition (*n* = 22).

Phase 1: Baseline

Participants in both conditions were then required to complete a pre-test in which they were tested through application exercises and a written knowledge test regarding their level of comprehension of DTT. Prior to the pre-test participants were provided with three sets of brief instructions on the DTT, one for each of the different application task, they then had a 10-minute period to review each of set of instructions. These basic tasks included identity matching, motor imitation, and pointing-to-named pictures. After reviewing the instructions they were required to complete the application test where they used DTT procedures on the three tasks to a confederate role-playing a child with autism. Each task included 12 trials, and for each trial the participant provided the confederate with a prompt to make a particular response, depending on the task at hand. The participant was given a score for each of the three tasks based on how many correct/incorrect moves they made. They were then asked to complete the written knowledge test on DTT, with a maximum of 60 minutes to complete it. This test included ten basic short answer questions on DTT, where the participant could receive a maximum score of 100.

Phase 2: Intervention

In the CAPSI condition participants studied the DTT manual, and mastered 11 unit assignments on CAPSI. They were required to master one unit (three questions with 100% accuracy) before moving to the next. Feedback from a trained research assistant was provided after each unit assignment. Participants in the manual condition received only the DTT manual, which includes a number of practice study questions, and no feedback was provided. Data was included from two sub studies where the only procedural differences were that study time was either supervised by a research assistant (*n* = 30), or study time was unsupervised (*n* = 12) and could be completed where and when the participant wanted. Both conditions were self-paced and participants were aware that they could end a study session at any time and continue at another time.

Phase 3: Post-Test

The post-test was similar to the pre-test or baseline. There were two different versions of the written test, one for each test the participant was required to complete over the course of the study (i.e., baseline and post-test), and each participant received the two versions in random order. Following the post-test, participants completed an evaluation questionnaire involving self-ratings of motivation, motivation change, and attitude valence. An overall averaged score for all four performance assessments (i.e., the written test and the application tests: pointing, matching, and imitation) was assigned to each participant. The difference between the averaged baseline score and the averaged post-test score was calculated and this represented the participants' overall performance score. Each test was administered using the same procedure. Copies of pre-test and post-test questions used in the written assessment are available upon request.

Inter-Observer Agreement (IOA) and Procedural Integrity (PI)

To ensure reliability of the application tests the following steps were taken. The confederates followed a highly scripted pattern of responses (there were specific scripts for each task) in order to confirm that teaching difficulty was equal among all participants. Confederate PI was taken for 20% of all video assessments, with a mean of 92.4%, ranging from 57% to 100%. IOA was calculated on 36% of video assessments, where the mean percent agreement was 79.7, ranging from 46% to 97%. We computed IOA by dividing the total number

of agreements by the total number of disagreements plus agreements, and multiplying by 100% (Martin and Pear, 2011). Without including outliers (below 70%) the mean agreement was 84.4%. Research assistants scored these outliers in the beginning stages of data coding before concrete rules were decided upon or occurred during a baseline assessment where it is more difficult to score. Markers were blind to participant's identity, and to the phase and the condition of the assessment being marked.

Results

Figure 1 shows the means of the dependent variables – motivation, attitude valence, and motivation change – after each condition (CAPSI + Manual vs. DTT manual Alone). Independent samples t-test indicated that the CAPSI + DTT manual group reported significantly higher motivation scores ($M = 4.55$, $SD = 0.5$) than did the DTT manual group ($M = 3.23$, $SD = 1.15$), $t(40) = 4.88$, $p = .001$. Additionally, CAPSI + DTT manual group reported a significantly higher increase in levels of motivation scores throughout the project ($M = 4.2$, $SD = 1.06$) than did the DTT manual group ($M = 3.23$, $SD = 1.38$), $t(40) = 2.58$, $p = .01$. However, the CAPSI + DTT manual group did

Figure 1. Mean motivation, attitude valences, and motivation change for CAPSI + DTT manual vs. DTT manual alone.

* $p < .01$; **$p < .001$

not report significantly higher attitude scores ($M = 4.15$, $SD = 1.06$) than did the DTT manual only group ($M = 3.95$, $SD = 0.59$), $t(40) = 0.86$, $p = .39$. Pearson correlation coefficients indicated that for participants in the CAPSI + manual condition, performance was significantly correlated with motivation $r(19) = 0.38$, $p < .05$; however attitude valence and performance did not show a significant correlation, $r(19) = 0.11$, ns. Participants in the DTT manual only condition did not show significant correlations with performance and motivation $r(21) = 0.2$, ns, and attitude valence $r(21) = .15$, ns. Finally, motivation change did not show significant correlations with performance in the CAPSI + manual condition $r(19) = -.07$, ns, or in the DTT manual only condition $r(21) = -.22$, ns.

In sum, participants in the CAPSI + DTT manual condition reported significantly higher levels of motivation, and significantly higher increases in motivation throughout the project, than participants in the DTT manual only group. However, only motivation was significantly correlated with performance scores for participants in the CAPSI + DTT manual condition.

Discussion

Overall, the findings indicate that CAPSI, a combination of both mastery learning and web-based instruction, demonstrated higher motivation levels (41% greater) and a larger increase in motivation over the course of the project (30% greater) (see Figure 1). No significant findings were found between the two conditions regarding attitude valence. Although there was no difference between groups, both did report a relatively positive experience learning DTT with their assigned learning method. For participants in the CAPSI + DTT manual condition, performance scores were significantly and positively correlated with only self-reports of motivation. This finding is particularly important since the results indicate that individuals in the CAPSI + DTT manual group showed reliably higher motivation scores. Therefore, it may be tentatively concluded that CAPSI tends to increase participants motivation levels and, in addition, motivation is a significant predictor of performance. It therefore seems to follow that CAPSI is potentially effective in increasing performance levels, although this was not tested directly in the present study.
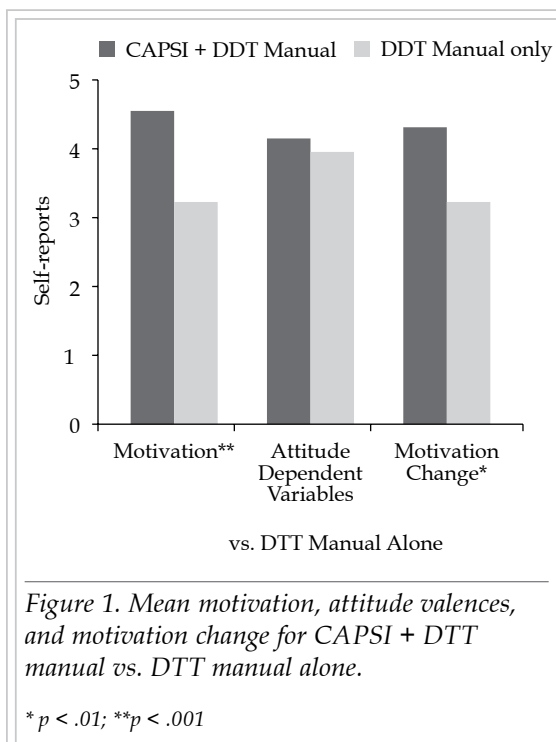
Several implications from these findings can be seen. Using CAPSI as a learning method for DTT seemed to be a positive and motivating experience for most individuals involved in this study. If awareness on the importance of DTT and can be broadened, it is possible that more individuals would be able receive training in DTT using CAPSI because it is a more convenient and accessible learning method. The significance of these results can add to our confidence in using CAPSI as an effective teaching method for training individuals in DTT.

Limitations throughout the study should be noted. First, the application test required participants to demonstrate DTT on a confederate playing the role of a child with ASD; it is possible that if they were required to teach children with ASD the findings may have been different. Second, facilities and research assistants were not always readily available, and consequently participants sometimes had to wait as much as a week between sessions. This may have led to a potential bias where many of the participants included in the study were those who were more motivated and held a more positive attitude towards completing the study, although resource availability was the same between both conditions. Third, this study did not include the peer-reviewing component of CAPSI, so the effects of peer review in a CAPSI course were not reflected in these results.

Further research should be conducted on students' performance levels and their correlation with attitude valences, motivation, and motivation change. Furthermore, future research is needed to demonstrate whether a role-playing confederate is generalizable to a child with ASD. It can be speculated that with the use of further supporting research, CAPSI + DTT manual may be shown to be a fruitful method for teaching DTT procedures. Because CAPSI includes convenience attributes such as accessibility, flexibility, and being low-cost, it should be a great asset for the use of training and educating more individuals on DTT.

Acknowledgements

Key Messages From This Article

People with disabilities: CAPSI may possibly lead to more persons with autism spectrum disorders receiving adequate behavioural interventions and to learn new tasks.

Professionals: CAPSI as a learning method for discrete-trials teaching is an effective, motivating, and favorable method of knowledge uptake.

Policymakers: Given the ongoing need for tutors trained in discrete-trial teaching it is important distinguish which methods of knowledge uptake are more convenient, favorable and motivating with the possibility of training more individuals on DTT

References

Babel, D. A., Martin, G. L., Fazzio, D., Arnal, L., & Thomson, K. (2008). Assessment of the reliability and validity of the discrete-trials teaching evaluation form. *Developmental Disabilities Bulletin, 36*, 67–80.

Fazzio, D., & Martin, G. L. (2011). *Discrete-trials teaching with children with autism: A self-instructional manual.* Winnipeg, Manitoba: Hugo Science Press.

Fazzio, D., Martin, G.L., & Yu, C.T. (2009). Instructing university students to conduct discrete-trials teaching with children with autism. *Research in Autism Spectrum Disorders, 3*, 57–66.

Fombonne, E. (2003). The prevalence of autism. *JAMA, 289*, 87–89.

Ironsmith, M., & Eppler, M. (2007). Mastery learning benefits low-aptitude students. *Teaching of Psychology, 34*, 28–31.

Jacobson, J. W., & Mulick, J. A. (2000). System and cost research issues in treatments for people with autistic disorders. *Journal of Autism and Developmental Disorders, 30*, 585–593.

Keller, F. S. (1968). "Good-bye, teacher...." *Journal of Applied Behavior Analysis, 1*, 79–89.

Kulik, A. J., Kulik, C. C., & Bangert-Drowns, L. A. (1990). Effectiveness of mastery learning programs: A meta-analysis. *Review of Educational Research, 60*, 265–299.

Kulik, A. J., Kulik, C. C., & Cohen, A. P. (1979). A meta-analysis of outcome studies of Keller's Personalized System of Instruction. *American Psychologist, 34*, 307–318.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*, 3–9.

Martin, G., & Pear, J. (2011). *Behaviour modification: What it is and how to do it?* (9th ed.). Upper Saddle River, NJ: Prentice Hall.

Martin, T. L., Pear, J. J., & Martin, G. L. (2002a). Analysis of proctor marking accuracy in a computer-aided personalized system of instruction course. *Journal of Applied Behavior Analysis, 35*, 309–312.

Martin, T. L., Pear, J. J., & Martin, G. L. (2002b). Feedback and its effectiveness in a computer-aided personalized system of instruction course. *Journal of Applied Behavior Analysis, 35*, 427–430.

Pear, J. J. (2002). Teaching and researching higher-order thinking in a virtual environment. In J. A. Chambers (Ed.), *Selected papers from the 13th International Conference on College Teaching and Learning* (pp. 143–150). Jacksonville, FL: Florida Community College at Jacksonville.

Pear, J. J., & Kinsner, W. (1988). Computer-aided personalized system of instruction: An effective and economical method for short- and long-distance education. *MachineMediated Learning, 2*, 213–237.

Pear, J. J., Schnerch, G. J., Silva, K. M., Svenningsen, L., & Lambert, J. (2011). Web-based computer-aided personalized system of instruction. In W. Buskist & J. E. Groccia (Eds.), *New directions for teaching and learning.* Vol. 128: *Evidence-based teaching* (pp. 85–94). San Francisco, CA: Jossey-Bass.

Sankaran, R. S, & Bui, X. T. (2001). Impact of learning strategies and motivation on performance: A study in web-based instruction. *Journal of Instructional Psychology, 28*, 19, 1–199.

Sankaran, R. S., Sankaran, D., & Bui, X. T. (2000). Effect of student attitude to course format on learning performance study in web vs. lecture instruction. *Journal of Instructional Psychology, 27*, 66–73.

Thomson, K., Martin, G., Arnal, L., Fazzio, D., & Yu, C.T. (2009). Instructing individuals to deliver discrete-trials teaching to children with autism spectrum disorders: A review. *Research in Autism Spectrum Disorders, 3*, 590–606.