

FUNCTIONAL ANALYSIS GRAPHS IN GOOGLE SHEETS

The Use of Checklist to Teach Creation of Functional Analysis Graphs in Google Sheets

by

Chase Carpenter

Submitted in Partial Fulfillment of the Requirements

for the Degree of

Master of Science

in the

Applied Behavior Analysis

Program

YOUNGSTOWN STATE UNIVERSITY

May 2022

FUNCTIONAL ANALYSIS GRAPHS IN GOOGLE SHEETS

The Use of Checklist to Teach Creation of Functional Analysis Graphs in Google Sheets

Chase Carpenter

I hereby release this thesis to the public. I understand that this thesis will be made available from the OhioLINK ETD Center and the Maag Library Circulation Desk for public access. I also authorize the University or other individuals to make copies of this thesis as needed for scholarly research.

Chase Carpenter BA, Student

Date

Approvals:

Dr. Kris Brown, PsyD, Thesis Advisor

Date

Dr. Ying Tang, PhD, Committee Member

Date

Christina Cole, MS, Committee Member

Date

Dr. Salvatore A. Sanders, Dean of Graduate Studies

Date

ABSTRACT

Many articles give detailed instructions on how to create different single-subject design graphs including functional analyses (multi-element design). The task analysis is a process often used in ABA to teach a skill by breaking it down into simpler components. A task analysis can be, and has been, used to teach behavior analysts to create single subject graphs. A task analysis for creating a multielement design graph in Google Sheets could be a useful way to teach this skill to behavior analysts. The purpose of the current study is to measure the effectiveness of a task analysis for creating a multielement design graph in Google Sheets. The results of the study showed an average increase of 33.125% from the baseline phase to the intervention phase between all four participants.

Keywords: *applied behavior analysis, Google Sheets®, graphing, multielement design, single-subject design graphs, task analysis*

Table of Contents

Introduction.....	1
History and Relevance of Graphing in Behavior Analysis.....	1
Importance of Graphing in Clinical Settings.....	2
Research on Graphs.....	4
Task Analyses.....	4
Statement of the Problem.....	7
Method.....	8
Participants.....	8
Setting and Materials.....	9
Procedure.....	9
Baseline.....	9
Intervention.....	10
Experimental Design.....	10
Independent and Dependent Variable.....	11
Results.....	11
Discussion.....	12
Limitations and Direction for Future Research.....	12
References.....	15
Figure 1.....	20
Figure 2.....	21
Appendix A.....	22
Appendix B.....	25

The Use of Checklist to Teach Creation of Functional Analysis Graphs in Google Sheets

Applied behavior analysis (ABA) is the application of principles of learning and condition to problems of social importance (Baer et al., 1968). Baer, Wolf, and Risley (1968) were the first to described 7 main dimensions of ABA, which included the term analytic. The authors described this term as “the analysis of a behavior, as the term is used here, requires a believable demonstration of the events that can be responsible for the occurrence or non-occurrence of that behavior” (Baer et al., 1968 p. 93-94). Part of this making changes in behavior a “believable demonstration” is graphing the changes in behavior over time in a way that shows the effectiveness (or lack thereof) of an intervention. Like any science, behavior analysis benefits from using standard measurements. These standard measurements are essential to allow scientists to identify and analyze phenomena under study. Visual analysis has aided scientists and applied behavior analysts by giving them a way to show believable demonstrations of the data that they record. Thus, graphing has been played an important role in the science of behavior analysis and continues to play a role in clinical settings.

History and Relevance of Graphing in Behavior Analysis

Data collection and graphing has long been a staple of ABA. In the early days of behavior analytic research, B.F. Skinner and colleagues recorded the rates of lever presses by rats under various experimental conditions (Kubina et al., 2017). Kubina & Lin (2008) wrote that “Visual inspection of the cumulative number of responses occurring in time, or the number of events over time, played a critical role in the discovery of basic principles of behavior” (p. 126). In this article they conclude that the proper use of terms like frequency allows for the accurate and repeatable quantification

that distinguishes scientific approaches from non-scientific approaches (Kubina & Lin, 2008). Behavior analysis has generally accepted that the visual demonstration of data is valid for proving that experimental control has been achieved (Bailey, 1984).

Importance of Graphs in Clinical Settings

The tradition of recording and graphing data for analysis continues today and is especially common when ABA is utilized as a treatment for developmental disorders such as autism spectrum disorder (ASD). In their review of graphs in the field, Kubina and colleagues stated that there was a shift from cumulative records to line graphs that coincided during the emphasis on applied work in behavior analysis (2017). Various kinds of graphs exist in the field of ABA and can include line graphs, bar graphs, and standard celebration charts (Carr & Burkholder, 1998). One type of line graph commonly used within the field of ABA is the multielement graph commonly used in a functional analysis (FA) of behavior. An FA is a systematic and experimental approach used to identify the maintaining variables of problematic behaviors exhibited by clients in clinical settings. Iwata et al., (1982) was the first to demonstrate the use of an FA to discover the reinforcement conditions under which self-injury was occurring. Doing so allows for selecting an appropriate intervention tailored to the function, thereby saving time and increasing effectiveness. Today, FAs are widely used by Board Certified Behavior Analysts (BCBAs) and are considered the gold standard assessment for identifying the causes of problematic behavior exhibited by individuals with developmental delays such as autism spectrum disorder (ASD). In their review, Hanley and colleagues (2003) found that the multielement design was the most common used with FAs, making their use in the field of ABA important. Further, Zaslowsky & Volpe

(2010) indicated that “summarizing student data in graphic form allows for clear and concise interpretation and evaluation of intervention-related information” (2010, p. 15). The authors also mention that using computers to collect data can allow practitioners to graph and analyze in real time which can lead to more efficient program decisions.

As stated, the multielement designs (and corresponding graphs) are important in the field of ABA. They are commonly utilized to display FA results and can also be used in a variety of other treatment applications (i.e., Shabani & Lam, 2013). One issue with the use of these graphs is that they can be complex to make. Clinicians need to know how to make graphs properly so that evidence of behavior change (or lack thereof) can be visually demonstrated for stakeholders and other practitioners. Even if someone has access to the software required to make these graphs, it can take time to learn to format them properly without training. Further, single subject designs are not utilized in all subfields of psychology, so individuals seeking to create them may be unfamiliar with them in general. While elaborating on the subject, Chok (2018) wrote:

In the field of applied behavior analysis, the utilization of graphs to interpret data is paramount. However, the process of creating graphs can be cumbersome, a challenge which has been ameliorated in part by the publication of tutorials which list out the steps necessary to create graphs using current popular software programs. (p. 265)

In the conclusion of this article, Chok mentioned that future researchers may want to create a task analysis for other software programs (Chok, 2018). In this article, he also stated that used a task analysis could be used to teach people how to create multiple single-subject design graphs such as reversal design graphs, latency design graphs, and

multielement design graphs. Thus, accurate graphing is an important part of the daily duties of behavior analysts working in clinical settings.

Research on Graphs

Due to the importance and ubiquity of graphing in ABA, many researchers have addressed how to make them in the peer-reviewed literature. These include articles that give detailed instructions on how to create different graphs for specific research designs and others that experimentally evaluate the effects of procedures to teach graphing. Examples of graphs taught in these articles include multielement graphs (i.e., functional analysis) graphs (Chok, 2019), reversal design graphs, and multiple baseline design graphs (Carr & Burkholder, 1998; Dixon, 2009; Lo & Konrad, 2007; Moran & Hirschbine, 2002; Pritchard, 2008; Zaslofsky & Volpe, 2010), multiple baseline designs (Hillman & Miller, 2004; Lo & Starling, 2009). There are also multiple studies that describe how to create phase changes lines on a graph (Deochand, 2017; Dubuque, 2015; Fuller & Dubuque, 2018), how to graph interobserver agreement (Reed & Azulay, 2011), how to graph generalized matching analyses (Reed, 2009), delay discounting (Reed et al., 2012), and more formative graphing procedures (Cole & Witts, 2015).

Task Analyses

One common procedure used in many articles is the use/development of a task analysis to teach graph creation. A task analysis is a process often used in ABA to teach a skill by breaking it down into simpler components (Jonassen & Hannum, 1986). Task analyses have also been used to teach behavior analysts to create single subject graphs. For example, Lo and Starling (2009) used a task analysis to teach a group of three graduate students to create a graph for a multiple baseline design. In their article, students

were three female graduate students majoring in special education. Results indicated a functional relationship between the number of correct graphing components and the use of their task analysis for all participants. Two of the three participants showed a functional relationship between the number of correct graphing components and the task analysis, while results were less conclusive for the third participant.

Dixon et al. (2009) also used task analyses to teach 22 graduate students to create single-subject design graphs in Excel including multielement, reversal, and multiple baseline design. In their article, participants were twenty-two graduate students enrolled in a graduate behavior analysis program. The participants were assigned to one of two groups. Group 1 received the task analysis written by Dixon et al, and Group 2 received the task analysis written by Carr and Burkholder (Dixon et al., 2009). Participants in each group were asked to create three graphs with hypothetical data. Their results showed that the task analyses created by Dixon and colleagues taught these participants to create faster and more accurate single-subject design graphs than the previous ones. In two different experimental articles, Lo and colleagues (2007, 2009) provided participants with a sample graph to make single subject design graphs along with a task analysis and hypothetical data as part of the intervention (Lo & Konrad, 2007; Lo & Starling, 2009). In the Lo and Starling (2009) article, three participants were asked to graph a multiple baseline data set. The dependent variable in this study was the number of graphing components created correctly using Microsoft Excel 2007 in 30 minutes. They measured the dependent variable using a 50-item checklist and used a multiple-probe design to assess effectiveness. The results of this study demonstrated that their task analysis was effective for teaching the graphing skill to all participants in the study.

In the Lo and Konrad (2007) article, 21 undergraduate students, 57 post-baccalaureate students, 7 Ph.D. students, and 1 special education faculty member were all given the task analysis, a data set for a three-tiered single data path multiple-baseline design, and a model graph. The graphs that the participants created were measured using a 10-criteria task analysis that corresponded to the major steps required to create the graph. The results of this study showed that 74% of undergraduates, 68% of post-baccalaureate students, 81% of Ph.D./faculty completed individual steps correctly with the use of the task analysis.

Mitteer et al. (2018) used a task analysis to teach behavior technicians to create single subject design graphs using GraphPad Prism®. In their study they used a video-model to teach four bachelor's-level registered behavior technicians (RBTs) to create a multiple-baseline design graph. Although they didn't describe the video-model as a task analysis, they broke the 37-minute recording into 36 timestamps that would take a viewer directly to a particular step in creating the graph. This is essentially the same structure as a task analysis in a video format instead of a written format. Results of their study indicated that all participants showed immediate mastery-level accuracy in graphing after the introduction of the video model. Their data suggested that bachelor's-level RBTs with no graduate level training can be taught to create accurate graphs in GraphPad Prism® immediately after watching their video model (Mitteer et al., 2018).

In addition to articles that are experimental in nature (e.g., Cole & Witts, 2015; Dixon, et al., 2009; Lo & Starling, 2009; Lo & Konrad, 2007, Luna & Rapp, 2018), several published articles have also used nonexperimental designs that only contained instructions on how to create different single subject design graphs (Barton et al., 2007;

Barton & Reichow, 2012; Carr & Burkholder, 1998; Chok, 2019; Deochand, 2017; Dubuque, 2015; Fuller & Dubuque, 2018; Hillman & Miller, 2004; Moran & Hirschbine, 2002; Pritchard, 2008; Reed, 2009; Reed et al., 2012; Reed & Azulay, 2011; Zaslofsky & Volpe, 2010). Deochand (2017) published a short article in *Behavior Analysis in Practice* using a task analysis to insert automating phase change lines in Microsoft Excel. In this article (Deochand, 2017) developed a task analysis that to teach people to insert phase lines and their labels as well as inserting phase line and labels when two Y-axes are needed. Carr and Burkholder (1998) reported on a task analysis to instruct people to create single subject design graphs in Microsoft Excel. Carr and Burkholder (1998) developed a task analysis to teach people to create a reversal design graph and a multiple-baseline design graph. Reed, Kaplan, and Brewer (2012) wrote an article to teach people to use Excel 2010 and Excel for Mac 2011 to conduct delay-discounting analyses. Chok (2019) wrote an article that used a task analysis to instruct people to create multi-element design graphs using Microsoft Excel® 2016 for PCs. Their task analysis instructed people to enter data, create the graph, and edit the graph as well as creating line graphs for latency functional analyses (Chok, 2019). The fact that several non-experimental articles have been published in peer reviewed journals demonstrates the applied importance of graphing in ABA. However, since these articles don't use an experimental design to verify the efficacy of the task analyses to teach graphing, it's not possible to assess the effectiveness of the task analysis.

Statement of the Problem

Although much research (experimental and non-experimental) is available on the use of task analysis and other procedures to teach graphing, most use software that has a

cost associated with it such as Microsoft Excel® or GraphPad Prism®. Google Sheets®, created in 2006, is a software that has many of the same graphing capabilities as other programs, and is free to anyone who has a Gmail® account (which is also free).

However, no instructional articles exist on how to create single subject design graphs that are used in ABA using Google Sheets. Since Google Sheets is a free software for anyone that has a Gmail account and internet access, using it might allow more behavior analysts to have access to adequate graphing tools they can use in clinical practice. A task analysis for creating a multielement design graph in Google Sheets could be a useful way to teach this skill to behavior analysts. Further, using data to verify the efficacy of the task analysis would also be important. Therefore, the purpose of the current study was to measure the effectiveness of a task analysis for creating a multielement design graph in Google Sheets.

Method

Participants

Participants were four undergraduates enrolled at Youngstown State University. All participants were above 18 years of age. The current study was approved by the Youngstown State University Institutional Review Board (Protocol Number 2022-97). All participants were presented a consent form that explained the stages of the experiment and consented to participate. Participants earned credit in their undergraduate psychology coursework for completion of the study. All participants were informed they were able to leave the study without consequence.

Setting and Materials

An empty laboratory room at Youngstown State University with a Microsoft Windows®-equipped computer was used as the location for the study. The computer had access to the internet and Google Sheets pulled up along with the mock data sets and model graphs in the Google Chrome® browser. The example graph given to participants along with the checklist is seen in Figure 1. A document with the task analysis for creating a multielement design graph was printed out and given to participants. The task analysis consisted of 28 steps created by the researcher after creating a multielement design graph in Google Sheets (see Appendix A). It was written in sentence form ranging from one to three sentences and described the specific steps needed to replicate the sample graph. A timer on the researcher's phone was used to time the 15-minute interval for each phase of the study.

Procedure

Baseline

Upon entering, participants were handed the typed consent form and (after consenting) were briefed on what the study would entail. During baseline, the participants were asked to sit at the computer with Google Chrome open and Google Sheets pulled up with the hypothetical data set and model graph. Participants were then asked to start making the multielement graph and the researcher started the 15-minute timer on his cellphone. After the 15-minute time sounded the researcher told the participants to stop making the graph. Feedback was not given after the phase ended. If participants asked questions about how to make the graph, they were told by the experimenter to "try to do their best". No reinforcement or feedback was provided to participants in this stage.

Intervention

During the intervention phase, the participants were asked to go to the next tab on the spreadsheet in Google Chrome that contained the hypothetical data sheet and corresponding model graph. Then, the participants were handed the checklist and given 2-minutes to look it over. After they looked it over, they were asked to start graphing and the researcher set the 15-minute timer. The researcher then asked the participants if they were “ready” to graph and then directed them to start after they indicated that they were ready to start. The researcher simultaneously started the timer while telling the participants to start graphing. Participants created one additional graph during the intervention phase. During the intervention phase, no reinforcement was given, and the researcher told participants to “try their best” when they had questions. No breaks were given during the intervention because the phase was only 15-minutes. No feedback was given during the intervention condition. After the 15-minute timer was up, the experimenter asked the participants to stop graphing and told them to leave the computers as they were. Participants were then told that the study was complete and they could leave the laboratory room and be credited for their participation later that day.

Experimental Design

A pretest posttest design was used in the study. A pretest posttest design is a pre-experimental design that does not have control or comparison groups and the same assessment measures are given to participants before and after they have the intervention (Dimitrov, & Rumrill, 2003). A pretest posttest design was appropriate for this study because it allows for researchers to compare performance before and after a specific intervention. Pretest posttest designs have been used for decades to compare the effects of

interventions in a variety of fields (Case-Smith et al., 2012; Dunn et al., 2012; Hasanzadeh, 2019).

Independent and Dependent Variable

The independent variable in the study was the use of the checklist to create a multielement design graph that was given to the participants after they completed the baseline phase. The dependent variable in the study was the percentage of steps on the checklist that were completed correctly. The percentage of steps completed correctly in each phase was then graphed to visually compare the effectiveness of the independent variable.

Results

During the baseline phase, Participant 1 completed 32.1% of the steps on the checklist correctly. Participant 2 completed 17.6% of the steps correctly in baseline. Participant 3 completed 64.3% of the steps correctly in the baseline phase. Lastly, Participant 4 completed 25.0% of the steps correctly during baseline. During the intervention phase Participant 1 completed 42.9% of the steps on the checklist correctly, Participant 2 completed 67.9% of the steps correctly, Participant 3 completed 82.1% of the steps correctly, and Participant 4 completed 78.6% of the steps correctly. All participants showed an increase in the percentage of steps completed correctly from baseline to intervention. Participant 1 demonstrated a 10.8% increase, Participant 2 demonstrated a 50.3% increase, Participant 3 demonstrated a 17.8% increase, and Participant 4 demonstrated a 53.6% increase in percentage of steps completed correctly. The average difference of increase from the baseline phase to the intervention phase between all four participants was 33.12% (see Figure 2).

Discussion

The results of the current study demonstrated that the task analysis increased the percentage of correct steps graphed in Google Sheets for all four participants from the baseline phase to the intervention phase. The average difference of increase from the baseline phase to the intervention phase between all four participants was 33.13%. This means that the task analysis created is potentially useful as an instructional tool for teaching students to graph in Google Sheets. The changes were also quick considering that all participants showed improvements in graphing within a 15-minute period when creating the graph. Additionally, the intervention was simple and only involved providing the task analysis to the participants.

Obviously, one reason for the effectiveness of the task analysis was that it provided information (i.e., task clarification) on what steps needed taken to create the graphs. Although the procedure is straightforward, such procedures have applied value to practitioners to help them create graphs quickly and accurately without the need for excessive time and/or training. In applied settings, practitioners would simply take the task analysis and use it to create the graph. The value of studies such as the current one is that they demonstrate the effectiveness of the task analysis and help establish its validity as an instructional tool.

Limitations and Directions for Future Research

Although all the participants had an increase during the intervention phase, however, none of them reached 100%. This may be because participants were all undergraduates and had never had experience in creating a multielement design graph. It's possible that results would have been more pronounced if the checklist was given to

graduate students in ABA or to BCBAs working in the field. Future research should be conducted with participants that have previously had experience creating multielement design graphs to test this hypothesis. Still, the fact that all participants increased their percentages of steps graphed correctly demonstrated that the checklist might be effective in teaching people to create a multielement design graph in Google Sheets. An additional limitation to the current study was the use pretest-posttest design. This design was chosen out of convenience and time-constraints. Although easy to use the pretest-posttest design is associated with several threats to validity. For example, it is more difficult to demonstrate a functional relationship using this design because the baseline is never reintroduced. A multiple-probe design may be a better to utilize to strengthen the internal validity in future research. Lastly, the small sample size was also a limitation of the current study. Small numbers of participants limit the extent to which results can be generalized from the current study. Future research should use more participants to provide more evidence of the effectiveness of the procedure to teach multielement graphs. It should also be replicated with actual clinicians in ABA to establish its usefulness in the field.

In conclusion, the results of this study demonstrated the effectiveness of a 28-step task analysis to improve the graphing skills of four undergraduate students in a free graphing program (Google Sheets). Although no participants scored a 100% correct graph, the task analysis improved the graphing for all participants in a short amount of time. The intervention was easy to use and showed improvement rapidly, with all four participants showing increases in a 15-minute session. Future research would improve on the current study by using a fully experimental design instead of a pretest-posttest design

and using more participants. Lastly, the procedure should be replicated with actual clinicians in the field. This would allow for more generalized findings that could help establish whether task analyzed teaching procedures are effective for teaching graphing skills.

References

- Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97.
<https://doi.org/10.1901/jaba.1968.1-91>
- Bailey, D. B. (1984). Effects of lines of progress and semilogarithmic charts on ratings of charted data. *Journal of Applied Behavior Analysis, 17*(3), 359-365. <https://doi-org.eps.cc.ysu.edu/10.1901/jaba.1984.17-359>
- Barton, E.E. & Reichow, B. (2012). Guidelines for graphing data with Microsoft® Office 2007™, Office 2010™, and Office for Mac™ 2008 and 2011. *Journal of Early Intervention, 34*(3), 129-150. <https://www.learntechlib.org/p/64898/>.
- Barton, E.E., Reichow, B., & Wolery, M.R. (2007). Guidelines for graphing data with Microsoft® PowerPoint™. *Journal of Early Intervention, 29*, 320 - 336.
- Carr, J., & Burkholder, E. (1998). Creating single-subject design graphs with Microsoft® Excel™. *Journal of Applied Behavior Analysis, 31*(2), 245–251.
<https://doi.org/10.1901/jaba.1998.31-245>
- Case-Smith, J., Holland, T., Lane, A., & White, S. (2012). Effect of a coteaching handwriting program for first graders: One-group pretest-posttest design. *American Journal of Occupational Therapy, 66*(4), 396–405. <https://doi-org.eps.cc.ysu.edu/10.5014/ajot.2012.004333>
- Chok, J.T., (2019). Creating functional analysis graphs using Microsoft® Excel™ 2016 for PCs. *Behavior Analysis in Practice, 12*, 265–292.
<https://doi.org/10.1007/s40617-018-0258-4>

- Cole, D. M., & Witts, B. N. (2015). Formative graphing with a Microsoft Excel™ 2013 template. *Behavior Analysis: Research and Practice, 15*(3-4), 171-186.
<http://dx.doi.org/10.1037/bar0000021>
- Deochand N. (2017). Automating phase change lines and their labels using Microsoft Excel®. *Behavior Analysis in Practice, 10*(3), 279–284.
<https://doi.org/10.1007/s40617-016-0169-1>
- Dimitrov, D. M., & Rumrill, P. D., Jr. (2003). Pretest-posttest designs and measurement of change. *Journal of Prevention, Assessment & Rehabilitation, 20*(2), 159–165.
- Dixon, M. R., Jackson, J. W., Small, S. L., Horner-King, M. J., Lik, N. M., Garcia, Y., & Rosales, R. (2009). Creating single-subject design graphs in Microsoft Excel 2007. *Journal of Applied Behavior Analysis, 42*(2), 277–293.
<https://doi.org/10.1901/jaba.2009.42-277>
- Dubuque E. M. (2015). Inserting phase change lines into Microsoft Excel® graphs. *Behavior Analysis in Practice, 8*(2), 207–211.
<https://doi.org/10.1007/s40617-015-0078-8>
- Dunn, W., Cox, J., Foster, L., Mische-Lawson, L., & Tanquary, J. (2012). Impact of a contextual intervention on child participation and parent competence among children with autism spectrum disorders: A pretest-posttest repeated-measures design. *American Journal of Occupational Therapy, 66*(5), 520–528. <https://doi-org.eps.cc.ysu.edu/10.5014/ajot.2012.004119>
- Fuller, T. C., & Dubuque, E. M. (2018). Integrating phase change lines and labels into graphs in Microsoft Excel®. *Behavior Analysis in Practice, 12*(1), 293–299.
<https://doi.org/10.1007/s40617-018-0248-6>

- Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36*(2), 147-185.
<https://doi.org/10.1901/jaba.2003.36-147>
- Hasanzadeh, M., Akbari, B., & Abolghasemi, A. (2019). Efficiency of acceptance and commitment therapy on psychological well-being and sexual function in women with infertility history. *Avicenna Journal of Nursing and Midwifery Care, 27*(4), 250-259.
- Hillman, H. L., & Miller, L. K. (2004). Designing multiple baseline graphs using Microsoft Excel™. *The Behavior Analyst Today, 5*(4), 372+.
<https://link.gale.com/apps/doc/A170112983/HRCA?u=ohlink104&sid=googleScholar&xid=44ef88a8>
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982). Toward a functional analysis of self-injury. *Analysis & Intervention in Developmental Disabilities, 2*(1), 3–20. [https://doi.org/10.1016/0270-4684\(82\)90003-9](https://doi.org/10.1016/0270-4684(82)90003-9)
- Jonassen, D. H., & Hannum, W. H. (1986). Analysis of task analysis procedures. *Journal of Instructional Development, 9*(2), 2-12.
- Kubina Jr., R. M., & Fan-Yu Lin. (2008). Defining frequency: A natural scientific term. *Behavior Analyst Today, 9*(2), 125–129.
<https://doi-org.eps.cc.ysu.edu/10.1037/h0100651>
- Kubina, R., Kostewicz, D., Brennan, K., & King, S. (2017). A critical review of line graphs in behavior analytic journals. *Educational Psychology Review, 29*(3), 583–598. <https://doi-org.eps.cc.ysu.edu/10.1007/s10648-015-9339-x>

- Lo, Y.-y., & Starling, A. L. P. (2009). Improving graduate students' graphing skills of multiple baseline designs with Microsoft® Excel 2007. *The Behavior Analyst Today*, *10*(1), 83-121. <http://dx.doi.org/10.1037/h0100666>
- Lo, Y., & Konrad, M. (2007). A field-tested task analysis for creating single-subject graphs using Microsoft® Office Excel. *Journal of Behavioral Education*, *16*, 155-189. <https://doi.org/10.1007/s10864-006-9011-0>
- Mitteer, D. R., Greer, B. D., Fisher, W. W., & Cohrs, V. L. (2018). Teaching behavior technicians to create publication-quality, single-case design graphs in GraphPad Prism 7. *Journal of Applied Behavior Analysis*, *51*(4), 998–1010. <https://doi.org/10.1002/jaba.483>
- Moran, D. J., & Hirschbine, B. (2002). Constructing single-subject reversal design graphs using Microsoft Excel™: a comprehensive tutorial. *The Behavior Analyst Today*, *3*(2), 235-242. <https://docplayer.net/21645777-Constructing-single-subject-reversal-design-graphs-using-microsoft-word-a-comprehensive-tutorial.html>
- Pritchard, J. K. (2008). A decade later: creating single-subject design graphs with Microsoft Excel™ 2007. *Behavior Analyst Today*, *9*(3/4), 153–161. <https://doi.org/10.1037/h0100655>
- Reed D. D. (2009). Using Microsoft Office Excel™ 2007 to conduct generalized matching analyses. *Journal of Applied Behavior Analysis*, *42*(4), 867–875. <https://doi.org/10.1901/jaba.2009.42-867>
- Reed, D. D., & Azulay, R. L. (2011). A Microsoft Excel® 2010 based tool for calculating interobserver agreement. *Behavior Analysis in Practice*, *4*(2), 45–52. <https://doi.org/10.1007/BF03391783>

- Reed, D. D., Kaplan, B. A., & Brewer, A. T. (2012). A tutorial on the use of Excel 2010 and Excel for Mac 2011 for conducting delay-discounting analyses. *Journal of Applied Behavior Analysis, 45*(2), 375–386. <https://doi.org/10.1901/jaba.2012.45-375>
- Shabani, D. B., & Lam, W. Y. (2013). A review of comparison studies in applied behavior analysis. *Behavioral Interventions, 28*(2), 158-183. <https://doi.org/10.1002/bin.1361>
- The history of Microsoft Excel - Microsoft*. Excel Help. (2021, February 16). Retrieved January 11, 2022, from <https://www.excelhelp.com/the-history-of-microsoft-excel/>
- Zaslowsky, A. F., & Volpe, R. J. (2010). Graphing single-case data in Microsoft Excel™ 2007. *School Psychology Forum, 4*(2), 15–24.

Figure 1

Example Multielement Graph

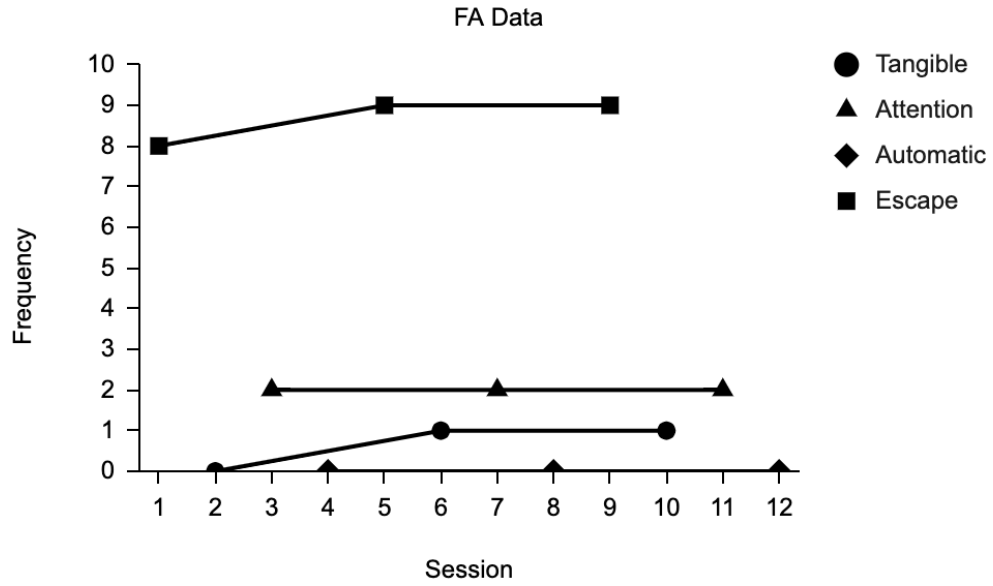
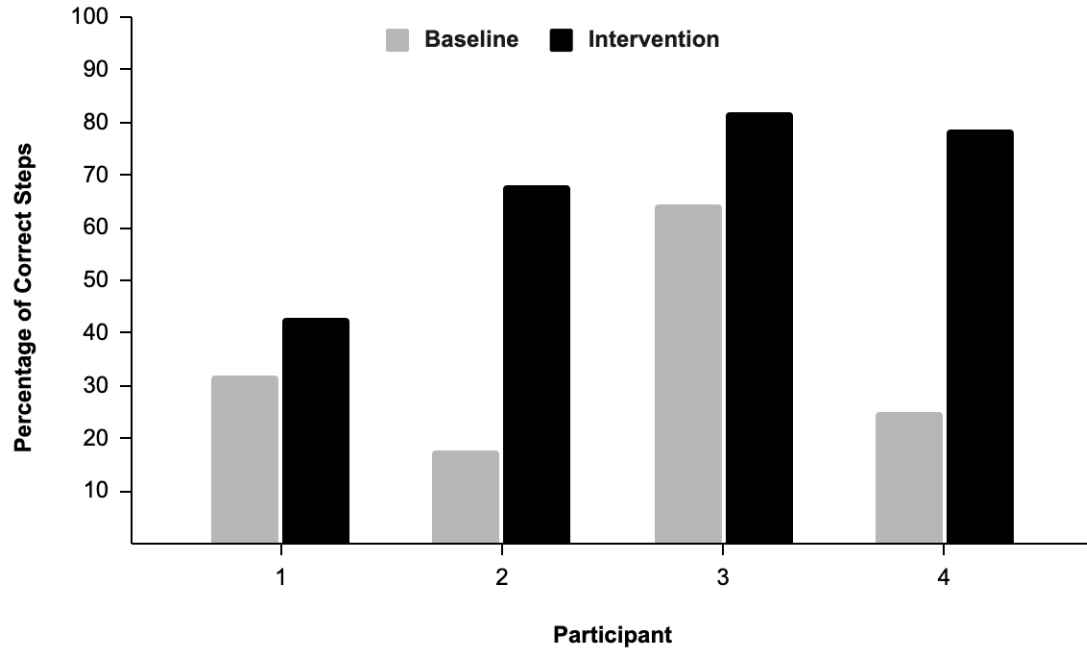


Figure 2

Pre and Post-Test Scores on Graphs for All Participants



Note. The percentage of steps completed correctly is shown on the y-axis and the participant number is shown on the x-axis. For each participant the baseline phase is shown to the left in blue and the intervention phase is shown to the right.

APPENDIX A
Graphing Checklist

1. Highlight the data on the spreadsheet and click insert in the toolbar.
2. Then, go down to chart and click to insert the chart. Select line chart in chart type (if not there by default).
3. If no X-axis, select Add X-axis under setup, select A1:A13.
4. If A1:A13 under Series, click the 3 dots next to A1:A13 and select remove.
5. After that, click Customize in the Chart Editor sidebar and select Chart Style. Under Chart Style select “Plot Null Values” and change the Border Color to White.
6. Unselect Chart Style and select Chart & Axis Titles so that it drops down in the menu.
7. Under Chart and Axis Titles select Chart Title if it’s not selected by default. Then, change Chart Title to “FA Data” and select Title Format and center the title. After that, select Text Color and change it to black. Next, select Font Size and change to 12.
8. Click on Chart Title once again to drop down a menu and then select Horizontal Axis Title.
9. Then, select the text box just below Title Text and input “Session”. After that, change the Title Font Size to 12 if it’s not already there by default. Finally, change the Title Text Color to black if it’s not already there by default.
10. Reselect Horizontal Axis Title to drop down the menu once again and select Vertical Axis Title.
11. Then, select the text box just below Text Title and input “Frequency”. After that, select the menu just below Title Font Size and select 12pt. Finally, select the menu under Title Text Color and change the color to black.
12. Click on Chart & Axis Title once again to retract the menu and then click on Series to drop down that menu.
13. Once in Series menu, select Apply to all series if not selected by default. Then, select the menu under Line Color and change it to black if it’s not auto selected.

14. After that, select Apply to All Series to bring down the menu and then select Escape. Select the menu under Point Size and change it to 7px. Then, select the menu under Point Shape and select Circle.
15. Then, select Escape once again to bring down the menu and select Tangible. After that, select the menu under Point Size and change it to 10px. Finally, select the menu under Point Shape and select Triangle.
16. Select Tangible again to bring down the menu and select Attention. Then, select the menu under Point Size and select 10px. After that, select the menu under Point Shape and select Diamond.
17. Select Attention again to bring down the menu and select Automatic. Then, select the menu under Point Size and select 10px. After that, select the menu under Point Shape and select Square.
18. Click on Series once again to retract the menu and click on Legend to drop down that menu.
19. Once in the Legend menu, select the menu under Position and select Right. Then, select the menu under Legend Font Size and change to 12px if not auto selected. After that, select the menu under Text Color and change to black if not auto selected.
20. Click on Legend once again to retract the menu and click on Vertical Axis.
21. Once in Vertical Axis menu, select the text box below “Min” and change to zero if not already there. Then, select the text box below “Max” and change to 10.
22. Click on Vertical Axis once again to retract the menu and click on Gridlines and Ticks.
23. Once in Gridlines and Ticks menu, click on the first menu and select Horizontal Axis if not automatically selected.
24. Under Major Spacing Type, select the menu and change to Step and then select the text box under Major Step and change to 1. Then, select the menu under Minor Spacing Type and change to Step and then select the text box under Minor Step and change to 1.
25. Unselect Major Gridlines and Minor Gridlines and then select Major Ticks. Select the menu under Ticks Position and select Outside and then select 6px in the menu under Ticks Length. Finally, unselect Minor Ticks.
26. Click on Horizontal Axis under Gridlines and Ticks to bring down the menu and select Vertical Axis.

27. Under Major Spacing Type, select the menu and change to Step and then select the text box under Major Step and change to 1. Then, select the menu under Minor Spacing Type and change to Step and then select the text box under Minor Step and change to 1.
28. Unselect Major Gridlines and Minor Gridlines and then select Major Ticks. Select the menu under Ticks Position and select Outside and then select 6px in the menu under Ticks Length. Finally, unselect Minor Ticks.

APPENDIX B

IRB APPROVAL FORM

Date: 3-3-2022

IRB #: 2022-97

Title: Checklist for Graphing a Functional Analysis via Google Sheets

Creation Date: 12-7-2021

End Date:

Status: **Approved**

Principal Investigator: Kris Brown

Review Board: YSU IRB Board

Sponsor:

Study History

Submission Type	Initial	Review Type	Exempt	Decision	Exempt
-----------------	---------	-------------	--------	----------	---------------

Key Study Contacts

Member	Chase Carpenter	Role	Co-Principal Investigator	Contact	cmcarpenter@student.ysu.edu
Member	Kris Brown	Role	Principal Investigator	Contact	kjbrown@ysu.edu
Member	Chase Carpenter	Role	Primary Contact	Contact	cmcarpenter@student.ysu.edu