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THE AUTOMATIC GRAPHING/ROTATION SCAN PROCEDURE FOR LAPTOPS AND CELLPHONES: AN ECOLOGICAL ASSESSMENT SYSTEM FOR DEVELOPING LOCAL NORMS

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ABSTRACT: Normative assessments are frequently used to assess children and adults in a multitude of settings. Normative assessments use large samples from a given population from which inferences can be made to individuals who share the characteristics of those in the standardization sample. Ecological assessments employ more direct assessments of behaviors within a particular setting. Normative assessments do not consider setting events or their influence on an individual's behavior. Functional behavior analysis and rotation scans are forms of ecological assessment that assess setting event variables and their relationship to one or more individuals' behavior within a particular setting. Unlike conventional normative assessment strategies, ecological assessment systems provide a basis for treatment grounded in the functions of behavior and the influence of setting variables. This paper describes a rotation scan procedure that provides simple and reliable recording and automatic graphing features.
KEYWORDS: **NEEDED**

Ecological assessment has a long history within behavioral psychology. Much of the interest in this assessment stems from the work of field theorists like J. R. Kantor. Kantor's (1959) interbehavioral field theory stresses a multifactor approach and the interdependent nature of stimulus, response, setting events, and interactional history. Bijou and Baer (1961) used Kantor's notion of a setting event and defined it as "a stimulus-response interaction which…will affect other stimulus-response interactions which follow it" (p. 21). In a classic article, Bijou,

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Peterson, and Ault (1968) demonstrated how descriptive and experimental accounts of behavior, setting events, and teacher and peer events can be combined and integrated through direct observational data in authentic settings to assess behavior and determine functional relationships. In addition, Bijou et al. suggest that such data can be used to establish a type of normative data that is context and setting specific.

Functional behavior analysis (FBA) is an ecological assessment that analyzes behavior within an operant psychological framework. The goal is to determine environment-behavior relations. Data is collected by one or more trained observers at the time and place in which the behavior is likely to be occasioned. FBA's advantage over normative assessment is that its idiographic characteristics translate more directly to interventions with particular individuals. Interview-based functional behavior assessment is a form of behavioral ecological assessment that uses third party observations, the details of which are evoked by an interviewer or a questionnaire, usually at a time much later than that at which the behavioral events of interest occurred. Momentary ecological assessments (MEA) use various forms of hand held electronic devices to self-record overt and covert behaviors, setting events, physiological measures, and antecedent events (Nock, Prinstein & Sterba, 2009; Smyth & Stone, 2003). Third party and self-assessment forms of ecological assessment raise both validity and reliability concerns. MEA's have an advantage over ecological assessments that rely on delayed recording strategies in that they provide a means of recording private events with only short delays between the private event and its recording.

Alessi & Kaye (1983) developed a form of ecological assessment based on operant psychology. The assessment, referred to as *automatic graphing*, involved a paper and pencil method of recording direct observation data that eventually resulted in a graph. Included in the method of automatic graphing was the simultaneous recording of comparison children seated near the targeted child, resulting in a type of local norm in which all children were under most of the same stimulus conditions and setting events. Ninness, Glenn, and Ellis (1993) used the term *rotation scan* to describe the procedure of systematically recording direct observation data for a targeted child in comparison to a composite child made up from data taken in equal proportions from two or more children within the setting, and recorded at the same time as the targeted child.

From a contemporary behavior analytic perspective, normative standardized testing strategies may be insufficient when trying to make predictions regarding how individuals or small groups are likely to behave during unstructured interactions. Normative standardized testing procedures generally do not allow for unstructured interaction between the individual's behavior and events occurring within an authentic setting. As Alessi and Kaye (1983) suggested, "Since behavior is specific to the environmental (ecological) context in which it occurs, national standardized norms would be of little direct help when interpreting local school data" (p. 4). Since each individual's behavior is continually interactive with dynamic setting events, normative assessment procedures are unlikely to predict prosocial or maladaptive behaviors that are specific to time and setting. Behavior analysts use their understanding of behavioral processes to develop technologies appropriate to the natural setting in which problem behaviors may occur. Rather than relying on normative sampling procedures and psychological constructs, MEA strategies make use of human observers who function as "transducers between the behavior and the record of that behavior" (Repp, Roberts, Slack, Repp, & Berkler, 1976, p. 501).

FBA procedures are predicated on the understanding that behavior serves a purpose for the individual and is maintained by dynamic environmental conditions. Thus, FBA procedures attempt to ascertain the variables interact with the occurrence of maladaptive behaviors. Before

FBA's are conducted, rotation scans may be employed to obtain samples of related features of the targeted behaviors and to obtain comparisons with non-targeted individuals. Rotation scans permit assessment of a wide range of behaviors within a given specific ecological context that includes common setting events, people, their behavior, recent interactional history, and other contextual variables. We are not recommending that a rotation scan be employed as an alternative to FBA; however, rotation scans can provide setting specific normative data that the FBA does not provide, potentially leading to different hypotheses regarding the variables responsible for any problem behaviors and subsequently leading to different interventions. Additionally, rotation scans can provide preliminary data that may help generate hypotheses to be tested in the FBA (e.g., Davis, Ninness, Rumph, McCuller, Ward, & Vasquez, 2008).

In a school context, students in regular education settings may be referred to a school psychologist or behavior analyst for exhibiting a wide range of problem behaviors. Prior to assuming that a student is conducting himself or herself in some unusual or maladaptive way, it is only reasonable that we should have some evidence pertaining to what students in the same context are doing. If students in the same academic setting are concurrently involved in high rates of inappropriate behaviors, then the referred student's behavior is "normal" given the setting events occurring within the classroom since non-referred students are behaving in a similar manner. However, if students in the same academic setting do not exhibit high rates of inappropriate behaviors, then the referred student's behavior might be viewed as "maladaptive" relative to the local norm. By conducting rotation scans of the referred student across settings within the same school, the school psychologist or behavior analyst can determine if the referred student's "maladaptive" behavior is specific to any particular setting. If the maladaptive behavior appears in only one setting within the school, then it strongly suggests that the referred student's maladaptive behavior is evoked by a set of particular conditions occurring only in the one setting. On the other hand, if the referred student's behavior is consistently inappropriate across school settings, it is likely that each setting has commonly shared conditions that evoke the inappropriate behaviors. In the same sense that an FBA provides contextual details regarding the particular conditions in which some types of problem behaviors are more likely to emerge, a rotation scan provides the behavior analyst or school psychologist with another assessment of environmental variables that may influence the probability of problem behaviors occurring.

In its original paper and pencil format, Alessi & Kaye (1983) developed an *automatic graphing* assessment strategy in which X's and O's were marked on a recording sheet to indicate the occurrence of the target behavior during each interval. At the conclusion of the observation session, the design of the columns and rows on the recording sheet yielded a bar graph depicting the frequency of the target behavior for the individual of interest as compared to the other observed individuals in the same environment. However, even with practice, the procedure was awkward in that the recording occurrences of targeted behavior necessitated the use "recording windows" in conjunction with "observation windows." For example, if the observer were employing 30 s partial interval recording, 25 s might be allocated to focusing on the target individual in conjunction with one of the three comparison individuals. At the end of this period, 5 s were allocated to placing an X or an O within the designated cell of the emerging paper and pencil automatic graph. Suffice it to say, the process of reliably tracking time in conjunction with behavior occurrences and non-occurrences emitted by different students at different points in time was "challenging." Using an electronic version of the above strategy, we have developed software that provides a more efficient and user intuitive system for accomplishing the same observation strategy while providing graphical illustrations that lend themselves to immediate

outcome interpretations by behavior analysts, school personnel, parents, and/or other caregivers. Even in its original paper and pencil format, this type of preliminary direct observation system appears useful in conducting an FBA in that it identifies the extent to which a referred student engages in dysfunctional behavior/s relative to a local norm (see Davis, Ninness et al., 2008, for a discussion).

Electronic Automatic Graphing

An electronic version of automatic graphing may provide a convenient way to implement the paper and pencil version of the automatic graphing process first described by Alessi and Kaye (1983). On laptop computers or hand held devices, the software allows the user to conduct real time direct observations of the referred individual and peers who are behaving concurrently in the same physical setting and experiencing similar setting events. Subsequent to selecting the interval width and session length, the observer records the maladaptive behavior occurrence/s in accordance with the operational definitions predicated on a review of the referred individual's records, previous informal observations, and discussions with teachers, administrators, caregivers, and other relevant sources. Figure 1 represents our Visual C# version of automatic graphic architecture, where the interval width and session length buttons are selected prior to initiating the observation session. Using partial-interval recording, the interval button allows each observation to be set in accordance with the operational definition of the problem behavior. Depending on the type of behavior the referred individual may be exhibiting, the observer may employ 5 s, 10 s, 30 s, or 1 min partial intervals. A commonly employed rule of thumb is the more frequently the problem behavior occurs, the shorter the interval width should be (Ninness et al., 1993).

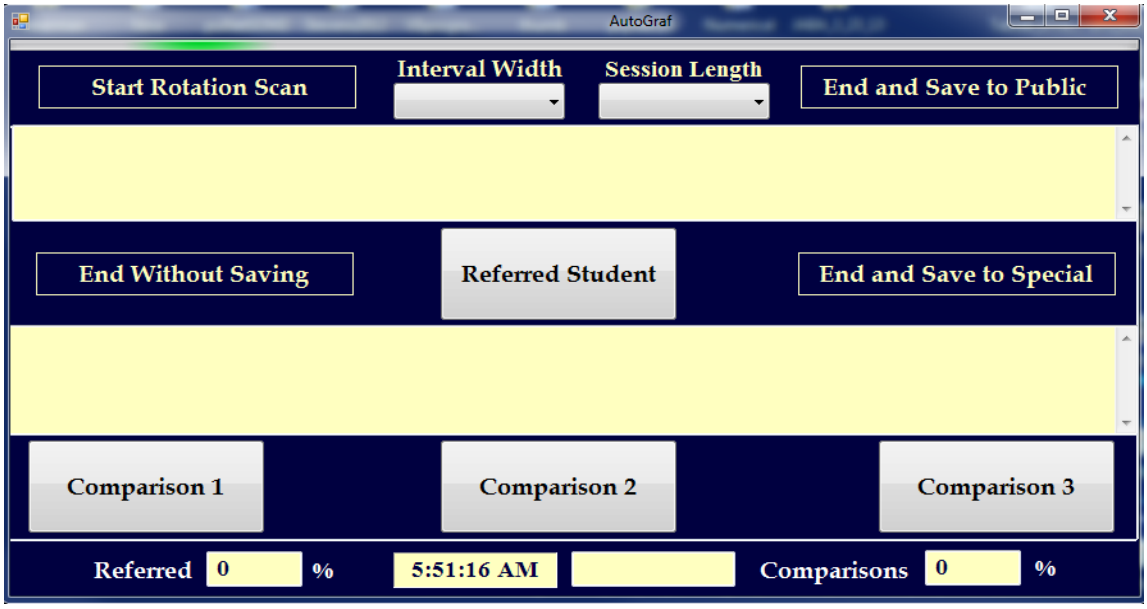

Figure 1. An illustration of our freely available Visual C# version of automatic graphic software. In this illustration, the interval width and session length buttons are selected prior to initiating the observation session

An observer can use our electronic rotation scan software to concurrently record the behavior of the referred individual and the behaviors of individuals identified as members in a comparison group. Ideally, when implementing the rotation scan, the individuals in the comparison group should be closer in proximity to the referred individual than individuals who are not part of the comparison group. This arrangement will ensure that all relevant factors influencing behavior within the setting are as similar as possible, and it will maintain optimal conditions for observation of all individuals being observed. The observer attends in a rotating sequence to one of the comparison group members and to the referred individual during each interval. The observer presses the relevant key, or button, to indicate an occurrence of the predefined behavior for the comparison member and/or the referred individual. At the end of each interval, the program automatically updates the data file that will, at the end of the observation period, yield a percentage of intervals during which the recorded observations occurred. The observer repeats the procedure in the next interval for another comparison member while continuing to record for the referred student. Each new interval then moves to the comparison students in a rotating sequence until the total session/observation period is reached.

Employing a 30 s partial-interval observation as an exemplar, the program continually displays the "Referred Student" button in the top panel. In the event the observer clicks this button during any part of the 30 s interval, the interval is closed until the beginning of the next interval (see middle panel of Figure 2, labelled Referred Student). Concurrently, the comparison group buttons are displayed successively in 30 s cycles within the panel immediately beneath the “Referred Student” button (see bottom panel of Figure 2, labelled Comparison 1, Comparison 2, and Comparison 3). That is, as each comparison student window for observation opens, his/her button becomes visible for the duration of the 30 s interval. At the close of the interval, the button disappears from the panel, and the next comparison student’s button becomes available for clicking, should the occasion arise. This rotating cycle of comparison student buttons continues throughout the duration of a given session.

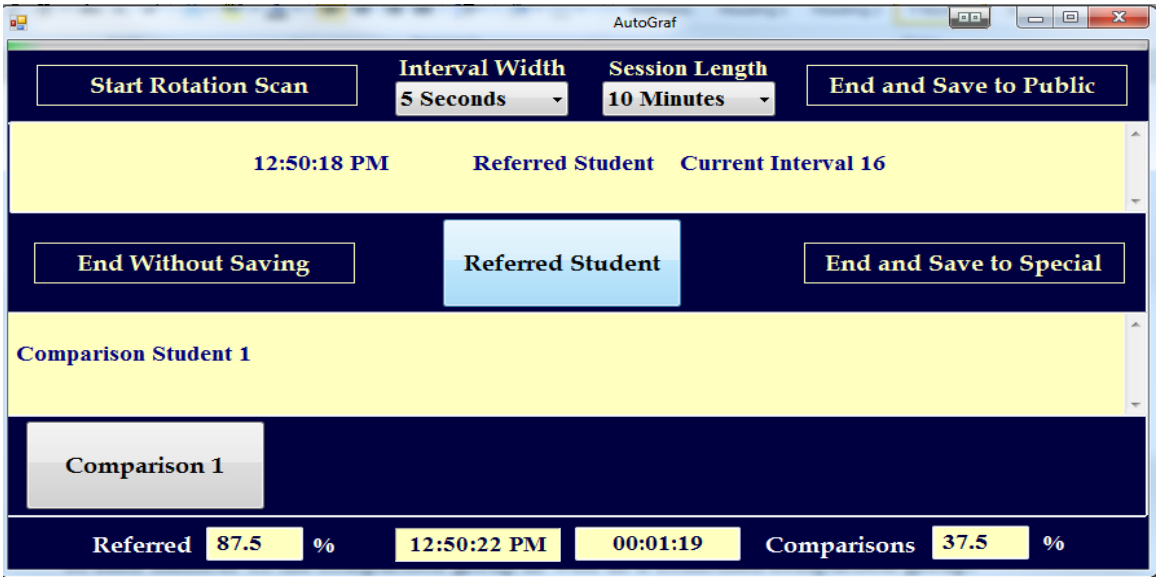

Figure 2. Employing a 30 s partial-interval observation as an exemplar, the program continually displays the "Referred Student" button in the top panel.

There are three ways in which the program can be closed whilst saving the entire set of aggregated data. As per Figure 1, the observer may select the "End and Save to Public" button. This option will close the program and concurrently save the data within the user's public folder as a CSV file named "Data1" by default. On the other hand, the program can be closed by clicking the button labeled "End and Save to Special." This option allows the user to close the program and save the file to any desired location within the computer. Alternatively, the observer can simply wait until the designated session time has elapsed and allow the program to close while saving the aggregated session data to the public folder in the form of a CSV file named "Data1."

When the CSV file is opened, the recorded/aggregated data is displayed at the bottom of the file such that the user can easily generate a graph by highlighting the block of descriptors and values within their respective fields. Figure 3 illustrates the saved CSV file where the hypothetical data show the Referred Student demonstrating problem behavior/s at 82.35 percent of the observed intervals whilst the three Comparison Students were identified as performing problem behaviors at 11.76, 11.76, and 11.76 of the observed intervals, respectively. In this conjectural example, the combined local norm appears substantially lower than the level of problem behavior emitted by the referred student.

Figure 4 shows the graph of these calculations that is quickly obtained as a function highlighting these fields by typing "F11" within the CSV file. The first bar in the hypothetical illustration shown in Figure 4 indicates the level of maladaptive behavior emitted by a referred individual during one 20 min observation session. The second, third, and fourth bars represent

	A	B	C	D	E
34	12:50:13 PM			15	
35	12:50:16 PM	ref stu		15	
36	12:50:18 PM			16	
37	12:50:20 PM	ref stu		16	
38	12:50:23 PM			17	
39					
40		Referred Student	82.3529412		
41		Comparison Student 1	11.7647059		
42		Comparison Studemt 2	11.7647059		
43		Comparison Studemt 3	11.7647059		
44		Combined Comparisons	35.2941176		
45					

Figure 3. Illustrates the saved CSV file employing hypothetical observations where the Referred Student exhibited dysfunctional behavior during 82.35 percent of the observed intervals whilst the three Comparison Students displayed problem behaviors at 11.76, 11.76 and 11.76 percent of the observed intervals.

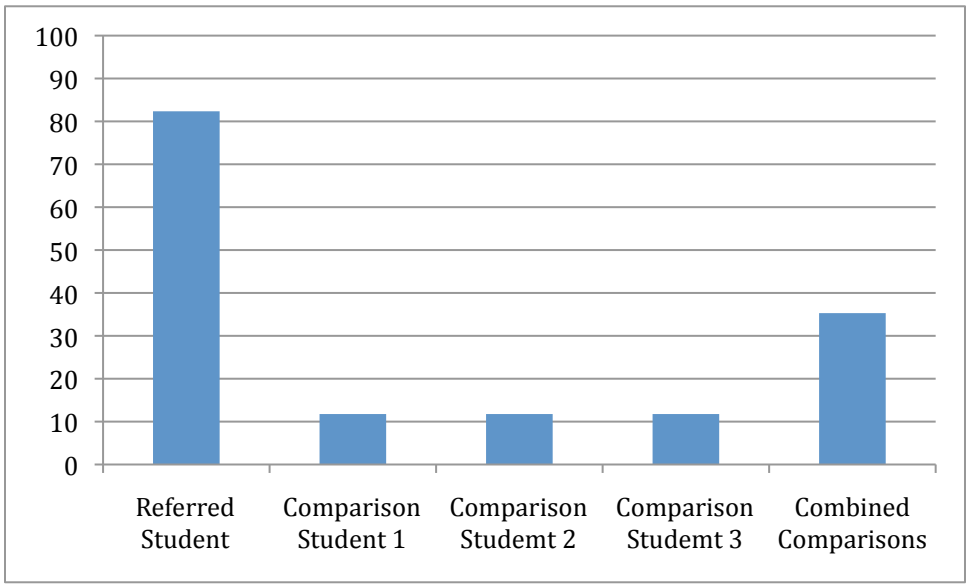

Figure 4. Shows the graph of the calculations that is obtained by simply highlighting the relevant fields shown in Figure 3 and typing "F11" within the CSV output file.

the percentage of intervals in which maladaptive behaviors were demonstrated by the referred individual and by each of the comparison individuals during the same observation session. The fifth bar represents a composite of the three comparison students in the form of a single bar. Given that each of the three comparison students were observed on a "rotating basis" [during one third of the session observations], this composite bar represents a practical localized norm. The graphical outcome provides a visual display that allows teachers, administrators, and parents to easily determine the degree to which the referred student is engaged in the observed behavior/s as compared to his or her peers. This determination allows for specific recommendations rather than speculations as to the degree to which the stated problem exists and the need for further data collection prior to intervention.

As with the original paper and pencil version of this system developed by Alessi and Kaye (1983), the composite recording of comparison behavior provides a local "norm" for the emergence of inappropriate behaviors in a particular context during the same time and under the same conditions as that of the referred student's behavior. The local norm is useful in determining the degree to which the referred student's behavior varies from that of other students in the same classroom. This local norm may have more practical use than comparing the referred student to a nationally averaged normative reference group.

Considerations in making simultaneous recordings on a referred student and a comparison group include the number of members in the comparison group and the discrete types of behavior being observed. As per Alessi and Kay (1983), employing three comparison students/individuals who are positioned relatively nearby the referred individual allows reliable recording while generating a practical and functional local norm. The observation becomes more complex as the number of comparison group members increase and as the types of behavior being observed increases.

Connecting to other devices

Our rotation scan software can be downloaded from Splashtop.com and deployed to any Windows-based operating system. We have found that employing laptop computers is one fairly convenient way to utilize this observation/graphing procedure. Alternatively, to remain as unobtrusive as possible, use of a low profile hand held technology device eliminates the need to use a traditional desk or laptop working space. Making a remote access connection from an iPhone or iPad to a desktop or laptop employing a Windows-based operating system has been made relatively simple with the use of Splashtop. Splashtop is a remote software application that, once downloaded on both devices, allows the user to simply click on the Splashtop application to access and control his/her computer from the portable computing device. Prior to its first use, Splashtop Streamer is downloaded onto the Windows-based computer from www.splashtop.com, and a Splashtop account is created. Before making the local connection, this account is activated by logging into it. When active on the desktop, the Splashtop Streamer provides the status of remote devices that are actively linked and ready to use. The user's portable computing device, such as an iPad or iPhone, requires purchase of the Splashtop application from an app store. The connection between the portable computing device and another Windows-based computer is made possible through the Splashtop's server. Since the hand held device is usually small and easily held while the observer is standing, sitting, etc., the observer can quickly move while using the device. This allows for easier and more accurate recording than attempting to hold and use some type of (relatively large) laptop computers.

Discussion

Rotation scan software provides a convenient way to implement the automatic graphing process first described by Alessi and Kaye (1983) while allowing interobserver agreement to be obtained. On laptop computers or hand held devices, the software allows the user to conduct real time direct observations of the referred individual and peers who are behaving concurrently in the same physical setting and experiencing similar setting events. The resulting data can be instantly graphed, permitting an immediate analysis/comparison of the referred individual's behavior relative to local norms. Rotation scans represent a direct observation approach to ecological assessment and the development of local norms that are independent of the assumptions pertaining to normal curve theory. This system provides a different (but complementary) type of behavior examination than that produced by a FBA. The rotation scan architecture allows an ecological assessment of the referred individual's behavior in comparison to a composite of the behavior from nearby peers. As such, the composite data generates a local norm for the setting under the specific conditions extant when the data was recorded. The referred student's data can then be compared with the normative data for the setting under the observed natural conditions. Subsequently, inferences then can be made regarding potential causes, possible interventions, and/or the need for additional assessments strategies.

Alessi and Kaye (1983) considered automatic graphing as an assessment to be used in schools with children. However, the logic in the implementation of rotation scans does not change when being used in settings other than public schools. During the course of three separate 25 min observations, field testing of our rotation scan software has generated interobserver agreements at 93.33%, 94.78% and 100% within public school settings; however, empirical studies from a variety of different settings are needed to establish the utility of this assessment

strategy as applied to settings outside schools, such as hospitals, clinics, and other clinical care facilities.

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