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The Dynamic Analog Scale: A generic method for single-item measurement[☆]

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ABSTRACT

The Dynamic Analog Scale (DAS) is introduced as a technique for generating single-item measures of personality traits. The DAS is comprised of extensive trait definitions and an analog scale on which respondents simultaneously rate themselves and others. In two studies the Big Five personality traits were assessed with the DAS and compared to a multiple-item questionnaire that measured the same traits. Statistical analysis supported the validity of the DAS for predicting self-reported behavioral acts, drinking behaviors, affect, and religiosity in ways similar to the multiple-item questionnaire. Consistent with previous research, both studies supported the viability of measuring personality traits with single items.

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1. Introduction

Psychologists have in recent years begun to recognize the viability of single-item questionnaires. Job satisfaction (Nagy, 2002), subjective assessments of pain and fatigue (Butt et al., 2008), and attitudes towards advertisements (Bergkvist & Rossiter, 2007) and the Big Five personality traits (Woods & Hampson, 2005), among other constructs, have all been effectively assessed with single items. Contrary to commonly held notions guided by classic psychometric theory, the cited studies have shown that single-item questionnaires can yield data with adequate test–retest reliability, predictive validity, and construct validity. Practitioners have also long recognized the many practical benefits (viz., brevity and ease of administration) of working with single-item questionnaires such as the Clinical Global Impressions Scale (Busner & Targum, 2007) and Global Assessment Functioning Scale (American Psychiatric Association [DSM-IV-TR], 2000). The coupling of practical advantages and sufficient psychometric properties indicates that single-item questionnaires are viable alternatives to multiple-item questionnaires in the assessment of psychological constructs.

In this paper we introduce a generic and flexible technique, the *Dynamic Analog Scale* (DAS), for constructing single-item questionnaires. We also present the results of two studies that support the

efficacy of this novel approach for assessing the Big Five personality traits.

1.1. The Dynamic Analog Scale

An example DAS for the construct “Extraversion vs. Introversion” is shown in Fig. 1 as it is generated by the Idiogrid program (Grice, 2002). As can be seen, a vertical continuous rating scale is anchored by extreme terms: “The Most Extraverted Person Imaginable” and “The Most Introverted Person Imaginable.” Accompanying the scale are instructions on how the ratings are to be made (viz., by dragging and dropping the name labels onto the scale) and detailed definitions regarding the bipolar construct that comprises this particular scale. The definitions for a given DAS are written by the psychologist on the basis of theoretical precepts. The people to be rated are provided by the respondent. Other figures (e.g., characters from books or movies), various selves (e.g., ideal self, ought self), or reference groups (e.g., the typical American, the typical man my age) can also be included in the list of people to be rated. Once the people are initially placed on the scale, they can be moved around, placed on the same point of the scale (e.g., see “Mom” and “My Self” in Fig. 1), or removed from the scale if the respondent is uncertain in his/her ability to judge a particular person.

A number of features thus distinguish the DAS from traditional analog scales or multi-point rating scales, and these features can be seen as extensions of previous research on single-item measurement and scaling. First, extensive definitions of the anchors are provided to the respondent (Woods & Hampson, 2005). Second, the person rates himself or herself in the context of others (i.e., his or her “social network”) and can move the people around on

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Fig. 1. Example Dynamic Analog Scale for the Extraversion/Introversion trait.

the scale during the rating process or remove a person from the scale (Denissen, Geenen, Selfhout, & Van Aken, 2008; Goffin, Jelley, Powell, & Johnston, 2009). Lastly, extreme terms are used to anchor the scale in order to control for individual differences in interpreting the end-point labels (Bartoshuk et al., 2002).

We assessed the efficacy of the DAS in two initial studies. First, we assessed the predictive validity of the DAS with regard to self-reported behavioral acts. According to Grucza and Goldberg (2007) behavioral act reports provide efficient and meaningful benchmarks for comparing and contrasting personality inventories. We therefore compared the predictive validity of the DAS and a popular multi-item measure of the Big Five personality traits with regard to self-reported behavioral acts. From the standpoint of classical test theory reliability is necessary but not sufficient for validity, and when assessing single item questionnaires test-retest stability comes to the forefront as the most useful index of reliability. In Study 2, we therefore addressed the immediate and approximate 2-week test-retest reliability of DAS ratings while again assessing their predictive validity regarding a number of different consequential outcomes.

2. Study 1

2.1. Method

Data were obtained from 113 undergraduates (46 males, 67 females; mean age = 21.10 years, SD = 3.30; 76.1% Caucasian)

who received course credit in exchange for participation. Approximately half of the participants ($N = 54$) completed a popular 50-item measure of the Big Five personality traits (retrieved from <http://ipip.ori.org/ipip/>; Goldberg et al., 2006) by judging the accuracy of self-descriptive statements (e.g., "I insult people", "I worry about things") using a 5-point Likert-type scale. This Big Five Questionnaire (BFQ) assessed Extraversion, Emotional Instability (Neuroticism), Agreeableness, Conscientiousness, and Intellect. Cronbach alphas ranged from .75 to .92.

The remaining participants ($N = 59$) completed the Dynamic Analog Scale based on six bipolar traits (Extraverted/Introverted, Agreeable/Disagreeable, Conscientious/Unconscientious, Emotionally Unstable/Emotionally Stable, Open-Minded/Close-Minded, and Intelligent/Unintelligent) with extensive definitions like those shown in Fig. 1.¹ Participants completed the DAS by first providing the names of 12 "marker individuals" (Grice, Jackson, & McDaniel, 2006) who fit the definitions for the poles of the six traits (e.g., "the most conscientious person you know personally") and writing brief statements describing how each individual demonstrated the trait in his or her behavior (e.g., "His house, just like his life, is very disorganized" for unconscientious person). Participants then simultaneously rated the 12 people and their *actual*

¹ The DAS definitions for Studies 1 and 2 can be obtained from the author. A more complete report of the results from both studies is also available as is a more thorough description of the theoretical rationale behind the construction of the Dynamic Analog Scale.

Table 1
Dynamic Analog Scale and Big Five Questionnaire correlations with five act components and Self-Esteem, Study 1.

Act components	E	A	C	N	I	O
<i>Dynamic Analog Scales</i>						
Gregariousness	.56**	.26*	.02	-.18	-.07	-.09
Drinking Behavior	.02	-.35**	-.20	.06	.13	.21
Isolation-Antagonism	.00	-.05	-.13	.11	.07	.10
Reading	-.16	.06	-.01	-.30*	.43**	.18
Creative Endeavors	.27*	.07	-.05	.26*	-.03	.08
Self-Esteem	.11	.18	.18	-.42**	.09	-.06
<i>Big Five Questionnaire</i>						
Gregariousness	.48**	.47**	.10	-.16	-.03	
Drinking Behavior	.25	-.23	-.19	.07	-.09	
Isolation-Antagonism	-.30*	-.31*	-.17	.14	-.11	
Reading	-.06	.38**	.22	-.29*	.38**	
Creative Endeavors	-.22	-.17	-.03	.11	.08	
Self-Esteem	.21	.07	.26	-.52**	-.02	

* $p < .05$, two-tailed.

** $p < .01$, two-tailed.

and *ideal selves* (14 people, total) on each of the dimensions. The DAS was administered in Idiogrid (Grice, 2002) which automatically delineates a scale that yields scores ranging from -200 to +200.

After completing the BFQ or DAS participants responded to 61 behavioral acts (e.g., "I hugged someone", "I broke a promise") that were collated from previous studies of human personality (Buss & Craik, 1981, 1983; Gruzca & Goldberg, 2007). Participants were asked to rate how often they engaged in the behaviors on a 5-point Likert-type scale ranging from "never in my life" (scored 0) to "more than 12 times in the past year" (scored 4). The act ratings for the 113 participants were reduced to five, Varimax-rotated orthogonal principal components that explained 38.56% of the total item variance. Based on the factor score coefficients and loadings (see Grice, 2001) the components were labeled (*Gregariousness, Drinking Behavior, Social Isolation-Antagonism, Reading, and Creative Endeavors*) and then scored using Thurstone's regression technique based on all 61 items. Finally, participants completed the Rosenberg Self Esteem Inventory (Rosenberg, 1965) using a 7-point Likert-type scale ($\alpha = .87$).

2.2. Results

Descriptive statistics indicated that for both the *actual self* ratings on the DAS and the BFQ scale scores the typical student construed himself or herself as extraverted, agreeable, conscientious, emotionally stable, and intelligent or open. The predictive validity coefficients between the two sets of trait measures and the five act frequency component scores and Rosenberg Self-Esteem Inventory are presented in Table 1. As can be seen, the overall pattern of correlations was highly similar for the DAS and BFQ. In fact, z -tests indicated that only the correlation between the Writing Behavior component and Extraversion was significantly different between the DAS ($r = .27$, $p < .05$) and BFQ ($r = -.22$, $p < .11$) groups ($z = 2.57$, $p < .01$, two-tailed). For the DAS group Writing Behavior was weakly associated with Extraversion while for the BFQ group Writing Behavior was weakly associated with introversion. It is also of interest to note that Reading was significantly correlated only with DAS Intellect and not with Openness, thus indicating that the two measures were not identical even though they were moderately correlated ($r = .55$, $p < .01$).

3. Study 2

In Study 2 we sought to directly compare the DAS and BFQ in predicting drinking behaviors, religiosity, and affect, which are

considered "consequential outcomes" in personality research (see Ozer & Benet-Martinez, 2006). Reliability was also addressed by administering the DAS three times on two different occasions to measure immediate and approximate 2-week test-retest stability. Finally, the DAS definitions were modified to increase their readability and to decrease the potential desirability of some of the trait poles (e.g., neuroticism is not a desirable self-description). Trait terms were also replaced by generic labels (e.g., "A-1" for agreeableness, "1-A" for disagreeable) in the definitions and on the scale anchors.

3.1. Method

One-hundred fifteen undergraduates (45 males, 70 females; mean age = 19.96 years, $SD = 3.29$; 80% Caucasian) participated in exchange for course credit. Of these participants, 87 (76%, 34 males, 53 females) returned for the second testing occasion, although complete data were obtained for only 75 participants.

DAS definitions were written for the Big Five traits: Extraverted/Introverted, Agreeable/Disagreeable, Conscientious/Unconscientious, Emotionally Stable/Emotionally Unstable, and Open-Minded/Close-Minded. Intellect was omitted to reduce participant fatigue. For approximately half of the participants, the generic labels in the extended definitions were reversed (e.g., A-1 was disagreeable, 1-A was agreeable) as was the order in which the trait descriptions were presented for each pair and on the rating scale.

Participants also completed, in counterbalanced order, the Daily Drinking Questionnaire (DDQ; Dimeff, Baer, Kivlahan, & Marlatt, 1999) that assessed the estimated number of weekly drinks consumed; the Drinking Frequency Questionnaire (DFQQ; Dimeff et al., 1999) that assessed the highest number of drinks consumed on a single occasion (1 = "no drinks" to 11 = "19 or more"); the Positive Affect Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; Cronbach's alphas ranged from .79 to .88); the Religious Orientation Scale (ROS; Allport & Ross, 1967) that yielded scores for Internal Religiosity and External Religiosity (alphas: .74 to .91); and the 50-item Big Five Questionnaire used in Study 1 (alphas: .82 to .91).

Participants were tested on two occasions separated by 1–3 weeks ($M = 9.73$ days, $SD = 4.03$ days). On the first occasion participants initially completed the DAS as described above. They then completed the PANAS, DDQ, DFQQ, and ROS in counterbalanced order. After completing the questionnaires, participants again rated the same people (self, ideal self, and ten others) from the initial DAS using the same trait definitions presented in the same order. For the second testing occasion the participants began by first rating the same people from the first occasion on the DAS. The order in which the pairs of trait labels were presented (e.g., "A-1" vs. "1-A", as described above), however, was randomly determined. Participants then completed the PANAS, DDQ, DFQQ, ROS, and the BFQ in counterbalanced order. The BFQ was not administered on the first occasion due to concerns of fatigue resulting from conducting the DAS ratings twice.

3.2. Results

With regard to the ratings for the *actual self* on the DAS, the participants were highly consistent across the two administrations for the first occasion. Specifically, the Pearson correlations between the actual self ratings were all above .80 for Extraversion (.85), Agreeableness (.85), Conscientiousness (.85), Neuroticism (.81), and Openness (.86) ($Mdn = .85$). Comparisons of the first and second administrations of the DAS to the third administration conducted approximately 2 weeks later yielded less impressive correlations. The correlations between the actual self ratings from the first DAS grid on the first testing occasion and the actual self

Table 2
Pearson correlations between Dynamic Analog Scale ratings, Big Five Questionnaire, and external criteria, Study 2.

Criteria	First occasion					Second occasion									
	Dynamic Analog Scale					Dynamic Analog Scale					Big Five Questionnaire				
	E	A	C	N	O	E	A	C	N	O	E	A	C	N	I
Drinks per week	.02	-.03	-.21*	-.04	-.07	.05	.01	-.01	-.15	-.09	.15	-.03	.10	-.13	-.04
Most drinks	.02	-.16	-.17	-.08	-.12	-.04	-.07	.10	-.19	-.08	.09	-.11	.13	-.06	.07
Negative Affect	-.33**	.00	-.20	.42**	-.15	-.23*	.06	-.15	.42**	-.10	-.18	.00	-.12	.57**	.09
Positive Affect	.24*	.27**	.25*	.06	.26*	.27*	.18	.24*	-.05	.11	.42**	.16	.20	-.22*	.20
Internal Religiosity	.22*	.29**	-.01	.21*	-.06	.13	.17	-.18	.26*	-.05	.18	.23*	-.11	.11	-.22*
External Religiosity	-.01	.22*	.02	.15	-.10	-.04	.28**	.03	.16	-.06	-.09	.21*	-.05	.29**	-.21*

Note: Values for First Occasion are based on averaged actual self ratings. Despite significant skewness in the drinking measures, Spearman's ρ correlations were highly similar to the tabled Pearson correlations.

* $p < .05$, two-tailed.

** $p < .001$, two-tailed.

ratings from the second testing session were lower (.60–.75, $Mdn = .67$), as were the correlations between the actual self ratings from the second DAS grid on the first occasion and the self ratings from the second testing session (.63–.82, $Mdn = .69$). The immediate consistency for the DAS was thus higher than the approximate 2-week consistency.

By way of comparison, the test-retest correlations (listed in parentheses) for the PANAS Positive (.70) and Negative (.70) Affect scales and for the ROS Internal (.94) and External (.86) orientation scales were in the moderate to high range. The total number of drinks consumed weekly was also fairly stable across testing occasions (.81) as was the estimated highest number of drinks consumed on a single occasion (.93).

Given the high correlations between test administrations the two DAS grids from the first testing occasion were averaged. The mean actual self ratings were then correlated with the drinking, emotion, and religiosity measures, and the results reported in Table 2. As shown, the DAS ratings for the Big Five traits were statistically related to a number of the external criteria.

Table 2 also shows these results were highly similar to those for the second testing occasion with regard to the magnitudes and signs (not necessarily the statistical significance) of the correlation coefficients. Several differences were noted, however; foremost, the assessed drinking behaviors were not significantly correlated with any of the Big Five traits on the second occasion. On the first occasion, the estimated number of drinks per week was negatively correlated with Conscientiousness. Additional minor differences can be seen in the table.

The correlations between the DAS actual self ratings and corresponding BFQ scale scores were all positive and moderate in magnitude. The lowest correlation was observed for DAS Openness and BFQ Intellect ($r = .22$), which is not surprising given these constructs are not identical, as shown in Study 1. The other correlations ranged from .54 (Agreeableness) to .64 (Neuroticism/Emotional Instability).

In order to evaluate the unique predictive capability of each measured trait, the DAS actual self ratings and BFQ scale scores were entered into multiple regression models. The different criteria served as the dependent variables in the models. Each model was evaluated for assumptions and statistical anomalies, and results revealed significant skew in the residual values for all but the Internal and External Religiosity dependent variables. Consequently, a more conservative p -value of .01 was used to determine statistical significance for the offending models.

Results of the analyses for the two drinking dependent variables mimicked the correlations reported in Table 2; specifically, the overall regression models were not statistically significant (R^2 values $< .11$), although the regression weight for the DAS Neuroticism actual self ratings as a predictor of the maximum number of drinks

was nearly significant ($\beta = -.34$, $p < .024$). The regression model for Negative Affect was significant ($R^2 = .45$, $p < .001$), with the BFQ Neuroticism ($\beta = .53$, $p < .001$) scores as the only significant predictor; whereas Positive Affect was significantly ($R^2 = .28$, $p < .004$) predicted from BFQ Extraversion ($\beta = .39$, $p < .010$). With regard to the two ROS scales, Internal Religiosity was significantly predicted ($R^2 = .26$, $p < .009$) from BFQ Intellect ($\beta = -.31$, $p < .014$) and DAS Neuroticism ($\beta = .29$, $p < .040$), whereas External Religiosity was predicted ($R^2 = .30$, $p < .002$) from BFQ Neuroticism ($\beta = .38$, $p < .007$), BFQ Intellect ($\beta = -.34$, $p < .006$), and DAS Agreeableness ($\beta = .29$, $p < .028$). The absolute magnitudes of these effects were not very large, but they indicated that, when competing for the same variance in consequential outcomes, the explanatory power of the DAS was comparable to the BFQ.

4. Discussion

The results of these two studies offer initial support for the Dynamic Analog Scale (DAS) as a generic, viable approach for single-item measurement. Participants completed the novel procedures with very little difficulty in both studies, and examination of the exemplary behaviors listed by the participants for the people they named for each of the traits also revealed clear understanding of the definitions. In both studies the participants generally rated themselves as extraverted, agreeable, conscientious, emotionally stable, and intelligent or open on the DAS. This general profile was also found for the 50-item Big Five Questionnaire (BFQ) scale scores. In Study 2 the ratings for the *actual self* on the DAS were found to be highly correlated with the BFQ, and the test-retest reliability coefficients also compared favorably across the two measures. These results were consistent with other studies supporting single-item measures of self-report constructs (e.g., Woods & Hampson, 2005). As has been pointed out, however, predictive validity is the most important criterion for judging the efficacy of brief and single-item measures (Burisch, 1997), and in this regard very few differences were found between the DAS and the BFQ. Both measures modestly predicted Gregarious and Reading behaviors and Self Esteem in Study 1, and affect and religiosity in Study 2. While a few differences were noted, overall the effect sizes for both the DAS and BFQ were not very large, thus failing to yield a clear advantage for either measure. The effect sizes were moreover typical of those reported in other studies of the Big Five personality traits; and the general conclusion to therefore be drawn is that the DAS is as effective in predicting consequential outcomes as the BFQ and other multiple-item questionnaires, but consistent with prior research the validity coefficients are modest in magnitude.

Given the DAS was not statistically superior to the 50-item BFQ in these two studies, the argument could be made that the latter

method is to be preferred. After all, the BFQ is freely available and can be conveniently administered in paper-and-pencil format, via a computer program, or even via the Internet. The BFQ also has a longer track record regarding its psychometric properties which can readily be understood in the context of the classical true score or domain sampling models. Nonetheless, there are a number of attractive features of the DAS that warrant further investigation and may yet prove its superiority. First, the DAS is flexible and permits discriminating between constructs that may have subtle differences. Study 1 above demonstrated that Intellect and Openness to Experience can be defined uniquely to yield significant differences, and potentially improvements, in predictive validity coefficients. The analog-like structure of the DAS may additionally be considered as propitious for maximizing predictive validity compared to single item Likert-type scales (Russell & Bobko, 1992), and the work of Goffin and his colleagues (2009) indicates that ratings involving social comparisons may also help maximize criterion validity. Second, the work of Bartoshuk and her colleagues (2002) on “supertasters” has shown that using extreme anchors on rating scales may control for different internal set-points individuals may attach to the scale labels. Manipulating the scale anchors may also provide an avenue to explore personality disorders using the Big Five or other traits. Recent research has in fact begun to employ just such a strategy in conceptualizing personality disorders as extreme manifestations of dimensional traits (Mullins-Sweatt, Jamerson, Samuel, Olson, & Widiger, 2006). “Excessively introverted” and “excessively agreeable” are examples of scale anchors used in this novel research. Third, the DAS may prove useful in cross-cultural studies of personality that rely on the translation of inventory items (e.g., Möttus, Pullmann, & Allik, 2006). Given that the DAS uses extensive trait definitions, greater care can be taken to insure that the persons understand the meaning of the translated terms. In summary, the DAS is a flexible and generic technique with a great deal of potential to measure a variety of self-report constructs, and results from the two studies above support its continued investigation.

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