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Development and Preliminary Validation of a New Measure of Values in Scientific Work

Tammy English¹, Alison L. Antes², Kari A. Baldwin², and James M. DuBois^{1,2}

¹Department of Psychological & Brain Sciences, Washington University in St. Louis, One Brookings Drive, Campus Box 1125, St. Louis, MO 63130, USA

²Division of General Medical Sciences, Washington University School of Medicine, 4523 Clayton Avenue, Campus Box 8005, St. Louis, MO 63110, USA

Abstract

In this paper we describe the development and initial psychometric evaluation of a new measure, the Values in Scientific Work (VSW). This scale assesses the level of importance that investigators attach to different values in scientific work. It taps a broad range of intrinsic, extrinsic, and social values that motivate the work of scientists, including values specific to scientific work (e.g., truth and integrity) and more classic work values (e.g., security and prestige) in the context of science. Notably, the values represented in this scale are relevant to scientists regardless of their career stage and research focus. We administered the VSW and a measure of global values to 203 NIH-funded investigators. Exploratory factor analyses suggest the delineation of eight values in scientific work, including autonomy, research ethics, social impact, income, collaboration, innovation and growth, conserving relationships, and job security. These values in scientific work showed predictable and distinct associations with global values. Implications of these findings for work on research integrity and scientific misconduct are discussed.

Keywords

values; research integrity; research ethics; responsible conduct of research; measurement; Values in Scientific Work

The concept of values has long been considered central to the understanding of human behavior (Locke, 1976; Rokeach, 1973). The organizational behavior literature has been particularly concerned with the role of values in understanding career choices and job performance (Dose, 1997; Judge & Bretz, 1992; Meglino & Ravlin, 1998). Although there are a number of existing measures to assess global values and values within the work domain (e.g., Elizur, 1984; Lyons, Higgins, & Duxbury, 2010; Schwartz, 1992; Super, 1970;

Corresponding author: James M. DuBois, jdubois@wustl.edu, (314) 747-2710 (p), (314) 454-5113 (f).

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for a review, see Cheng & Fleishmann, 2010), there is not yet a validated measure of values in scientific work.¹

This gap is surprising considering the growing effort and time dedicated to fostering the responsible conduct of research (RCR). According to the National Academies of Science (NAS), scientific standards are applications of fundamental values such as honesty, openness, and respect for others (National Academies of Science, 2009). Moreover, the NAS speaks of social and political values as motivating much of research (e.g., on healthcare or climate change), and of the material value that research discoveries can have as they generate intellectual property (products that generate patents or copyrights) (National Academies of Science, 2009). Accordingly, much of the NAS guide to RCR focuses on the tension between potentially conflicting values such as truth and integrity, income, and social value. To some extent, the potential for value conflicts exists even with regard to the values that are intrinsic to science such as innovation and rigor: while scientific breakthroughs require innovation and creativity, science also depends heavily on conformity with standards and adherence to rules.

To the extent that values drive behavior (Allport & Vernon, 1960; Bardi & Schwarz, 2003), the relative importance that individuals place on different values in scientific work—such as income, research ethics, and social impact—may provide insight into risk and protective factors for violations of research integrity, aiding in determining predictors of scientific misconduct as well as exemplary science. A recent root cause analysis of researcher referrals for remediation training following instances of noncompliance or research integrity breaches found that many cases arose from a simple failure to prioritize compliance and research integrity as much as other scientific tasks and outcomes (DuBois, Chibnall, Tait, & Vander Wal, 2016). Differential valuing of income and research ethics might also explain variance in how researchers navigate conflicts of interest in work (Institute of Medicine, 2009). Even within one nation such as the United States, the research workforce is international and culturally diverse (Matar, Garner, Millum, Sina, & Silverman, 2014; National Science Foundation, 2014); a values in scientific work measure could be used to explore differences between researchers from diverse nations, in sundry fields, and at different career stages. This seems particularly important not only because there are individual and cultural differences in how values are ranked, but also because—despite the relative stability of values—individual values can shift as one moves into a new culture (Bardi, Buchanan, Goodwin, Slabu, & Robinson, 2014; Daniel, Schiefer, & Knafo, 2011). Additionally, a measure of values in scientific work would be useful in assessing the outcomes of required RCR instruction courses (National Institutes of Health, 2009; Watts, Medeiros, Mulhearn, Steele, Connelly, & Mumford, 2016). Some leading RCR instructors have argued that greater emphasis should be placed on positively affecting attitudes and values, which may play a greater role in shaping research integrity than isolated knowledge of rules (Kalichman

¹A measure of “norms of research” was developed by Anderson et al. (2010). However, their measure focused on what they call Mertonian norms such as disinterestedness and organized skepticism. We consider such norms to flow from the work values in science, which are more basic. Moreover, the scale by Anderson and colleagues was not validated either through factor analysis (to examine its internal structure) or through correlation with other measures (convergent validity). Hence, one cannot be sure that two norms such as disinterestedness and organized skepticism in fact function as one factor pertaining to scientific objectivity, nor that the items actually measure what they purport.

& Plemmons, 2015). A reliable measure of values in scientific work would allow for the examination of factors that may lead to changes in values by comparing pre- and post-ratings on a values in scientific work measure (Antes & DuBois, 2014).

The aim of this paper is to provide initial data on the psychometric properties for a new measure of values in scientific work. After reviewing the literature on global values and work values, we describe the development of this scale, its underlying factors and internal consistency, and the pattern of intercorrelations between the resulting subscales. In addition, we report the associations between the various values in scientific work and global values to provide a preliminary test of construct validation.

Values

Basic values are abstract principles for best living that can be used to guide decision-making and behavior across a wide range of situations (Rohan, 2000; Rokeach, 1973; Schwartz, 2007; Schwartz & Bilsky, 1990). Attitudes, in contrast to values, correspond to the evaluation of specific objects or situations (Rohan, 2000). The importance placed on specific types of values differs across individuals and these value priorities are more stable over time than attitudes (Ravlin & Meglino, 1989; Rokeach, 1973; Schwartz, 1994).

The most prominent theory of values, put forth by Schwartz (1994), proposes a value system that delineates ten basic, global values (see Table 1 for definitions): self-direction, stimulation, hedonism, achievement, power, security, tradition, conformity, benevolence, and universalism. These values are thought to be rooted in the fundamental requirements for human existence, and as such should be universally found across cultures. Indeed, research has documented the comprehensiveness of this set of values and their cross-cultural relevance (Schwartz, 1994; Schwartz & Sagiv, 1995). Schwartz and colleagues have identified two sets of opposing high-order values: self-transcendence versus self-enhancement, and openness to change versus conservation. Each of the ten basic values belongs to a primary higher-order domain (with hedonism straddling self-enhancement and openness) (Schwartz, 1994; Ros, Schwartz, & Surkiss, 1999). Pursuit of any given value can either facilitate or undermine other values depending on their level of compatibility. For instance, behaviors that promote universalism still allow for the attainment of benevolence because these values are congruent in terms of their underlying motivation to promote the welfare of others; both belong to the higher-order domain of self-transcendence. In contrast, behaviors that promote personal achievement can interfere with the pursuit of benevolence because the former requires self-enhancement while the later requires self-transcendence.

A large body of research has documented the importance of values for understanding psychological and behavioral outcomes. For instance, values have been shown to predict college course selection (Feather, 1988), voting for political parties (Graham, Haidt, & Nosek, 2009; Koleva, Graham, Iyer, Ditto, & Haidt, 2012), religiosity (Schwartz & Huijsmans, 1995), and overall well-being (Sagiv & Schwartz, 2000). As theorized, there is some evidence that individuals are more likely to engage in certain behaviors that align with their values (Bardi & Schwartz, 2003; Schwartz & Bardi, 2001). However, this is not always the case. For instance, when there are discrepancies between personal values and social

values (i.e., perceptions of others' judgments about best living) then individuals may act in ways that do not necessarily reflect their own personal value priorities (Rohan, 2000).

Work Values

Values have been studied in the context of various domains of life, such as religion, politics, and sports (Sagie & Elizur, 1996). Work values are standards used to evaluate outcomes that may be achieved in the context of one's work (Dose, 1997; Ros et al., 1999). They represent the relative importance individuals place on various aspects of one's job, guiding the selection and pursuit of more specific work goals (Ros et al., 1999; Schwartz, 1994). Conceptualized as a reflection of various motives that can be addressed through one's work, such as security, social connection, and self-actualization, work values are more specific than basic human values (which are trans-situational rather than context-specific) but broader than vocational interests and job-related attitudes (Ros et al., 1999; Super, 1995).

Although a number of work values have been proposed (Leuty & Hansen, 2011), there is general agreement on the existence of three broad categories of work values (Elizur, 1984; Ros et al., 1999; Schwartz, 1999; cf Lyons et al., 2010): (1) intrinsic values (process-related, intangible rewards such as interest and challenge), (2) extrinsic values (outcome-related, tangible rewards, such as salary and job security), and (3) social values (interpersonal rewards such as forming connections with coworkers and contributing to society). These values are thought to overlap with broader categories of basic human values, such that intrinsic work values align with openness to change motives, extrinsic work values align with conservation motives, and social work values align with self-transcendence motives (Ros et al., 1999). Work is a means through which individuals can pursue these higher order personal motivations and basic human needs for autonomy, competence and relatedness (Ryan & Deci, 2000; Vansteenkiste, Neyrinck, Niemiec, Soenens, Witte, & Broeck, 2007).

Accordingly, individuals tend to gravitate towards careers that reflect their values (Judge & Bretz, 1992; Lyons, Duxbury, & Higgins, 2006; Lofquist & Dawis, 1971; Super, 1970). They also are more satisfied in jobs where there is a high level of congruence between their own value priorities and those of the organization (Kristof-Brown, Zimmerman, & Johnson, 2005; Meglino & Ravlin, 1998; Verquer, Beehr, & Wagner, 2003). Person–organization value misfit (Cennamo & Gardner, 2008; Chatman, 1989; Ostroff & Judge, 2007) can lead to negative work-related attitudes, decreased performance, and more turnover (Adkins, Russell, & Werbel, 1994; Schneider, Kristof, Goldstein, & Smith, 1997; Vandenberg & Scarpello, 1990), as well as lower well-being in the workplace (Edwards, Caplan, & Harrison, 1998; Edwards & Shipp, 2007; Kristof, 1996; Sagiv, Roccas, & Hazan, 2004). Beyond the effects of congruence, there is also evidence that prioritizing extrinsic work values (e.g., salary) over intrinsic work values (e.g., interest) can be detrimental to job performance and satisfaction (Vansteenkiste et al., 2007), as well as job flexibility (Van den Broeck, Vansteenkiste, Lens, & Witte, 2010). These findings are consistent with self-determination theory (Ryan & Deci, 2000), which proposes that humans gather satisfaction from fulfilling their fundamental needs for autonomy, competence, and relatedness. However, it is worth noting that prioritizing extrinsic values may be beneficial in certain work contexts. One study found that MBA graduates who valued prestige and salary spent more time working,

received more promotions, and earned higher salaries (Frieze, Olson, & Murrell, 2006). Overall, work values are an important predictor of work-related attitudes and behaviors (Dose, 1997; Feather & Rauter, 2004), as well as job satisfaction, commitment, and work-related stress (Dawis & Lofquist, 1984; Kristof, 1996; Locke, 1976; Meyer, Irving, & Allen, 1998).

Present Research

Values in scientific work pertain to work values specifically in the context of scientific research (Rokeach, 1979). The aim of this paper is to provide preliminary evidence of the reliability, validity, and factor structure of a new measure, Values in Scientific Work (VSW). We administered the VSW to a sample of researchers funded by the National Institutes of Health (NIH). The items were generated rationally, drawing on the literature about values in work and science (Ros et al., 1999).

Ros et al (1999) applied the four overarching categories of global values (self-transcendence, self-enhancement, conservation, and openness to change) to the work setting. Analyzing data from a sample of 999 adults in Israel, Ros et al offered evidence in support for the global value framework applied to the work setting, but it remains less commonly used than the traditional threefold approach to work values (extrinsic, intrinsic, and social). We wrote an equal number of items to represent each of the three traditionally-recognized broad categories of work values (Ros et al., 1999). Intrinsic values included 5 items for each of the following four subdomains: personal achievement and growth, independence and autonomy, truth and integrity, and innovation. Extrinsic values included 5 items for each of the following four subdomains: salary, security, prestige, and compliance with oversight. Social values included 5 items for each of the following four subdomains: care for subjects (human and animal), harmonious relationships, scientific collaborations, and broader social impact. We wrote 60 items anticipating that we would drop approximately 40% of items due to low primary factor loading or high factor cross-loadings. As a secondary aim of analysis, we examined whether the traditional threefold division of work values or the fourfold global values framework proposed by Ros, Schwartz, and Surkiss (1999) provides a more useful conceptual framework for scientific work values.

The items in each of the twelve sub-domains incorporated both general work-related values such as salary, security, personal achievement, independence, and harmonious relationships, as well as values commonly discussed in leading textbooks on research integrity and the responsible conduct of research (Kon, Schilling, Heitman, Steneck, & DuBois. 2011), such as compliance with oversight systems, care for subjects, scientific collaborations, innovation, truth and integrity, and social impact (Howard Hughes Medical Institute, 2006; Macrina, 2014; National Academies of Science, 2009; Steneck, 2007). Given that there are only 10 basic, global values, we did not anticipate that factor analysis would generate a 12-factor solution; rather, the rationale for using 12 sub-domains was to ensure adequate conceptual coverage of values in scientific work.

Following best-practice recommendations (Cabrera-Nguyen, 2010; Clark & Watson, 1995; Gerbing & Anderson, 1988; Messick, 1995, Woithington & Whittaker), initial scale items

were subjected to expert review and then cognitive interviewing (Willis, 2005). Following administration to our study participants, the item pool was then reduced via exploratory factor analysis in order to refine the factor structure of the scale. We examined the internal consistency of the resulting subscales, as well as the associations between these different values in scientific work. In order to address the construct validity of the scale, that is, whether it taps the values we purport that it does, we examined how global personal values are linked to different values in scientific work.

Method

Participants

We recruited two hundred and three NIH-funded researchers. Table 2 presents demographics of the sample, which was nearly evenly divided between males and females, US-born and non-US-born researchers. Among non-US-born researchers, 82% were born in Asia. Participants had conducted research for 12.24 years on average ($SD = 7.86$; range 1–45 years), and worked in 4 research labs or groups ($SD = 1.63$; range 1–12 labs/groups). We intentionally recruited researchers who represented diverse career stages and nations of origin to ensure the initial validation sample reflected the diversity of the U.S. research workforce (Kent, 2011; National Science Foundation, 2014).

Recruitment and Procedure

We identified participants using the NIH RePORTER database. The database identifies principal investigators and award types, including training (T32), career development (K01), and fellowship (F), and research (R01) awards, which enabled us to target investigators at diverse career stages. We extracted investigators' names, institutions, and email addresses from RePORTER. We conducted Internet searches to identify investigators' sex and phone numbers, and estimate their nation of origin and native language for screening purposes only.

We emailed invitations to an initial cohort of investigators with the request to participate in a study of how NIH-funded researchers perceive research rules, norms, and values in science. We estimated that participation would require less than one hour and offered a \$50 payment for their time. We sent up to three reminders by email and made follow up calls to individuals who did not respond to the first two reminders. To ensure that our initial validation sample reflected the diversity of the NIH-funded research workforce, we monitored response patterns to ensure adequate representation of researchers at diverse career stages and nation of origin. This enabled us to oversample subgroups as needed as we approached a second cohort in the same manner described above.

Each email included a link to the survey hosted on the Qualtrics survey platform. Investigators completed the VSW in addition to measures of professional decision-making in research, the perception of diverse rules in science, and exposure to various research practices. This report focuses on the findings with regard to the values in scientific work.

Measures

Values in Scientific Work (VSW)—We developed the VSW to assess personal values in scientific work. As described above, the items were rationally derived based on a review of the literature on values in science and on work values associated with scientific work, as well as validated measures of values. In terms of the item structure and response format, we adopted the Schwartz Portrait Values Questionnaire (PVQ) as a template (Schwartz et al., 2012), such that items represent a statement about a person's values (e.g., "Freedom to choose what he does is important to him.") and respondents are asked to indicate how similar that person is to themselves, from 1 (*not like me at all*) to 6 (*very much like me*) scale. All items—generic and science-specific—were written with reference to scientific contexts and were relevant to respondents regardless of their career stage and kind of research. Lexile scores for all items were kept below 1100, with a mean score of 733, which roughly corresponds to the 50th percentile reading level of 5th graders. Although the test was developed for use among researchers working in the U.S., we wanted to write items with a low Lexile score to ensure understanding by English as a Second Language participants.

Cognitive interviews (Willis, 2005) were conducted by a team member (K.A.B.) with 8 researchers representing diverse fields of science, career stages, and nations of origin. Interviews proceeded in stages. First, we asked about general impressions of the scale, whether instructions were clear, and whether they would feel comfortable addressing items. Then we asked what individual items were trying to assess, and whether they would have difficulty responding to individual items. Finally, we asked them to consider blocks of items representing the initial 12 value domains, and to describe what the block was intended to address. The interviewer recorded detailed notes from each interview, and the feedback was compiled for review by the item development team (T.E., A.L.A., and J.M.D). Final edits were made to the items based on this feedback before submitting them to factor analysis to determine the scale structure.

Global Values—The 57-item PVQ5X Values Survey (Schwartz et al., 2012) was used to assess global personal values. An example item includes "Being creative is important to him (her)". For each item, participants indicated how much the person described is like him or her on a scale from 1 (*not like me at all*) to 6 (*very much like me*) scale. Mean scores were computed for each of the 10 value domains: self-direction (Cronbach's alpha = .76), stimulation (Cronbach's alpha = .78), hedonism (Cronbach's alpha = .77), achievement (Cronbach's alpha = .71), power (Cronbach's alpha = .82), security (Cronbach's alpha = .83), tradition (Cronbach's alpha = .91), conformity (Cronbach's alpha = .74), benevolence (Cronbach's alpha = .82), and universalism (Cronbach's alpha = .84).

Social Desirability—The 13-item Marlowe-Crowne Social Desirability Scale (MCSDS; Reynolds, 1982) was used to assess the tendency to engage in socially desirable responding. The items were summed after reverse-scoring negatively keyed items, such that higher scores reflect greater social desirability.

Data Analysis—Exploratory factor analysis using principal-axis factoring was used to assess the factor structure of the scale and identify poorly performing items (e.g., those with

high cross-loadings or low factor loading across all factors). Promax rotation was used because the value factors were expected to be correlated. Decisions regarding the number of factors to extract were based on the scree plot of eigenvalues, the relative amount of variance explained by the factors, and number and magnitude of items loadings on factors across potential factor solutions (Clark & Watson, 1995; Floyd & Widaman, 1995). Cronbach's alpha was used to assess the internal consistency of the subscales, that is, how strongly the items with a subscale correlate with each other. Convergent and discriminant validity was assessed using Pearson's correlations with global values. Specifically, if the new scales correlate with global values that they theoretically should relate to (e.g., valuing autonomy in scientific work correlates with generally valuing self-direction), and do not correlate with others that they should not (e.g., valuing autonomy in scientific work does not correlate with generally valuing hedonism), this provides initial evidence for the construct validity of the scales.

Results

Factor Structure and Reliability

In order to determine the factor structure of the scale and trim poorly performing items, we ran an initial exploratory factor analysis with all 60 items. Factorability of the items was confirmed by a significant Bartlett's test of sphericity, $\chi^2(1770) = 6175.79, p < .01$, and a Kaiser-Meyer-Olkin value of greater than .6 ($KMO = .82$). Results of the factor analysis indicated a 12-factor solution that accounted for 61% of the variance. There were 7 items that did not load onto any specific factor (i.e., factors loadings all less than .30), so we dropped these items from further consideration in scale development. Next, we conducted a second exploratory factor analysis with the remaining 53 items, this time extracting 8 factors because the scree plot in the initial analysis suggested this would be a more parsimonious solution. Ten items were trimmed in this second round because of weak primary factor loadings (i.e., less than .40) or substantial cross-loadings onto another factor (i.e., greater than .30) suggesting they did not unambiguously represent a specific dimension of values in scientific work. The remaining 43 items were submitted to a third factor analysis. Eight more items were discarded due to weak primary loadings or substantial cross-loadings.

The factor loadings for the final factor analysis are provided in Table 3, along with the proportion of variance explained by each factor. Together, the 8 factors accounted for a substantial portion (62%) of the total variance in the final set of 35 items. It is important to recall that exploratory factor analysis aims to identify the smallest number of latent variables or constructs that explain response patterns; whereas items may be written within a theoretical framework, exploratory factor analysis generates subscales empirically, and these subscales must be named based on what the actual remaining pool of items appears to measure. Accordingly, in what follows, some factors have names directly corresponding to the names of theoretical dimensions we used when writing items, whereas other factors have names that reflect the merger of theoretical dimensions or the refinement of concepts based not only on the remaining items, but also their correlation with global value subscales, which provides some indication of what they actually measure.

Each of the items clearly loaded onto one of the 8 factors and the cross-loadings on other factors were all low. The first factor includes 5 items tapping the value of *autonomy*, such as “She/he strongly values being able to define her/his own scientific aims”. The second factor includes 6 items tapping the value of *research ethics*, such as “It is very important to her/him that researchers properly care for animals”. The third factor includes 4 items tapping the value of *social impact*, such as “It is important to her/him that research helps to solve real-world problems”. The fourth factor includes 5 items tapping value of *income*, such as “She/he measures success by how much her/his salary increases each year”. The fifth factor includes 4 items tapping the value of *collaboration*, such as “She/he seeks collaborators with diverse expertise to work with her/him on projects”. The sixth factor includes 5 items tapping the value of *innovation and growth*, such as “Doing work that is innovative is important to her/him.” The seventh factor includes 4 items tapping the value of *conserving relationships*, such as “She/he goes to great lengths to avoid conflict with coworkers”. (Note: We named this factor “conserving relationships” rather than “harmonious relationships” given its strong correlation with global conservation values, and the fact that highest loading items focused on avoiding conflict within the group.) The eighth factor includes 2 items tapping value of *job security*, such as “Job security is important to her/him”.

As indicated by the estimates of Cronbach’s alpha provided in Table 3, there was good internal consistency (i.e., Cronbach’s alpha > .70) for seven of the eight factors; reliability for the conserving relationships factor was acceptable, falling slightly below the .70 threshold. Descriptive statistics for the eight values in scientific work subscales are provided in Table 4. On average, individuals reported placing the most importance autonomy, research ethics, and innovation and growth. The least importance was placed on the extrinsic value of income. There were moderately sized positive correlations between most of the values in scientific work, as shown in Table 4, as would be expected if they tap slightly different, but related aspects of values. In addition, social desirability was linked to greater endorsement of certain values in scientific work, including research ethics, social impact, collaboration, innovation and growth, and conserving relationships. Therefore, we computed the partial correlations between each of the values in scientific work controlling for social desirability (see Table 4, above the diagonal). Again, the intercorrelations between values in scientific work after controlling for social desirability were moderate to small.

Results from t-tests comparing values in scientific work based on demographic variables (i.e., gender, race, and country of birth) are provided in Table 6; t-tests based on research-related variables (i.e. rank and type of research) are provided in Table 7. There were no gender differences for any values in scientific work, but there were racial differences. Specifically, Asian researchers placed more value on conserving relationships and social impact, and less value on research ethics compared to non-Asian researchers. In addition, researchers who were born outside the U.S. reported placing more importance on conserving relationships and social impact, as well as autonomy. Compared to more senior researchers, post-doctoral trainees placed less value on autonomy, social impact, collaboration, and innovation, but placed more value on research ethics. Finally, human subjects researchers reported valuing social impact and collaboration more than other research scientists.

Correlations between values in scientific work and global values

As shown in Table 5, values in scientific work showed moderate to high correlations with the global values for which they shared conceptual overlap (evidence of convergent validity) and weak or no correlations with global values that are theoretically more distinct (evidence of divergent validity). Valuing autonomy and innovation and growth in scientific work were most highly correlated with self-direction, whereas valuing research ethics in scientific work was most highly correlated with benevolence and universalism. Individuals who endorsed the importance of social impact and collaboration in scientific work were also likely to generally value universalism. In contrast, valuing income in scientific work was highly correlated with the global value of power. Valuing conserving relationships in scientific work was most strongly correlated with conformity and security, both conservation values. Valuing job security in scientific work showed the weakest associations with global values, but, as expected, it was most strongly correlated with security.

Discussion

The goal of the present research was to develop a scale assessing scientific work values and provide initial validation evidence by considering the association with global values. We evaluated the factor structure of this new measure of values in scientific work and demonstrated the internal consistency of the resulting subscales.

Content validity was carefully considered during development of this measure of values in scientific work (Clark & Watson, 1995; Haynes, Richard, & Kubany, 1995). Work values have been found to cover three broad domains: intrinsic values, extrinsic values, and social values (Elizur, 1984; Ros et al., 1999). Accordingly, the initial set of items generated for the VSW evenly covered each of these domains, but specifically in the context of scientific work. In addition to generic work-related values, such as independence, salary, prestige, and relationships, we included values tapping research integrity and the responsible conduct of research. Notably, the scale items were designed to be relevant and readily understandable for scientific researchers working in the U.S. in any discipline, at any career stage, and from any nation, with at least a 5th grade English reading level.

A secondary aim of our analysis was to evaluate whether the traditional framework of basic work values (intrinsic, extrinsic, and social) is a better fit with values in scientific work than the higher-order global values of self-enhancement, self-transcendence, conservation, and openness to change. We noted in the introduction that Ros, Schwartz, Surkiss (1999) hypothesized (and confirmed) that work values that are commonly labeled “extrinsic” would be split into the high-order global values of “self-enhancement” and “conservation” values. This was clearly reflected in our findings. Moreover, judging from the correlations presented in Table 5, the items for some subscales that were written within the threefold work values framework (intrinsic, extrinsic, social)—particularly research ethics and conserving relationships—loaded most strongly onto meaningful factors that did not fit neatly within any of these three overarching categories; however, they fit conceptually within one of the four higher-order global value domains. For example, within the global values framework we readily recognize that the remaining VSW items about team relationships concern conformity or conservation ($r=.59, p<.01$); this seems to describe their nature better than

calling them “extrinsic” and not “social”. Moreover, it seems more accurate to characterize researchers’ concerns with job security as pertaining to conservation rather than labeling it more vaguely as “extrinsic,” a concept that also encompasses hedonism and power. In short, results of the exploratory factor analyses suggested an eight-factor structure to the VSW, and each of these factors is an excellent conceptual fit with one of the four higher-order values and is moderately to strongly correlated with specific values within the relevant higher-order domain. In what follows, we discuss briefly the fit of each VSW subscale with the higher-order global values of openness to change, self-transcendence, self-enhancement, and conservation.

The VSW contains two factors associated with “openness to change”: autonomy and innovation and growth. The first factor, which accounted for most of the total variance, taps the value individuals place on autonomy in scientific work. This subscale was closely associated with, but distinct from, an innovation and growth factor that also emerged from this scale. These two factors clearly align with other commonly found “openness to change” work values identified by Ros et al (1999), including autonomy, creativity, personal growth, interest, and intellectual stimulation. The validity of the autonomy and innovation and growth subscales is supported by their moderately high correlation with the global value placed on self-direction ($r=.60$ and $r=.50$ respectively, $p<.01$), which taps independence of thought and action (Schwartz, 1992).

Three “self-transcendence” values emerged from the factor analysis: research ethics, collaboration, and social impact. Research ethics encompassed valuing truth and integrity and care for human and animal subjects. Although concern for research integrity and care for subjects may seem like different value domains—and we wrote separate items for each domain—in fact, response patterns suggest that they function as one unified value. Individuals who highly endorse this value in scientific work place relatively more importance on participant respect and safety, research compliance, data integrity, and replication of findings. Valuing collaboration taps the importance of forming scientific collaborations and building a multidisciplinary research team. Social impact includes being motivated by considerations of the practical significance of research and the broader impact of research on society. Valuing collaboration and social impact in scientific work were both linked with the global value of universalism, which centers on appreciation, tolerance, and concern for the lives of others, not only one’s ingroup.

Only one “self-enhancement” value emerged from our factor analysis: income. Valuing income in scientific work was strongly ($r=.58$, $p<.01$) linked to the global value of power, which is considered a self-enhancement motive centering on concerns for one’s own self-interest (Schwartz, 1992).

The VSW contains two subscales that fit within the higher-order value domain of “conservation”: conserving relationships and job security. Conserving relationships includes placing importance on getting along and avoiding conflict with others, both with regard to one’s own relationships and also relationships among others on one’s research team. Conserving relationships in scientific work was linked to the global values of conformity and security. These associations make sense given that conformity is driven by the

motivation to avoid impulses that will upset or harm others and security is in part rooted in the motivation to maintain harmony and stability in one's relationships. In contrast to income, valuing job security showed little overlap with broader self-enhancement type values and instead was associated with the global value placed on security, that is maintaining safety and stability (Schwartz, 1992).

As noted above, we expected to discard approximately 40% of items due to poor primary factor loading or high cross-loadings; we dropped 42% of items (26/60). If we consider the fate of the 60 items written to represent 12 theoretical domains of values in scientific work after being factor analyzed into 8 subscales, we find the following. The original domains of truth-integrity, care for research subjects, and compliance are represented by one subscale on "research ethics." The disappearance of the compliance items appears due to the fact that a fundamental commitment to research ethics (care for research subjects and truth-integrity) appears more basic. The domain of prestige is represented primarily by "income" and "innovation and growth"; all original items were eliminated because they cross-loaded heavily onto other domains, primarily income (suggesting that prestige may function as a surrogate for the desire for material enrichment) and innovation and growth (suggesting that prestige may function as peer validation that one is doing innovative work as an accomplished scientist). The original domains of innovation/creativity and of achievement/growth merged into one subscale. All other theoretical domains generally remained intact as originally framed.

Perhaps not surprisingly, scientists reported placing the most value on the values of autonomy, research ethics, and innovation and growth. Although it is possible that this pattern is specific to NIH-funded researchers who represented the current sample of participants, the nature of scientific work may appeal more to individuals who are motivated by these intrinsic values. Relatedly, parapublic employees (e.g., working at universities or hospitals) place more value on contributing to society and public servants value intellectual stimulation and challenge in their work more than do others, whereas those in the public sector tend to prioritize prestige (Lyons et al., 2006). Of all the values in scientific work, income was the least commonly endorsed on average. Again, this pattern of responses may have to do with selection effects whereby individuals that are more motivated by monetary incentives are less likely to pursue a career in government-funded science. In general, being motivated by extrinsic work values rather than intrinsic work values has been shown to be detrimental to job performance and satisfaction (Vansteenkiste et al., 2007), and also adversely impact overall life satisfaction (Spector, 1997). Accordingly, there may be negative consequences for scientists who prioritize extrinsic values in their work.

This study intentionally recruited a demographically diverse sample evenly divided between US-born and non-US-born researchers. Because the purpose was to determine the psychometric properties of the VSW, tests of significant differences among subgroups are necessarily exploratory. Nevertheless, several significant differences between U.S. born and non-U.S. born, Asian and non-Asian, junior and senior scientists, and human subject researchers versus those doing other types of research were identified. Some of these differences— particularly those surrounding matters of research ethics—merit further study.

As expected, valuing research ethics correlated with the global values of benevolence and universalism, both of which are rooted in self-transcendence or the motivation to promote the welfare of others (Schwartz, 1992). Therefore, this subscale may be particularly important for targeting individuals who may be at risk for research misconduct, questionable research practices (e.g., data mining, p-hacking), or noncompliance with human subjects protection or animal use and care protocols. Interventions aimed at enhancing research integrity could track changes in scores for this subscale in order to gain some insight into effects on values.

Although values are relatively resistant to change (Ravlin & Meglino, 1989; Rokeach, 1973), targeted intervention may be able to modify the relative importance individuals place on specific values in scientific work. Early socialization is thought to play a major role in determining work values but later experiences in one's work and non-work roles can also impact the evaluation of different value domains (Mumford, Connelly, Scott, Espejo, Sohl, Hunter et al., 2005; Mumford, Waples, Antes, Murphy, Connelly, Brown, et al., 2009). Examination of the relative contribution of these various factors in predicting values in scientific work could help shed light on the development of individual differences in motivation.

Limitations and Conclusion

The current study provided a preliminary evaluation of the psychometric properties of the newly developed Values in Scientific Work (VSW) measure. Our analyses suggest that this scale can be used to reliably delineate eight specific types of values in scientific work: autonomy, research ethics, social impact, income, collaboration, innovation and growth, conserving relationships, and job security. However, 38% of the variance in responses was still left unexplained by these factors. Additional studies with a larger sample size are needed to more rigorously test the structure of this scale using confirmatory factor analysis. Future work is also needed to demonstrate the temporal stability of responses, which should be relatively high given past evidence of the enduring nature of values (Ravlin & Meglino, 1989; Rokeach, 1973).

Different values in scientific work showed unique patterns of correlation with global personal values, such that associations were stronger for values that shared more conceptual overlap (e.g., research ethics and benevolence) and weaker for ones that were theoretically more distinct (e.g., research ethics and hedonism). These findings lend initial support to the convergent and discriminate validity of the VSW measure. An even stronger assessment of its validity could be gained by examining how responses to this values in scientific work scale predict responses to a wider range of scales, such as those assessing research integrity, forming of collaborations, job satisfaction, and other relevant behaviors and outcomes. Past work has documented the utility of values in predicting certain types of behaviors (Schwartz & Bardi, 2001), but at times individuals act in ways that do not align well with their value priorities (Rohan, 2000). Future research is therefore needed to test whether individuals are actually less likely to engage in violations of research integrity if they report placing more value on research ethics and less emphasis on external values such as income.

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Table 1

Schwartz's (1992) 10 Basic Global Values

Higher-Order Value Domains	10 Global Values	Brief Definition
Openness to change	Self-direction	Autonomy of thought and action
	Stimulation	Excitement, novelty, and challenge
(Openness/Self-Enhancement)	Hedonism	Pleasure and self-gratification
Self-enhancement	Achievement	Personal success and demonstrating one's competence
	Power	Social status, prestige, and dominance
Conservation	Security	Personal safety and stability of one's society and relationships
	Conformity	Compliance with social norms and avoiding upsetting others
	Tradition	Maintaining cultural and religious traditions
Self-transcendence	Benevolence	Caring for close others or members of one's social group
	Universalism	Tolerance, societal concern, and protecting nature

Table 2

Demographics (N=203)

Characteristic	%	Characteristic	%
Male	54	Field of Research	
US Born	50	Human subjects, social/behavioral	38
Race		Human subjects, clinical	33
Asian	53	Animal	40
White	46	Dry lab	21
Black	2	Wet lab	59
English Native Language	60	Other	2
Age		Academic Rank	
20s	6	Post-doc	35
30s	59	Instructor	6
40s	25	Assistant Professor	37
50s	8	Associate Professor	9
60 or older	2	Full Professor	10
Degrees		Other	3
Research doctorate (e.g., PhD or ScD)	86	Percentage of Degrees Earned in US	
Professional doctorate (e.g., MD)	21	Research doctorates	89
Master's degree (e.g., MPH or MS)	18	Professional doctorates	81
		Master's degree	97

Table 3
Descriptive statistics, scale reliability, and item factor loadings from exploratory factor analysis for VSW

	M (SD)	1: Autonomy	2: Research ethics	3: Social impact	4: Income	5: Collaboration	6: Innovation, growth	7: Conserving relationships	8: Job security
Being able to set her/his own research agenda is important to her/him.	5.31 (0.77)	0.82	-0.09	0.04	-0.01	-0.02	0.04	0.01	0.02
She/he strongly values being able to define her/his own scientific aims.	5.31 (0.72)	0.80	0.04	0.01	-0.04	-0.06	0.11	-0.01	-0.02
She/he values making her/his own decisions about how her/his work will be done.	5.25 (0.78)	0.64	0.15	-0.04	-0.03	0.01	-0.05	-0.14	0.03
It is important to her/him to have a high level of professional autonomy.	5.30 (0.80)	0.64	0.05	0.07	-0.03	-0.03	-0.01	-0.13	0.19
She/he is always working to keep her/him research projects fully funded.	5.08 (0.93)	0.44	-0.04	-0.07	0.08	0.03	0.11	0.10	0.04
She/he believes that researchers should disclose all foreseeable risks to participants.	5.47 (0.75)	0.02	0.80	-0.01	0.01	0.00	-0.14	0.03	0.00
It is very important to her/him that researchers properly care for animals.	5.18 (0.99)	0.00	0.73	-0.04	0.01	0.04	-0.05	-0.08	-0.09
She/he feels researchers should go out of their way to ensure the safety of participants.	5.27 (0.92)	-0.06	0.61	0.14	0.02	-0.07	-0.01	-0.10	-0.03
She/he thinks researchers should ensure participants fully understand consent information.	5.37 (0.80)	0.07	0.55	-0.09	-0.02	0.25	0.07	0.05	-0.02
She/he regularly verifies the accuracy of her/his data.	5.36 (0.68)	0.11	0.52	-0.09	0.03	-0.02	0.13	0.07	-0.05

	M (SD)	1: Autonomy	2: Research ethics	3: Social impact	4: Income	5: Collaboration	6: Innovation, growth	7: Conserving relationships	8: Job security
It is important to her/him that research results can be replicated.	5.46 (0.65)	0.00	0.36	-0.08	-0.07	-0.09	0.28	0.09	0.00
It is important to her/him that research helps to solve real-world problems.	4.99 (1.04)	-0.10	0.00	0.88	0.04	0.03	0.11	-0.13	-0.07
Doing research that improves the lives of others is important to her/him.	5.12 (0.98)	-0.05	0.01	0.81	-0.09	0.01	0.10	0.01	0.06
She/he embraces the idea that research should have social significance.	4.68 (1.29)	0.10	-0.10	0.75	-0.02	0.02	-0.05	0.14	-0.06
She/he believes the general public should play a role in setting research priorities.	3.49 (1.45)	0.10	0.03	0.48	0.03	0.12	-0.20	0.13	-0.08
She/he measures success by how much her/his salary increases each year.	2.74 (1.31)	0.08	0.01	-0.12	0.80	0.06	0.01	0.15	-0.14
It is important to her/him that she/he is paid a lot.	3.62 (1.19)	-0.03	0.03	0.05	0.70	-0.04	0.13	-0.07	0.18
She/he is always seeking ways to generate new income.	3.25 (1.39)	0.18	-0.12	0.15	0.65	0.06	-0.16	0.10	-0.08
She/he would take a new job if it offered a significantly better salary.	3.70 (1.30)	-0.22	-0.02	-0.16	0.65	0.06	0.03	0.09	0.06
Earning a good salary is important to her/him.	4.46 (1.14)	-0.06	0.19	0.11	0.56	-0.19	0.03	-0.15	0.23
Working with people from other research teams is important to her/him.	4.78 (0.95)	-0.06	0.05	0.08	0.06	0.78	-0.06	-0.09	0.07
It is important to her/him to form new collaborations.	4.87 (0.96)	-0.05	-0.05	0.02	-0.02	0.77	0.17	-0.16	0.13
She/he believes it is essential to form	5.07 (0.95)	-0.02	0.00	0.10	-0.01	0.74	0.00	-0.06	-0.03

	M (SD)	1: Autonomy	2: Research ethics	3: Social impact	4: Income	5: Collaboration	6: Innovation, growth	7: Conserving relationships	8: Job security
collaborations across disciplines.									
She/he seeks collaborators with diverse expertise to work with her/him on projects.	5.02 (0.89)	0.04	0.02	-0.05	-0.02	0.68	-0.03	0.18	-0.03
Exploring creative ideas energizes her/him.	5.50 (0.66)	0.06	-0.01	-0.01	-0.09	0.02	0.71	0.03	-0.03
Doing work that is innovative is important to her/him.	5.36 (0.75)	0.13	-0.13	0.01	0.18	0.08	0.69	-0.03	-0.15
She/he pursues science primarily to discover truth.	5.05 (0.91)	-0.03	-0.02	-0.08	-0.20	0.02	0.52	0.16	0.18
She/he wants to feel that she/he has done important work.	5.52 (0.73)	0.04	0.04	0.10	0.12	-0.07	0.50	-0.06	-0.08
She/he is always seeking ways to become the best researcher she/he can be.	5.16 (0.81)	0.04	0.16	0.02	0.05	0.06	0.46	0.02	-0.05
She/he goes to great lengths to avoid conflict with coworkers.	4.57 (1.12)	-0.06	0.03	0.09	0.07	-0.01	-0.08	0.76	0.03
She/he does not speak up when it might offend her/his coworkers.	3.28 (1.34)	-0.05	-0.13	-0.07	0.11	-0.09	0.12	0.55	-0.03
Maintaining harmonious relationships with coworkers is important to her/him.	5.34 (0.69)	-0.10	0.14	0.21	-0.06	-0.07	0.08	0.42	0.16
It is very important to her/him that people on her/his research team get along well.	5.24 (0.76)	0.04	0.12	0.25	0.00	0.03	0.06	0.40	0.08
Job security is important to her/him.	5.10 (0.88)	0.11	-0.14	-0.03	0.00	0.01	-0.02	0.02	0.86
It is important to her/him to know	5.12 (1.01)	0.06	0.00	-0.10	0.10	0.10	-0.13	0.06	0.70

	M (SD)	1: Autonomy	2: Research ethics	3: Social impact	4: Income	5: Collaboration	6: Innovation, growth	7: Conserving relationships	8: Job security
she/he will have a job in five years.									
Variance explained (%)		21.09	9.18	7.41	6.15	5.22	4.66	4.23	3.71
Cronbach's alpha (α)		0.83	0.79	0.83	0.81	0.85	0.75	0.66	0.77

Notes. *M* = Mean. *SD* = Standard Deviation. Possible range of scores: 1 (*not like me at all*) to 6 (*very much like me*).

Table 4

Intercorrelations between VSW subscales

	M (SD)	1	2	3	4	5	6	7	8
1. Autonomy	5.25 (0.61)	–	.31**	.23**	.03	.28**	.51**	.06	.21**
2. Research ethics	5.35 (0.55)	.32**	–	.24**	.04	.27**	.38**	.13	.11
3. Social impact	4.57 (0.96)	.23**	.27**	–	.20**	.44**	.31**	.26**	.11
4. Income	3.55 (0.95)	.02	.02	.17*	–	.15*	.15*	.14	.28**
5. Collaboration	4.94 (0.78)	.27**	.29**	.47**	.13	–	.35**	.21**	.21**
6. Innovation and growth	5.32 (0.54)	.50**	.40**	.34**	.13	.38**	–	.18*	.16*
7. Conserving relationships	4.61 (0.69)	.06	.16*	.30**	.11	.24**	.21**	–	.15*
8. Job Security	5.11 (0.85)	.21**	.12	.11	.27**	.22**	.16*	.16*	–

Notes. Correlations above the diagonal are partial correlations controlling for social desirability; correlations below the diagonal are raw correlations.

* $p < .05$;

** $p < .01$.

Correlations between VSW subscales, global values, and social desirability

Table 5

Basic Work Value	High-Level Global Value Domains	Basic Global Values	Values in Scientific Work (VSW) Subscales [^]							
			Openness to Change		Self-Enhancement		Conservation		Self-Transcendence	
			Autonomy	Innovatin & growth	Income	Conserving relation	Job security	Collaboration	Research ethics	Social impact
Intrinsic	Openness to change	Self-direction	.60**	.50**	.06	-.05	.17*	.26**	.38**	.12
		Stimulation	.17*	.29**	.16*	.04	.04	.27**	.13	.14*
Extrinsic 2	(Mixed ↑↓) Self-enhancement)	Hedonism [†]	.05	.19**	.10	.20**	.14*	.21**	.13	.10
		Achieve	.31**	.34**	.30**	-.03	.18*	.18**	.20	.07
		Power	.16*	.18**	.58**	.03	.16*	.15*	-.13	.08
		Security	.15*	.31**	.32**	.42**	.31**	.25**	.27**	.27**
Extrinsic 1 ^{††}	Conservation	Tradition	.12	.24**	.21**	.23**	.17*	.19**	.09	.33**
		Conformity	-.01	.16*	.12	.59**	.22**	.19**	.13	.29**
		Benevolence	.29**	.29**	-.03	.11	.23**	.28**	.47**	.19**
Social	Self-transcendence	Universalism	.30**	.46**	.07	.22**	.18**	.47**	.49**	.50**
		Marlow e-Crowne	0.02	0.18*	-0.09	0.21**	0.03	0.20**	0.16*	0.25**

Notes.

* p < .05;
** p < .01

Sharing indicates areas of theoretical overlap between Ros et al’s (1999) global value framework for work and the 8 VSW subscales.

[^] Ros, Schwarz, and Surkiss (1999) demonstrated a connection between the broad domains of intrinsic, extrinsic, and social work values with global values. In this table, we illustrate how each of the VSW subscales is most strongly correlated with a value within the corresponding global value domain. These are precisely the relationships one would expect.

[†]Hedonism cross-cuts openness to change and self-enhancement within the universal values framework (Ros, Schwartz, Surkiss, 1999).

^{††}Extrinsic values are denoted in two colors to denote the fact that Ros, Schwartz, Surkiss (1999) hypothesized (and confirmed) that work values that are commonly labeled “extrinsic” would be split into “self-enhancement” and “conservation” values, which is clearly reflected in our findings.

Table 6Results of *t* tests comparing VSW subscale scores based on demographic characteristics

	Men	Women	<i>t</i> (df)	Born in U.S.	Not born in U.S.	<i>t</i> (df)	Asian	Not Asian	<i>t</i> (df)
Values in scientific work									
Autonomy	5.24	5.26	-15(201)	5.13	5.36	-2.69(201)**	5.32	5.17	1.77(201)
Research ethics	5.29	5.42	-1.65(201)	5.39	5.31	1.10(201)	5.22	5.49	-3.55(201)**
Social impact	4.54	4.61	-0.54(201)	4.37	4.77	-3.05(201)**	4.73	4.40	2.45(201)*
Income	3.57	3.54	0.23(201)	3.46	3.65	-1.37(201)	3.63	3.47	1.20(201)
Collaboration	4.88	5.10	-1.16(201)	4.83	5.04	-1.90(201)	5.02	4.84	1.68(201)
Innovation and growth	5.39	5.24	1.86(201)	5.27	5.37	-1.23(201)	5.36	5.28	1.13(201)
Conserving relationships	4.68	4.53	1.54(201)	4.44	4.77	-3.44(201)**	4.77	4.42	3.66(201)**
Job security	5.07	5.15	-0.71(201)	5.04	5.17	-1.06(201)	5.08	5.14	-0.43(201)

Notes. Values reflect group means, *t* statistics, and degrees of freedom (df) associated with *t* tests of group differences.* $p < .05$;** $p < .01$.

Table 7
Results of *t* tests comparing VSW subscale scores based on research characteristics

	Trainee	Senior researcher	<i>t</i> (df)	Human subjects researcher	Not human subjects researcher	<i>t</i> (df)
Values in scientific work						
Autonomy	5.07	5.35	-3.17(201)**	5.28	5.22	0.67(201)
Research ethics	5.47	5.29	2.25(201)*	5.31	5.39	-1.02(201)
Social impact	4.13	4.81	-5.13(201)**	4.86	4.33	4.14(201)**
Income	3.53	3.57	-0.28(201)	3.51	3.59	-0.62(201)
Collaboration	4.76	5.03	-2.41(201)*	5.07	4.83	2.27(201)*
Innovation and growth	5.20	5.38	-2.34(201)*	5.29	5.35	-0.83(201)
Conserving relationships	4.57	4.63	-0.61(201)	4.59	4.62	-0.35(201)
Job security	5.05	5.14	-.072(201)	5.11	5.11	-.01(201)

Notes. Values reflect group means, *t* statistics, and degrees of freedom (df) associated with *t* tests of group differences. Trainee was coded such that post-doctoral students = 1 and all other senior researchers (e.g., professors or instructors) = 0.

⁺ $p < .10$

^{*} $p < .05$;

^{**} $p < .01$.