Predicted Sub-Industry Job Satisfaction Using Color Preference

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Overview

This paper summarizes a series of analyses aimed at establishing the concurrent validity of the Dewey Color test, while providing operational background information for online web implementations of the Dewey Color test. The following is essentially a study of concurrent validity, as it will be determined the extent to which people's current jobs or job classifications can be predicted from the Dewey Color test. Unlike earlier color tests, and indeed unlike all other career tests, the Dewey Color test was explicitly designed for online computer administration (i.e., via intra- or internet). In cases where immediate feedback is provided online as well, it is desirable to also obtain an index to reflect the degree of confidence that can be placed in the results.

So to address both aspects discussed above, two sets of analyses were performed. The first goal was to predict in which sub-industry or which specific jobs respondents are currently employed. These sub-industries include among others, Education, Health, Banking, Finance, Government, Information Sciences, Leisure, Manufacturing, and Construction. The resulting validation below indicated these sub-industry categories as the building blocks or our construct validity.

Secondly, the additional analysis that provides the occupational recommendations for the Color Career indicator 4.0 will be performed to determine whether color preferences can predict test takers' current occupations. To be sure, *the Dewey Color test is the only source of the predictor variable throughout* – i.e., no demographic or other background information is used. As is described in the Method section below, the prediction is based on a two-stage procedure that combines methods from artificial intelligence with standard statistical methods.

Method

<u>Variables</u>: As part of the online Dewey Color test, respondents are asked to rank 15 color swatches in order of their general preference. The specific instructions are “Click on the color you MOST prefer to look at.” Upon being clicked, a selected swatch disappears. Respondents continue this process until all 15 swatches have disappeared. A previous test / retest study indicated a reliability of 0.86 of this aspect of the Dewey Color test. Also, to identify respondents who enjoyed their current jobs, all rated their current job as either “don’t enjoy,” “somewhat enjoy,” “mostly enjoy,” or “totally enjoy.”

In 1997, a total of 48 undergraduate students (20 men, and 28 women) with an average age of 21 years participated in what was described as a “test/retest study on color preference” at Georgia State University by Dr. Clarence Holland, known for his work on the Myers Briggs. Using a testing booklet with the Dewey Color stimuli and a pen and paper answer sheet, he conducted two classroom sessions in which the students were asked to “rank the colors that you most prefer to look at" twice, within an eight-week interval.

The first administration took place in March of 1997, and the second in May of that year. The same fifteen colors were included as were the focus in the current research. A spearman (rho) rank-correlation coefficient was computed between the two rankings of these fifteen colors for each of the 48 students. These coefficients were then transformed according to Fisher's Z, and the inverse transformation applied to the average Z was found to be 0.86. This finding thus indicates that the Dewey Color test has excellent test-retest reliability.

<u>Data</u>: Respondents were recruited through the online publication of 14 career articles that were featured on 10 front pages of the MSN and AOL websites between November 2009 and July 2010. MSN and AOL directed volunteers to the “careerbuilder.com” site to take the Dewey Color test, and their participation entitled them to a free career analysis. A total of 770,326 valid and complete respondent records were obtained this way. Surprisingly, 728,213 of the 15-item color preference patterns are unique – and only 42,113 (fewer than 6%) patterns occurred more than once. To minimize the possibility that respondents' color reflect a particular response bias, or other systematic response tendency (e.g., rank colors in the order shown), all records with the color choices occurring elsewhere in the data base were eliminated. Of the remaining cases, only those respondents indicating enjoying their current jobs (n = 116,206) were used for analysis.

Analyses: A mixture of statistical and artificial intelligence procedures was used. First, the 225 features (as defined by a respondent's 15 colors x 15 orders of selection) were used to train a standard Bayesian classifier (cf., Mitchell, 1997/2011). As noted earlier, both entire industries (n = 42), and specific jobs (n=272) were designated as the "classes" to be predicted. During the learning stage, a "Stage One" sample of randomly selected records was used to calibrate the Bayesian classifier, yielding a number of predictors equal to the number of classes.

Classes are sorted according to decreasing magnitude of their modeled predictors. Then success is inversely related to the rank assigned to the actual class. Due to the difference in the number of classes in the two applications, a prediction is deemed successful if the actual class has rank 10 or less among the 42 sub-industries and rank 20 or less among the 242 specific job classifications.

The Stage Two sample is used to determine whether the inclusion or exclusion of a prediction from among the top-10, or top-20, for sub-industries and job classifications is indeed correct. This was done by entering all the modeled probabilities as predictors in a logistic regression, using the correctness of the classification as the dependent variable. For instance, assume that a respondent is actually employed in a finance sub-industry.

This person's classification is correct if his or her predicted class is among the top 10 best choices and the person is indeed currently employed in finance, *or* the predicted class has a rank greater than 10 and she/he is not currently employed in finance. The classification is incorrect otherwise.

The author in the Python 2.7 language implemented the Bayesian classifier and it is tailored to the processing of Dewey Color Test applications. This software also produced the required input for SPSS V 18 (Mac version) to perform the logistic regressions.

Results

Sub-Industry level

Using the procedures outlined in the “Method Section-Stage One” and two samples of people of size 110,449 and 5,707, respectively. The Stage One data were used to train a Bayesian Classifier to predict in which of 42 sub-industries each respondent was currently occupied (recall that respondents were asked to indicate if they enjoyed their current jobs). These sub-industries

include Education, Health, Banking, Finance, Government, Information Sciences, Leisure, Manufacturing, and Construction. The classifier was then applied to the Stage Two validation sample, and all results reported next refer to this sample only.

In the analyses of the Step Two data, prediction was said to be successful when the actual sub-industry occurred among the top 10 predicted outcomes. The data indicate that the median rank of the correct (i.e., actual) sub-industry was 7, which is far higher than would be expected by chance alone ($p < .0001$). Further – and strongly supporting concurrent validity – 60.9% of respondents’ were correctly classified by their jobs’ sub-industry.

Also, when the 42 classification variables are used as predictors in a logistic regression, we could determine with considerable precision (70.1%) whether the predicted sub-industry classification fell indeed among the top 10. Thus, as is important in online applications, we have obtained a mechanism to judge the plausibility of the predictions made by the Bayesian classifier.

Job-Specific Level

The over 2,000 entries listed were adopted from the Occupational Information Network (O*NET) published yearly by the United States Labor and Bureau of Labor Statistics Departments.

Each Occupation listed in the "Top 50 Most Enjoyable Occupations" is from a subset of 272 jobs that were created by combining the same jobs across industries and sub-industries. The data was divided into Stage One and Two samples of size 110,314 and 5,840, respectively, and the Bayesian classifier was trained on the Stage One sample.

In the analyses of the Step Two data, prediction was said to be successful when the actual sub-industry occurred among the top 10 predicted outcomes. The data indicate that the median rank of the correct (i.e., actual) sub-industry was 7, which is far higher than would be expected by chance alone ($p < .0001$). Further – and strongly supporting concurrent validity – 60.9% of respondents' were correctly classified by their jobs' sub-industry.

Stage Two Sample, we found that excellent overall prediction because the cases were ranked significantly higher than would be expected by chance ($p < .0001$) and across all cases the median rank was 14. Given the large number of jobs, prediction was deemed successful if the correct name was among the top 20 candidates. A total of 3645 cases (or, 62.4%) met this criterion.

Analogous to the procedure followed for the sub-industries, logistic regression over the 272 classification variables was used to assess the correctness of the classification. The correctness of slightly more than 2 in 3 (68.6%) classifications could successfully be predicted, thus indicating that the likely correctness of a particular prediction can reliably be assessed.

Discussion

This research showed unambiguously that the people's color preferences co-vary with people's career choices, and the nature of the careers they will likely enjoy. Accordingly, the present research provided strongly supports the (concurrent) validity of the Dewey Color test. Its usefulness is further enhanced by the option to assess the likely correctness of its occupational career predictions. Hence, as might prove very valuable for real-life online applications, the Dewey Color test can inform its users concerning the quality of its predictions. They receive their "Top 50 Most Enjoyable Occupations." No interpretation is required from the end user." The user can type a recommendation into a career job site search engine and receive a list of available job opportunities.

It should be stressed none of the career predictions relied on simple preferences ("people who like red …"), or common choice themes ("people who select dark colors last …."). Rather, it follows that the entire pattern of preferences must be taken into account simultaneously, and that the sequence of choices must be compared against a calibrated library of patterns as embodied here by Bayesian Classifiers. This mirrors the conclusions that we reached in earlier research (Lange and Rentfrow, 2007) which relied on neural nets instead of Bayesian classifiers.

The necessity of complex prediction machinery is supported by the fact that color preferences are highly idiosyncratic, and that searching for simple common patterns is therefore likely to fail. We found that only 5% of over 770,000 people had identical answer patterns. Since there are 1,307,674,368,000 different color orderings, it seems that people's preferences are not limited to clearly delineated subsets thereof. For this reason alone it seems unlikely that simple prediction rules will yield useful predictions.

References

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