Color and Personality: Strong's Interest Inventory and Cattell's 16PF

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Introduction

Color is an important aspect of our efforts to create personal spaces to our own liking. Moreover, color choices can have important social consequences as our choices are part of our presentation to others, and thus these choices may influence how others perceive us. Yet, little is known about why people like or dislike the colors they do. This paper asks whether people's color preferences reflect meaningful information about their personalities, interpersonal styles, and behaviors. Surprisingly, relatively little research has been done to investigate the links between such variables and individuals' color preferences. The research summarized here represents our efforts to identify links between people's color preferences and their personal characteristics as derived from two well-established psychological inventories.

Background

At the most basic level, color has been shown to affect our mood, thereby affecting the way we interact with our environment. A growing body of research in environmental psychology has shown that the color of a room or work setting can have profound effects on individual enjoyment and performance on a variety of tasks. For instance, Stone (2003) showed that task performance varied as a function of the color of the room in which the task was performed. In another study by Stone (2001), positive mood tended to be higher when individuals worked in a blue carrel compared to a red carrel. Performance is also affected because individuals read slower and comprehended less when performing a reading task in a red environment. This study thus provides direct evidence that color has an effect on cognitive ability, suggesting that the cognitive impairments produced by color could be driven by physiological arousal. Indeed, Stone's (2003) findings indicate that the color red increased individuals' levels of arousal, which when paired with a stimulating task, caused deficits in cognitive performance.

More importantly, the preceding raises the possibility that the effects of color on performance can have differential effects, depending on one's preferences or aversions for particular colors. For example, Eysenck (1967, 1970) postulated that Introverted individuals are high in internal arousal (i.e., they are preoccupied with their thoughts and feelings more than are Extraverts), and therefore prefer social environments (e.g., where they are alone) that allow them to reduce or maintain their optimum level of arousal. Thus, when Introverts are with other people their level of arousal might rise to the point that they feel uncomfortable and overwhelmed. The preceding work on the effects of color on arousal therefore suggests that color preferences and personality might be related. Specifically, individuals high in internal arousal (i.e., Introverts) might prefer "calm" colors like blue to reduce their level of arousal, whereas individuals low in internal arousal (i.e., Extraverts) might prefer "exciting" colors like red to increase their level of internal arousal Lüscher (1971).

Perhaps the most prominent theorist arguing that color preferences and personality are linked is Lüscher (1971) who proposed that individuals with similar color preferences should also possess similar personality characteristics. According to Lüscher, the physiological reactions that individuals experience while viewing primary colors (blue, red, yellow, and green) reflect basic psychological needs of the individuals. When a primary color is not liked, for example, this dislike is considered to reflect a deficit or unmet physiological and psychological need. For instance, if an individual has a particularly strong dislike for the color red, this is believed to reflect unconscious anxiety within that individual.

Whereas Lüscher (1971) regarded color preferences as a reflection of the *unconscious* drives within individuals, contemporary perspectives on the color-personality relationship view color preferences as a reflection of *conscious* (i.e.,

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reportable) motives, drives, and values. For instance, French and Alexander (1972) found that individuals preferring the color blue were calmer and preferring yellow was related to "positive" feelings (e.g., happiness). However, the hypothesis that red reflects "negative" feelings (e.g., tension) was not supported. Additionally, Seefeldt (1979) investigated sex differences in color preference, and found that yellow was preferred more highly by women than men. Yet, Stimpson and Stimpson (1979) found no sex differences in color preferences, nor did they observe a relationship between color preferences and personality. Finally, Picco and Dzindolet (1994) failed to show that color preferences are related to self-descriptions, even when controlling for social desirability (e.g., participants favoring green and blue were not more introverted than those favoring red or yellow). Taken together then, support for Lüscher's theories about the correlates of color preference is mixed at best.

The present research

The following addresses topics similar to the above, however, with two major differences.

Firstly, a different color test is used that derives from the patented Dewey Color System (Sadka, 2000), which is currently in commercial use (cf., Sadka, 2004). This Dewey Color System Test uses distinctive spectrum divided color hues. In particular, starting with yellow, blue and red, they are mixed to visually create shades of green, purple and orange with no visible characteristics of the primary shades. Likewise, the intermediates are fabricated from a primary and a secondary color. Black, white, and brown are also added. Although the Dewey Color System Test covers preferences among primary, secondary, achromatic colors, and intermediate colors, the major task to be performed in this test is the ordering of 15 colors according to respondent's preferences. In fact, it is the preference order of these fifteen choices that constitutes the basic predictor variable in this study. These colors can be described as teal, purple, brown, red-orange, yellow, magenta, orange, white, lime green, blue, gold, green, black, indigo, and red. The entire test can be seen in color at the website http://www.deweycolorsystem.com.

Secondly, Lüscher's own research, as well as later research inspired by his work, relied exclusively on standard statistical tests and correlations. Thus, hypotheses were tested mainly based on piece-meal analyses of counts and average preferences, which were then analyzed according to the analytical options provided by standard statistical methodology which treats each choice as the basic unit of analysis. By contrast, we hypothesize that the identification of global *patterns* of color preferences is far more informative than a series of piece-meal analyses. In particular, individual choices should be combined into patterns that simultaneously encompass respondents' likes and dislikes, while not giving undue weight to the evaluation of a particular color sample. Thus a contextual approach is needed that identifies and captures specific color combinations, while ignoring irrelevant variation in isolated choices. It is proposed that such an approach is provided by the use of neural nets (cf., Galant, 1994), and details concerning the present use of such nets are provided in later sections.

From a practical perspective, the present research promises to assess personality and occupational qualifications on the basis of tests that have no perceived face validity to the respondents. Thus, it will not be readily apparent to respondents how their color preferences relate to their personality characteristics or occupational proclivities. Accordingly, issues of socially desirable responding should be less of a concern than in standard paper-and-pencil tests, thereby decreasing response bias.

Study I: Strong's Interest Inventory

The latest version of the Strong Vocational Interest Blanks – called the Strong Interest Inventory (Harmon, Hansen, Borgen, and Hammer, 1994) – is a questionnaire consisting of 317 questions which inquire about respondents' interest in a wide rang of items associated with occupations, occupational activities, hobbies, leisure activities, school subjects, and preferred types of people. While the Strong Interest Inventory provides a variety of other information as

well, this research focused on respondents' general orientation to work as reflected by six separate factors, dubbed Basic Interest Scales (BIS). In particular, a distinction is made (Harmon, et al., 1994, pp. 70-78) among Realistic BIS (including agriculture, nature, military, athletics, and mechanical activities), Investigative BIS (science, mathematics, and medical science), Artistic (music/ dramatics, art, applied arts, writing, and culinary arts), Social BIS (teaching, social and medical service, and religious activities), Enterprising (public speaking, law/politics, merchandising, sales, and organizational management), and Conventional BIS (data management, computer activities, and office services).

Procedure. A commercial testing center headed by a former Human Resource Director at a leading aerospace company was charged to administer the Strong Interest Inventory to volunteers who participated in a series of Career Transition Clinics provided by an Atlanta, GA church. As part of a battery of occupational tests (including Cattell's 16PF as used in Study II), four professional psychologists administered Strong's Interest Inventory together with a paper-and-pencil version of the Dewey Color System Test. These psychologists processed and evaluated the answers, and respondents returned after two weeks to learn about the results. The resulting sample of 885 potential career changers consisted of 524 women and 359 men, and 2 persons with unknown gender. The respondents' average age was 32.1 years (*Median* = 29.0, *SD* = 12.9 years) with missing age information for 28 individuals.

Analyses. Although other methods were considered as well, the results reported here derive exclusively from analyses based on standard neural nets using backpropagation based on standard logistic squashing, momentum, and varying learning rates (cf. Gallant, 1994). The software used was a Delphi implementation of that described in Lange (1996). Throughout, one intermediate layer was used. To facilitate deployment of the resulting neural net, this software also produced a standalone Delphi program that provides an efficient implementation of the forward pass of the neural net for use as a web (.NET) component.

Results

The six panels of Figure 1 are scatter plots of the relation between the actual – but squashed – Strong BIS (X-axis) and the squashed BIS values as predicted by the neural net (Y-axis) from the color test inputs. Visual inspection reveals that prediction is quite successful for each of the six BIS. As is shown in Table 1, the finding of sizeable correlations between the actual and predicted squashed BIS values supports this interpretation. For instance, the median correlation across all BIS is 0.68, and the lowest correlation, i.e., for Social BIS, is 0.54. Further, given the very nature of the color test, it is at least suggestive to note that the highest correlation (*r = 0.73*) obtains for the Artistic BIS.

We conclude therefore that respondents' color preferences as assessed by the Dewey Color System Test are indeed powerful predictors of all Basic Interest Scales of the Strong Interest Inventory. These findings thus open the exciting possibility that people's vocational interests can be inferred quite accurately from their color preferences.

Study II: The 16PF

The Sixteen Personality Factor questionnaire (16PF) is a 185-item instrument that comprises 16 personality primary factor scales originally identified by Raymond Cattell (cf., Catell, Eber, & Tatsuoka, 1970). Historically, letters only identified these factors, but it has become customary to add descriptive labels also (Russel & Karol, 2002). The complete list of factor designation is: Factor A (Warmth), Factor B (Reasoning), Factor C (Emotional Stability), Factor E (Dominance), Factor F (Liveliness), Factor G (Rule-Consciousness), Factor H (Social Boldness), Factor I (Sensitivity), Factor L (Vigilance), Factor M (Abstractedness), Factor N (Privateness), Factor O (Apprehension), Factor Q1 (Openness to Change), Factor Q2 (Self-Reliance), Factor Q3 (Perfectionism), and Factor Q4 (Tension).

Figure 1: *Actual vs. Predicted Values for All Six Strong BIS (Study I)*

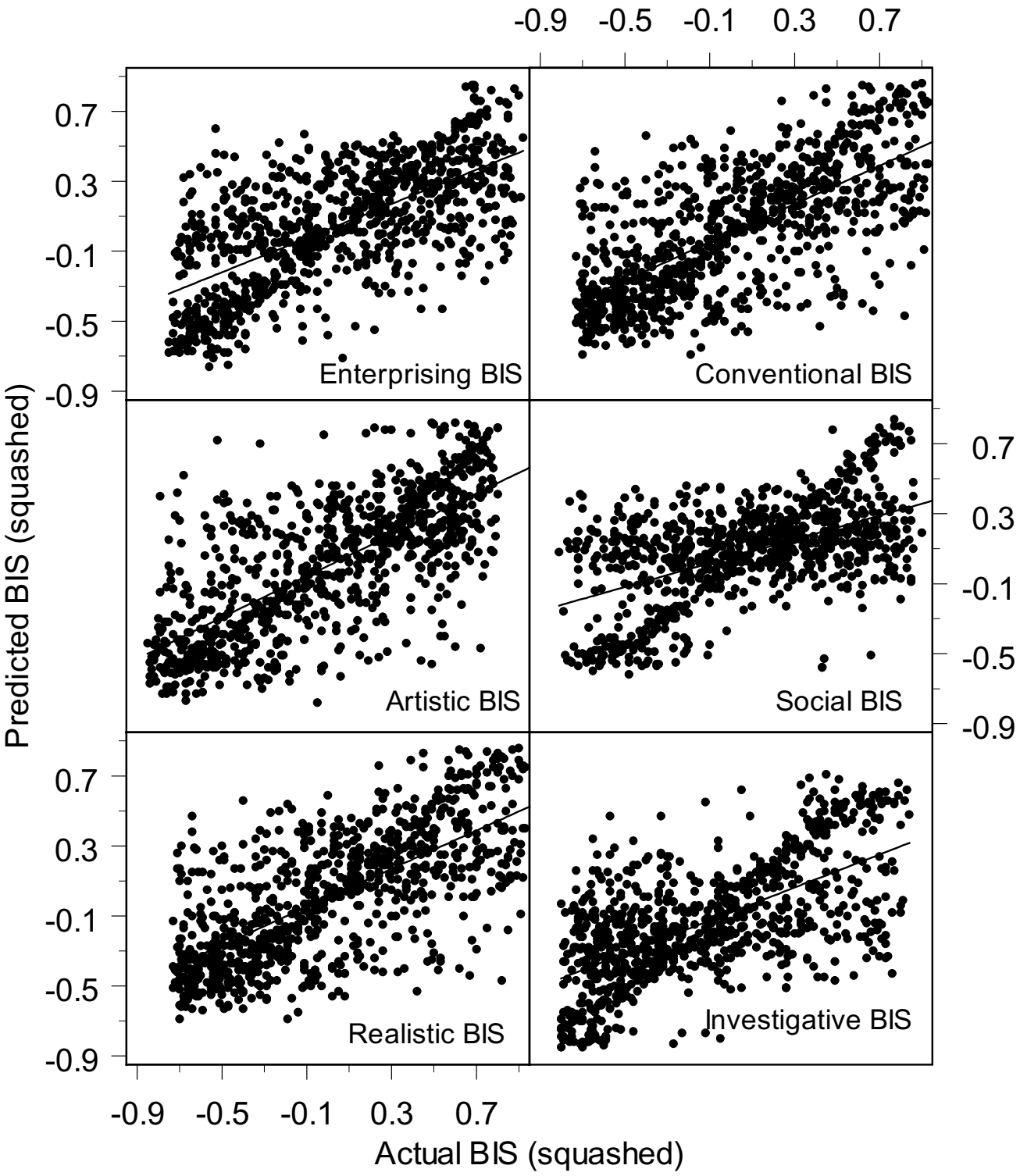


Table 1: *Pearson Correlations Between Actual and Predicted BIS Values (Study I)*

Strong Basic Interest Scale (BIS)	Pearson Correlation
Realistic	*0.70*
Investigative	*0.64*
Artistic	*0.73*
Social	*0.54*
Enterprising	*0.66*
Conventional	*0.70*

Note: *All correlations shown are statistically significant at $p < .001$.*

From these sixteen factors, as well as from particular combinations of low or high factor scores, it is possible to derive other personal characteristics as well. However, as such combinations can be always derived once the sixteen primary factors are known, this topic is not further pursued here.

Procedure. The 16PF was administered in the same context as the Strong and details are therefore not repeated. A subset of 1010 volunteers, which partially overlapped with those taking the Strong Interest Inventory in Study I, completed both the 16PF and the Dewey Color System Test. This sample consisted of 602 women and 403 men, and 5 individuals with unknown gender. The average age was 32.7 years (*Median* = 30.0, *SD* = 13.6 years) – with missing age information concerning 27 individuals.

Results

Analogous to the procedure followed for the Strong, respondents' scores on each of the sixteen primary factors were transformed to *z*-scores, and then squashed using a logistic function. These sixteen quantities were then predicted from respondents' color choices on the Dewey Color System Test. The sixteen panels of Figure 2 summarize the observed relations between respondents' actual (squashed) factor scores (X-axis) and the squashed predicted values produced by the neural net (Y-axis). (Note: In this figure the points are offset along the X-axis by random amounts to better display their local frequencies). The correlations between the actual and predicted values of these factors are listed in Table 2.

It will be clear that respondents' color preferences provide powerful predictors of their personalities. The highest correlation is obtained for Factor H (Social Boldness), and the magnitude of this correlation ($r = 0.68$) is comparable to the highest value obtained in Study I for the Strong Interest Inventory. Also, the median correlation in this study (*0.51*) is similar to that found earlier. However, the correlation of the worst performing variable – Factor O (Apprehension) with $r = 0.33$ – falls well below the worst performing BIS (i.e., Social) of the Strong Interest Inventory.

Nevertheless, given the results for the Strong Interest Inventory, the findings for the 16PF clearly reinforce the notion that color preferences as assessed by the Dewey Color System Test are indeed valid indicators of personality.

Figure 2: *Actual vs. Predicted Values for All Sixteen Primary Factor Scales (Study II)*

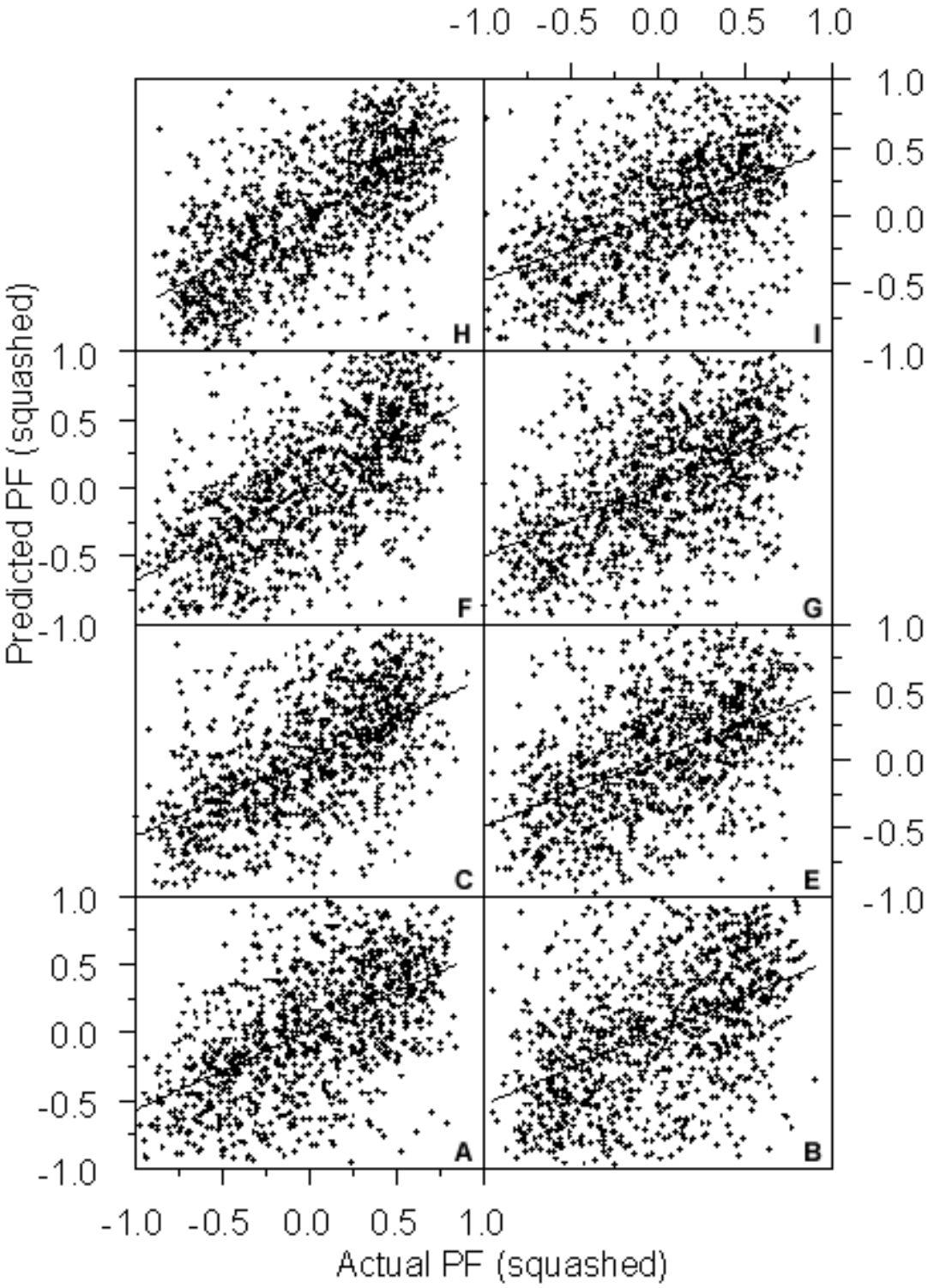
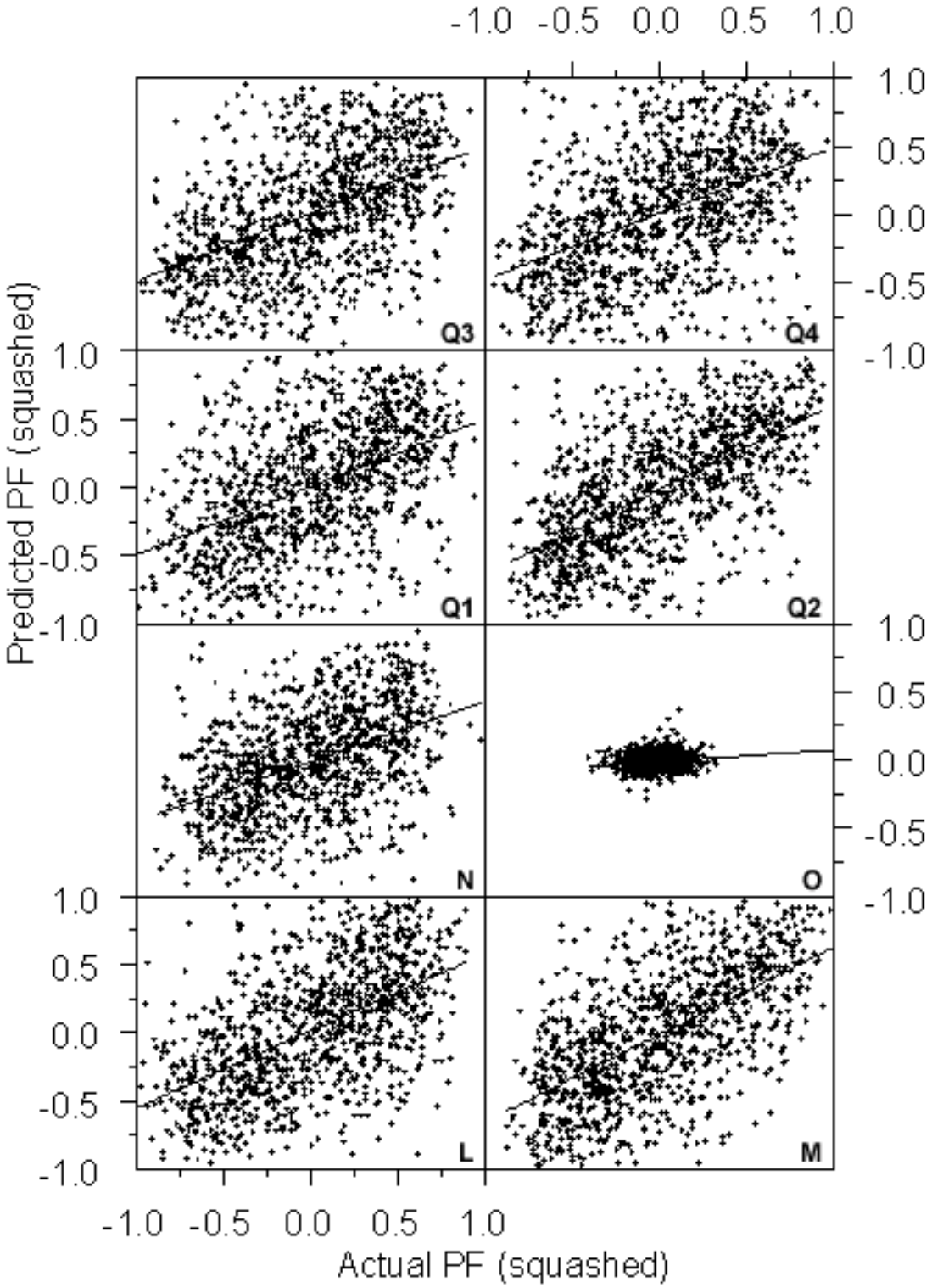


Figure 2: *Continued*



Note: *The letters in the sub-panels of this figure refer to the 16 factors listed in Table 2.*

Table 2: *Pearson Correlations Between Actual and Predicted Primary Scale Values (Study II)*

16 PF Primary Factor Scale	Pearson Correlation
Factor A (Warmth)	*0.57*
Factor B (Reasoning)	*0.50*
Factor C (Emotional Stability)	*0.59*
Factor E (Dominance)	*0.51*
Factor F (Liveliness)	*0.65*
Factor G (Rule-Consciousness)	*0.52*
Factor H (Social Boldness)	*0.68*
Factor I (Sensitivity)	*0.50*
Factor L (Vigilance)	*0.57*
Factor M (Abstractedness)	*0.63*
Factor N (Privateness)	*0.50*
Factor O (Apprehension)	*0.33*
Factor Q1 (Openness to Change)	*0.49*
Factor Q2 (Self-Reliance)	*0.63*
Factor Q3 (Perfectionism)	*0.49*
Factor Q4 (Tension).	*0.47*

Note: *All correlations shown are statistically significant at $p < .001$*

Summary and Discussion

As was anticipated, the present findings clearly indicate that people's color preferences, as assessed via the Dewey Color System Test, indeed provide meaningful information about their personalities, interpersonal styles, and behaviors. In particular, the data indicated that this test predicted with considerable precision all six of the Basic Interest Scales of Strong's Interest Inventory (Harmon, et al., 1994), and nearly all of the sixteen Primary Factors of Cattell's 16PF (Russel & Karol, 2002). As such, the present findings show far greater consistency than do those obtained in earlier research inspired by Lüscher's (1971) work (cf., Stone, 2001, 2003; French & Alexander, 1972; Seefeldt, 1979; Stimpson & Stimpson, 1979; Picco & Dzindolet, 1994).

A number of issues remain, however. For instance, it is not clear at this point whether our findings must be attributed to the differences between the colors contained in the Dewey Color System Test and Lüscher's color test, whether neural nets simply provide a superior method of analysis relative to the simpler statistical methods employed in previous research, or whether the particular test and analysis combination used here is responsible. Also, while it is true that neural nets form a holistic oriented approach in which choices are combined into patterns that simultaneously encompass respondents' likes and dislikes, neural nets have the disadvantage of being a *black box* only, i.e., they must be used "as is." In particular, neural net's weights are difficult to interpret directly (Gallant, 1994), and even knowing all its weights provides little guidance in identifying which patterns of color preferences are associated with which particular personality traits.

It should be kept in mind that we have essentially bridged the relation between two types of tests, i.e., color preferences and the personality related variables assessed by the Strong and the 16PF. However, what we have *not* yet established is that the Dewey Color System Test also predicts the behaviors for which these personality tests are typically used. Thus, more extensive validation should consider using color preferences *directly* to predict variables such as job satisfaction, leadership potential, etc. Given the promising findings, and given the advantages of having non-verbal tests, we believe that the present research justifies the cost and effort involved in conducting such studies.

Finally, the present findings may have implications beyond standard personality assessment. For instance, observers can (and *do*) infer characteristics of people based on such cues as physical appearance, clothing, nonverbal behavior, facial features, appearance of bedrooms and offices (Gosling, Ko, Mannarelli, & Morris, 2002), websites (Vazire & Gosling, 2004), and music preferences (Rentfrow & Gosling, 2003). Thus, to the extent that people's theories about others' use of color play similar roles, the study of color preferences could be expanded to areas such as advertising, web-design, on-line dating, and interpersonal perception in general.

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