

Kinds of individuals defined by patterns of variables

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Abstract

This paper argues that investigators should consider replacing the popular practice of comparing individuals varying in gender, social class, and/or ethnicity on one or more continuous measures with a search for kinds of individuals defined by patterns of properties that include not only their values on outcome measures but also their gender, social class, and ethnicity. Investigators who believe that a particular predictor contributes to an outcome independent of the gender, class, or ethnicity of the participants often implement statistical procedures that promise to remove the contributions of the above categories. These analyses lead to misleading conclusions when the controlled category is correlated with the dependent measures. The final sections summarize the properties of genders, classes, and ethnic groups that make distinctive contributions to many psychological outcomes. The paper ends by noting that a society's ethical beliefs constitute a defensible basis for ignoring the biological properties associated with these categories in order to allow members of these groups access to whatever educational or occupational goals they desire.

Subjective experience, as well as the referents of scientific constructs, consist of kinds of entities defined by patterns of features. Change one or more of the defining features and the observable properties of the entity are liable to change. Each person is a pattern of biological and psychological features that includes the person's genome, developmental stage, gender, social class, and ethnicity. The psychological properties of this pattern depend, of course, on the society and historical era. A small number of adolescent girls from wealthy families in Bangladesh possess properties that are missing from the profiles of most wealthy, adolescent girls or boys.

The first of this paper's five major sections explains the conditions under which psychologists should replace the popular practice of reifying single measures with a strategy that searches for kinds of persons. This is not an original suggestion (Allport, 1937; Bergman, 1998; Grove, 1991; Hinde, 1998; Magnusson, 1998; Magnusson & Tørestad, 1993; Werner & Smith, 1982).

The second section describes the problems trailing the popular strategy of using statistics to remove the contributions of gender, class, and/or ethnicity to an outcome. The final three sections summarize the biological and psychological properties of these three categories and note the conditions under which they contribute unique sources of variation to many psychological outcomes.

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Reifying Continuous Measures

Many psychologists treat the variation in a host of continuous measures as possessing the same correlates, and therefore the same meaning, across diverse populations. Examples include the cortisol waking response, heart rate, heart rate variability, skin conductance, pupillary dilation, potentiated startle, prepulse inhibition, event-related potentials, theta-gamma ratio, working memory, spatial reasoning, magnitude of the blood oxygen level dependent signal to a brain site, functional connectivity, cortical thickness, shy behavior, looking times, response latencies, and verbal reports of a personality trait or past history.

These investigators assume, without sufficient empirical support, that a high, moderate, or low value on a measure has the same pattern of correlates in individuals of different genders, social classes, or ethnic groups. This assumption is flawed. About 5% of 6-year-old children who had spent their first 24 to 42 months in a depriving Romanian orphanage before being adopted by a British family attained high scores on tests of cognitive abilities that were equivalent to the scores of a larger number of adopted British children who had not experienced severely depriving circumstances (Rutter, O'Connor, and the English and Romanian Adoptee [ERA] Study Team, 2004). This fact implies that the similar scores were the result of different causal cascades.

The death rates due to an opioid overdose among Americans vary with their gender, class, and ethnicity. Non-Hispanic, White males from families in the bottom third of the income distribution living in the Northeast or on the West Coast had the highest rates (30/100,000). Economically advantaged White females from a western state had the lowest rates (7/100,000) (Rudd, Seth, David, & Scholl, 2016).

Most of the modest, but significant, correlations between a predictor and an outcome in psychological research are due to the 15% to 20% of the sample who were low or high on both measures. Investigators, however, usually imply a linear relation between the variables instead of examining the distinctive properties of those who had the low or high values on both variables (Beatty et al., 2018)

Some critics of the strategy advocated here argue that because every individual is a unique pattern of features, no generalizations are possible. However, persons belonging to the same gender, class, and ethnic categories are likely to share select properties. More adolescent boys reared by economically stressed parents belonging to a minority group in the society are likely to share traits that are missing from girls who grew up in wealthy families belonging to the majority ethnic group. These include failure to graduate high school, engagement in unprotected sex, gang membership, violence, and a feeling of marginalization.

Many of the psychologists who attribute the same meaning to particular values on a measure do so because they are more concerned with the consequences of a trait with respect to adaptation, or want to confirm a favored, a priori hypothesis. Hence, they are receptive to a consensual claim that a particular measure is a sensitive index of the construct they wish to affirm, whether security of attachment, impulsivity, or anxiety.

These investigators ignore the fact that a variety of cascades can generate the same value on the measure they chose. Some children, for example, make many errors on a flanker task because they are not motivated to perform well. Others with the same error score have difficulty inhibiting an urge to act. Still others have minimal anxiety over poor performance. The same score on a questionnaire measure of depression can be due to the stress of poverty, a serious physical illness, chronic insomnia, loss of a close relative, or guilt over an action that harmed another (Carpenter et al., 2017).

The likelihood of being deprived of research funds when the National Institutes of Health and the National Science Foundation were first established is a second reason why psychologists celebrate continuous measures. The threat of being excluded from the disciplines that could apply for grants forced social scientists to reify quantitative measures, as natural scientists do when they quantify mass, energy, or electric charge. This strategy tempts social scientists to ignore the distinct cascades that can result in the same outcome. The complex, reciprocal relations among the brain's neurons, glia, transmitters, autonomic targets, and immune system make it easy to defend the claim that few, if any, psychological or biological outcomes are the product of a single casual cascade (Dantzer, 2018).

The influence of the English language

A third reason for the reification of measures stems from the fact that a majority of published papers in the last 80 years are written in English. English, unlike some of the world's languages, allows the same predicate to be used with different

agents and targets, even though the network of schemata and words linked to the predicate varies with the agent and/or target. Examples include the predicates *run*, *give*, *open*, *eat*, *grab*, *give*, *compute*, *integrate*, *learn*, *kill*, *anxious*, *depressed*, *angry*, and *sad*. The language of a small population in New Guinea, by contrast, invented different words for the predicate *give* when an agent gives water to a dog versus advice to a friend (Foley, 2000). Mandarin speakers use different words to describe an infant who is fearful of a stranger and an adult who is fearful of offending an authority figure (Wierzbicka, 1999).

Most predicates need a noun to disambiguate their meaning because there are more nouns for different kinds of things than there are verbs for the distinct functions of things. Because the networks of associations evoked in readers by the predicate *eat* differ when a spider, whale, infant, or woman is the noun, the predicate has different meanings in sentences that specify these agents.

English also allows predicates to function as nouns. Each of the popular emotion terms can be a noun, as in "Fear is unpleasant." Once a predicate naming a process is treated as a noun, it is easy to think about it as a natural kind. That may explain why Fanselow and Pennington (2018) declared that fear was a brain state generated by a particular pattern of neuronal activity. Other scientists argued that the mouse ventral hippocampus contained anxiety neurons because they were activated by stimuli that signaled an aversive experience (Jimenez et al., 2018).

Buzsaki and Llinas (2017), however, reject the notion that neurons can represent fear or anxiety. These words were invented to allow one person to communicate to another the quality of their subjective state. It is unlikely that the words languages invented to help humans talk about their feelings should correspond to particular brain profiles (Francken & Slors, 2018). I assume that no contemporary neuroscientist would search for the brain site that represents a feeling of piety or sinfulness. No language carves nature at its joints. However, English happens to be a particularly misleading language of description for psychological phenomena because its predicates fail to specify the agent and the context.

Statistical procedures to find kinds of persons

Statistical methods, such as latent class, latent profile, cluster, configural, or network analysis, can reveal theoretically important categories of individuals based on combinations of predictor and outcome measures (Bruno et al., 2017; Byrd & Carter-Andrews, 2016; Christensen, Taylor, & Zubrick, 2017; Goldberg & Halpern, 2017; Loken, 2004; McElroy, Shevlin, & Murphy, 2017).

Application of one of these methods to the performances of college students on a navigation task that required learning two different routes within the same virtual environment revealed three distinct groups (Weisberg & Newcombe, 2016). A network analysis of the strengths of associations of self-reported feelings in Americans with generalized

anxiety disorder or major depression disorder, who noted their psychological state at random times over a 30-day period, revealed a number of individual networks that differed from the network for the entire sample (Fisher, Reeves, Lawyer, Medaglia, & Rubel, 2017). A small, but growing, number of scientists are documenting the value of discovering the networks of genes, physiology, past history, culture, and current life conditions that are correlated with particular symptoms of a mental illness (Boorsboom, Cramer, & Kalis, 2018; Guloksuz, Pries, & van Os, 2017).

These methods are not applied more frequently because they require large samples and have stringent requirements that are hard to meet. Samples of 200 are often too small to discover subgroups of individuals with special patterns. In addition, faculty teaching statistics and journal reviewers prefer analyses that compute analyses of variance, multivariate analyses of variance, and regression on continuous variables and noting interactions. Investigators prefer to state that there was a significant interaction among gender, class of rearing, and ethnicity with respect to the use of illegal drugs. Had they performed a detailed analysis of the evidence they might have discovered several categories of drug-abusing youths that differed in class, gender, and ethnicity.

Removing the Contributions of Correlated Variables

The use of statistics to remove the contribution of gender, social class, or ethnicity from a relation between an independent and dependent measure often violates two critical requirements. The relationships between the predictor and outcome variables have to be the same across all levels of the controlled variables and their impact on an outcome must be additive. If one or both of these requirements are not met, the investigator cannot be confident in the inferences drawn about causal relations (Gelman & Hill, 2007).

These assumptions are violated when the contribution of social class is removed from the relation between childhood abuse and an outcome measure of social anxiety, depression, antisocial behavior, marital status, or academic achievement because the contribution to the outcome measures is dissimilar for members belonging to different class groups (Alto, Handley, Rogosch, Cicchetti, & Toth, 2018; Knutson, 1995; Sasser, Bierman, Heinrichs, & Nix, 2017).

Consider, for example, a study evaluating, in a diverse sample, the relation between maternal failure to respond quickly to her infant's distress (attachment theorists call such mothers insensitive) and the probability that the adolescents who had this experience as infants would be arrested for a crime. Investigators who controlled for the contributions of gender, class, and ethnicity remove different contributions to the outcome for White girls from advantaged homes compared with Black males from poor families, rendering the results of the analysis uninterpretable. It is always better to match experimental and control groups on age, gender, class, and ethnicity than to use statistics to remove the contributions of these conditions.

The reliance on statistics to control for class is a problem in long-term longitudinal studies because the less well-educated participants are more likely than the better educated to drop out of the study. Investigators who use statistics to impute the missing values for these individuals exaggerate the effect of parental education on the outcome (Lewin, Brandeer, Benmarhnia, Frederique, & Basile, 2018).

The self-reports of internalizing symptoms by adolescents from one of seven nations (France, Germany, Turkey, Greece, Peru, Pakistan, and Poland) reveal the danger of controlling for the contribution of variables, in this case reports of stress and maternal acts that provoked anxiety, that are correlated with the outcome. The analysis, revealing that boys had more internalizing symptoms than girls in five of the seven nations, is inconsistent with the many investigations of diverse samples reporting higher levels of internalizing traits in females. (Seiffge-Krenke et al., 2018).

Nonlinear relations, often S-shaped functions, are common in psychology (Looser & Wheatley, 2010). A small number of individuals with extreme values on a measure can tempt investigators to arrive at misleading inferences when they use statistical manipulations that seek least squares minimization (Breckler, 1990; Judd, McClelland, & Culhane, 1995; MacCallum & Austin, 2000).

Despite the advice of John Tukey, one of the world's most respected 20th-century statisticians, to examine data carefully before implementing any formal statistical procedure, many investigators do not consistently check to see if the relations among their variables are roughly linear, distributions are close to normal, and there are no outliers (Cox, 2017).

A number of scholars who are sophisticated in statistics have criticized the practice of controlling for sources of heterogeneity in order to assess the contribution of a single variable to an outcome (Achen, 2005; Kraemer, 2015; Rohrer, 2018; Spector & Brannick, 2013; Torrey & Yolken, 2018). Donald Rubin wrote (personal communication, October 2017), "Very few social scientists understand the geometry behind regression and many interpret their results without a clear comprehension of what the method did with their data." Helena Kraemer (personal communication, December 2017) was blunt, "Removing (controlling for) certain variables is just crazy. . . . I really do think that quite generally the conclusions based on removing sources of heterogeneity are more likely to be false than conclusions in which this is not done."

One reason for this critical view of statistical methods presumed to control for the contribution of gender, class, or ethnicity to mean values on outcome measures is that different causal cascades can lead to the same average values. Youth who have grown up in a disadvantaged family vary in the features that are common among the disadvantaged in every society. These include more frequent infections, a chronic pro-inflammatory state, compromised language skills, less adequate schools, younger mothers, single-parent families, intensity of identification with one's class, shame over one's status, and anger at the privileged. Investigators who control for social class are removing dissimilar

contributions among the members of the category (Bleakley et al., 2017).

No statistical manipulation can control for all the diverse contributions of a person's gender, class, or ethnicity to outcome measures. Hence, investigators should be more cautious before concluding that one particular condition contributed to an outcome, independent of the variables whose contributions were removed. I know of no biologist who would remove the contribution of rainfall in order to evaluate the contribution of hours of sunlight to the growth of a plant because plants need both sunlight and water.

Reasons for current practices

The contemporary, egalitarian ethos allows investigators to assume that the members of gender and ethnic groups are generally similar in their physiologies, abilities, and emotional responses. If this were true, most measures would have the same meaning across individuals. As we shall see, the evidence does not support that premise. Nonetheless, some papers in prestige journals fail to tell readers the ethnic composition of their sample (Kim et al., 2017). Some are indifferent to both ethnicity and social class (Kosinski, 2017).

Although no educational degree, occupation, political position, or social role in contemporary society requires talents or traits that are restricted to one gender or ethnic group because of their biological properties, many worry that the prejudiced members of a society will exploit the discovery of a statistically significant difference between genders or ethnic groups as a reason for imposing such restrictions, an example of the naturalistic fallacy. A society is neither foolish nor irrational if it chooses to ignore the biological variation between genders or ethnic groups in order to promote an ethical value held by a majority of the population.

The rest of this paper summarizes the properties of the genders and class and ethnic groups that point to the value of looking for categories of individuals defined by patterns that include the variables of interest together with gender, class, and ethnicity.

Gender

A person's sex is defined by his or her sex chromosomes, which, in most cases, determine the genital anatomy and the ability to carry out the reproductive functions of a female or a male. Gender, however, is defined by the identity the person assumes. Cultural values and socialization of the properties that comprise sex role stereotypes exert important influences on gender (Fiske, 2017; Serbin, Poulin-Dubois, & Eichstedt, 2002). The fact that the percentage of violent crimes committed by American women has increased over the past 20 years has to be attributed to social changes in American society.

Cultures vary in the admirable traits they expect each gender to acquire. Some of these representations can appear before the second birthday (Zosuls et al., 2009). Athens

celebrated female goddesses at the same time that the Chinese did not bother to give their daughters a name. Boys and men in most cultures are more likely than females to encounter highly competitive social contexts in athletic games and dyadic interactions, which, in turn, shape a behavioral style that is less common in girls and women.

Despite the powerful effects of experience, investigators cannot ignore the biology that contributes to sex differences in select behaviors and vulnerabilities in humans, chimpanzees, baboons, and monkeys (Lonsdorf, 2017; Zaruli et al., 2018).

The influence of biology

The sexes vary in genes; epigenetic marks; physiological responses to select events; the anatomy, chemistry, and connectivity of the brain; prevalence of left handedness; violent behaviors; illnesses; ease of acquiring specific cognitive skills; and susceptibility to select stressors (Ardekani, Figarsky, & Sidtis, 2013; Kurth, Thompson, & Luders, 2018; McCarthy, de Vries, & Forge, 2017; Pavlova, Sokolov, & Bidet-Ildei, 2015; Satterthwaite et al., 2015; Tomasi & Volkow, 2012; Zhan et al., 2017).

The National Institutes of Health require investigators studying a phenomenon in an animal species that has relevance to human health to include both sexes. This decision was motivated by the extensive evidence revealing significant sex differences in multiple domains in many species (Gillies, Virdee, Pienaar, Al-Zaid, & Dalley, 2016).

The sex hormones. The secretion of testosterone by males during an 8-week interval as a fetus and during the first 3 postnatal months has a profound effect on brain structure and function, genital anatomy, and other physical features (Amunts et al., 2007; Barth, Villringer, & Sacher, 2015; Keller & Menon, 2009; Kosciak, O'Leary, Moser, Andreasen, & Nopoulos, 2008; Lombardo et al., 2012; Salinas et al., 2012; Shiino et al., 2017).

The female's secretion of estradiol at puberty is accompanied by a variety of consequences, including higher tonic levels of dopamine in the ventral striatum, due partly to the fact that estrogen protects the dopamine neurons in the substantia nigra and ventral tegmental area from apoptosis (Smith & Dahodwala, 2014). As a result, females are more likely than males to experience a smaller phasic increase in dopamine to the same unexpected, but desired, event and, therefore, may interpret the event as less pleasant (Becker, 1999; Dluzen, 2005; Gold et al., 2018; Kelly & Goodson, 2015; McCarthy 2008). Cholens, Galea, Sohrabji, and Frick (2018) have published a useful review of sex differences in brain-behavior relations in animals.

More male than female infants, humans as well as monkeys, prefer to play with objects that move (Alexander & Hines, 2002; Hassett, Siebert, & Wallen, 2008). Close to one-third of American mothers reported that their young child had an intense interest in an object or activity, usually a toy

that moved, such as a car, train, or truck. More than 75% of these children were boys (DeLoache, Simcock, & Macari, 2007).

Many female infants who saw an adult cradle a balloon in one video and punch the balloon in a simultaneous video imitated the former action. Many boys chose the punching response (Benenson, Tennyson, & Wrangham, 2011). This observation is consistent with the fact that preschool boys from varied cultures engage in more vigorous motor activity than girls (Pioreschi et al., 2017; Veldman et al., 2017).

Girls born with high levels of adrenal androgens because of a rare recessive disorder called congenital adrenal hyperplasia preferred to play with masculine toys, reported an interest in a masculine career, and were vulnerable to developing a gender identity disorder (Berenbaum, Beltz, Bryk, & McHale, 2018; Nordenstrom, Servin, Bohlin, Larsson, & Wedell, 2002; Servin, Nordenstrom, Larsson, & Bohlin, 2003; Walia, Singla, Vaiphei, Kumar, & Bhansali, 2018).

Far more boys than girls say they enjoy engaging in physical aggression in their play and commit more acts of physical aggression as children, youths, and adults (Benenson, Carder, & Geib-Cole, 2008; Pedersen & Bell, 1970). In addition, more males than females with an intention to commit suicide used methods, such as a gun or hanging, that are likely to be successful (Mergl et al., 2015).

By contrast, twice as many females as males from a variety of cultures report high levels of worry, anxiety, and depression. The likely targets of worry include failure to meet personal standards on attractiveness, academic performance, popularity, or the proper response to a sexual incentive. The resulting guilt can provoke a bout of depression (Wichstram, 1999).

A latent class analysis of the health of more than 28,000 Swedish twins between ages 41 and 64 revealed five classes. Class 1 included those with no serious health problems. Classes 2 through 5, which accounted for 34% of the variance, had more women than men reporting chronic pain, anxiety, or depression (Kato, Sullivan, & Pedersen, 2010).

Only the disadvantaged American adolescent girls who had been neglected or abused as children developed a depression; the neglected boys did not (Alto et al., 2018). The female susceptibility to worry was also observed in American and Hong Kong adults who feared contracting a respiratory illness (Moran & Del Valle, 2016) and German emergency medicine physicians (Sand et al., 2016).

The excitatory effect of estrogens on the basolateral region of the amygdala represents one reason for the female susceptibility to bodily feelings that are often interpreted as worry or fear (Blume et al., 2017; Carnevali, Thayer, Brosschot, & Ottaviani, 2017) as well as a risk averse posture toward uncertainty (Panno, Donati, Million, Chiesi, & Primi, 2018).

Estrogens cannot be the only reason for the female's susceptibility to uncertainty because female infants display more frequent avoidance of relevant incentives. Observations of mainly middle-class, Caucasian infants and 2-year-olds revealed that more girls than boys showed behavioral avoidance

of incentives that generated uncertainty (Buss, Brooker, & Leuty, 2008; Planap, Van Hulle, Gagne, & Goldsmith, 2017).

Spatial skills. Although males and females have similar average scores on tests measuring abilities in mathematics and spatial reasoning, it is equally true that more males than females attain scores in the top 5% of these distributions, especially for tasks that require mental rotations of three-dimensional geometric forms (Hyde, 2005; Spelke, 2005; Zell, Krizan, & Teeter, 2015). The ratio of male to female participants in International Mathematics Olympiads, who typically have test scores in the top 1% of the distributions, approaches 9:1 (Hyde & Mertz, 2009).

Success on tests of spatial reasoning requires the person to hold schemata of different forms in visual working memory long enough to decide if they are versions of the same or different forms (Bergold, Wendt, Kasper, & Steinmayr, 2017; Handa & McGivern, 2015; Heil & Jansen-Osmann, 2008; Machin & Pekkarinen, 2008; Nowell & Hedges, 1998). Sex differences in this skill emerge during the preschool years (Hood, Cole-Davies, & Dias, 2003; Levine, Huttenlocher, Taylor, & Langrock, 1999). Children's drawings reveal more sophisticated spatial skills among boys, and few studies find a gender difference in spatial skills that favors girls (Brown, 1992; Tuman, 1999).

The ability to mentally rotate forms involves sites in the parietal cortex, especially in the right hemisphere (Lamp, Alexander, Laycock, Crewther, & Crewther, 2016). The surface area of this region was larger in one sample of American males compared with females (Levman, MacDonald, Lim, Forgeron, & Takahashi, 2017). In addition, individuals processing mathematical symbols typically activate the intraparietal sulcus, which is longer and deeper in males than females (Fish et al., 2017). These observations invite the speculation that androgens make a contribution to the male superiority on mental rotation problems (Beking et al., 2017; van Hemmen et al., 2016).

Because chess requires spatial skills, it is not surprising that more boys than girls select chess as a hobby and the select group of women who play in tournaments have lower ratings than the men (Stafford, 2018). Males are more accurate than females in localizing the source of a particular familiar sound in a collection of familiar sounds coming from other locations (Zundorf, Kamath, & Lewald, 2011), integrating two different routes in the same virtual environment (Weisberg & Newcombe, 2016), and tracking the trajectory in space of a single moving object embedded in an array of moving objects across an age span from adolescence to old age (Nakayama, personal communication February 2018).

Finally, the speech of boys from 14 to 46 months contained more words relevant to space, such as *in*, *on*, *behind*, and *between*, than the speech of girls. Although the mothers of sons also used more space words, the investigators could not rule out the possibility that the types of play boys display invited the mother's use of space words (Pruden & Levine, 2017). This observation is in accord with the male superiority

in geometry, but not in arithmetic, in societies that promote gender equality (Guiso, Monte, Sapienza, & Zingales, 2008) and with a bias among 4-year-old boys, but not girls, to use visual cues to judge the spatial position of their invisible hand (Livesay & Intili, 1996).

Although these observations indicate that biology contributes to the higher scores of males on tests requiring spatial abilities, biology is not destiny. When first-grade Israeli children were trained in how to solve mental rotation problems, the mean scores of girls and boys were not significantly different (Tzurriel & Egozi, 2010). This result implies a gender difference in initial strategy, rather than a fixed, biologically based compromise in the cognitive abilities required to solve these tasks. The fact that males show greater functional connectivity within than between hemispheres, while females have greater interhemisphere connectivity, may allow males to keep a schema for a spatial representation separated from a verbal label. Variation in the ease of acquiring and activating a talent appears to be a useful way to view the gender differences in spatial abilities.

An obvious reason for the excess of males in careers that require mathematical and spatial skills is that boys are socialized to believe they should be proficient in these fields. After all, there are far more eminent male than female role models in these disciplines. Douglas Hofstadter remembers, as a 15-year-old, perusing the pages of Rudolf Carnap's *The Logical Syntax of Language* in a bookstore. Although he was too young to understand the dense prose, Hofstadter recalls that the book set his "brain on fire" because it promised deep secrets understood only by geniuses (Sigmund, 2017).

The belief that the self is much more intelligent than one's peers, which Hofstadter assumed geniuses feel, is a more pressing concern for males than for females. As a result, young men with the appropriate talents are attracted to the difficult science, technology, engineering, and math (STEM) disciplines. They find them more interesting, partly because their mastery is accompanied by a special pleasure. The motivation for the pleasure that accompanies working on and solving difficult mathematical and spatial problems appears to be as, or perhaps more, significant than cognitive abilities in explaining the gender differences in these domains.

A decision by the German government to require high school students to take a course in advanced mathematics did not support the premise that if girls took more math courses they would have more confidence in their talent and would consider a STEM field for a career. Measures of mathematical knowledge, confidence in one's mathematical ability, and vocational aims were gathered on 4,730 males and females attending a high school in the state of Baden-Württemberg before and after the requirement.

The females who took the advanced course had, as expected, higher scores on the tests of mathematical knowledge than the females who did not. However, to the surprise of many, the former group had less confidence in their mathematical talent and were less likely to favor a STEM career. The authors' interpretation was that the females who took

the advanced course were exposed to many boys who were more competent than they in the classroom. Hence, their prior self-confidence was compromised. Girls with reasonable confidence in their math ability who were protected from interacting with the many proficient boys in the advanced course retained a prior belief in their talent and were willing to consider a STEM career (Hubner et al., 2017). Talented youths living in small towns often have more confidence than equally talented adolescents living in a large city who encounter many peers who are more talented than they: a phenomenon called "the big fish in a small pond" effect. Only 6 of the 20 American presidents who were elected after 1900 spent their childhood years in one of America's major cities or suburbs.

Many males do not find STEM fields interesting, and some females, such as Rosalind Franklin, Lisa Randall, and Vera Rubin, do. Nonetheless, more American and European males than females reported a greater interest in manipulating objects than in interacting with people; more females than males reported the opposite preference (Morris, 2016; Su, Rounds, & Armstrong, 2009; Vock, Koller, & Nagy, 2013). The author knows many undergraduate women who were receiving A grades in their mathematics and physics courses who later decided to drop their concentration in these fields because they did not find the work satisfying.

The evidence implies the potential error that accompanies pooling data from males and females because the means are not significantly different. A recent paper on the stability of alpha band asymmetry at F7/8 to an approaching stranger in infants seen at both 6 and 12 months reported a significant level of stability for the entire sample (Brooker, Canen, Davidson, & Goldsmith, 2017). My examination of the raw data, sent to me by one of the authors, revealed that the stability was only significant for girls. This is not the only occasion when my examination of the evidence from a published paper revealed that the report of a significant effect for the entire sample held for only one gender.

Class of Rearing

The need to include the social class of the family as an element in a pattern is as persuasive as the case for gender. Class has two correlated meanings: objective measures of income and education, and/or occupation or a person's subjective judgment of his or class position in the society. The two indexes are modestly related. The correlations are about .4 in White Americans and only .1 in African Americans (Cundiff & Matthews, 2017). Income, education, and occupation have become the preferred indexes of class over the past 50 years, especially in the United States and Europe, as ethnicity, religion, and family pedigree lost their significance as signs of class status (Cohen, Shin, Liu, Ondish, & Kraus, 2017). Even citizens of Denmark, an affluent nation with minimal income inequality, believe their country has significant class divisions based on income and education that are difficult to change (Robison & Stubager, 2017).

The English language reflects the presumption that the advantaged classes are more potent. Most Americans would say that the sentence “The poor resemble the rich in the desire for a civil society” sounds better than “The rich resemble the poor in the desire for a civil society” because of a bias that favors making the more potent object the referent (Chestnut & Markman, 2016).

The proportion of families living under extreme economic hardship has decreased steadily over the past 1,000 years. As a result, being poor has become a more salient feature of a person’s self-concept in 2017 than it was in 1017. As the proportion of poor in developed nations declined from the 11th to the 21st century, the label poor gradually lost its associations with the semantic networks for hard working and loyal and acquired associations with lazy and incompetent.

When a person’s ethnicity, religion, gender, or family pedigree had a determining influence on class position, as it did in medieval Europe, the less advantaged felt less shame or guilt because they could rationalize their compromised status as due to conditions not under their control. The less advantaged members in most developed societies in 2018 are told that anyone with average ability who is willing to work hard can acquire an education and a career with a high income and status. Americans are reminded of Andrew Jackson, Abraham Lincoln, Henry Ford, and Thomas Edison, who grew up in families with modest means in communities lacking special advantages. As a result, a blend of shame and/or guilt rose among a proportion of the economically less fortunate who did not attend college and did not live near the centers of finance, art, movies, and information technologies (Chase & Walker, 2012).

Class of rearing is, at the moment, the best predictor of many outcomes of concern to parents, social scientists, and psychiatrists. Class of rearing is correlated with variation in health, adequacy of medical care, diet, parental practices, quality and years of schooling, achievement scores in reading and mathematics, IQ scores, values, asocial behavior, depression, anxiety level, personality traits, marital status, inflammatory states, and brain profiles. Some of these differences appear as early as age 2 (Bjornsdottir & Rule, 2017; Conejero, Guerra, Abundis-Gutierrez, & Rueda, 2018; Du Paul, Morgan, Farkas, Hillemeier, & Maczuga, 2017; Figlio, Freese, Karbownik, & Roth 2017; Fink, Patalay, Sharpe, & Wolpert, 2018; Kishiyawa, Boyce, Jimenez, Perry, & Knight, 2009; Manuck, Flory, Ferrell, & Muldoon, 2004; McLeod, Horwood, & Ferguson, 2016; Prins, Bates, Keyes, & Muntaner, 2015; Rentfrow, Jakela, & Lamb, 2015; Tackett, Herzhoff, Smack, Reardon, & Adam, 2017). Martha Farah (2017) has written an excellent review of the associations between a person’s class and varied brain measures.

Investigators who find a predictive, longitudinal relation between a behavioral or biological measure in young and older children often attribute the result to preservation of a particular personal feature. In many cases, however, growing up in a more or less advantaged family provides a more valid explanation (Bailey, Duncan, Watts, Clements, & Sarama,

2018; Rose, Feldman, & Jankowski, 2015; Sasser et al., 2017; Sylvester et al., 2017).

The contexts encountered by disadvantaged youths can increase the temptation to commit a crime. Although close to half of an urban, Midwestern sample of disadvantaged White and minority women who had been abused or neglected as children were arrested for a crime, an equal proportion of women with the same high-risk profile had no arrest record (Trauffer & Widom, 2017). It is likely that more of the former group lived in neighborhoods with less cohesiveness and more criminal activity (Chauhan, Schuck, & Widom, 2017).

Mental illness

The symptoms that define the DSM-5 mental illness categories for an anxiety or depressive disorder or delayed brain development are usually more prevalent among the less advantaged across varied societies (Bekhuis, Boschloo, Rosmalen, de Boer, & Schoevers, 2016; Betancourt et al., 2016; Bjorkenstom, Burstrom, Vinnerljung, & Kosidou, 2016; Bosma, Brandts, Simons, Groffen, & van den Akker, 2015; Brendgen, Girard, Dionne, & Boivin, 2016; Garratt, Chandola, Purdom, & Wood, 2017; Gilman et al., 2017; Karevold, Røysamb, Ystrom, & Mathiesen, 2009; Steenkamp et al., 2017).

One reason is that parental educational levels affect child-rearing practices. Parents without a high school degree are more likely to abuse or neglect their infant (Knutson, 1995; Martin et al., 2011; Sperry & Widom, 2013) and less likely to promote language and academic motivation (Schiff et al., 1978).

Ethnicity

Ethnicity contributes to patterns that define categories of persons because the major ethnic groups differ in a large number of alleles that affect the likelihood of varied brain states, physiological profiles, select diseases, cognitive abilities, pain sensitivities, and behaviors (Galanter et al., 2017; Kidd et al., 2017; Kredlow et al., 2017; Lu, Zeltzer, & Tsao, 2013; Majid & Kruspe, 2018; Zhu et al., 2016).

A principal components analysis of the variation in 130 short sequences of DNA (about 300 base pairs) that contained two or more single nucleotide polymorphisms on 96 populations scattered around the world revealed that reproductively isolated groups possess different genomes. The first component, which accounted for 39% of the variance, differentiated among the populations in Africa, southwest Asia, south central Asia, East Asia, Europe, the Americas, and the Pacific islands (Bulbul et al., 2017).

Far Eastern Asians are more likely to possess the short allele in the promoter region of the gene for the serotonin transporter (*SLC6A4*) than Europeans and Africans. Possession of this allele is associated with reduced expression of the gene for the transporter and less gray matter in select cortical sites (Liu et al., 2015). Chinese and European American infants differ in ease of arousal and soothing (Freedman & Freedman, 1969; Kagan et al., 1994).

Individuals with an African pedigree are more likely to possess a small number of repeats of CAG trinucleotides in exon 1 of the gene for the androgen receptor, which implies higher levels of androgen receptor activity. By contrast, most East Asians have the largest number of repeats and the lowest levels of receptor activity. Caucasians and Hispanics fall in between (Ackerman et al., 2012).

The psychological consequences of genetic differences always depend on the person's setting. A Chinese youth in Beijing encounters a friendlier social context than one who grew up as the only Asian in a small Mississippi town. More Blacks than Asians reside in the Deep South, and more Asians than Blacks live on the West Coast. New England and the upper plains states have the highest percentages of White residents. These facts imply that the sources of variance removed by investigators who control for ethnicity in a sample of New England participants differ from the sources of variance removed in multiethnic samples living in the Deep South.

The variation among ethnic groups in vagal tone on the heart can be detected in the fetus, with African fetuses showing the largest values and Asians the smallest (Tagliaferri et al., 2017). Similar differences were found in 5- to 6-year-old children, belonging to one of five ethnic groups, born to parents who migrated to Amsterdam from one of five nations (de Rooij, van Eijsden, Roseboom, & Vrijkotte, 2013).

The variation in the balance of sympathetic and vagal tone on the heart is reasonable given the latitudes these populations occupied originally. An autonomic nervous system that favored parasympathetic over sympathetic activity would be adaptive in the warm climate of sub-Saharan Africa where dilation of skin capillaries allows body heat to escape. A brisker sympathetic arm, accompanied by constriction of the skin's capillaries in order to conserve body heat, is more advantageous in the colder regions of Europe and Asia that are above the 40th latitude. The ethnic variation in vasodilation and constriction of skin capillaries to cold temperatures is in accord with this hypothesis (Maley, Eglin, House, & Tipton, 2014).

Investigators who employ Mechanical Turk adults as subjects in psychological studies are insufficiently concerned with the fact that more than a third have a south Asian pedigree (Litman, Robinson, & Rosenzweig, 2015; Paolacci, & Chandler, 2014). Equally important, the MTurk employees who learned English after age 13 and are subjects for an English-speaking scientist lack the associations between words, images, and feeling states that are present in those for whom English is their native language (Hayakawa & Keysar, 2018). As a result, some of the answers these MTurk subjects provide may have an idiosyncratic meaning.

Henrich, Heine, and Norenzayan (2010) have criticized the fact that many inferences in social psychology and personality are based on data Americans provided. Nielsen, Haun, Kartner, and Legare (2017) made the same point for studies of children. More than 90% of 1,582 papers with children as participants relied on American or European children. Some welcome signs of progress were the issues of *Child Development* (2017, 88,

no. 3), *Developmental Psychology* (2017, 53, no. 11), and *Perspectives on Psychological Science* (2017, 12, no. 5) devoted to the importance of class, ethnicity, and culture on values, cognitive styles, behaviors, and identity.

Given the evidence favoring a search for kinds of persons, what can be done to persuade psychologists to at least look for such categories, rather than only compute means across all participants? Editors should require authors to submit in appendices scatter plots of the relations among the major variables for individuals belonging to different genders, classes, and ethnic groups. They should also require authors who use covariance manipulations to state whether their evidence revealed linear or nonlinear relations and whether they examined the properties of participants whose values on major measures fell in the top or bottom quartiles of the distributions.

Summary

This paper has tried to make three points. The primary theme was a plea to investigators to consider the possibility that their evidence implies the presence of categories of persons defined by patterns of properties that include gender, class, and ethnicity. Because these three conditions are linked to exposure to different life settings, Mischel's (2004) insistence on the role of the context is satisfied.

Although a majority of psychologists do not design their research with the intention of discovering categories of individuals, those who analyze their evidence carefully often discover such categories (Barker et al., 2015; Braga & Buckner, 2017; Bruder, Tenke, Warner, & Weissman, 2007; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Davis & Buss, 2012; Degnan et al., 2011, 2014; Feng, Shaw, & Silk, 2008; Goodyer, Ban, Croudace, & Herbert, 2009; Karalunas et al., 2017; Ladd, Ettekal, & Kochenderfer-Ladd, 2017; McLaughlin, Rith-Najarian, Dirks, & Sheridan, 2015; Pappa et al., 2014; Plevoy, Muckle, Seguin, Ouellet, & Saint-Amour, 2017; Reynolds, 2015; Sarkisian, Gerena, & Gerstel, 2007).

The absence of words that describe kinds of persons contributes to the resistance to searching for them. It is easier, and more acceptable to reviewers, to compute the correlation between the frequency of being a victim of a bully and later measures of anxiety or depression, controlling for class, ethnicity, and gender statistically, than to combine frequent victimhood, a disadvantaged class, male gender, White ethnicity, and presence of anxiety or depression into a category for which no name exists.

I suggest that the second of the following two descriptions of an unpublished finding discovered by Bergman and Andersson (2017) is more informative than the first.

After removing the contribution of social class, grades in mathematics and reading, aggressive behavior, and a stable or unstable family, teacher ratings of 13-year-old Swedish boys on inability to maintain attention and activity level in the classroom predicted persistent criminal activity with an R^2 of 0.18.

A cluster analysis of data from a longitudinal study of Swedish male adolescents revealed that 37 percent of the boys whom teachers rated as unable to maintain attention and restrain restless activity had a record of frequent criminal activity, compared with only three percent of boys who were rated as low on both variables.

A second aim was to question the popular practice of removing the contributions of the gender, class, or ethnicity under the assumption that a single, favored predictor could contribute to an outcome without being part of a larger pattern. This premise is likely to be incorrect when the variable whose contribution was removed was correlated with the predictor and/or the dependent variable or the relations among some of the measures were nonlinear. If school-age children who had

spent their first 2 years in a severely depriving, Romanian orphanage display significant variation in select psychological properties, due perhaps to the gender, class, or ethnicity of the child or the biological or adoptive parents, it is hard to imagine a study of psychological variables that would not profit from a search for kinds of persons.

Finally, it is worth repeating that the biological properties that are preferentially associated with one gender, class, or ethnic group cannot be a defensible basis for restricting access to an educational program, vocation, or position of authority. Investigators who discover a property that is more frequent in one gender, class, or ethnic group should not have to worry over being criticized for holding a prejudicial attitude.

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