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The Meaning and Measurement of Environments in Holland's Theory

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A major advantage of Holland's (1997) theory is that it provides a parallel way of describing people and environments. Vocational psychology has provided many ways of assessing people but not environments. One of Holland's major contributions during the past four decades has been to develop techniques for assessing and classifying different vocational environments, principally educational settings and occupations. These techniques have allowed Holland and his associates to plumb the validity of his environmental formulations. His newest environmental measure, the *Position Classification Inventory* (G. Gottfredson & Holland, 1991) promises to stimulate intensive research, both inside and outside vocational psychology, on vocational environments.

Holland's theory (1997) is unique among career theories in providing a parallel way to describe people and environments. It classifies both according to six model types—Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). The theory thus also provides a ready way to assess person–environment fit and test key predictions about vocational development. Despite the importance of validly measuring both people and their environments in testing the theory, researchers have focused on the former. For nearly four decades, however, Holland and his associates have themselves developed various techniques for assessing vocational environments and illuminated much about their structure and influence on incumbents.

HOLLAND'S ENVIRONMENTAL FORMULATIONS

Holland's six *personality* types represent personal dispositions, that is, characteristic patterns of interests, competencies, and behavior. Realistic personali-

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ties, for example, enjoy working with their hands, tools, and machines; perceive themselves as having mechanical, technical, and athletic abilities but lacking social skills; exhibit traditional values; and are practical (Holland, 1997, pp. 21–22). The six parallel *environmental* models (see Table 1) are settings that elicit, develop, and reward the six patterns of interests, competencies, and behaviors. Thus, Realistic environments are those that reward people for traditional values and require or encourage people to use machines or tools, develop technical competencies, and see themselves as having those skills but lacking ability in human relations (Holland, 1997, p. 43).

In Holland's theory, environmental profiles are characterized in ways analogous to personality profiles. The psychological distance between any two environmental (or personality) types is calculated according to their distance on the RIASEC hexagon, where adjacent types are most similar and those opposite on the hexagon are most different. Accordingly, Realistic types are most similar to Conventional and Investigative types and least similar to Social types.

Neither people nor environments resemble only one model type, but rather all types to some degree. The resulting profile of resemblance to the six types can be described in terms of differentiation, consistency, and identity, all these concepts being important in Holland's theory for predicting how people will behave in different settings. For example, people who strongly resemble some types but not others (have differentiated interests) or who most resemble two adjacent (R-I) rather than two nonadjacent types (R-S) on the hexagon (have consistent interests) are presumed to be more predictable. Similarly, work environments that make highly differentiated or consistent demands on workers are expected to have stronger effects on them, whether that be to stabilize choices among people with congruent interests or repel those with incongruent interests (see Holland, 1997, pp. 52–54, for other predictions).

The parallelism in Holland's theory for describing people and environments greatly simplifies the study of how the two affect each other during development. For instance, it is a relatively simple matter to assess person–job congruence in Holland's theory. Testing the theory's predictions about this and other crucial matters rests, however, on the validity with which both people and environments are assessed. The results of those tests can mislead if either is not measured accurately. Holland's inventories of personality types—the Vocational Preference Inventory (VPI) and Self-Directed Search (SDS)—have been extensively researched and debated for decades. Not so his measures of environments. A short history of their development and use, however, reveals their progress and promise.

ASSESSMENT OF HOLLAND ENVIRONMENTAL MODELS

Much research on Holland's theory, particularly its claims about person–job match, involves the characterization of occupational environments. Holland's theory has also been used to assess broader institutional climates, principally college environments, and their effects on incumbent populations. We focus here

TABLE 1
A Brief Description of the Holland Environmental Typology

Attribute	Environmental type						
	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
Requires	Manual and mechanical competencies, interaction with machines, tools, and objects	Analytical, technical, scientific, and verbal competencies	Innovation or creative ability, emotionally expressive interaction with others	Interpersonal competencies, skill in mentoring, treating, healing, or teaching others	Skills in persuasion or manipulation of others	Clerical skills, skills in meeting precise standards for performance
Demands and rewards the display of	Conforming behavior, practical accomplishment	Skepticism and persistence in problem solving, documentation of new knowledge, understanding or solution of problems	Imagination in literary, artistic or musical accomplishment	Empathy, humanitarianism sociability, friendliness	Initiative in the pursuit of financial or material accomplishment; dominance; self-confidence	Organizational ability, conformity, dependability
Values or personal styles allowed expression	Practical, productive and concrete values; robust, risky, adventurous styles	Acquisition of knowledge through scholarship or investigation	Unconventional ideas or manners, aesthetic values	Concern for the welfare of others	Acquisitive or power-oriented styles, responsibility	Conventional outlook and concern for orderliness and routine
Occupations and other environments involve	Concrete, practical activity; use of machines, tools, materials	Analytical or intellectual activity aimed at trouble- shooting or creation and use of knowledge	Creative work in music, writing, performance, sculpture, or unstructured intellectual endeavors	Working with others in a helpful or facilitating way	Selling, leading, manipulating others to attain personal or organizational goals	Working with things, numbers, or machines to meet predictable organizational demands or specified standards
Sample occupations	Carpenter, truck driver	Psychologist, microbiologist	Musician, interior designer	Counselor, clergy member	Lawyer, retail store manager	Production editor, bookkeeper

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only on the smaller body of research that assesses and validates the environmental models themselves.

Incumbent-Based Measures of Occupations and Environments

Holland's initial efforts to measure environments were based on the assumption that a major portion of environmental influences is transmitted through other people (Linton, 1945). This assumption was first formulated by Holland as "people make the environment." This formulation allowed him to classify occupational environments by knowing only the personality types of their incumbents or aspirants; a Realistic occupation is one dominated by Realistic people, and so on. This classification principle was then generalized to larger environmental units such as colleges and universities. The environment of a college could be assessed by the number of students (relative to institutional size) of each type. Similarly, the environment of a business enterprise could be measured in terms of the relative number of employees of each type.

Knowledge about vocational environments thus depended on information about the types of people in them. Accordingly, classifying occupations in terms of the typology began with the gradual process of collecting VPI data, SVIB-simulated VPI profiles, and SDS results for different occupational groups and educational programs (Campbell & Holland, 1972; Holland, 1966, 1975). The profile for a given field became the mean profile of individuals in that field. Profiles for fields, like the profiles for individuals, could be summarized by three-letter codes (RIA, IAS, SEC, etc.). Such codes became the critical core around which all later Holland occupational coding systems would be built.

Holland and his colleagues (e.g., G. Gottfredson & Holland, 1991, 1996; L. Gottfredson, 1980; Holland, 1997; Richards, Seligman, & Jones, 1970) gradually came to realize that not only people but also work activities and institutional structures in a setting could be classified as Realistic, Investigative, and the like. This realization made it possible to measure the characteristics of environments independently of the characteristics of the people in them, a highly desirable characteristic for research on the impact of environments on incumbents. Moreover, such activities and structures may be logically prior to the people in various environments. For example, the curriculum of a college may be logically prior to the characteristics of the student body, and a curriculum can be assessed in terms of the relative number of courses of each type (Richards, Seligman, & Jones, 1970; Richards, Bulkeley, & Richards, 1972).

Transition from Incumbent-Based to Public Record-Based Measures of Environments

A first step in describing environments independently of their incumbents was to classify common occupations and educational programs on the basis of the personalities typically populating them, and then to use public records (for example, government publications, college catalogs, and professional directories) to estimate the mix of jobs and programs in different settings. Most studies of

public record-based environmental measures have involved college environments, but such measures also have been used to develop three-letter Holland codes for all occupations listed in the *Dictionary of Occupational Titles* (G. Gottfredson & Holland, 1996).

Using public records to classify institutional environments: The Environmental Assessment Technique. Once Holland codes had been determined for major occupations and educational programs, the distribution of environmental types within different colleges could be determined from public records. The earliest example of such use of public record-based environmental assessment came as part of the overall research program of the National Merit Scholarship Corporation when Holland was director of the program. Astin and Holland (1961; Astin, 1963) developed the Environmental Assessment Technique, or EAT (an early example of Holland's life-long liking for giving names to procedures that produce joking acronyms), for measuring college environments. This technique assessed colleges in terms of institutional size, average test scores of students, and relative emphasis on the six Holland types. Assessment of college environmental profiles was based on the number of students at various institutions who obtained baccalaureate degrees in major fields falling into the six types. These data were obtained from the government publication *Earned Degrees Conferred in Higher Educational Institutions: 1957–1958* (United States Office of Education, 1959). The EAT measures were shown to have moderate to high reliability over periods of 1 to 5 years and to be related to other measures, such as the *College Characteristics Index* of Pace and Stern (1958) in ways that supported the construct validity of the EAT profiles. The EAT sample of colleges was restricted to the 355 institutions that actually enrolled 15 or more students who had taken the National Merit Scholarship Qualifying Test, but Astin (1965) subsequently extended the procedures or outgrowths of them to all accredited 4-year institutions.

The EAT was explicitly developed for research on the impact of college environments on students. For this purpose it was strongly criticized (McConnell 1968; Yonge, 1965) on the grounds that (a) the EAT confounds student characteristics with environmental characteristics and (b) last year's graduates cannot be the environment for this year's entering freshmen. Although these criticisms were technically correct, in retrospect they seem to have involved more academic competition and one-upmanship than a serious effort to produce a cumulative science of environmental assessment. Certainly the criticisms failed to recognize the distinction between the environment and a measure of it.

During this time Holland had moved to the American College Testing Program (ACT) and had developed a research program and research team there. The ACT researchers wanted to build on the strengths of the EAT (thus seeking a cumulative science) while addressing the above criticisms. Since the faculty and the curriculum traditionally have been important aspects of the college environment, it seemed logical to classify them too in terms of the six types. Moreover, comprehensive information about faculties and curricula is readily available in

college catalogs. Accordingly, catalog-based studies were conducted of environmental measures based on faculties and curricula for both undergraduate and graduate school environments at 4-year institutions (Richards, Seligman, & Jones, 1970) and for 2-year colleges (Richards, Bulkeley, & Richards, 1972).

These studies found that faculty and curriculum measures were reliable over periods up to 20 years, and that they were highly correlated with each other as well as with baccalaureate degree measures. In other words, measures based on faculty, curriculum, and degrees all tap stable characteristics of the college environment that are common to all three domains. These measures also were correlated with other measures of the college environment, such as the *College and University Environment Scales* developed by Pace (1963), the various Astin environmental measures, and alternative measures of 2-year college environments developed at ACT (Richards, Rand, & Rand, 1966). The correlations generally supported the construct validity of both the type scales and Holland's environmental theory in that they were usually moderate to high where the theory suggested they should be, but low where the theory suggested no correlation should be present. In these catalog and compendium based studies, institutional size was measured by the total number of faculty members or courses, but no measure of the average academic aptitude of entering students was available. Other research (Astin, 1965) has suggested that institutional "affluence" (such as budget, library books, and faculty members per student) or "selectivity" (percentage of applicants admitted) might be reasonable alternatives to measuring the average academic potential of a student body, but none has suggested alternatives to Holland's six types.

The success of environmental measures based on faculty and curriculum raised the possibility of new kinds of environmental research. For example, many college and university libraries contain college catalogs over the years that such catalogs have been issued. These catalogs could be used to study the history of college environments. Similarly, compendia are available that list faculties for institutions of higher learning in various nations (e.g., Association of Commonwealth Universities, 1969; International Association of Universities, 1962). These data make it possible to study international differences in college environments.

The latter possibility has been explored in studies of Japanese universities (Richards, 1973) and of universities in British Commonwealth nations (Richards, 1974). Results generally support the usefulness of these theory-based environmental measures for studying international differences. Japanese universities placed more emphasis on Realistic and less emphasis on Artistic education than did universities in the United States. In both the United States and Japan, institutional size was associated with a relative emphasis on Realistic fields, but in the British Commonwealth institutional size was associated with an Investigative emphasis. In the United States, Japan, and British Commonwealth, technological universities emphasized Realistic fields. Finally, a multivariate analysis of the colleges composing the Oxford and Cambridge Universities indicated that

TABLE 2
Relative Emphasis on the Six Types in a Representative Sample of U.S. Colleges and Universities

% of faculty who are	Mean	*SD*
Realistic	5.3	7.8
Investigative	21.3	16.6
Artistic	29.3	16.9
Social	30.7	14.2
Enterprising	8.7	12.7
Conventional	4.5	6.5

Source. Richards (1987a).

Cambridge colleges tended to be more Realistic than Oxford colleges while Oxford colleges tended to be more Artistic than Cambridge colleges.

Faculty and curriculum measures also facilitate the examination of particular kinds of colleges. For example, one study (Richards, 1987a) used such measures to compare the environments of predominantly and traditionally Black colleges and universities (both 2-year and 4-year) with the environments of a representative sample of American colleges and universities. Faculty data indicated that Black colleges were significantly lower on Realistic, Artistic, and Enterprising and significantly higher on Social and Conventional. In other words, Black colleges provided less training in fields that prepare students for technical and managerial careers and more training in fields that prepare students for social service careers.

The results for the representative sample of institutions are especially interesting because they provide the best available evidence about relative emphasis on the six types in U.S. higher education (Richards, 1987a). Table 2 shows means and standard deviations for the percentages of faculty falling in the six types. The six types in order were Social, Artistic, Investigative, Enterprising, Realistic, and Conventional. These results seem consistent with the conventional wisdom about the content of college education in the United States and confirm a fairly strong emphasis on the fields associated with traditional liberal arts education.

Public records also have been used to apply Holland's theory to the careers of population scientists (Richards, 1993). The basic source of data was the 1980 *Directory* of the Population Association of America (PAA). The undergraduate and graduate major fields and current occupations of all scientists listed in this *Directory* were classified in terms of the theory and averaged to yield profiles for the occupational environment of population science. All three profiles had the same three-letter code, IES. The congruence (Holland, 1997) of codes for individual scientists with IES was positively related to persistence in PAA and to a variety of measures of scientific productivity, findings that confirm the predictions of the theory. Many other scientific and professional associations publish directories that provide similar comprehensive information about their members,

and the methods of this study could be applied to such information to provide further tests of the theory.

Using job analysis data to classify all occupations: From the "Occupations finder" to the "Dictionary of Holland occupational codes." To be maximally useful, occupational classifications such as Holland's must be comprehensive. However, administering the VPI or SDS to occupational incumbents or aspirants is clearly an impractical way to code the many thousands of occupations in the United States economy. Holland and his colleagues therefore turned to several large bodies of job analysis data documenting the duties, skill requirements, work contexts, and other characteristics of specific occupational titles.

Holland's theory predicts that occupations will reflect particular patterns of job requirements and rewards depending on which of the Holland environmental models they most resemble. For example, job analysis data should reveal that Realistic occupations involve extensive use of hands, tools, and machines but not much involvement with people, whereas the reverse should be found true of Social occupations. If such predictions were confirmed, this would not only support the validity of the environmental models but also provide a way to estimate Holland codes without having to administer the VPI or SDS to incumbents. It would also help answer the early objection that Holland's method of classifying occupations was circular (a Realistic job is the one that Realistic people tend to hold), that is, not independent in either concept or method of how he classified their members.

In the first such research (Holland et al., 1972), Holland categorized by type the 832 occupations for which there were detailed data from the Position Analysis Questionnaire (PAQ), basing his judgmental classification on his knowledge of accumulated incumbent-based data for specific occupations. The PAQ rates jobs on almost 200 attributes, including work activities, tools and machines used, working conditions, and emotional as well as physical stressors. Holland et al. (1972) found that the PAQ's 32 dimensional scores (e.g., communicating judgments, businesslike situations) distinguished reasonably well among the six environmental types and did so in a generally sensible and expected manner, thus supporting the validity of his judgmentally assigned, incumbent-based occupational codes. The PAQ data were also used to simulate VPI profiles, a procedure which produced results moderately close to the codes that Holland had assigned judgmentally. Holland then collated these PAQ results together with prior data for specific occupations from the VPI and SVIB to hone a now much expanded list of occupational codes for counseling and research.

A subsequent series of similar studies with job analysis data from the *Dictionary of Occupational Titles* (DOT) resulted in the development and successive revisions of the *Occupations Finder* (Holland, 1978) and the *Dictionary of Holland Occupational Codes* (DHOC; G. Gottfredson & Holland, 1996; see also the account in Holland, 1997, chap. 8). The nearly 13,000 job titles in the Fourth Edition DOT have now been assigned a three-letter Holland code based on their DOT ratings. The codes are better substantiated for some titles than others,

depending on the amount and quality of job analysis, VPI, and other data on which they are based.

The foregoing series of studies also provided three-letter Holland codes for occupational categories in the five other major current federal job classification systems, including the Standard Occupational Classification (SOC) and the Guide for Occupational Exploration (GOE; G. Gottfredson & Holland, 1996). Rounds et al. (1998) have also estimated Holland codes for the occupations in the new federal O*NET database, which will eventually replace the DOT and various other current federal occupational classifications. Needless to say, adding Holland's codes to the various federal classifications provides tremendous opportunities for researching Holland's theory and implementing it in counseling.

A Direct, Theory-Based Measure of Occupational Environments: The Position Classification Inventory

The Position Classification Inventory (PCI), developed by G. Gottfredson and Holland in 1991, is an important advance in assessing vocational environments, partly because it provides a direct measure of environments independent of the individuals who populate them. The PCI is a 10-min, 78-item, self-scoring job analysis inventory which has incumbents or supervisors rate how often a job requires certain activities, abilities, values, and perspectives. These items follow directly from Holland's theory. In other words, the PCI does for environments what the SDS does for people: it directly and individually assesses them according to the theory's constructs. The instrument yields a 6-point profile from which an environment's differentiation and consistency can also be assessed. Validity evidence in the PCI manual is supplemented by more recent large-sample, longitudinal research (DeFruyt & Mervielde, 1998; Maurer & Tarulli, 1997).

The PCI opens new vistas in the classification and study of environments. It can be used to classify new (and hypothetical) occupations as well as nonoccupational environments. It is also valuable for assessing the heterogeneity of specific occupations, similarity of jobs across locations, differences in perceptions of job supervisors and incumbents, the ways in which jobs are (or could be) transformed by incumbents, and much more that concerns individuals and their organizations. This new tool provides many new opportunities for studying the course of vocational development through the lifespan. It will also greatly encourage the use of Holland's theory in industrial-organizational psychology, which has long been concerned with understanding and shaping work environments.

ASSESSING THE CONSTRUCT VALIDITY OF HOLLAND'S OCCUPATIONAL TYPES

Holland has provided the tools for implementing his theory of environments, but how valid are his environmental formulations? Most importantly, just what presses and rewards do the six occupational types represent, the environments with which the theory is most concerned?

The meaning of Holland's *personality* types—their construct validity—has been explored by correlating people's VPI or SDS scores with their performance on various personality and aptitude tests to see to what extent Holland's personality types overlap other psychological traits. One question, for instance, has been whether his "personality types" really do reflect personality traits as conventionally defined. The same construct validation process has been pursued, although less vigorously, for the *occupational* models. The first question has been whether, in fact, the psychological meaning of jobs resides substantially in jobs themselves, not just in the social climates created by their incumbents. That is, is there anything psychologically meaningful in work environments besides the other people in them? If yes, the second question concerns *which* job attributes are psychologically relevant to incumbents and aspirants and whether they are organized in the manner Holland's theory suggests. The availability of detailed job analysis data for a wide range of occupations is especially useful for answering these questions.

Holland et al. (1972) carried out the first job analysis study of the environmental models in their effort to extend coverage of the occupational classification. As noted, they found that the incumbent-based occupational codes were sufficiently related to PAQ job elements to use the PAQ ratings to estimate codes for many other occupations. Perhaps the most compelling demonstration that incumbent-derived environmental codes reflect objective and theoretically meaningful differences among jobs themselves was provided by a quite different kind of study involving the Occupational Analysis Inventory (OAI; Cunningham, Slonaker, & Riegel, 1987). Cunningham et al. developed an experimental work activity preference inventory based on items parallel to OAI descriptors of hundreds of specific work activities in over 1000 occupations. Upon factor analyzing the activity preferences, Cunningham et al. discovered that the resulting activity-interest factors paralleled the Holland personality types. The same link between people-based and job-based dimensions of work had now been confirmed from opposite directions.

Subsequent analyses with PAQ and Occupational Reinforcer Patterns (ORP) data went further by testing the hexagonal ordering of the environmental models. ORPs, developed by the Minnesota Work Adjustment Project, are ratings of the relative importance of 21 behavioral requirements and reinforcers such as try out own ideas, bosses back up their men, and opportunities for advancement. Hyland and Muchinsky (1991) found that the six Holland categories of occupation differed on 11 of the 13 general PAQ factors and that the six types were arrayed in similarity according to the predicted hexagonal relations. Using essentially the same ORP data but different analytical procedures, Toenjes and Borgen (1974) and Rounds et al. (1978) found that the Holland types tended to differ significantly in ORP attributes, but only the former study confirmed the hexagonal ordering.

Hyland and Muchinsky (1991) noted that the PAQ factors differ considerably in their ability to discriminate across the hexagon and that, on the whole, the PAQ

is more relevant to some Holland types (Realistic and Conventional) than others (Investigative, Artistic, and Enterprising). The same is true of the ORP data. Although half of the 21 ORP factors differ significantly across Holland type, only two (do things for other people and paid well relative to other workers) are useful in distinguishing the types (mostly Social vs Enterprising) after controlling for the types' large differences in job level (L. Gottfredson, 1980). Half the ORP dimensions (e.g., busy all the time, work not morally wrong) seem frankly irrelevant to Holland's theory, although the research on its validity has treated them all as equally relevant.

Holland's environmental models are meant to represent the full range of work activities, meaning that job analysis data that do not sample well across the full range of activity are limited in their ability to test the merits of the theory. In contrast to the PAQ and ORP, the DOT provides ratings more comparable in breadth and generality to the concepts in the Holland models. They thus have been more useful in clarifying the meaning of the types. Especially interesting, for example, is the DHOC's accounting, with DOT activity, interest, aptitude, and work conditions ratings, of the distinctions between *adjacent* types around the hexagon (G. Gottfredson & Holland, 1996, pp. 715–716).

A key but understudied issue in validating the occupational types involves cataloging which domains of job attributes (work activities, aptitude requirements, working conditions, and so on) are most critical in structuring the types, that is, in creating their overlapping gradients of similarity and difference. Worker activities are clearly central, as suggested by Cunningham et al.'s (1987) analyses, among others. In his effort to understand "why interest inventories work," Prediger (1982) asked whether job activities themselves can be distilled into a few more fundamental dimensions. He demonstrated, in fact, that the hexagon of environmental models can be reproduced by characterizing jobs along two-bipolar dimensions of general human activity: data vs ideas and people vs things. (Be aware that his measures of these activities differ from the same-named attributes in the DOT.)

Ascertaining the role of different aptitudes in defining the models has been more difficult, partly because there are no assessments of general interpersonal skills comparable to those for cognitive and psychomotor skills. The former are at least as important in Holland's theory as are the latter. Nonetheless, there are indications that the latter two aptitude domains are systematically related to the Holland environmental models. When L. Gottfredson (1986) organized GOE occupational groups according to their rated cognitive and psychomotor demands, she found that they formed four broad categories reflecting different functional foci of work (dealing with physical relations, bureaucratic order, social/economic relations, and performing). These four foci in turn mirrored Holland's environmental models in reverse hexagonal order (I/R, C, E/S, A). Together with earlier research (L. Gottfredson, 1980), this work indicated that the aptitude demands of work track the patterns of activities occupations require

(dealings with data, people, and things), those activity patterns in turn being consistent with Holland's predictions.

Thus, aptitude demands are related to the Holland models, but perhaps only indirectly by virtue of the activity demands that different occupations make. The same is probably true of working conditions. By their very nature, many activities necessarily impose different working conditions and aptitude requirements. For instance, serving people (Social) and creating original works of art (Artistic) necessarily preclude the precise procedures that accounting (Conventional) and DNA testing (Investigative) require if the work is to be done well. Conversely, we might expect distinctions in working conditions, rewards, and so on that do not arise from distinctions in work *activities* to be weakly related, if at all, to the Holland environmental models.

A less expected finding in the foregoing research was that the typical characteristics of the Holland models differ according to the level of work involved. The major distinction among jobs in the American economy is, in fact, their general intellectual complexity level (L. Gottfredson, 1986, 1997). Overall complexity level appears to arise from jobs' complexity of dealings with data, which imposes successively higher requirements for intelligence and results in higher prestige ratings for occupations. These three job attributes constitute a single dimension of work. The point here is that this dimension constrains which activities and specific aptitudes are likely to be characteristic of job families within a type. For instance, Social and Enterprising have more involvement with people and Realistic and Investigative with things, on the average. However, none shows complex involvement with either unless the job families in question are *at least moderate in job level.*

Accordingly, patterns of aptitude requirements, net of intelligence, vary by job level *within* Holland type. Several specific findings make that point: net of intelligence, (1) numerical ability is rated important in the I/R, E/S, and C foci of work only when job families are of average level (data complexity) or above; (2) various psychomotor skills are rated important in I/R and C, but only in the lower-level job families; (3) verbal aptitude is important in E/S and the verbal arts only when job families require moderately complex dealings with people; and (4) spatial ability is rated important in I/R and the spatial arts, but only where work with things is moderately complex. Thus, for example, as the job families in the I/R focus of work range from low to high in overall complexity and prestige, psychomotor aptitudes such as motor coordination and manual dexterity are replaced in rated importance by cognitive ones such as spatial and numerical.

The DHOC (G. Gottfredson & Holland, 1996, Tables 10–14) reveals similar patterns of within-type variability for DOT ratings: some attributes vary primarily by job level, others by job type, and some by both type and level. The implications for Holland's theory of this level-associated shift in the meaning of the Holland types remains an intriguing question. The 1996 edition of the DHOC (G. Gottfredson & Holland, 1996, p. 723) has made it easy to examine this shift by providing an improved measure of job complexity (Cx) for all occupational titles.

A final general conclusion about validating the Holland models is that research on Holland-classified occupations that fails to sample jobs from comparable complexity levels is likely to mislead. This conclusion rests on the confluence of two facts. Many job attributes correlate very highly with this general level factor, among them the DOT ratings of complexity of involvement with data, General Educational Development (GED) level, and repetitive work (negative) and the PAQ ratings for importance of advising, decision making, negotiating, analyzing, and persuading. Second, the different Holland work environments tend to be distributed quite differently by job complexity/prestige level (L. Gottfredson, 1980). For instance, most Realistic work is low-level work and, conversely, most low-level work is Realistic. By contrast, Investigative jobs are found primarily in the higher strata of work and Enterprising work is spread more evenly across different job levels.

Examining mean differences by Holland type in DOT ratings of data, people, and things (ignoring job level) would correctly reveal, for example, that Realistic work has more complex involvement with things than does Social or Enterprising and that the reverse is true for involvement with people. Nevertheless, mean differences would *incorrectly* suggest that Realistic work has much less complex involvement with data and better perceptions of bosses and company policies (ORP ratings) than do workers in Investigative work (respectively, Tables 6 and 10 in L. Gottfredson, 1980).

In short, Holland and his associates have documented level-associated differences both *within* and *between* job families in his six environmental types. Although job level has been outside the scope of Holland's theory, its consideration is critical in understanding his environmental types as they exist in the real world. It is clear, however, that the six environmental types capture crucial differences in the patterning of occupational activity and aptitude requirements and consequent rewards.

RELATIONSHIP TO OTHER APPROACHES IN ASSESSING ENVIRONMENTS

The need for psychology as a science to assess the characteristics of environments has long been recognized (Lewin, 1936). Two approaches have dominated efforts by psychologists to assess environments. The first is usually traced to Henry Murray's (1938) theory of individual "need" and environmental "press." This theory implies that environments should be assessed in the same ways that individual personalities are assessed. Therefore, researchers using this approach typically develop items and scales that resemble items and scales in objective personality tests. These environmental scales then are administered to the inhabitants of a given environment and combined in some way to yield scores for that environment. Several researchers have used this approach to develop environ-

mental measures, both for colleges and universities (Pace, 1963; Pace & Stern, 1958) and a wide variety of other settings (Moos, 1974, 1975; Stern, 1970). A persistent weakness of this approach has been a lack of clarity about procedures for combining individual inhabitant scores into overall environment scores. Indeed, researchers frequently have failed to recognize that such procedures are necessary, and have incorrectly analyzed the reliability and validity of the environmental scales only at the level of individual inhabitants (Richards, 1990). Pace (1963) addressed this issue by scoring an environmental item only if a majority of inhabitants answered in a given direction and summing such consensus items to yield scale scores for the environment. Other researchers using these scales (Astin & Holland, 1961; Richards, Seligman, & Jones, 1970) have used the simpler procedures of averaging inhabitant scores to yield scores for a given environment.

The second approach is explicitly based on an ecological perspective (Barker, 1968; Brunswick, 1956; Hawley, 1950). This perspective views the world in terms of populations of specific environments (representative sampling from such populations becomes an issue for environmental research), with each environment being an organized whole characterized by its pattern of activities. Consequently, a typical procedure is to collect a variety of measures from public records about a sample of environments and to use factor analysis to search for the dimensions underlying these measures (Astin, 1965; Richards, 1973, 1987b; Richards, Rand, & Rand, 1966, 1968). In general, these studies have yielded meaningful factors and these factors have been related to incumbent-based measures in ways that support the interpretations given to these factors.

Holland's approach began explicitly with a personality test approach, but over the years has more and more moved toward an ecological perspective. This is especially clear in the classification of all occupations in the *Dictionary of Occupational Titles* in terms of the typology (G. Gottfredson & Holland, 1996). This classification clearly views the world of work as a population of occupational environments, with each occupation being an organized whole characterized by its pattern of activities. Holland's movement toward an ecological perspective and his sensitivity to the proper statistical analysis of ecological-level data seem highly desirable for building a science of environments (Schoggen, 1989).

CONCLUSIONS ABOUT HOLLAND'S CONTRIBUTIONS

Two important criteria for evaluating scientific theories are the range of phenomena they organize and the extent to which they stimulate research. By the first of these criteria, Holland's has been successful. The theory organizes environments for all occupations in the United States and for all types of colleges and universities throughout the world. It also organizes the fit between individuals and their environments and the effects of particular types of environments on particular types of individuals. This organization is parsimonious, involving only six dimensions for both individuals and environments. Finally, no alternative formulation is currently available for organizing these phenomena. Holland's is still the "only game in town."

Holland's theory has also stimulated extensive research, but more on vocational behavior than on vocational environments, with Holland and his colleagues conducting most of the latter. But that will soon change. The reason is that the four decades of sustained research by Holland and his associates has produced much evidence on the construct validity of his environmental formulations, led to new insights into the nature and effects of educational and occupational environments, classified all occupations in the United States, and yielded a simple, theory-driven inventory (the PCI) for assessing any vocational setting. The PCI, in particular, opens up entirely new avenues in studying people in environments. In short, Holland has transformed vocational psychology by providing the theoretical and measurement tools—indeed, the impetus—for understanding vocational environments.

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