UNIVERSAL DESIGN AS A REHABILITATION STRATEGY

DESIGN FOR THE AGES

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Universal Design as a Rehabilitation Strategy
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Jon A. Sanford, MArch
This book is dedicated to Bettye Rose Connell, friend, colleague, and
general pain in the ass without whom much of the content in this
book would still be just random thoughts and who will forever be
known as the first author of the Principles of Universal Design just
because her last name happened to come alphabetically before the
other nine of us.
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Much has been written about the use of environmental intervention as a rehabilitation strategy, including both assistive devices/technologies and accessible design. Similarly, much has been written about universal design, but rarely as a rehabilitation strategy. The reason is simple, universal design is typically viewed as incompatible with the fundamental goals of rehabilitation itself. Rehabilitation, by its very nature, is about the individual, specifically an individual with impaired function. As such, rehabilitation interventions such as assistive technologies and accessible designs are specialized designs that are tailored to the needs of individuals or groups of individuals with specific types of functional limitations. In contrast, universal design is not about specific individuals or about impaired function. It is not specialized, accessible design. Universal design is about design for all people with all types and levels of abilities. As Steinfeld (1994) pointed out, these differences are not simply semantic. Specialized design typically results in separate facilities for people with disabilities (e.g., “handicapped parking,” “handicapped entrance,” “handicapped bathroom”), whereas universal design provides one design solution that can accommodate people with disabilities and everyone else.

In fact, because impaired function is a universal human experience, universal design is about people with (dis)abilities. Although this approach is inclusive of those with and without rehabilitation needs, it promotes interventions that are not individualized and are useful in the absence of a health condition. As a result, it is, by its very nature, antithetical to traditional paradigms that guide not only current rehabilitation practice but also U.S. health care policy that drives reimbursement for that practice.

Why should universal design be considered as a rehabilitation strategy? The most basic reason is that rehabilitation professionals should use every possible tool available to improve the lives of their clients and
people with disabilities in general. If universal design happens to help others along the way, then society as a whole will benefit as well. In addition, disability is rarely static. Not only are many limitations progressive but also, as people age, their abilities typically decline. Universal design accommodates change over time. It can enable people to continue to engage in activities and participate in society with as little disruption in their lives as possible. From a market standpoint, design for everyone makes good sense because it creates economies of scale that are considerably more cost-effective than niche-marketed specialized assistive technologies and accessible designs. This is not to say that universal design is a panacea that will forever obviate the need for specialized design. Rather, it creates a higher, more inclusive baseline from which rehabilitation can operate. As a result, it may eliminate the need for specialized design for some or reduce the need for others. In either case, it not only enhances function and participation but also facilitates rehabilitation practice and reduces health care costs.

This text is intended for rehabilitation, design, and building professionals. It is not a treatise on disability, a coffee-table book of best-practice universal design exemplars, or a how-to-book on the Americans with Disabilities Act Accessibility Guidelines (ADAAG) in disguise. It is a book about awareness and understanding of human function, physical form, and design functionality. For rehabilitation professionals who do not design for the general population, it is awareness about form and understanding of how to apply their knowledge of function to everyday design. For designers and builders who do not design for special populations, it is awareness about function and understanding of how to apply their knowledge of form to specialized design. For each, it is awareness of why the form of everyday design achieves neither function nor functionality for most users and understanding why universal design transcends traditional disciplinary design problem solving to produce form that achieves both.

*Universal design* is a term originally articulated by Ron Mace, an architect who had a disability, a leading advocate of legislation promoting accessible design, a designer of assistive devices, and the founding director of the Center for Universal Design at NC State University (originally the Center for Accessible Housing). Despite his staunch support for traditional rehabilitation strategies, Mace developed the concept of universal design to describe design of everyday physical form, including objects; controls, hardware, and other user interfaces; buildings; and public spaces that would overcome the stigma, segregation, and other social
shortcomings of the specialized designs that characterized traditional rehabilitation practices. Universal design is intended to engender both positive activity and participation outcomes by focusing on all abilities of all individuals rather than on people with disabilities alone. As a result, universal design is not just about access for some, but it is about usability and inclusion for all.

Whereas these concepts may be conceptually appealing, this book recognizes that universal design is a utopian design theory that may not always be technically achievable. It imagines what a world should be, not necessarily what the world will be. As a result, the contribution of this text is in providing rehabilitation professionals with a new way of thinking about rehabilitation interventions rather than a cookbook of the interventions themselves.

This is not an easy task because adopting universal design as a viable rehabilitation strategy requires discarding current, yet outdated 20th century paradigms that favor activity- and function-based interventions over those that also promote participation and functionality. Despite the technical success of traditional specialized design strategies in increasing function for individuals, they have, on the one hand, created signalizing, stigmatizing, and segregating environments while, on the other, failed to live up to their expectation that being able to engage in activity would lead to societal integration of people with disabilities. Such experiments in the “activity-begets-participation” paradigm have demonstrated that even if we build it, not everyone will come. In contrast, universal design is rooted in a more integrative rehabilitation paradigm that makes function and functionality (i.e., usability and inclusivity) the design norm rather than the exception. By integrating specialized design into everyday design, universal design is not just hard to see, it is invisible.

This idea of intervention invisibility is clearly not an outcome with which rehabilitation practice is familiar. Therefore, to familiarize rehabilitation professionals with universal design, this text not only describes what universal is but also contrasts it with what it is not—disability-specific specialized designs with which rehabilitation professionals are very familiar. More specifically, it makes the case that specialized design, as embodied by the technical specifications in the ADAAG, defines a set of prescriptive rules of “what to do,” whereas universal design, as articulated by a set of performance guidelines (i.e., Principles of Universal Design), defines “why it should be done.” As such, specialized design is an application approach to improve function that requires little expert problem solving (i.e., anyone can do it), whereas universal design is a problem-solving
approach that requires rehabilitation and design expertise to achieve both
function and functionality.

When the reader reaches the end of this book, there should be no big “duh
moment.” There will be no silver bullet that will define what to do and for
whom. In fact, it is just the opposite. This book is about how to think about re-
habilitation problems in a broader more universal way. Then again, perhaps
the big duh is why universal design is not a rehabilitation strategy already.
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Prologue

FIVE MYTHS ABOUT UNIVERSAL DESIGN THAT HAS LIMITED ITS USE AS A REHABILITATION STRATEGY

Myth 1: Universal design is just another term for assistive technology, accessible design, and design for aging. Universal design is not a euphemism for either accessibility or assistive technology for people with disabilities or older adults. Although the origin of universal design comes from the disability rights movement and has been widely adopted by the aging community, universal is not about design solely for people who have disabilities or limited abilities. On the contrary, it is about design for people of all abilities.

Myth 2. Universal design is just another term for the Americans with Disabilities Act–Architectural Barriers Act Accessibility guidelines/standards. Universal design is not about compliance with legal minimum legal guidelines and standards. It does not prescribe rules of what must be done or demand compliance with existing codes and standards. It is a performance-based approach that describes why and how to do it. In fact, there are times when universal design may not even meet the Americans with Disabilities Act–Architectural Barriers Act Accessibility (ADA-ABA) guidelines, but that is a problem of ADA myopia, not universal design.

Myth 3. Universal design is just about improving performance in daily activities. Universal design is about improving performance in daily activities. However, the inspiration for universal design is rooted in the ideas of social equity and inclusivity. Although facilitating engagement in activity can create opportunities for inclusion, activity performance by itself is not sufficient to guarantee it. As such, universal design equally addresses activity and inclusivity through participation in community and societal roles.
Myth 4. Universal design is ugly and institutional. Universal design is not a prescribed set of design features or attributes. It could, just like the design of any object, space, product, or system, be ugly. However, ugly is not intrinsic to universal design, just like it is not intrinsic to any other design. Aesthetics reside in the design, not the design process, although universal design, which integrates functionality from the beginning and throughout the design process, is more likely to be aesthetically pleasing than a design paradigm that does not. Neither is universal design institutional looking. Universal design is contextual, that is, the aesthetics are appropriate for the context regardless of the setting. In the end, universal design is invisible.

Myth 5. Universal design costs more. It could, and sometimes it does; but it does not have to. Higher cost is not inherent in universal design. Cost is an artifact of the free market system, and things that are of good design often command a greater price. Universal design is, simply, good design.
PART 1

FORM, FUNCTION, AND FUNCTIONALITY
Universal design is the design of all products and environments to be usable by all people to the greatest extent possible without the need for adaptation or specialized design (Mace, Hardie, & Place, 1991). Unlike traditional rehabilitation strategies that use specialized assistive technologies and accessible designs to increase function (of individuals) by minimizing demands of physical form of everyday design on individuals with specific disabilities, universal design increases function and functionality (of design) by using physical form itself to minimize demands on individuals with all types and levels of abilities. As a result, the extent to which any physical form is universal is dependent on the degree to which its attributes minimize demands on the widest array of users (Sanford, 2010).

**FORM**

Physical *form* (n) is the design of an object. It is the outward appearance, proportions, shape, and structure of something as distinguished from its substance (American Heritage Dictionary, 1985). Physical form can be two- or three-dimensional, thus encompassing design at all scales from interfaces, products, and spaces to digital and graphical information. Its features and the attributes of those features make any form distinguishable from other forms.

A design *feature* (n) is any identifiable design element at any scale of design, from spaces and places (e.g., door, window, toilet, ramp, walkway, park, lake) to products, devices, and technologies to hardware and interfaces. Design features are merely categories of identifiable objects (i.e., they have a name). As such, they cannot be measured; they can only be described as being either present or absent. Environmental features can be described at three scales of design: spaces, products, and user interfaces (e.g., controls/hardware). Spaces include interior building spaces, such as rooms and corridors, and exterior spaces, such as playgrounds, parks, streets, pedestrian walks, or parking areas. Products are located in rooms or other
spaces and include appliances, such as stoves, refrigerators, and microwave ovens; plumbing fixtures, such as toilets and sinks; vending and fare machines; and building elements, such as doors and windows. Controls and hardware interfaces are either operable or inoperable. Operable controls and hardware, such as handles, knobs, and locks on doors; levers and faucets on toilets or tubs; and electronic or mechanical controls on appliances or building elements are generally components of a product. In contrast, inoperable hardware, such as handrails and grab bars, are fixed and are generally installed as part of a space.

Although features are categorical, not all features of a specific type (e.g., ramp) look or act alike. They can be made of different material and have different shapes, sizes, configurations, and colors. Even standard ramps, which have specific requirements mandated by the ADAAG, do not all look alike. In fact, it is difficult to find two that do look alike (Figure 1.1). What differentiates one feature from other features of a specific type are its design attributes.
A design attribute (adj.) is a measurable (i.e., quantifiable or describable) characteristic of a feature, such as height, length, width, color, texture, and condition that define the proportions, appearance, and other qualities (e.g., acoustic) of a feature (Figure I.2). Not only are attributes themselves variable, but they also vary by type of feature (see also Sanford & Bruce, 2010; Sanford & Jones, 2001; Stark & Sanford, 2005). For example, common attributes of spaces include configuration/layout (e.g., size of space/subspaces, orientation of structures, and arrangement of key elements); entry (e.g., location, width, entryway height, threshold height); circulation routes/level changes (e.g., location of routine and emergency egress/ingress, visibility, width, length, slope); orientation cues (e.g., location of signage, landmarks); location of products, devices, and technologies (e.g., clear floor space for approach and use, mounting height); location of environmental controls (e.g., mounting height and clear floor space at switches and outlets); ground/floor and wall materials/finishes (e.g., color, type, texture, reflectivity, slip resistance); and ambient conditions (e.g., light levels, temperature, shade, acoustic properties, and noise levels). In contrast, attributes of products, devices, and technologies include type, dimensions (e.g., height, shape, width), weight, location of user interfaces (mounting height and location, space between controls), and materials/finishes (type, texture, and color contrast).

Finally, user interfaces include a variety of controls and hardware. They can be either operable (e.g., doorknob or thermostat) or fixed (such as a drawer pull or grab bar). Generally, their purpose is to operate products, although occasionally inoperable hardware, such as grab bars, operates independently of a product or device. In addition, although many operable interfaces are located on products or devices, environmental controls,
whether wired or remote, including light switches, elevator call buttons, thermostats, and alarm systems, are typically located in the surrounding spatial environment rather than attached directly to the product. Specific attributes of user interfaces that affect performance include type of interface (dispenser, toilet handle, lock, assist, receptacle, and control); minimum approach distance and angle (space needed to use the device); size (diameter, length, and width); activation method (voice and grip required); operational characteristics (direction and distance interfaces need to be moved, calibration, type of sensory feedback, force required, and voice sensitivity); and materials/finish (type, texture, and color contrast).

**FUNCTION AND FUNCTIONALITY**

*Function* refers to the types of intrinsic human abilities, such as learning, ambulating, seeing, communicating, and hearing. *Functionality* is usability and inclusivity of physical form that enable engagement in activities/tasks and participation in society and societal roles. Functionality is a product of the interaction between demands exerted by physical form and human function. Features, being only categorical descriptions of the environment, do not exert demands directly on individuals. As such, they do not, in and of themselves, determine functionality of form.

Basic assumptions can be made about the functionality of form based on the inherent properties of a feature. For example, steps are vertical, whereas a ramp is inclined, disabling a wheelchair user from rolling up steps but enabling the same user to roll up a ramp. However, these assumptions may not always be true. The same individual with the same abilities may not be able to roll up every ramp even though all ramps, by definition, have the same property of inclination. Therefore, although properties of features have a propensity to exert a certain type of demand, their lack of variability from feature to feature suggests that their demand strength is constant.

Attributes, on the other hand, vary among features of the same type. As a result, they have different demand strengths. Demand strength interacts with abilities to determine functionality. A ramp, for example, can have different angles of inclination or slopes. Inclination is a property of the ramp; degree of inclination is an attribute. Therefore, a wheelchair user will not be able to roll up a ramp when the slope of the ramp exceeds his or her abilities.
To affect functionality, the relevant demand-producing attributes of any feature must be identified and the potential interactions between those attributes and human function must be clearly understood. For example, spatial attributes, such as the layout of a space, will influence way finding given a person’s cognitive and visual abilities; configuration of rooms along corridors will affect an individual’s ability to access spaces given their ability to ambulate and maneuver; light levels can determine if an individual can read a sign or see a door handle given his or her visual ability; and the height of a towel dispenser will affect whether a person can reach it given a person’s stature and reaching ability. Similarly, product level attributes, such as the location of controls at the front or rear of an appliance given an individual’s reach and stature, will affect operation, or the weight of a door interacting with strength will determine if an individual can open it. Finally, user interface attributes, such as the size and shape of a door handle given an individual’s gripping ability, the color of a digital display given and the individual’s acuity and contrast sensitivity, or the audibility of a doorbell given one’s hearing ability, all impact usability.

The magnitude of demand-producing attributes interacting with the level of an individual’s ability determine the influence that the environment has on functionality (i.e., demand strength). The goal of universal design is to minimize demand strength across all levels of ability.
The Functionality of Form: The Link Between Design and Rehabilitation

Although the physical environment has long been associated with individual functioning and disability (Iwarsson, 2004, 2005; Rubenstein, 1999; Scheidt & Windley, 2006; Wahl, 2001), there has been a disconnect between rehabilitation practice, on the one hand, and rehabilitation theory, on the other. Practice has been driven by federal health care policies in which disability is the result of an impairment or medical condition intrinsic in the individual, whereas theory has consistently espoused social models in which disability is a result of intrinsic and extrinsic contextual factors. As a result, rehabilitation practice has focused on fixing the individual, whereas theory suggests that fixing both the person and the environment are equally important strategies.

Traditional medical models do not differentiate pathology from disability, attributing disability primarily to intrinsic health conditions that resulted in deficits in the individual. As a result, any impairment of a given severity is sufficient to result in disability (Brandt & Pope, 1997). In 1980, this paradigm was clearly articulated by the World Health Organization in its *International Classification of Impairment Disability and Health* as “any restriction or inability resulting from a disturbance or loss of bodily or mental function associated with disease, disorder, injury, or trauma or other health-related state” (WHO, 1980, p. 143).

Toward the end of the 20th century, however, the emergence of social construction models represented a paradigm shift that moved the focus of disability from the individual to the society. Embracing Nagi’s (1965, 1976) earlier work that defined *disability* as the outcome of an interaction between impairment and environmental factors, social construction models associated restrictions in activity and participation with a societal-imposed
human disadvantage (Samaha, 2007). As a result, disability is an outcome of the interaction of intrinsic and extrinsic factors.

**SOCIAL CONSTRUCTION MODELS**

A key tenet of social construction models is that disability is situational—the result of complex interactions between an individual’s abilities (as opposed to limitations) and the demands of the physical, social, economic, and political environments. More specifically, physiological factors set the threshold on ability, whereas environmental factors set the threshold on when limitations in ability become a disability (Stineman, Ross, Maslin, & Gray, 2007). As a result, engagement in activity is expressed as the fit or misfit between an individual’s abilities and the design of relevant environmental attributes. Design that fits an individual (i.e., low demands) will facilitate engagement in activities when, where, and with whom he or she desires. In contrast, an environment that does not fit an individual (i.e., high demands) will result in low levels of functionality that may make it difficult or even prevent an individual from engaging in an activity altogether.

Social construction models represent a critical shift in attitudes and approaches to disability that have wide-ranging implications for rehabilitation practice. In moving away from intrinsic causes of disability to include extrinsic influences, social models suggest that rehabilitation is both individual and societal. Although rehabilitation strategies can often promote function regardless of form at the individual level, at the unit (e.g., family/home, work/workplace) or societal level, where others are exposed to individualized rehabilitation interventions, the fit between form and function for everyone in the unit is essential. Universal design is a rehabilitation strategy that promotes that fit.

Over the past three decades, a number of ecological–social construction models have been proposed. Although the models differ slightly on the relationship among medical conditions, impairments, functional limitations, and effects of the interaction of the person with the environment (Brandt & Pope, 1997), the relationship between the person and the environment is always dynamic, complex, and interdependent (Rigby & Letts, 2003). Among the various models, four models of person–environment (P-E) interaction contribute to a fundamental understanding of the link between design and rehabilitation that is relevant to universal design as a rehabilitation strategy. These include the environmental press model, person–environment–occupation model (PEO), enabling–disabling process model, and the International Classification of Functioning, Disability, and Health (ICF). The first three are rehabilitation models, albeit from different rehabilitation disciplines (psychology,
The Functionality of Form: The Link Between Design and Rehabilitation

Aim: The aim of this chapter is to describe the functionality of form as it relates to the design of products and environments for rehabilitation.

The Link between Design and Rehabilitation: The latter is a public health paradigm that encompasses rehabilitation.

Environmental Press Model: The environmental press model (Lawton & Nahemow, 1973) provides the first rehabilitation conceptualization of the P-E fit. It is based on Lewin’s field theory, a psychological model that described behavior as the outcome of a transactional relationship between an individual and the environment (Lewin, 1951). Building on Lewin’s work, the model describes an individual’s behavior as the outcome of a transactional relationship between an individual’s competence (e.g., cognitive, social, and behavioral skills and abilities) and the level of demands posed by the environment, referred to as press. As a result, functionality of design and therefore engagement in activity is an expression of the fit or misfit between an individual and his or her environment.

Because the environmental press model has its origins in gerontological psychology, much of the language used is behavioral rehabilitation rather than physical rehabilitation. Nonetheless, the concepts (Figure 1.1) are equally applicable to rehabilitation in general. The level of an individual’s competencies is conceptually represented on the vertical axis, and the strength of environmental demands is represented on the horizontal axis. The outcome of a transaction is depicted on the graph at the intersection of an individual’s skill level and demand strength.

![Environmental Press Model](image-url)
As indicated by the zone of maximum comfort to maximum performance, optimal P-E fit occurs when an individual’s abilities and the environmental demands are compatible. In other words, when the strength of the demand is commensurate with one’s ability, the environment acts as a facilitator of function, and hence, the form has functionality. Conversely, when the strength of demands either exceeds (i.e., the environment is too challenging) or falls short of ability (i.e., environment is not challenging enough), form is not functional, and there is a P-E misfit. Therefore, as an individual moves farther to the right or to the left of his or her baseline adaptation level, negative behavioral outcomes occur, defined by either negative affect (i.e., emotion) or maladaptive behavior.

The environmental press model has generated several hypotheses that are relevant to understanding the impact of the environment on people with reduced abilities. First, following the transactional nature of disability, Lawton and Nahemow (1973) postulated that excess disability, defined by an individual’s level of dependency, will be greater than expected given the level of impairment alone. Second, the environmental docility hypothesis (Lawton, 1990; Lawton & Simon, 1968) suggests that the demand strength (i.e., the amount of influence that the environment has on functionality) is a result of the interaction between the physical form and an individual’s ability. In other words, although all physical form has demand-producing potential, actual demands are only exerted when the environment comes into contact with human ability. Further, the strength of actual demands will be greater on individuals with less ability than individuals with greater levels of ability. As a result, individuals with less ability will be more challenged by the same environmental demands than individuals with greater levels of ability.

The environmental press model has played a major role not only in geriatric rehabilitation but also in establishing a theoretical basis for using design intervention as a rehabilitation strategy. However, the model only conceptualizes the relationship between design and rehabilitation. It does not provide a basis for measuring either an individual’s competence level or the demands of a particular physical form. As a result, the model only provides a rationale for design as a rehabilitation intervention; it does not provide a mechanism that will translate that knowledge into rehabilitation practice.

**Person–Environment–Occupation Model.** The relationship between person and environment has been an important component of occupational therapy practice for some time. Nonetheless, in the decade between the publication of the *Americans with Disabilities Act Accessibility Guidelines*
in 1991 and the ICF in 2001 (discussed later in this chapter), a number of occupational therapy-specific models emerged (Letts, Rigby, & Stewart, 2003) that shared common elements of person, environment, and occupation factors, although how these factors were defined and interacted varied considerably. These models include the following: the ecology of human performance model (Dunn, Brown, & McGuigan, 1994), the model of human occupation (Kielhofner, 1995), the PEO (Law et al., 1996), the Canadian model of occupational performance (Canadian Association of Occupational Therapists, 1997), the person–environment–occupation–performance model (Christianson & Baum, 1997), the competent occupational performance in the environment (Hagedorn, 2000), and the occupational adaptation model (Schkade & McClung, 2001).

Among these models, the PEO is most relevant as an adaptation of the environmental press model for the field of occupational therapy (Law et al., 1996). As an adaptation, the PEO model tends to be more of an elucidation of assumptions made by and about the environmental press model than a unique model itself. Nonetheless, because there were two key changes that added an activity and function rehabilitation emphasis to the existing model, the PEO model (Figure 1.2) warrants discussion.

First, whereas Lawton’s model focused on behavior and affect as outcomes of P-E transactions, the PEO model specifically articulates occupational performance as an outcome of person–environment interactions. This adaptation clearly makes the model more function friendly, although the focus on behavior in the original model is an artifact of its psychology origins and is, as discussed above, conceptually generalizable to other rehabilitation outcomes. Second, whereas the environmental press model does not
specifically identify engagement in activity as a component of P-E transactions, such interaction is implicit, as it is clear that the environment does not exert demands in the absence of activity. Nonetheless, the PEO model makes that relationship explicit by defining occupational performance as the outcome of transactions among person, occupation, and environment within which the occupations are performed. Further, in the PEO model, occupations are viewed as self-directed tasks and activities in which the person engages to meet intrinsic needs for self-maintenance, expression, and fulfillment, within a variety of roles throughout the life span (Rigby & Letts, 2003). Thus, the model suggests, although never explicitly states, that occupations, like the environment, also exert demands on the individual.

**Enabling–Disabling Process Model.** In 1997, the Institute of Medicine (IOM), complying with a request from Congress, convened a panel to assess the state of rehabilitation science, engineering, and practice. Among the tasks was an evaluation of existing rehabilitation models. Based on their analysis, the committee proposed the enabling–disabling process model (Brandt & Pope, 1997), which clearly identified the environment as a pathway for rehabilitation intervention. Unlike the earlier IOM and other models, the enabling–disabling process model defined both a pathway to disability as well as a pathway to restore function. The model (Figure 1.3) suggests that due to increasing needs relative to the environment, the *disabling process* is the dislocation of an individual from his or her prior

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**Figure 1.3**

The IOM enabling–disabling process model (1997)
integration in the environment. In contrast, the enabling process is either the restoration of the individual’s function or environmental modification to remove barriers to improve design functionality.

Although the model explicitly identifies these two potential pathways to rehabilitation, it offers little insight into how to identify or measure the environmental demands that account for the misfit among form, function, and functionality. Unlike the environmental press model, which suggests that P-E misfit is the result of the interaction between measurable competencies and potentially measurable demands, only the person side (i.e., impairment) of the P-E misfit equation is measurable in the enabling–disabling process model. The environment, on the hand, is a black box, with no acknowledgment that there are specific measurable factors that contribute to the misfit. As a result, the model provides no explicit guidance for using design as a rehabilitation strategy.

**International Classification of Functioning, Disability, and Health.**

Two decades after the WHO (1980) published its *International Classification of Impairment Disability and Health* medical model, it developed a new model based on a more robust social construction paradigm. Although a health-based model, the revised ICF described human function and disability as important components of health (WHO, 2001). The new framework (Figure 1.4) not only defines disability as the interaction of body function and structure with contextual (i.e., environmental and personal)
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factors but also extends that interaction to include health, as well as activity and participation outcomes. Specifically, the ICF attributes differences between what individuals can do (capacity to engage in activities and participation based on body function and structure) and what they actually do (performance of activities) to the influence of personal and environmental (both social and physical) factors. As a result, the environment is viewed as either a barrier or a facilitator to activities and participation in social roles.

In addition, the ICF not only includes but also distinguishes between activity and participation as equally important rehabilitation goals. Activity, defined as “the execution of specific tasks or actions by an individual,” is clearly in the domain of the individual without the connection to others. In contrast, participation, which is “involvement in a life situation” lies in the social context, including involvement in valued occupations (e.g., employment), social roles, social relationships, independence/interdependence, and assimilation (i.e., sense of inclusion; Dijkers, 2006; Rochette, Korner-Bitensky, & Levasseur, 2006; Winkler, Unsworth, & Sloan, 2006).

Although the ICF has a theoretical framework, its primary purpose is to serve as a classification system. As a result, it includes several components. First, it considers changes in functional states associated with health conditions and the body (i.e., body function and structure), including anatomical and physiological functions of the human body. Second, it outlines the range of activities performed by an individual and describes areas of life in which an individual participates. Finally, unlike the other models, the ICF provides a fairly complete taxonomy of environmental features at all scales of design, organized in sequence from the individual’s most immediate environment to the general environment. The classification system not only associates environmental factors with positive or negative outcomes but also provides a mechanism for measuring the level of P-E fit/misfit by rating the strength of a particular factor as a facilitator (from 0 to positive 4) or a barrier (from 0 to negative 4).

The ICF, as a health model, in contrast to basic rehabilitation models that are based on impairment and associated limitations in ability, assumes a continuum of degrees of ability in all people. By assuming that individuals have differential abilities to begin with, the ICF recognizes that a health condition does not have to be a prerequisite for functional deficits and design intervention. Moreover, the environmental classification index is the most comprehensive description of environmental factors that contribute to activity and participation deficits, and it represents the first attempt to
identify and measure salient environmental factors that contribute to the P-E misfit.

Unfortunately, the ICF reflects little understanding of the interaction between form, function, and functionality that would enable design to be useful in rehabilitation practice. First, it lacks an understanding of the environment that would provide a taxonomic structure that is familiar to designers and engineers (e.g., features are organized by products and technology and natural and human-made changes to the environment). Second, the taxonomy is primarily based on design features rather than the demand-producing attributes that are necessary to identify specific P-E misfits and subsequently appropriate design interventions.

Interestingly, the environment classification system is the only ICF construct, including body structure/function and personal contextual factors that is defined by features rather than by demand-producing attributes. For example, personal factors are characterized by a variety of individual attributes, such as age, gender, education, coping style, and social background. However, the taxonomy’s focus on environmental features (e.g., a ramp), even though other constructs clearly focus on specific attributes, limits measurement of environmental factors to that of categorical descriptions of what exists (e.g., a ramp that is provided or not provided) rather than measurable demand-producing attributes (i.e., a ramp has a 1:12 slope). Without a framework for quantifying environmental demands, the ICF, like other models, lacks a mechanism to implement environmental intervention as a rehabilitation strategy.

THEORETICAL IMPLICATIONS FOR UNIVERSAL DESIGN AS A REHABILITATION STRATEGY

Although social models of disability have facilitated a shift from focusing on individual deficits to examining the interaction between design and rehabilitation practices, they are not a panacea. In particular, social models have a tendency to ignore how impairment in and of itself has the potential to debilitate regardless of the environmental and social conditions (Shakespeare & Watson, 2001).

In addition, although all models are based on press mediating between what an individual can and cannot do, none account for the range of contextual factors that place demands on the individual and contribute to differences between capacity and actual performance. Implicit in the environmental press model are the physical and social environments. The PEO
model goes one step further and includes occupation as exerting demands. Nonetheless, a number of other factors lie outside of, yet interact with, the ability to create press (Bruce & Sanford, 2009), including physical environmental factors, social environmental factors (e.g., attitudes of others), individual factors (e.g., preferences, cultural or spiritual beliefs, values, financial limitations), organizational factors (e.g., policies, employer support), external factors (e.g., legal restrictions, cost, and availability of assistive technologies), and occupational/task factors (e.g., lifting, pulling, and bending). Whereas the demands exerted by physical environmental factors are clearly of greatest concern for universal design, the demands placed by all of the factors are themselves transactional, interacting with the physical environmental to determine overall demand. As such, these interactions are important in understanding the impact of design on functionality and, more specifically, in determining what is universal within any context.

Finally, from a design perspective, all of the models fail to provide a mechanism to quantify environmental demands that impact functionality. Even the ICF, which quantifies the overall strength of demands exerted by environmental features, does not specifically quantify the demands themselves. As a result, none of the existing ecological models provide a framework that enables us to specify which environmental attributes create demands during the performance of specific activities. If we want to identify environmental attributes that create demands during the performance of specific activities, we need a framework that links attributes to ability. The next chapter will begin to lay out that framework.