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Eating Behavior

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Synonyms

[Eating habits](#); [Eating practices](#)

Definition

Eating behavior is a broad term that encompasses food choice and motives, feeding practices, dieting, and eating-related problems such as obesity, eating disorders, and feeding disorders. Within the context of behavioral medicine, eating behavior research focuses on the etiology, prevention, and treatment of obesity and eating disorders, as well as the promotion of healthy eating patterns that help manage and prevent medical conditions such as diabetes, hypertension, and certain cancers.

Description

Eating behavior is complex; humans make hundreds of food decisions each day that are influenced by a variety of personal, social, cultural, environmental, and economic factors. What people eat and how much they eat has a

considerable influence on their health. An ecological model that considers the impact of individual factors, social environments, physical environments, and macro-level environments on food choices is useful in understanding the multitude of determinants of eating behavior. Intraindividual factors influencing eating behavior and food choice include physiological processes (e.g., hunger, satiety, innate preference for sweet foods, brain mechanisms) and psychological processes (e.g., learned food preferences, knowledge, motivations, attitudes, values, personality traits, cognitive processes, self-regulation). The social environment has also been shown to have a substantial effect on eating behavior. Eating behavior is shaped indirectly through observing others and internalization of food rules, as well as directly (i.e., one eats more in the presence of others than when alone). The physical environment, including availability of foods, the context in which foods are provided, and the external cues, such as proximity to food, salience of food, packaging, plate/serving size, and variety of food assortments, have all been shown to affect the type and amount of food eaten. Finally, macro-level environments, including economic systems, food and agricultural policies, food production and distribution, food marketing, and cultural norms and values, may have a more indirect yet powerful impact on food choices and eating behavior. The research on determinants of eating behavior has largely emphasized intraindividual variables, whereas there is considerably less known about the environmental influences and the interaction

between these. In particular, there is a need to conduct multilevel research, among diverse subgroups, using better measures, in order to better understand the mechanisms involved in eating behavior (Larson & Story, 2009).

Cross-References

► Obesity

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Eating Disorders: Anorexia and Bulimia Nervosa

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Definition

Prevalence

Anorexia nervosa afflicts an estimated 0.9% of females, with 0.5% of men reporting having

anorexia at some time in their lives (Hudson, Hiripi, Pope, & Kessler, 2007). Bulimia nervosa is estimated to occur in 1.5% of females and in 0.5% of men (Hudson et al., 2007). Approximately 3.5% of women and 2% of men reported having binge-eating disorder (BED) at some point in their lives (Hudson et al., 2007). BED affects about 8% of people who are obese. Eating disorders typically (86%) are reported by the age of 20, with the majority of those affected (43%) with anorexia reporting onset between the ages of 16 and 20. Thirty percent of those afflicted report duration from 1 to 5 years, and 31% report duration from 6 to 10 years. The full recovery rate of women with bulimia has been reported to be significantly higher than that of women with anorexia, with 74% of those with bulimia achieving full recovery, whereas only 33% of those with anorexia achieved full recovery (Herzog et al., 2009). Approximately one third of both women with anorexia and with bulimia relapse after full recovery (Herzog et al., 2009).

Adolescent and young women account for 90% of cases (women between the ages of 12 and 25) of eating disorders (American Psychiatric Association [APA], 2000). In anorexia, there is a female to male ratio of about 11 to 1. Bulimia has a female to male ratio of about 30 to 1. Anorexia nervosa may arise in children as young as 8 years of age, whereas bulimia rarely appears before the age of 12. Increasing numbers of older women and men have these disorders with up to 5–10% of all cases of eating disorders occurring in males (Academy of Pediatrics Committee on Adolescence [AAP], 2003). Teen boys have shown an increasing trend in dieting, use of diet products, and their use of exercise for weight control, with Hispanic boys being the most likely to practice weight control, followed by black and then white boys. Binge-eating disorder is more prevalent than both anorexia nervosa and bulimia nervosa, but the treatment outcome for individuals with BED is also more favorable (Fairburn, Cooper, Doll, Norman, & O'Connor, 2000).

There is relatively little data on the role of ethnicity or racial background in eating disorders. Some data show that ethnic minority women who

seek treatment for anorexia have lower admission weights than white women, suggesting that anorexia may go undetected or untreated longer in minority women. Typically a disorder of white affluent women, disordered eating appears to be increasing among nonwhite groups, including Hispanics and American Indians (Croll, Neumark-Sztainer, Story, & Ireland, 2002).

Etiology

There is no one single cause but rather a complex interaction between biological issues, such as genetics and metabolism; psychological issues, such as control; coping skills; personality factors; family issues; and social issues, such as a culture that promotes thinness and media that transmits this message.

Comorbidities

People with eating disorders suffer higher rates of other mental disorders including depression, anxiety, obsessive-compulsive disorder, and substance abuse (Hudson et al., 2007). There is an increased frequency of mood disorders in individuals with anorexia and bulimia nervosa, which may develop at the same time, or the mood disorder may precede the eating disorder (APA, 2000). Obsessive-compulsive features are prominent in individuals with anorexia nervosa, whereas increased frequency of more general anxiety symptoms is more common in those with bulimia (APA, 2000).

Cross-References

- [Anorexia Nervosa](#)
- [Bulimia](#)

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Eating Habits

- [Eating Behavior](#)

Eating Practices

- [Eating Behavior](#)

EBV

- [Epstein-Barr Virus](#)

ECG

- [Electrocardiogram \(EKG\)](#)

Ecologic Bias

► Ecological Fallacy

Ecological Fallacy

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Synonyms

[Ecologic bias](#)

Definition

Ecological fallacy is improperly inferring an association (or lack of association) at an individual-level based on a group-level relationship.

Ecologic studies use measures taken at the level of a group (such as a country, school, or hospital) rather than at the individual (such as patient) level. Ecologic studies are widespread in behavioral medicine literature due their low cost and convenience since ecologic data can often be obtained through census records or existing surveys and records. Two typical behavioral medicine ecologic examples are a study investigating the association between alcohol availability and violence (Gorman, Zhu, & Horel, 2005) in which data were collected at the census tract level and a study investigating the association between needle exchange programs and HIV seroprevalence among injecting drug users (Hurley, Jolley, Kaldor, 1997) in which data were collected at the city level.

When risk factors and outcomes are measured at an aggregate level, the relationship between the group-level variables may be different than the relationship between variables measured at the individual level. An often-cited example used to illustrate the issue involved a nineteenth century

study which found higher suicide rates within Prussian provinces that had higher proportions of Protestant residents (Durkheim, 1951). The conclusion that Protestant individuals (rather than Catholic individuals) were more likely to commit suicide cannot be inferred based on the observed association among the provinces (Morgenstern, 1982; Robinson, 2009). One possible scenario is that Catholic residents within the largely Protestant provinces had the high suicide rates, resulting in a positive association between percent Protestant and suicide rate. Extrapolation of aggregate results to individuals is a mistake in logic which can lead to a potentially misleading conclusion.

Because of the many limitations of ecologic studies, including ecological fallacy, they are often used as exploratory or hypothesis-generating studies rather than as confirmatory.

Cross-References

- [Aggregate Data](#)
- [Hypothesis Testing](#)

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Ecological Framework

- [Ecological Models: Application to Physical Activity](#)

Ecological Models: Application to Physical Activity

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Synonyms

Behavioral ecological model; Ecological framework; Social ecological framework; Social ecological model

Definition

Ecological models are a series of models/frameworks that emphasize multiple levels of influences on behaviors. These influences usually include intrapersonal, interpersonal, organizational, community, physical environment, and policy (Sallis, Owen, & Fisher, 2008). Numerous ecological models have been created to explain specific behavior or to guide behavioral interventions. Although different ecological models may involve different terminology, they share two basic principles: (1) multiple levels of influence on behaviors and (2) interactions across levels of influence. In the context of behavioral change interventions, two additional principles apply as follows: (1) effectiveness of multilevel interventions and (2) emphasis on behavior-specific ecological model (Sallis et al., 2008).

Description

History of Ecological Models

The evolution of ecological models highlights a process of proliferation, diversification, and specification. At the early stage, the conceptual basis of ecological models was the general idea that the environment influenced behaviors. Skinner conceptualized most behaviors as a

product of interactions between individuals and the environment (i.e., “operant behaviors”) (Skinner, 1953). Barker was a founder of environmental psychology (a.k.a. “ecological psychology”) and emphasized “behavior settings,” where behaviors take place (Barker, 1968). Later on, Bronfenbrenner developed Ecological Systems Theory and defined the “microsystem,” “mesosystem,” and “macrosystem” as different levels of environmental influences (Bronfenbrenner, 1979). The more recent models were created specifically for health behaviors. McLeroy et al.’s Ecological Model of Health Behavior emphasized five sources of influences on health behaviors, including intrapersonal, interpersonal, institutional, community, and policy factors (McLeroy, Bibeau, Steckler, & Glanz, 1988). Stokols’ Social Ecological Model for Health Promotion offered theoretical guidance for behavioral interventions (Stokols, Allen, & Bellingham, 1996; Stokols, Grzywacz, McMahan, & Phillips, 2003). Hovell et al.’s Behavioral Ecological Model (Hovell, Wahlgren, & Adams, 2009; Hovell, Wahlgren, & Gehrman, 2002) incorporated Skinner’s Operant Learning Theory (Skinner, 1969) and emphasized multiple contingencies of reinforcement for behavior. Some models were created for a specific health behavior, such as Glanz and colleagues’ Model of Community Food Environments (Glanz, Sallis, Saelens, & Frank, 2005), Sallis and colleagues’ Ecological Model of Four Domains of Active Living (Sallis et al., 2006), and Fisher and colleagues’ Resources and Skills for Self-Management Model (Fisher et al., 2005).

Ecological Models and Physical Activity

The development of ecological models parallels the conceptual evolution of the field of physical activity. Decades ago, “exercise” (i.e., planned physical activity for fitness purpose) was the main focus of physical activity research and most behavioral interventions applied cognition-based theories and targeted individual-level correlates (Sallis et al., 2006). The limitations of these interventions included small number of target individuals who benefited from interventions, small-to-moderate effect sizes

(Dishman & Buckworth, 1996; Dishman, Oldenburg, O'Neal, & Shephard, 1998), and lack of maintenance of behavioral change (Marcus et al., 2000).

More recently, the concept of “active living” emerged to expand previous understanding of physical activity by emphasizing different domains of physical activity, including occupational, leisure-time, household activities, and active transportation (Pratt, Macera, Sallis, O'Donnell, & Frank, 2004). Disciplines outside public health, such as urban planning, transportation, and leisure science, became involved in physical activity research because the multiple levels of influence and domains of activity highlighted needs for expanded expertise. As a result of multidisciplinary collaboration, ecological models have been widely accepted and applied in the field of physical activity.

Sallis et al. (2006) summarized empirical findings and conceptual associations from multidisciplinary research and developed Ecological Model of Four Domains of Active Living (Sallis et al.). In this model, factors influencing physical activity are multilevel and domain specific (Sallis, Adams, & Ding, 2011). Based on the model, physical activity is influenced by intrapersonal factors (e.g., demographic and psychosocial variables), interpersonal factors (e.g., social support and social modeling), perceived environment (e.g., safety, convenience, aesthetics), behavioral settings (e.g., home equipment, walking and biking facilities, parks), and policy environment that directly influences the built environment (e.g., zoning codes, park policies, transportation policies) (Sallis et al., 2006). Most environmental influence is domain specific, for example, bike lanes provide settings for bicycling (especially for transportation purpose), while parks provide settings for leisure-time physical activity. Similarly, transportation policies and parking regulations are more likely to influence transportation physical activity, while policies regarding parks and recreation facilities are more likely to influence leisure-time physical activity (Sallis & Glanz, 2009; Sallis et al., 2011).

Strengths and Limitations of Ecological Models in Physical Activity Research

A major strength of ecological models is the comprehensiveness. Unlike most cognition-based models that include mostly psychosocial variables, ecological models place an individual's behavior in a larger context and take into account multiple levels of influence external and internal to the individual. This approach offers a wide range of opportunities for interventions. Furthermore, ecological models emphasize the effects of the built environment and policies on physical activity and prioritize environment and policy changes to promote active life-styles. Once these changes have been implemented, they are likely to affect a large population and promote sustainable behavioral change.

Current ecological models have weaknesses. First, most models lack specificity and do not include behavior-specific or setting-specific factors; therefore, they cannot provide clear research hypotheses or intervention strategies (Sallis et al., 2008). Second, ecological models do not provide information about mechanisms of how specific factors affect behaviors and how different influences interact across levels. Third, although multilevel interventions have been recommended as an effective approach for producing behavioral change, such interventions are extremely difficult to implement and evaluate. Because it is not feasible to randomly assign individuals to neighborhoods, randomized controlled trials cannot normally be conducted to determine the effectiveness of a specific environment or policy intervention (Sallis & Glanz, 2009).

Cross-References

- Built Environment
- Physical Activity and Health

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Ecological Momentary Assessment

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Definition

Ecological momentary assessment (EMA) refers to a collection of methods often used in behavioral medicine research by which a research participant repeatedly reports on symptoms, affect, behavior, and cognitions close in time to experience and in the participants’ natural environment (Stone Shiffman, 1994). Technologies such as written diaries, electronic diaries, telephones, and physiological sensors are often utilized in EMA studies. EMA studies can be utilized to study a variety of topics such as depression, social support, relationships, diet, work activity and satisfaction, psychotherapy, drug use, allergies, psychological stress, medications, self-esteem, and asthma.

Description

EMA is not a single research method. Instead it encompasses a range of methods that differ in their particular design, assessment schedule, content, and technology. However, all EMA studies have four aspects in common. They all assess research subjects in their natural environments,

in their current or recent states, at selected times, and repeatedly over time (Shiffman, Stone, Hufford, 2008). First, in all EMA approaches, data are collected in real-world environments as subjects go about their normal lives. EMA recognizes that many behaviors and experiences are affected by the context in which they are studied. For an assessed experience or behavior to be representative, it has to be sampled in the context in which it naturally occurs. Therefore, with EMA, psychological processes are not studied in a laboratory environment, but in the natural setting of the subject. EMA allows for improved ecological validity (generalization to the subjects' real lives and real-world experience) because data are collected in the subject's natural setting.

Second, all EMA assessments focus on a subject's current state. For example, EMA self-report items ask about current feelings (or very recent ones), rather than asking for recall or summary over long periods. This aims to reduce biases associated with retrospection. That is, errors or inaccuracies in recalling information are not just random, but are often systematically biased and can change the data in systematic ways. For example, people are more likely to retrieve positively charged information when they are in a good mood, thus introducing biased reporting. Because EMA assesses behaviors, attitudes, emotions, and other characteristics at the moment they occur, it reduces cognitive biases that are often a part of retrospective recall reports.

Third, the moments that are assessed with EMA are strategically selected for assessment. This avoids pitfalls associated with allowing participants to choose when they will provide data. Strategic selection of assessment points can be based on particular features of interest (i.e., occasions when subjects smoked), by random sampling, or by other sampling schemes.

Finally, subjects complete multiple assessments over time. These multiple assessments provide the researcher with a rich picture of how subjects' experiences and behaviors vary over time and across various situational contexts in the participants' normal environment. EMA studies range in the frequency of assessments. Some

studies may implement a very frequent schedule of assessment (i.e., assessing subjects every 30 min over a period of days). In other studies, subjects are assessed less frequently (e.g., daily) over periods as long as a year.

Although there are many advantages of EMA such as increasing ecological validity, avoiding retrospective recall, avoiding global summarizations, and being able to study dynamic processes that unfold over time, there are also drawbacks to EMA studies. For example, EMA methods are onerous for participants and require a tremendous level of compliance (Shiffman Stone, 1998). Depending on the design of the study, subjects can be required to stop what they are doing and complete an assessment multiple times a day. EMA studies also place demands on the investigator (Shiffman & Stone). For example, automated methods for prompting or data capture can be expensive. Additionally, the volume of data collected can make data management challenging.

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Ecology

► [Ecosystems, Stable and Sustainable](#)

Ecosocial Theory

► [Social Epidemiology](#)

Ecosystems, Stable and Sustainable

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Synonyms

[Ecology](#); [Sustainability](#); [Units of nature](#)

Definition

Ecosystems: Basic units of nature within which living organisms continually interact with non-life forms, whose boundaries are arbitrary, and which exist in “dynamic equilibrium.”

Ecosystem services: A way of thinking about the benefits provided to humans and other species by nature; examples range from obvious (oxygen, food, water) to subtle (regulation of the carbon cycle) and psychological (aesthetic beauty). Sometimes called “nature’s services.”

Biodiversity: Abundance of biological variety.

EcoHealth: A term that indicates linkages between human and ecological well-being.

Sustainability: A debate exists concerning the definition of “sustainability” (or its earlier formulation “permanence”). One pole is anthropocentric (humans first), the other is biocentric

(life in its basic form first). A formulation that many would consider anthropocentric is: “capacity to meet long-term human needs enduring over many generations.” In this definition, human coexistence with a sufficient quantity and quality of nature is only implicit. The definition risks interpretation as meaning that nature can be replaced with human-made substitutes. A biocentric definition is: “a process of living within the limits of available physical, natural, and social resources in ways that allow the living systems in which humans are embedded to thrive in perpetuity.” This is explicit about the need for ecosystems to thrive but is vulnerable to the criticism that human well-being may be exchanged in order to preserve nature, whether for itself or for the benefit of future generations.

Description

The original definition of an “ecosystem” dates only to 1935 (Tansley, 1935). It linked nature with physics, describing “basic units of nature” within which living organisms continually interact with non-life (the abiotic), including the climate system. The “system” part of the term is linked with ideas of holism, synthesis, emergence, self-organization, cybernetics (from the Greek for steersman, or governor), and, more recently, complexity theory (Fauth, 1997). More recently, Lovelock has extended the ideas of Tansley and Vernadsky by conceptualizing the Earth system as a self-regulating organism floating in space. This insight recognizes that a continual interaction between life and non-life maintains planetary balance (homeostasis).

Tansley coined the term “ecosystem” to contrast alternatives such as “complex organism” and “biotic community.” He suggested that ecosystems belong to a category of physical systems in a catalogue from “the universe to an atom.” He recognized that the boundaries between these components, including differently configured ecosystems, are arbitrary but argued that such reductionism (i.e., thinking non-systemically) was essential for their analysis. Tansley also

recognized that ecosystems are in “dynamic equilibrium,” an idea he traced to the Scottish philosopher Hume and the Roman philosopher Lucretius. Implicitly, this recognizes that ecosystems are never stable but are constantly evolving and changing, including sometimes between alternative new states. A related concept is biodiversity, a contraction of “biological diversity,” a term now about 30 years old.

Ecosystem Services and Human Well-Being

Ecosystems are of more than philosophical and scientific interest. Ecosystems and their services have probably been recognized as essential (though not necessarily conceptualized in these terms) by indigenous populations since the time that concepts of any kind evolved (Berkes, Kislalioglu, Folke, & Gadgil, 1998). However, as humans became more urbanized and reliant on technology, the complete dependence of humans on nature’s services has become more disguised and less direct. Indeed, since the industrial revolution some 175 years ago, civilization’s selected path has led to whole cultures becoming disconnected from the ecosystems that fundamentally sustain them, leaning increasingly on technology as a substitute for the services formerly derived from nature.

A widely used classification of ecosystem services was developed in the 2001–2005 Millennium Ecosystem Assessment, which conceptualized four forms of ecosystem goods and services: provisioning, regulating, culturally enriching, and supporting (see Table 1) (Millennium Ecosystem Assessment, 2003). Some ecologists have criticized the idea of “services” as excessively anthropocentric. From an extreme biocentric (deep ecology) position, the intrinsic value of an algal bloom, jellyfish swarm, or school of cod may be considered proportional to its biomass; however, such arguments seem like sophistry to those concerned with sustainable human well-being. The framers of the Millennium Ecosystem Assessment classification argued that an anthropocentric perspective was a necessary strategy with which to better engage policy makers, most of whom were thought to prioritize monetary over other kinds of value.

Ecosystems influence the entire human enterprise and incorporate, for example, wilderness, cornfields, oceans, and palm oil plantations. The vast human population (now over seven billion) could not be fed solely by hunting and gathering of wild species. For at least ten millennia, it has been increasingly dependent on domesticated plants and animals, grown ever more intensively through agriculture. Even ecosystems that appear wild, with no apparent significant human modification, such as remote mountains, deserts, rainforests, and tundra, have been altered through invasive species, the environmental atmospheric transportation of pollutants (e.g., organochlorines), and via anthropogenic climate change. Indeed, humans have been called the single greatest patch disturbers of all species on the planet (Soskolne et al., 2008).

Extensively transformed ecosystems, such as farms, are today essential for human well-being in order to provide goods in huge quantities, including food, fiber, biofuel, timber, and medicinal agents. But wild and minimally transformed ecosystems are also vital. While both categories of ecosystems provide all four categories of ecosystem service (see Table 2), it would be hubristic if humanity were to imagine that it could successfully transform the whole planet into a farm or garden. Wild places have intrinsic (“existence”) value, but perhaps of even more importance, they provide enormous ecosystem regulating services which benefit humanity on a scale that modified ecosystems cannot approach. They also hold a vast reservoir of poorly catalogued species, some of which will be discovered to hold important pharmaceutical and other uses (Chivian & Bernstein, 2008). In general, wild ecosystems are shrinking, with their cultural and regulating services being exchanged for greater provisioning services.

Current economic models ignore (externalize) the costs of harming or maintaining ecosystem services. This practice intensifies several forms of inequity, including polarization between rich and poor and between current and future generations. Those who purchase goods and services tend to underpay, while others, especially the poor, bear the burden of risk and remediation,

Ecosystems, Stable and Sustainable, Table 1 The Millennium Ecosystem Assessment classified ecosystem “services” into four kinds. The selected examples represent only a tiny fragment of a very rich and complex set. Many ecosystems provide multiple ecosystem services; for example, a forest may provide food, fiber, water regulation, water purification, and cultural services. Most employment is provided by provisioning services, including through the transformation of wilderness to farms and plantations

Ecosystem service	Examples of benefit	Ecosystem examples
Provisioning	Food (calories, nutrients), fresh water, fiber, medicinals	Rice fields, aquaculture ponds, bamboo groves, cattle feedlots, wild plants, and wild animals
Regulating	Soil erosion reduction, coastal storm protection, atmospheric carbon stabilization, some cases of infectious disease limitation (e.g., malaria, Lyme disease)	Forests (including on slopes), coastal wetlands, mangroves, extinction of the passenger pigeon contributed to a cascade of ecological changes that enhanced habitat for ticks that transmit Lyme disease
Culturally enriching	Inspiration, aesthetic beauty, spiritual refreshment, religious observation, ancestral links, ceremonial materials, tourism income	Sacred groves, charismatic landscapes and species e.g. coral reefs, tiger reserves, old growth forests, bird of paradise feathers
Supporting	Soil fertility, nutrient cycling, pollination, insect control; many indirect benefits for other services	Many species enhance soil fertility, pollinate, and disperse seeds; bats and birds help control insects; bacteria and fungi recycle nutrients

Ecosystems, Stable and Sustainable, Table 2 Ecosystems can be grouped between two extremes, minimally and extensively transformed; no ecosystem is entirely “natural.” Both kinds perform valuable ecosystem services. In general, wild ecosystems are shrinking, with their cultural and regulating services being exchanged for greater provisioning services. To flourish, humanity requires all four kinds of service in abundance

Ecosystem service	Extensively transformed ecosystem	Wild or minimally transformed ecosystem
Provisioning	Farms, plantations, greenhouse vegetables, farmed fish	Game, bushmeat, ocean fish, timber, a reservoir of species with potential human benefit
Regulating	Trees planted to reduce soil erosion, carbon sink from a long lived tree plantation, artificial wetlands	As opposite, but benefits vastly larger in scale; e.g., carbon sink of Amazon forest, scavenging services by wild birds and mammals
Culturally enriching	Bonsai tree, flower garden, zoological garden, artificial wetland; some people find cultivated areas very attractive	Knowledge of the existence of wild areas and species, wilderness hiking, contact with wild birds and mammals adapted to urban ecosystems
Supporting	Earthworms in a garden, planted legumes that fix nitrogen, complementary plantings that reduce pesticide use	Species that pollinate and disseminate seeds, animals that improve soil water absorption, algal varieties that enhance water purification

such as hazardous exposures and waste disposal costs. Indeed, accumulating impacts increasingly approach thresholds which threaten the collapse of crucial ecosystems, harming both present and future generations. Internalization of such costs would motivate consumer behavior more conducive to sustainability (Daly, 1996). A powerful reason for the transformation of wild ecosystems to one which provides intense provisioning services is that greater monetary profits can be made and that more people can be employed. But this transformation is always at a cost: not only to the species which are altered or lost but also, in many

cases, to indigenous populations who lack sufficient political and economic power to resist.

Human Health

All ecosystem services are essential, directly or indirectly, for health, a concept captured by the term “ecohealth” (Wilcox, Aguirre, & Horwitz, 2011). Some ecosystem properties, including biodiversity, influence the distribution of important human infectious diseases, including malaria, onchocerciasis, Lyme disease, Chagas disease, and sleeping sickness (Keesing et al., 2010).

Although there are claims that ecosystems that are less transformed by human action provide an infectious disease-regulating “service,” such that intact ecosystems lower infectious diseases, the picture is more complex (Butler, 2008). For example, there are many cases in which ecosystem transformation has improved health, such as the clearing of swamps, which reduces mosquito habitat and may thus lower malaria transmission. Somewhat relatedly, “paddies paradox” describes how health can improve even where increased irrigation leads to more potential mosquito habitat in malarial areas. Increased malaria is not inevitable; for example, some of the increased wealth generated by irrigated agriculture can be used to promote technologies and behaviors which are health protective, such as treated bed nets, insecticides, and health services. Areas of high biodiversity may also harbor infectious agents, such as Ebola and HIV, in reservoir species including bats and some nonhuman primates.

Disease introduction can have profound effects on ecosystems, and indirect human health effects. In the late nineteenth century, the epizoonosis (a disease that infects only nonhuman animals) rinderpest entered eastern Africa via imported cattle, causing catastrophic harm to the ecology and human well-being. Immunologically naive oxen (domesticated and wild) died in huge numbers. The loss of oxen reduced plowing and thus agricultural productivity. Infection in wild animal species also reduced meat available for hunting. Exacerbated by periodic droughts, as many as one third of the Ethiopian population and two thirds of the Maasai people of East Africa died in this period, a time known to the Maasai as the *Emutai* (“to wipe out”) (Gillson, 2006).

Psychological Health and Ecosystem Cultural Services

Ecosystems are also an important source of “cultural services,” essential for good psychological health and thus for individual and community well-being. Ecosystems that help provide this vary from sacred groves (Ramakrishnan, Saxena, & Chandrashekara, 1998) that maintain species

with spiritual or symbolic value to viable populations of charismatic species within national parks and tracts of roadless wilderness. Many cultural symbols, decorations, and ceremonies rely on materials from nature, including sacred plants, fungi, and animals or seasonal displays, such as animal migration.

There is increasing evidence that exposure to gardens and wild areas is beneficial for behavior and good mental health (Louv, 2008). This effect may be particularly strong among those with high biophilia (sensitivity to nature) (Wilson, 1984).

Supporting Ecosystem Services

The fourth category of service described by the Millennium Ecosystem Assessment is “supporting” ecosystem services. This category may be the least obvious, but brief reflection shows that they are fundamental because they underpin all the other forms of ecosystem services. Examples include pollination, seed dispersal, and the recycling of nutrients and the formation and aeration of soil by earthworms, ants, and termites. In Western Australia, the brush-tailed bettong *Betulia pwcillata* (an endangered species) has been shown to improve the absorptive capacity of moisture in soil through its habit of digging for fungi. Many birds, bats, and other mammals assist in seed dispersal, forest maintenance, and insect control. White nose syndrome, a devastating fungal disease affecting several bat species in the USA will lead to increased insect populations, forcing increased reliance on pesticides and fossil fuels to maintain agricultural productivity. This illustrates the interdependency of life, including of our own species.

Prospects

Globally, the progression toward an increase in ecosystems which provide provisioning ecosystem services, such as the exchange of biodiverse forest ecosystems for monocultural plantations that provide food or biofuels, seems unstoppable (Danielsen et al., 2008). Fundamentally, this transformation has been driven by the enormous expansion of human populations since the industrial revolution supported by fossil fuels and agriculture. But there are now numerous warnings

that these processes are unsustainable and that this path places not only health and well-being, but civilization itself at increasing risk of grave harm (Soskolne et al., 2008). This risk occurs through multiple pathways, particularly the accumulation of greenhouse gases which worsen climate impacts and which threaten diverse and adverse feedbacks that could lead to the crossing of system thresholds with extreme danger (Lovelock, 2009).

Solutions

There is widespread denial about the extent, trend, and consequences of the relentless transformation of ecosystems. Many highly transformed ecosystems also risk degradation due to overuse, overgrazing, and contamination by chemicals, invasive species, and even landmines. Human well-being will inexorably decline if these trends are permitted to continue. Indeed, in some countries, constitutional law is changing in ways that will provide better ecosystem protection (Soskolne et al., 2008).

The tragedy of the commons can be overcome (Buck, 1985). But this will not happen without a vast amount of effort, exceeding that of the Space Race or even World War II. As Aldo Leopold wrote (using land as a synonym for ecosystems):

We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the aesthetic harvest it is capable, under science, of contributing to culture (Leopold, 1949).

The question of why, collectively, humanity seems incapable of changing its economic and consumer models to ones that are more sustainable is beyond the scope of this entry. Suffice it to say that denial is made possible because humans are remarkably adaptive; many seem to live in hope of a technological solution to the crises that await under current trends. Ultimately, consciousness of humanity's inseparable dependence on nature's services is required if a functioning civilization is to be maintained.

Cross-References

- [Ecosocial Theory](#)
- [General Population](#)
- [Health Economics](#)
- [Infectious Diseases](#)
- [Mental Illness](#)
- [Mental Stress](#)

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Education, Health

► Health Education

Education, Lack Of: As a Risk Factor

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Synonyms

Socioeconomic status (SES)

Definition

Lack of education as a risk factor of health conditions is part of the category of factors termed socioeconomic status (SES). Level of education can be measured in several manners including years of education (e.g., 5, 10, 18 years), stage of education (e.g., primary school, secondary school, professional vocation, academic degree, graduate studies), as well as types of education (e.g., vocational, humanities, engineering, biomedical, social sciences). Low education has been shown to be a risk factor of multiple disease outcomes and can be construed as a source of health inequalities. For example, (Clegg et al. 2009) found that level of education below high-school education was a risk factor of cancer in

men and women. In a Scottish study, lower education was associated with shorter height, high blood pressure, smoking, poorer lung functioning, and higher risk of death (Davey Smith et al., 1998). In the same study, occupational status however emerged as a more important risk factor than education. Nevertheless, these studies show that lack of education can be a risk factor of known disease risk factors (e.g., smoking, high blood pressure) and of actual illnesses (e.g., cancer).

Among the mechanisms suggested to link low education with poor health outcomes are poor health behaviors (e.g., smoking, poor diet), stress, and physiological factors (e.g., inflammation, cardiovascular reactivity, oxidative stress). For example, Finkelstein, Kubzansky, Capitman, and Goodman (2007) found an inverse correlation between levels of education (below 12 years, 12–15 years, college, professional) and stress levels. Janicki-Deverts, Cohen, Matthews, Gross, and Jacobs (2009) found that initially high education levels predicted lower levels of oxidative stress and higher levels of antioxidants. Oxidative stress is a major etiological factor of multiple chronic diseases including cancer, heart disease, and dementia. Taken together, low education level is a risk factor of poor health, possibly via various psychophysiological pathways, access to material and health resources, and inadequate health behaviors.

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Education, Patient

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Synonyms

[Health education](#)

Definition

Patient education is a basic step in medical care, reflecting empowering patients with knowledge on the risk of or nature of an illness, how to prevent it, how to perform self-care, and when to seek help. Patient education can be provided by physicians, nurses, physiotherapists, health psychologists, etc. and is a basic part of adequate clinician-patient communication. This can be seen as part of health education, where people learn to prevent, identify the signs, seek treatment for an illness, and perform self-care behaviors. This reflects the move in medicine from a hierarchical doctor-patient style toward a more self-managed and active patient role. Patient education can include, for example, information on the consequences of smoking and excessive alcohol consumption, use of condoms and the consequences of not using condoms, how to perform self-monitoring and management of insulin levels in diabetic patients, and adherence to medical treatment in cardiac patients after surgery. Lager, Pataky, & Golay (2010) reviewed 35 meta-analyses of 598 studies on therapeutic patient education in asthma, cancer, and diabetes,

among various chronic diseases. They found that in 64% of studies, improvements were found. However, unlike “therapeutic education,” patient education alone relies mainly on increasing knowledge, but rarely addresses patients’ psychological factors that impede healthy behaviors such as barriers and social pressures against adopting healthy behaviors. Studies have found multiple barriers in relation to healthy eating, physical activity, and in cardiac patients’ medical adherence (e.g., Zunft et al., 1999). Furthermore, in the context of condom use, for example, studies have shown that education led to little or no increases in condom use (Gallant & Maticka-Tyndale, 2004). In contrast, use of the “psychological inoculation” method, which precisely trains people to break their own barriers, may have better effects than health education alone (Duryea, Ransom, & English, 1990). Thus, while patient education is an essential element of prevention and treatment, its effectiveness can be increased when accompanied by cognitive-behavior skills for reducing patient barriers and increasing self-efficacy, or by including simple behavioral tips for moving patients along different stages of behavior change.

Cross-References

► [Self-care](#)

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EEG

► Brain Wave

Effect Modification

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Definition

Effect modification occurs when an effect modifier is associated with both an apparent case and an apparent effect and modifies the association of interest (Katz, 2001).

Consider the example of the association between vigorous exercise and risk for heart disease. This association is real, but its direction varies with level of fitness. An individual who is essentially fit will in all likelihood reduce his or her risk of heart disease by exercising vigorously. However, an individual who is unfit may acutely increase his or her risk by participating in such exercise, or by engaging in other vigorous physical activity. An unfortunately too frequent example of this occurs when unfit individuals attempt to shovel heavy snow, a very physically demanding task, and suffer a myocardial infarction. The association between vigorous exercise and heart disease, therefore, while real, is not unidirectional, but is modified by an individual's level of physical fitness.

Cross-References

► Cardiovascular Disease

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Effectiveness

► Efficacy

Efficacy

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Definition

The efficacy of a treatment is a measure of its influence on a clinical characteristic or outcome of interest when administered in tightly controlled, near-ideal circumstances. It is a measure of benefit.

The term “efficacy” can be meaningfully differentiated from the related term, “effectiveness.” Effectiveness, which is of greater clinical interest, is a measure of the treatment's influence under real-world conditions (Katz, 2001).

Efficacy is typically assessed wherever possible in a randomized controlled clinical trial, since this provides the best approximation to “near-ideal circumstances.” A paradox of such assessment, however, is that the deliberate (and, at this point in time, desirable) nature of the tightly controlled environment in which the treatment is assessed limits the generalizability of the therapeutic results obtained to interventional therapy administered outside that setting. There are many reasons for this, including the relatively homogenous nature of the subjects participating in the trial: Strict inclusion and exclusion criteria are typically employed. From a statistical perspective, this tightly controlled subject population is beneficial in that it reduces extraneous variation that may lead to a genuine treatment effect being difficult to detect. However, a clinically important effect seen in a well-controlled trial may not be reflected when the treatment is applied to a heterogeneous population in circumstances of real-world clinical practice.

This is why effectiveness assessments are so important. Various approaches can be employed. One is to conduct large-scale trials (sometimes called mega-trials or large simple trials) which employ much more simple measurement schedules that focus on the one aspect of interest and that are conducted in conditions much more akin to clinical practice.

Cross-References

- [Baseline](#)
- [Comparative Effectiveness Research](#)

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Efficacy Cognitions

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Definition

Efficacy cognitions: Efficacy cognitions are thoughts that develop from self-efficacy. Self-efficacy is the belief in personal ability to successfully perform challenging life tasks (Bandura, 1977a). Self-efficacy develops from mastery experiences, modeling, social persuasion, and physiology (Bandura, 1977b).

Description

Efficacy cognitions include thoughts about performance that are optimistic, pessimistic, productive, or self-debilitating. Efficacy cognitions are influenced by mastery experiences which promote cognitive expectations. Efficacy cognitions

can be modeled similar to self-efficacy. Social persuasion, in the form of encouragement from others to achieve, or stated positive expectations, promotes positive efficacy cognitions. Negative persuasion in the form of discouragement or deflating comments promotes negative efficacy cognitions. Negative interpretations of physiological responses such as strong emotions (e.g., anxiety) and the physiological accompaniments (fast heart rate) influence efficacy cognitions as negative, “I’ll never be able to do this, I’m terrified” or positive, “I’ve got this in the bag, I’ll just enjoy it!” Efficacy cognitions spring from interpretations and can contribute to habitual interpretations.

Efficacy cognitions are not perfectly aligned with reality – hence the concert pianist overcome with doubts about their potential to produce beautiful music and the exuberant child overestimating the pleasantness in tone of their singing voice. Efficacy cognitions contribute to motivation to perform an activity, personal well-being, positive health behavior, and future achievement. Negative efficacy cognitions result in avoidance of the activity, whereas confident efficacy cognitions promote engagement in the task. Emotions related to activity performance will ally with the tone of the efficacy cognitions – stress and anxiety for tasks about which efficacy cognitions are negative, joyful immersion for activities about which efficacy cognitions are positive.

Productive efficacy cognitions contribute to a view that difficult tasks are challenges to be mastered. Armed with such thoughts, people are more likely to approach the difficult task at hand with zestful effort. Self-debilitating efficacy cognitions are centered on tasks as insurmountable or fearsome result in activities that are dropped after minimal obstacles intervene. Optimistic efficacy cognitions promote task enjoyment whereas pessimistic thoughts promote task-associated distress and early failure. Efficacy cognitions influence action planning for future goals. Individuals planning to implement a health behavior change – such as smoking cessation, eating a healthier diet, exercising, or adhering to recommendations for managing a chronic illness – are more likely to be successful at

implementation when efficacy cognitions are positive. In the health behavior change model, individuals progress through stages of change that culminate in maintaining lasting change (Prochaska & Velicer, 1997). Early in the process, during the contemplation stage, efficacy cognitions are particularly important. Individuals who doubt they can make a successful health change during the contemplation may not reach the preparation stage – in which planning for change will occur – or the action stage when substantive changes are made.

The expectancies in efficacy cognitions may influence future performance more than objective measures such as past performance (Schunk & Pajares, 2005). Efficacy cognitions have wide-ranging implications as the perception that one can accomplish something can be as motivating as having accomplished the task in the past. Thus, positive efficacy cognitions can have a tremendous effect on personal motivation and willingness to experience activities. Conversely, negative efficacy cognitions – even in the face of contradictory objective evidence – can stymie efforts to engage in challenging tasks. Individuals expecting poor outcomes, “I’ll never be able to quit smoking, I’ve tried and failed a dozen times” may indeed be more likely to experience poorer outcomes. In contrast, individuals facing health behavior change with positive expectations may be able to incorporate adaptive strategies for success into their planning more effectively (Gollwitzer, 1999; Schwarzer, 1992).

Efficacy cognitions do not develop in complete independence from objective evidence of past performance and therefore often are realistically correlated with outcomes. Multiple factors influence the development of efficacy cognitions in addition to experiences – such as environmental factors or propensity for anxiety. Individuals who might be expected to feel competent based on other predictors may not if efficacy cognitions have developed in the face of physiological state challenges (anxiety, stress, fear), negative expectations from the social environment (such as stated gendered expectations for performance in athletics or mathematics), or faulty interpretations of past experience

(not recognizing a strong or poor performance) (Schunk & Pajares, 2005). Positive efficacy cognitions are strongly associated with performance because such cognitions promote action and use of skills. Negative efficacy cognitions hold individuals back from achieving all they might in their lives and for their health.

Cross-References

- Affect
- Cognitive Appraisal
- Cognitive Distortions
- Cognitive Restructuring
- Cognitive Strategies
- Efficacy
- Implementation Intentions
- Locus of Control
- Self-Efficacy

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Egg Donation

► [In Vitro Fertilization, Assisted Reproductive Technology](#)

Egg Donor

► [In Vitro Fertilization, Assisted Reproductive Technology](#)

Ego-Depletion

► [Self-Regulatory Fatigue](#)

eHealth and Behavioral Intervention Technologies

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Synonyms

[Behavioral intervention technologies](#); [Internet-based interventions](#)

Definition

eHealth is a broad term that refers to the use of information and communications media to facilitate access to health-related information and to support or deliver healthcare. eHealth can include health informatics, health knowledge management, and health data management. Telemedicine and telehealth are subsets of eHealth. Telemedicine refers to the provision of clinical services via telecommunications technologies

(e.g., phone, instant messaging), while telehealth is a more general term (Jordan-Marsh, 2011) that refers to the broader use of telecommunications in healthcare and health promotion (e.g., electronic access to personal health records, websites allowing patients to schedule appointments).

Although healthcare providers and administrators are also targets of eHealth, we will restrict this review to the use of communication technologies aimed at changing patients' behaviors, cognitions, and emotions in the service of better health outcomes. We refer to these interventions as Behavioral Intervention Technologies (BITs). BITs promote behavior change through electronic provision of didactic material, skill-building tasks, feedback, decision-making aids, risk self-assessments, or patient self-management tools.

Description

Remote Provision of Clinical Services. The use of videoconferencing, telephone, and instant messaging harnesses communications technologies to extend care geographically while preserving the traditional structure of behavioral treatments. Videoconferencing has been shown to be an effective treatment delivery medium for a variety of mental health problems, as well as teaching self-management strategies for chronic conditions and providing support to caregivers of older adults. Older studies used videoconferencing to extend care to remote clinics where there was an absence of specialized care, but newer studies are harnessing the capacity to videoconference directly into patients' homes.

Many trials have examined the telephone-based delivery of behavioral interventions to address a wide range of targets including preventive health behaviors such as weight loss and smoking cessation, self-management interventions for chronic illnesses, and mental health. Telephone treatments have generally been shown to be effective, and there is evidence that the use of the telephone may improve access and reduce attrition. A few studies have also indicated that the use of instant messaging to deliver

standard psychological interventions can be effective.

While extending care, each of these delivery modalities progressively decreases the “bandwidth” for social cues (e.g., nonverbal behavior; Mohr, Cuijpers, & Lehman, 2011), which has raised concerns that the reduction in cue bandwidth may reduce efficacy. There is no evidence to date that videoconferencing or telephone delivery reduces efficacy, although this has not been rigorously tested. The evidence for instant messaging is too preliminary to begin to speculate on its comparative efficacy.

Web-Based BITs. Web-based BITs have been evaluated for a growing number of health behavior and mental health problems, including weight loss, physical activity, insomnia, adjustment to illness, depression, and anxiety. While most, but not all, trials find evidence supporting the efficacy of web-based BITs, the effect sizes vary considerably and range from negligible to effects on par with traditional face-to-face care. This variability is likely due to a variety of factors, including website design, implementation, and support features.

The structure of web-based BITs can vary on a wide variety of dimensions, including the degree to which they present static information versus interactive features, the degree of personalization, the use of multimedia, the manner in which patients progress through the intervention (e.g., all material being completely available from the beginning, versus some or all material being presented according to criteria such as time or task completion), the expected length of engagement with the intervention, whether the website is freely available to the general public versus contingent on patient characteristics or healthcare system, and the degree of human support. Improvement in health behaviors is maximized by the incorporation of features such as automated text messages and email, personalized feedback, human support via email or telephone, use of multiple behavior change strategies, and a theoretically informed choice of participants and intervention content (Webb, Joseph, Yardley, & Michie, 2010).

Lower efficacy is often associated with poor patient adherence (e.g., few logins to the site) or

treatment dropout (ranging from extremely high, >95% for free-standing depression websites with no human support, to minimal). Website usage may be increased by ensuring that the site is easily usable and navigable, provides tools and information that help the user to achieve his/her goals, is attractive, and conveys credibility (Fogg, 2003). Periodic updates to the website content are likely to draw users back to the site (Brouwer et al., 2011). In addition to website design, a fairly consistent body of literature has shown that the adherence and efficacy of web-based BITs are enhanced when the website is supported by human interaction (Andersson & Cuijpers, 2009; Brouwer et al., 2011). One theoretical model to explain the benefits of human support, called supportive accountability, posits that adherence is enhanced by accountability to a supportive coach or provider. Mutually-agreed-upon process goals (e.g., logging into the website or using website tools) are monitored by a supportive coach, and the user is expected to account for use or nonuse at pre-specified times through personal contact via brief telephone calls, email, or messaging (Mohr et al., 2011).

Variability in adherence may also be associated with the selection of research participants. Trials that have extensive screening processes likely select for patients who are more motivated and more likely to adhere. When screening involves contact with an evaluator, adherence may be even higher. Websites that are accessible to the general population with little or no entry processes can produce high rates of initial access, with few participants returning to the website after one or two visits. It is not yet clear the degree to which these low return rates are due to large numbers of potential users, for whom the website is not appropriate, being able to easily find and investigate the site, versus design and implementation flaws, or users finding the information or help they desired more quickly than expected.

Internet Support Groups. Internet support groups have proliferated, often with the aim of fostering empowerment and sense of community, decreasing illness-related stigma, promoting the sharing of information, and increasing social

support. There is some evidence that therapist-moderated internet support groups can reduce distress. However, findings regarding the efficacy of un-moderated internet support groups are mixed. Some trials demonstrate modest improvement, but many trials find no significant effect or even increased distress for some users. This suggests that assumptions as to why and how these groups might be helpful may be erroneous. Thus, while the appeal of social media is considerable, little is currently known about how to effectively harness online social networks to improve health outcomes.

Emerging BITs. Web-deployed virtual worlds offer a diverse range of health intervention and educational experiences. For example, Second Life is being used to provide health-related information, meetings, support groups, simulations of medical procedures or symptoms, discussion groups, appointments with human healthcare providers, movies, and opportunities to practice new skills (e.g., role plays; Beard, Wilson, Morra, & Keelan, 2009). Serious gaming is a field in which the entertainment value of games is harnessed for a purpose, such as improving health (Zyda, 2005). Serious health-related games have been developed, in particular to increase physical activity and improve diet in children. Although outcomes have been promising, more research is needed to demonstrate clinical efficacy.

Mobile BITs. Mobile electronic devices (e.g., handheld computers, mobile phones) and wireless technology can be used to establish a continuous connection with patients as they conduct their daily lives. This subset of eHealth is often referred to as mHealth. Real-time delivery of intervention (e.g., encouragement, information, therapeutic tools) can be provided to the patient in their own environment. mHealth BITs can also collect information about the patient's current state and provide tailored intervention based on that state. Finally, as Smartphones can access the web, web-based and mobile components can be integrated into the same intervention.

A growing number of studies have examined mobile phone BITs that target preventive health behaviors (smoking cessation, weight loss, and physical activity), self-management of chronic

illnesses (e.g., diabetes, asthma), mood and anxiety disorders, schizophrenia, and medication adherence. Trials have found positive short-term benefits. However, literature on the effects of mHealth is still limited in many clinical areas, and not enough high-quality studies have been conducted to enable a reliable quantitative meta-analysis (Heron & Smyth, 2010).

Most mHealth BITs include SMS messages, which vary on a number of dimensions. Some studies send informational messages or reminders, while other interventions employ SMS dialogues which are commonly automated and lead to the provision of tailored information. SMS dialogues are often initiated by the intervention, but some focus on or allow patient-initiated SMS dialogues. For example, many of the disease self-management interventions require the patient to provide information (e.g., blood pressure for hypertension interventions), which then results in tailored SMS feedback. The frequency of the SMS messages can vary from 5+ per day to a little as once weekly, and is usually tied to the expected frequency of the targeted behavior. Degree of tailoring and personalization also varies, with some mHealth BITs providing highly tailored messages, while others provide more generic messages or tips. Finally, mHealth BITs vary to the degree to which they rely solely on the mobile intervention or are supplemented by other intervention strategies such as interactive websites or consultations with healthcare providers.

An emerging area in mHealth is the development of passive data collection methods that avoid problems related to patient's reluctance to log information. In this way, mHealth BITs can detect when intervention is needed, without requiring the patient to self-report their current state. Passive data collection uses sensors to automatically collect data that can help to infer patient states. Such sensors can be located within the mobile device itself (e.g., GPS, accelerometer), or through wirelessly connected external devices (e.g., heart rate or glucose monitors). There are two ways in which intervention delivery can be informed by sensor data. First, algorithms can be developed based on existing scientific knowledge (i.e., expert systems).

The algorithms are then applied to make inferences regarding the patient's state, and consequently their need for intervention, from the sensor data. As mobile devices can also allow patients to self-report their current states, the second approach is to use machine learning techniques (Witten & Eibe, 2005) to model the relationship between sensor data and patient states. These models are then used to predict patient's states solely from new sensor data, with the advantage being that the models were automatically generated and personalized. Use of machine learning in this way is a new and complex approach that has been applied to detect physical activities, mood, and social context with varying levels of accuracy (e.g., Burns et al., 2011).

Potential Benefits of BITs. The primary anticipated benefit of BITs is increased access to behavioral healthcare services. Telehealth can be used to assess and provide services to patients living in rural areas, those with medical conditions that affect mobility, or patients for whom travel to service providers is too time consuming given their employment, caregiving, or other responsibilities. Web-based and mHealth BITs are expected to deliver care at substantially reduced costs, and there are some preliminary studies suggesting that web-based BITs can be very cost effective. For example, BITs are usually designed to require less time burden on clinicians, and since BITs can be delivered remotely, they might also reduce the patient's transportation costs and lost work productivity due to time spent in transit. However, there is still a paucity of cost-effectiveness studies examining eHealth compared to usual care, and results may vary based on whether costs and benefits are calculated in terms of the individual patient, the healthcare system, or society as a whole.

Given the prevalence of obesity, smoking, chronic illness, and mental illness, there will never be enough behavioral health specialists to meet population needs for behavioral care. BITs offer the possibility of bridging the gap between behavioral health interventions, which have traditionally been delivered on an individual or small group basis, and population-level public health intervention. Access to the web is growing

rapidly. Mobile phones have reduced the Digital Divide between racial/ethnic minority and majority groups in the United States, with African American and English-speaking Hispanic adults using mobile devices to access the web at greater rates than White, non-Hispanic adults (Smith, 2011). Thus, mobile BITs might be used to more equitably distribute healthcare services. Should BITs fulfill expectations to increase access to care in underserved populations, this may also facilitate a transition away from acute, crisis-based care toward preventive care.

eHealth interventions, particularly those involving remote patient monitoring or real-time outreach, may increase detection of emergency situations. Often, web-based and mobile BITs also allow patients a 24-h capability to send messages to providers. This convenience may encourage patients to report their difficulties in real time rather than at their next scheduled appointment, by which time the problem may have worsened or the patient may have forgotten important information. Many studies have demonstrated safe implementation of BITs in specific clinical areas.

Potential Risks of BITs. The Digital Divide refers to continuing disparities in internet access and familiarity based on age, race/ethnicity, and socioeconomic status. These disparities may be reduced by sensitivity to differences in the way technology is used between different populations. For example, only 2% of mobile phone owners 65+ years of age access social networking sites using their mobile phone, while 24% use text messaging (Smith, 2011). Trends suggest that text messaging will be used by increasing numbers of the elderly; thus, if peer support is involved in a BIT for older adults, the forum for peer communication at this time should likely be text messaging rather than a website. Community-based participatory research and careful usability testing of BITs should also be conducted with underserved populations to address issues of access, level of familiarity with the technology, and concordance with the ways in which the population already uses and perceives the technology.

Privacy and security are hotly debated issues in BITs research. Privacy refers to the prevention of

improper disclosure of personal information, while security refers to the technical and procedural mechanisms used to protect privacy. Security protocols are a necessary part of any BIT, and they require ongoing consultations with an IT expert who will remain current on security vulnerabilities in supporting components (e.g., the operating system and servers; Bennett, Bennett, & Griffiths, 2010). Encrypted data transmission and restricted access to research data should be standard protocols. Increasingly, however, the efficiency of BITs is being maximized by conducting much of the computing on the user's device. This introduces privacy risks when the patient uses devices that are shared or monitored by others, such as public or work computers. Protocols for wiping data on these remote devices should thus be in place.

Assuming adequate technical security measures, privacy is more likely to be compromised by procedures associated with the interventions, and by the users themselves not taking advantage of security measures such as passcodes. Research staff require ongoing training to avoid procedural errors (Bennett et al., 2010) and effectively teach patients to do the same. Another challenge is conveying to patients how their health information will be handled in terms that are clearly understood. This is an ethical responsibility, and may also help to gain the trust of individuals whose privacy concerns or unanswered questions may prevent them from accessing or fully utilizing potentially beneficial BITs.

Future Directions. BITs research integrates and absorbs methodology from many disciplines, including behavioral science, medicine, computer science, engineering, human computer interaction, computer-mediated communication, visual design, education, and public health. There is a need for individual researchers with expertise across a number of these areas, as well as multidisciplinary team science. New, integrated theoretical frameworks are also needed to describe interactions between use of technology and behavioral change processes. For example, given the virtually ubiquitous presence of information and communication technologies and

their resulting ability to engage with individuals as they interact with multiple spheres of their daily lives (e.g., intrapersonal, interpersonal, institutional, the natural environment, and macro-social factors such as public policy and economic realities), an ecological intervention model has been created that would encompass expertise in each of these domains (Patrick, Intille, & Zabinski, 2005).

Due to the rapid development of new technological capabilities, new methods are evolving to evaluate the efficacy of BITs. The randomized controlled trials traditionally used to demonstrate efficacy are time intensive, and by the time such trials are concluded, the technology being evaluated is likely to be outdated. Disciplines outside of clinical science, in which the rapidity of technological advances has long been a common concern, may be well suited to help behavioral researchers address this challenge. Methodologies that borrow from engineering, such as Multiphase Optimization Strategies (Collins, Murphy, & Strecher, 2007), may be more appropriate in optimizing and evaluating new BITs.

Dissemination. Strategies to disseminate and integrate BITs into healthcare are largely unexplored. BITs can be deployed independent of healthcare delivery systems; this is evidenced by the growing number and use of websites aimed at supporting diet, weight loss, and health lifestyle, as well as the proliferation of mHealth Smartphone applications. There is little efficacy data for many of these BITs, or information on how their use impacts health, healthcare utilization, or healthcare cost. There is also considerable interest in integrating BITs into existing healthcare delivery systems. This integration will require research on at least four levels: (1) Research should determine how BITs will fit in with existing treatment options. For example, stepped care models may first provide the patient with a BIT, and reserve more clinician-intensive treatments for patients who fail to respond. (2) BITs can be integrated into electronic medical records and patient management systems to facilitate referrals, treatment monitoring, follow-up care, and integration of the

BIT into the patient's overall treatment plan. (3) Demonstrated cost-effectiveness of BITs relative to existing treatments will be required for adoption by healthcare systems. (4) Implementation research will be required to identify implementation barriers and opportunities, as well as develop implementation models that can optimize the uptake and use of efficacious BITs by both patients and healthcare providers.

Cross-References

- [Behavior Change](#)
- [Electronic Health Record](#)
- [Health Care Access](#)
- [Medication Event Monitoring Systems](#)
- [Patient Adherence](#)
- [Research to Practice Translation](#)
- [Translational Behavioral Medicine](#)

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Elderly

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Synonyms

[Aged](#); [Older adult](#); [Senior](#)

Definition

The term “elderly” is derived from the Middle English word *eald* (meaning old) and generally refers to an individual who is near or surpassing

the average life expectancy for his or her community, culture, and historical period. The term differs from clinical or medical language used to describe older adults (e.g., senescent or geriatric) in that it does not describe biological aspects of aging. Rather, “elderly” is used more broadly in the context of social gerontology, and carries the connotation of having achieved a certain degree of respect, status, expertise, or wisdom with advanced age (i.e., as an *elder*). For the purposes of research and policy efforts, the age cut off for “elderly” is often set in western countries at 65 or 70, based on the age at which individuals have historically been able to receive government retirement benefits. However, the term is descriptive rather than scientific, and does not typically denote a particular age band within older adulthood.

Cross-References

- [Aging](#)
- [Gerontology](#)

Electrocardiogram (EKG)

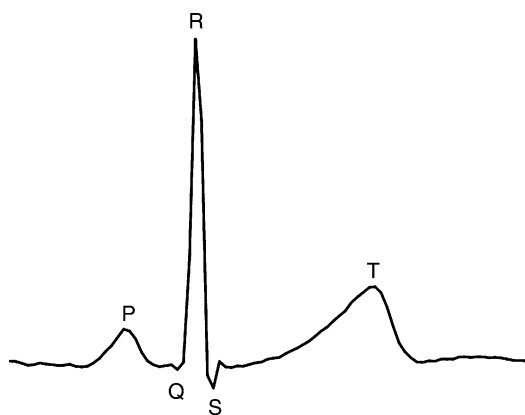
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Synonyms

[ECG](#)

Definition

The electrocardiogram (EKG) is the noninvasive record of the electrical activity of the heart muscle, as reflected in tiny electrical changes on the skin, during the heart’s active (systole) and passive (diastole) phases (Hampton, 2008). The EKG can be recorded easily from two electrodes



Electrocardiogram (EKG), Fig. 1 EKG waveform

placed on either side of the heart, for example, on the chest or on the left and right arms. For clinical and diagnostic purposes, however, it is usual to attach an array of 12 electrodes at various bodily sites so that the EKG can be recorded from different orientations. The characteristic wave form (see Fig. 1) that identifies the heart’s active phase, i.e., when it beats and pumps blood into the systemic circulation, was first described in 1903 by Willem Einthoven, in Leiden in the Netherlands, although electrical records of heart beats had been made as early as 1872. In 1924, Einthoven was awarded the Nobel Prize for Medicine for his research in EKG. The first wave in the three-wave systolic portion of the EKG record is the P-wave, and it represents the depolarization, i.e., the contraction, of the atrial chamber of the heart. Next, the R-wave, usually considered at the whole QRS complex, reflects the depolarization of the ventricles. Finally, the T-wave represents the repolarization, i.e., recovery, of the ventricles. In behavioral medicine, interest in the EKG is usually confined to the derivation of heart rate, the number of systoles in a given minute, or to its reciprocal, heart period, the time between successive R-waves. The former indicates the speed at which the heart is beating under specified circumstances, such as during relaxed rest or psychological stress exposure. Unfortunately, this tells us nothing about volume of blood being pumped by the heart into the circulation: for that, we need

other techniques, such as impedance cardiography and, more recently, Doppler echocardiography. The latter, heart period and its variability, can, particularly when subject to spectral analysis of frequency, tell us about the extent of activation of the heart by the main parasympathetic nerve, the vagus, and about the balance between parasympathetic and sympathetic neural activation of the heart. Finally, the precise configuration of the EKG can tell us other useful things, particularly in clinical settings. For example, a blunted or inverted T-wave is a reasonable indicator of cardiac ischemia, where the heart muscle is suffering from impaired blood flow and hence a restricted oxygen supply.

Cross-References

► [Heart Rate](#)

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Electrodermal Activity (EDA)

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Definition

Electrodermal activity (EDA) reflects the output of integrated attentional and affective and motivational processes within the central nervous system acting on the body. EDA is a valuable tool in behavioral medicine as a biomarker of individual (state and trait) characteristics of emotional responsiveness, as an index for direct examination of axis of stress-related effects on bodily function, and as a potential avenue of treatment of psychosomatic conditions through

biofeedback training. Below is an overview of EDA with examples of its application to behavioral medicine.

Description

What Is Electrodermal Activity?

Electrodermal activity (EDA) is a measure of neurally mediated effects on sweat gland permeability, observed as changes in the resistance of the skin to a small electrical current, or as differences in the electrical potential between different parts of the skin. The EDA signal reflects the action of sympathetic nerve traffic on eccrine sweat glands. There are two salient features of this sympathetic innervation that enhance the usefulness of EDA in psychophysiology and behavioral medicine. First, there is no antagonistic parasympathetic innervation of sweat glands (i.e., EDA reflects only sympathetic activity not sympathovagal balance), and second neurotransmission at the effector synapse is (almost completely in adults) cholinergic, i.e., mediated by acetylcholine release. This differs from the noradrenergic neurotransmission typical of other sympathetic effector synapses and further makes the EDA signal independent of circulating adrenaline and noradrenaline levels.

Sympathetic neural activity in skin is closely coupled to changes in mental state: In the laboratory setting, at rest and constant temperature, EDA indexes change in attention and cognitive and emotional states of arousal, expressed both as sustained shifts in tonic level (skin resistance level, SRL, or skin conductance level, SCL; see below) and transient responses evolving over the course of a few seconds (galvanic skin response, GSR, sympathetic skin response, SSR, skin resistance response, SRR, or skin conductance response, SCR) (Venables & Christie, 1973). Tonic and phasic aspects of EDA interrelate, yet are dissociable.

Within the brain, psychological influences on EDA are thought to emerge from activity within reticular formation centers within the brainstem and thalamus, in turn influenced by cortical mechanisms controlling orientation to salient

information (Luria & Homskaya, 1970). Frontal lobe regions strongly influence the orienting electrodermal reflex (Venables & Christie, 1973). Correspondingly, the magnitude of EDA responses in humans is reduced following discrete lesions to the prefrontal cortex and also related “attentional centers” within the anterior cingulate and right parietal lobe (Zahn, Grafman, & Tranel, 1999). Moreover, individual differences in the frequency of discrete EDA responses correlate with the size of prefrontal lobe regions (Raine, Lencz, Bihle, LaCasse, & Colletti, 2000). Functional imaging studies implicate ventromedial prefrontal cortex (Critchley, Elliot, Mathias, & Dolan, 2000) and anterior cingulate and amygdala (Williams et al., 2000) in phasic EDA responses to motivationally important stimuli. Nagai, Critchley, Featherstone, Trimble, and Dolan (2004a), using EDA biofeedback during functional neuroimaging, showed differential coupling of brain regions to phasic EDA responses (widespread enhancement within the anterior cingulate/dorsolateral prefrontal cortices and subcortical thalamic and brainstem centers) when compared to the tonic EDA level (which was inversely correlated with activity in ventromedial prefrontal cortex and subgenual cingulate). This latter observation links the EDA level to processes ascribed to the “default mode network” of brain function (Raichle et al., 2001).

Applications of Electrodermal Activity

Among the autonomic nervous system responses, EDA is a particularly useful parameter because EDA responses are easy to measure and to elicit reliably (much more difficult to suppress). However, EDA is sensitive to a wide variety of stimuli, hence careful interpretation is required. Changes in EDA also typically occur as part of a complex, patterned autonomic reaction wherein EDA may serve as a circumstantial marker of an accompanying physiological response. As noted, a number of functional variables can be derived from recorded EDA. The basal (tonic) level of electrodermal arousal reflected in SRL/SCL can be used to track individual differences in the general level of arousal and the integrity of diurnal rhythms: The skin resistance level rises

during sleep and drops sharply in the morning on awakening, returning to approximately the same level of presleep resistance by the evening. Phasic electrodermal responses such as SRR and SCR are easily elicited by emotional stimulation or a change in attention and interact with the tonic basal level of electrodermal arousal. Thus EDA in a combined form has been widely applied as an index of physiological and emotional arousal in studies of stress responsivity, including challenges with pain shock, emotional films, and mental and physical effort (e.g., Folkins, 1970).

Psychological and Psychosomatic Illness

This relevance of such studies to understanding the psychological and physical manifestations of chronic stress is based on the notion that individuals with increased physiological (EDA) reactivity to stressors are most at risk of long-term detrimental health consequences. In clinical populations, higher skin conductance level and increased phasic responsivity are reported in anxiety patients (Raskin, 1975). In this context, EDA may be a more specific biomarker; patients with panic disorder and agoraphobia showed delayed habituation and greater nonspecific phasic fluctuation compared with other anxiety patients (Birket-Smith, Hasle, & Jensen, 1993); patients with posttraumatic stress disorder (PTSD) also show slower habituation even in response to neutral stimulation (this has been suggested as a trait marker for PTSD susceptibility; Rothbaum et al., 2001).

In contrast, EDA hypo-responsivity and hyporeactivity are reported with patients with depression (Williams, Iacono, & Remick, 1985) and related to higher occurrence of suicidal attempts (Thorell, 1987). Faster EDA habituation is reported in patients with a history of suicidal attempt compared to those with non-suicidal attempts (Jandl, Steyer, & Kaschkaet, 2010). Hyporesponsivity and risk is also a feature of psychopathy (Hare, 1978). While in some countries EDA is incorporated in polygraphy used in criminal justice proceedings and forensic evaluations, it is worth noting that hyporesponsivity may be present across constitutional, or developmentally acquired, disorders of empathy.

Personality factors are commonly linked to differences in vulnerability to stress-related disease, the concept of Type A personality being particularly studied. Type A behavior is characterized by excessive competitiveness, aggressiveness, impatience, chronic haste, and striving for achievement. People with characteristics of Type A behavior are reportedly more prone to coronary heart disease (CHD) related to psychological (emotional) stress and its impact is mediated by brain-triggered autonomic nervous reactions as well as neuroendocrine responses. It is hypothesized that Type A individuals are physiologically hyperresponsive to stress stimuli, evoking greater sympathetic activity (accompanied by shifts in sympathovagal cardiac responses and enhancement within both adrenomedullary and hypothalamic-pituitary-adrenocortical systems). Type A behaviors such as impatience and hostility have been proposed to reflect underlying sympathetic reactivity. However, while EDA shows some promise as a functional biomarker for cardiac vulnerability and Type A personality, findings are inconclusive (Stephoe & Ross, 1981). Thus in psychosomatic medicine, EDA can be used to quantify individual differences in autonomic reactivity to salient challenges, where enhanced reactivity in one sympathetic axis (EDA) may signal risks (e.g., of hypertension or arrhythmia) mediated through related autonomic pathways.

Therapeutic Applications of Electrodermal Activity

EDA biofeedback has been studied as a treatment tool for anxiety states and stress-sensitive physical disorders. Biofeedback is a biobehavioral treatment approach where an individual/patient learns to gain volitional control over an involuntary bodily process, e.g., the “emotional arousal” associated with sympathetic innervation of the skin. In contrast to other biofeedback approaches including neurofeedback with electroencephalography, EDA biofeedback is easy to implement. Typically EDA biofeedback has been used to train people to reduce their sympathetic arousal with the aim to induce psychological as

well as physiological relaxation states that alleviate stress-related tension. One of the earliest applications was for the treatment of tension headaches, where a significant reduction in frequency and intensity of patients’ headaches was attained. EDA biofeedback relaxation therapy has been shown to be successful in treating the irritable bowel syndrome (IBS) (Leahy, Clayman, Mason, Lloyd, & Epstein, 1998), where 4 weeks of biofeedback relaxation training improved scores across a range of IBS symptoms (Leahy et al.). EDA biofeedback relaxation training has been tried for other specific psychological (anxiety disorders, hyperkinesia) and physical (hyperhidrosis, bruxism, weight control, migraine, tics, tremor) conditions. However, the research evidence base is limited and inferences regarding the effectiveness of these approaches are constrained by variation in treatment delivery. In recent years, it has become clear that EDA biofeedback arousal, i.e., training to increase sympathetic arousal in the skin, has therapeutic value. In neurological patients with drug-resistant epilepsy, electrodermal biofeedback was applied to reduce seizure frequency (Nagai, Goldstein, Fenwick, & Trimble, 2004b). Electrodermal biofeedback to increase the sympathetic arousal level was neuroscientifically motivated from the observation of an inverse relationship between the EDA level and the central cortical arousability quantified using electroencephalography. In a small randomized controlled trial, 1 month of electrodermal biofeedback training was associated with a significant decrease in seizure frequency, with 6 of 10 actively treated patients exhibiting more than a 50% seizure reduction at 3 months (and a subset reporting sustained effects at follow up over 3 years).

Conclusion

Electrodermal activity provides an accessible index of the brain’s neural influence on the bodily organs, and hence a measure of the emotional capacities and psychophysiological vulnerabilities of individuals. As a route for biobehavioral intervention EDA shows promise, with potential advantages of low cost and implementability.

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Electronic Health Record

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Synonyms

Computer-based patient record; Electronic medical record; Electronic patient record; Health information record; Personal health record

Definition

The electronic health record (EHR) is a computer-based record of patient health information. It is generated by one or more encounters in any healthcare delivery setting. The EHR includes information on patient demographics, progress notes, medications, vital signs, clinical history, immunizations, laboratory results, and reports of diagnostic procedures. The EHR documents evidenced-based decision-making, quality management, and patient outcomes.

Although the term EHR is used interchangeably with the electronic medical record (EMR), there are differences. The EMR most often refers to a single healthcare event whereas the EHR includes the entire patient record of healthcare encounters.

Description

Computer-based health records have been shown to be far superior to paper records not only because they decrease error due to handwriting and documentation issues, but also allow for the portability of and timely access to data. Other benefits include the aggregation and privatization of health data to facilitate research and promote the further education and knowledge base of clinicians.

In addition to safe, efficient, and high quality care, patients expect privacy, rights to access, and the opportunity to give consent for research uses of their health information. An EHR system must satisfy its users regarding privacy, confidentiality, and security. In the United States, the Health Insurance Portability and Accountability Act (HIPAA) ensures that these goals are met (<http://www.hhs.gov/ocr/hipaa/>).

There are other practical, economic, political, and professional concerns that arise regarding the implementation of computerized documentation. Individual physicians and practice groups have concerns related to cost, time to implementation, and learning curves associated with the EHR. There are also questions about whether to convert current records retrospectively or prospectively.

Research has shown that the healthcare industry will save approximately 80\$ billion dollars annually by adopting electronic documentation. National mandates dictate that by 2014 all health documentation be in a computerized form. The EHR has the potential to improve patient outcomes, improve coordinated care (optimally worldwide), automate adverse event and medical error disclosure, as well as to allow for more efficient diagnosis and treatment.

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Electronic Medical Record

- [Electronic Health Record](#)

Electronic Patient Record

- [Electronic Health Record](#)

Elevated Blood Pressure

- [Blood Pressure, Measurement of](#)

Embryo Donation

- [In Vitro Fertilization, Assisted Reproductive Technology](#)

Emotion

- [Affect](#)
- [Anger Management](#)

Emotion Modulation

- [Emotional Control](#)

Emotion Regulation

- [Anger Management](#)
 - [Emotional Control](#)
-

Emotional Control

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Synonyms

[Emotion modulation](#); [Emotion regulation](#)

Definition

Emotional control can be thought of as a facet of emotion regulation, but refers primarily to attempts by an individual to manage the generation, experience, or expression of emotion, and/or one's emotional responses (Gross, 1999). Emotional control, like emotional expression, is tied the broader context of emotion regulation. Emotional control can occur as part of antecedent-focused regulation prior to generation of emotion or through response-focused regulation after an emotion has been generated (Gross, 1998a). Emotional control can refer to the ability to exercise influence over emotion, and modulate emotion through the use of cognitive or behavioral strategies (Gross, 1998b; Lazarus & Folkman, 1984). The ways in which individuals are able to achieve emotional control have implications for health and well-being (Beck, 1995; Berg, Skinner, & Ko, 2009).

Description

Emotional control has varied definitions in literature on stress and coping and emotion regulation. Emotional control includes efforts by the individual to alter the generation of emotion,

emotional experience, and emotional expression. Strategies aimed at emotional control can impact health in both positive and negative ways and are contextually dependent on situation, individual differences in personality and social context, and well as demographic factors such as ethnicity, culture, gender, and age (Berg, Skinner, & Ko, 2009).

Emotional control is an important facet of emotion regulation and can be facilitated by types of emotion regulation. Antecedent-focused regulation can have an influence on emotional control (Gross, 1999). Antecedent-focused regulation refers to altering and regulating aspects of a situation and emotional experience prior to generation of emotion (Gross, 1998a). There are several ways that an individual may use antecedent-focused regulation for emotional control. Essential parts of antecedent-focused regulation are situation selection, selective attention, and cognitive appraisal. Situation selection is defined as deciding where to go, what to be exposed to, or who to be exposed to as a means of controlling emotion (Gross, 1998a). Selective attention is defined as choosing aspects of a situation to minimize emotional impact such as distraction or attending to less emotionally salient features of the situation (Gross, 1998a; Strecher & Rosenstock, 1997). Cognitive appraisal is defined as changing the meaning of situations so as to mitigate emotional impact such as looking at positive aspects or minimizing importance (Gross, 1999, 2007; Strecher & Rosenstock, 1997).

Use of antecedent-focused regulation strategies as a means of emotional control can lead to health outcomes, both positive and negative. For example, situation selection can reduce the likelihood that someone might encounter negative emotional experiences. However, selecting to avoid activities can potentially lead to decline in physical, emotional, and social functioning that may be associated with morbidity and mortality (Gross, 2007). Shifting attention, such as use of distraction, may be adaptive in the short-term (e.g., pain management) (Berg et al., 2009; Gross, 1998a). Prolonged use of distraction may not allow individuals to address aspects of problems that they can control or may prevent

accurate detection of symptoms (Gross, 1998a, 2007). Cognitive appraisal can prevent misinterpretations of situations known to impact emotional and physical health such as catastrophizing, emotional reasoning, or black and white thinking (Beck, 1995). However, if one appraises problems as nonthreatening then appraisals may not translate to appropriate emotional reaction or “over control” when it may be appropriate to react leading to worse outcomes (Lazarus & Folkman, 1984; Strecher & Rosenstock, 1997).

In contrast to antecedent-focused regulation, response-focused regulation occurs after emotion has been generated and includes direct attempts to alter experiential, physiological, and behavioral responses to the experience of emotion after the emotion has occurred (Gross, 1998a, 1999, 2002). Response-focused regulation is also a means of emotional control. Emotion can be controlled by situation modification. Situation modification is defined as changing aspects of a situation to reduce emotional impact. Situation modification relies on coping strategies such as generation of multiple solutions and problem solving (Gross, 1998a). Once an emotion has been generated, individuals may choose to actively solve the problem which can allow for emotional arousal to subside. Use of problem-solving skills may provide health benefit when problems are well-defined and controllable (Berg et al., 2009). However, when problems are ill-defined, ambiguous, and perceived as uncontrollable, use of problem solving may prolong stress, reactivity, and negative emotion. Thus, the way an individual chooses to control emotions can depend on the context of the problem.

Emotional control is an important facet of emotion regulation and can occur through efforts to minimize negative emotional experience prior to emotion generation (e.g., antecedent-focused regulation) or following an event through the use of coping strategies (e.g., response-focused regulation). Such skills are taught to individuals engaging in cognitive behavioral therapy for management of illness, psychopathology, and everyday problems (Beck, 1995). Cognitive and behavioral strategies can help individuals have greater control over emotional arousal that

produces ill health effects (Gross, 1999). Emotional control can be achieved through provision of skills related to problem solving (Gross, 1998a, 1999). These include behavioral skills to facilitate emotional control such as stress management skills (e.g., deep breathing, progressive muscle relaxation), exercise, and/or, engaging in regular healthy behaviors such as sleep hygiene and diet. Similarly, using cognitive appraisal skills to alter ongoing emotional experience may be helpful. Use of antecedent- and response-focused regulation for emotional control can help downregulate negative emotion and reduce physiological reactivity which may confer health benefits (Gross, 1999, 2002). Inability to effectively control emotion can have detrimental effects on health and well-being. Difficulty in controlling emotional reactions has been linked to psychopathology such as personality disorders, anxiety disorders, as well as risky behavior all of which have adverse association with health (e.g., poor social support, prolonged interpersonal stress, substance abuse, risk-taking behaviors) and may have a neural basis (Gross, 2007; Strecher & Rosenstock, 1997).

Cross-References

- ▶ [Cognitive Appraisal](#)
- ▶ [Cognitive Behavioral Therapy \(CBT\)](#)
- ▶ [Emotional Expression](#)
- ▶ [Physiological Reactivity](#)
- ▶ [Problem-Focused Coping](#)
- ▶ [Stress](#)
- ▶ [Stress Management](#)

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Emotional Disclosure

- [Disclosure](#)

Emotional Disorder

- [Psychological Disorder](#)

Emotional Distress

- [Negative Affect](#)
- [Stress, Emotional](#)

Emotional Expression

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Definition

Emotional expression refers to how one conveys emotional experience through both verbal

and nonverbal behavior (Gross, 1998b, 1999). Emotional expression should be distinguished from emotional experience in that it is possible to experience emotions without expressing them. Emotional expression is an important part of emotion regulation and can affect health outcomes. Emotional expression is embedded in the broader domain of emotion regulation, which is defined as how individuals, either consciously or unconsciously, influence, experience, and express emotions (Gross, 1999). Emotion regulation unfolds over time in a given situation either before emotional experience, during emotional experience, or in response to emotional experience (Gross, 1998a). Emotion regulation involves coordination of several systems including how one thinks about emotion, physiological reactivity elicited by emotion, and behavioral responses such as emotional expression and utilizing coping strategies that either promote health or contribute to poorer health. Emotional expression can be adaptive or maladaptive and may be dependent on context (Gross, 1998a, 2002).

Description

Emotional expression is part of the emotion regulation process and functions as a way to communicate internal states to others. Emotional expression can include behavioral, nonverbal, and/or verbal expressions (Gross, 1998a). Emotional expression can be beneficial when adaptive and fit to a given situation. For example, suppression of emotion may be inappropriate in some instances such as displays of anger or sadness while at work. However, prolonged suppression of emotion can result in poorer health. Links between maladaptive emotional expression and prolonged suppression have been made to cardiovascular disease. Similarly, “venting” negative emotion may perpetuate negative emotion via physiological and social responses to venting. Thus, the popular idea that “letting it out” may be beneficial for well-being or health may be inaccurate (Gottman, 2000; Gross, 2002; Hatfield, Cacioppo, & Rapson, 1994). Expression of positive emotions may also help to in buffering

negative emotional experience and has been shown to impact the affiliative quality of marital relationships (Gottman, 2000). It is important to acknowledge that emotional expression involves many components of the emotion regulation process and that health effects can be dependent on contextual factors of the situation and individual difference characteristics such as age, ethnicity, and gender (Gross, 1999).

Emotional expression as a means of emotion regulation has its roots in the stress and coping paradigm originally put forth by Lazarus and Folkman (Gross, 1999; Lazarus, 1991). The stress and coping paradigm asserts that emotional expression can act as a coping strategy and thus may impact health and well-being. Lazarus and Folkman made a distinction between emotion-focused coping, defined as changing the internal state to meet the demands of the stressor (e.g., altering emotions associated with stressor, reappraisals of stressor) and problem-focused coping, defined as changing the environment to meet the demands of the stressor such as finding a problem solution (Lazarus). Emotion-focused strategies (e.g., controlling emotional expression, changing the way one thinks about a stressor, acceptance) were thought to be associated with poorer health outcomes (Lazarus). However, recent models of emotion regulation have recognized nuances of regulatory process as emotion regulation unfolds at points over time in a given situation.

Points of regulation specifically linked to emotional expression are defined as antecedent-focused regulation or as response-focused regulation (Gross, 1998a). Antecedent-focused regulation refers to altering and regulating aspects of a situation and emotional experience prior to generation of emotion (Gross, 1998a). In contrast, response-focused regulation occurs after emotion has been generated and includes direct attempts to alter experiential, physiological, and behavioral responses to the experience of emotion after the emotion has occurred (Gross, 1998a, 1999, 2002). Emotional expression can be altered through both antecedent-focused coping and response-focused coping.

The clearest link between emotional expression and health outcomes occur as a function of response-focused coping and how one chooses to express emotion after an emotion has been generated. Individuals may choose to express emotions in a productive way (conveying how they feel or felt through communication with others, journaling), in an aggressive manner (punching, kicking, self-mutilation), or suppress emotions all together (Gross, 2002; Kennedy-Moore & Watson, 1999). Emotional expression can include behavioral expressions of emotion such as engaging in risky health behaviors (e.g., substance use, overeating). Risky health behaviors may be useful for altering emotion and physiological reactivity in the short term but can damage health over time. The ability to use adaptive coping strategies can attenuate physiological reactivity (Gross, 1998b, 1999, 2007) and can confer health benefits. For example, adaptive coping mechanisms might reduce cardiovascular risk, promote feelings of control, and self-efficacy which are important in choosing positive health behaviors. Adaptive coping responses can protect against prolonged negative mood states associated with metabolic dysregulation, poor immune response, inflammatory processes, and insomnia (Gross, 2007). Conversely, maladaptive coping strategies such as substance abuse and risky behaviors can be associated with physical injury, poorer health status, morbidity, and mortality (Gross, 2007; Kennedy-Moore & Watson, 1999).

The effect of emotional expression on health may be contextually bound. Emotional suppression can decrease emotionally expressive behavior but simultaneously may not impact physiological responding. In certain instances, suppression of emotion may be effective as a coping mechanism but long-term suppression can negatively impact life satisfaction and depression. Emotional suppression can dampen emotional expression in the context of social interactions resulting in less positive social support which may lead to poorer health. Expression of emotion may also convey health benefits. For example, expression of emotion through writing

has been associated with better adjustment in cancer patients, especially in patients that may prefer to avoid or deny managing cancer-related problems. Emotional expression in the context of support groups for health problems may help patients to tolerate and find benefit through others' emotional expression as they react to an illness (Kennedy-Moore & Watson, 1999). In close relationships, being able to express emotions in a less negative way may reduce the negative emotional arousal that can affect members of a couple (Gottman, 2000; Hatfield, Cacioppo, & Rapson, 1994). It should also be noted that the expression of positive emotion can also contribute greater satisfaction in relationships and can be associated with more affiliation and less hostility as couples interact (Gottman, 2000).

Cross-References

- [Comorbidity](#)
- [Coping](#)
- [Emotional Responses](#)
- [Emotions: Positive and Negative](#)
- [Expressive Writing and Health](#)
- [Mortality](#)
- [Physiological Reactivity](#)
- [Problem-Focused Coping](#)
- [Stress](#)

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Emotional Reactions

- [Emotional Responses](#)

Emotional Responses

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Synonyms

[Affective responses](#); [Emotional reactions](#)

Definition

Emotions are defined as multicomponent response tendencies that unfold over a relatively short span of time. Emotions occur in response to a stimulus or event. The emotional response consists of an appraisal process, during which individuals determine the personal significance of the stimulus or event (e.g., is it harmful or beneficial, does it affect personal goals). The emotional response also includes the subjective experience of emotion, cognitive processing, and physiological changes (e.g., activation of the amygdala and hypothalamus, and subsequent release of

epinephrine, norepinephrine, dopamine, and cortisol). Emotions are believed to have evolved to promote behaviors necessary to survive and thrive. Researchers often conceptualize emotions as varying along two dimensions: (1) valence (i.e., negative to positive); and (2) activation (aroused to unaroused). Discrete emotion theorists, in contrast, consider each emotion as a distinct entity. Researchers who examine emotional responses to a stimulus or event (e.g., emotional responses to stress) commonly measure multiple aspects of the multicomponent response. For example, when examining emotional responses to a laboratory stressor, researchers may measure cognitive appraisal components (appraisals of threat or harm), affective components (e.g., reports of anxiety and fear), and physiological components (e.g., rising cortisol levels).

Sometimes, the terms emotion, affect, and mood are used interchangeably. Many researchers, however, make distinctions among these terms. Whereas emotions are short-lived responses to stimuli, moods are relatively long-lasting emotional states, and are not always linked to a stimulus or event. Affect is a term used to describe the conscious, subjective aspect of an emotion, separable from any physiological response.

Cross-References

- ▶ [Affect](#)
- ▶ [Affect Arousal](#)
- ▶ [Anger](#)
- ▶ [Anger Expression](#)
- ▶ [Emotional Expression](#)
- ▶ [Emotions: Positive and Negative](#)
- ▶ [Mood](#)
- ▶ [Negative Affect](#)

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Emotions: Positive and Negative

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Synonyms

[Affect](#); [Mood](#); [Positive and negative affect](#)

Definition

Emotions are defined as multicomponent response tendencies that unfold over a short span of time, and include cognitive processing, physiological responses, and the subjective experience of emotion (i.e., affect). Emotions are often conceptualized as varying in valence, from positive (e.g., happiness, excitement, contentment, curiosity) to negative (e.g., sadness, anger, anxiety, disgust). Subjectively, people experience positive emotions as feelings that reflect a level of pleasurable engagement with the environment. Negative emotions, in contrast, reflect a general feeling of distress. Emotions are thought to have evolved to promote the behaviors necessary to survive and thrive. Positive emotions facilitate approach behavior or continued action; experiences of positive affect prompt people to engage with their environments and partake in activities which are adaptive. Negative emotions, on the other hand, prompt withdrawal behavior and signal when a particular behavior or course of action may not be adaptive.

Description

There is some debate in the emotion literature about whether positive emotions and negative emotions are bipolar extremes of the same factor, or whether they are orthogonal or independent factors. Evidence suggests that positive and negative emotions may be managed by different structures in the nervous system (i.e., positive emotion activation in left frontal cortex; negative emotion activation in right frontal cortex), and that neurotransmitters may respond differently to negative versus positive emotions, which supports the notion that negative and positive emotions are orthogonal factors. In addition, in many studies, researchers have noted the unique contribution of negative and positive emotions (i.e., each contributed to outcomes after controlling for the other), and the low correlation between negative and positive emotion. Some studies, however, have observed moderate to strong (negative) correlations between positive and negative emotion (particularly when “state” vs. “trait” emotions are measured), and many studies do not find unique effects of negative and positive emotion. Research on the distinction between negative and positive emotions is ongoing; thus, while most consider positive and negative emotions to be orthogonal factors, some researchers consider positive and negative emotions to be opposite ends of the same scale.

There are several measures currently used to assess positive and negative emotions. Among them are two commonly used self-report measures that ask people to rate their experience of positive and negative emotions. Because these measures are assessing the subjective experience of emotion, they are more appropriately labeled measures of affect. The PANAS (Positive and Negative Affect Schedule) includes a 10-item Positive Affect (PA) scale and a 10-item Negative Affect (NA) scale. High scores on the PA scale reflect high energy and concentration (e.g., attentive, interested, alert), whereas high NA reflects a state of general distress (e.g., guilty, hostile, irritable). The POMS (Profile of Mood States) is another measure commonly used to

assess positive and negative affect. The POMS has one PA scale reflecting “vigor” (e.g., alert, energetic, cheerful, active, lively), and four NA subscales measuring depression, anger, fatigue, and tension-confusion. For both the PANAS and the POMS, instructions can be modified to ask for current state (which is most likely to reflect “emotion”), as well as mood in the last day, general mood, or mood over the last few weeks or longer (note that mood is longer lasting compared to emotions, which are short-lived). Researchers often distinguish “state” PA and NA (current emotion, or mood in the last day) from “trait” PA (general mood or mood over the last few weeks or months). In addition to measuring the subjective experience of emotion, researchers have also used mood induction procedures to generate positive and negative emotions in the laboratory and observe their effects on outcomes. In general, research (largely correlational) suggests that positive emotions are beneficial for health, and that negative emotions are detrimental for health. Researchers urge caution in interpreting these findings, however, as most studies linking negative emotion and health do not control for the effect of positive emotions, and most studies linking positive emotion and health do not control for the effect of negative emotion.

There is some debate in the literature about the value of distinguishing individual positive and negative emotions (e.g., happiness, excitement, sadness, anger) versus aggregating positive emotions and aggregating negative emotions. Some research suggests that people are not sensitive to individual emotions and experience similar responses across emotions within a valence (i.e., positive or negative). However, there is also research to suggest that different emotions within a valence have different associations with outcomes (e.g., distinct positive and negative emotions are associated with distinct immune responses). Most researchers currently examine aggregated emotions, distinguishing only positive from negative, but increasingly research suggests that there may be value in distinguishing among emotions within a valence.

Cross-References

- [Affect](#)
- [Anger](#)
- [Emotional Expression](#)
- [Happiness and Health](#)
- [Mood](#)
- [Negative Affect](#)
- [Negative Affectivity](#)
- [Positive Affect Negative Affect Scale \(PANAS\)](#)
- [Positive Affectivity](#)

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Empathy

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Definition

Empathy is the ability of a person to perceive, understand, and accept the experiences of

another. It is having the capacity to identify with another's feelings without actually experiencing the situation. In a healthcare setting it is often therapeutic for clients going through difficult situations to have healthcare professionals that can be empathetic to their situations.

Empathy is different than sympathy, which is concern or pity for another person generated by a subjective perspective. Oftentimes this subjective perspective is a barrier to problem solving. The most therapeutic approach to clinical situations is often an objective empathetic approach.

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Emphysema

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Synonyms

[Chronic bronchitis](#); [Chronic obstructive pulmonary disease](#)

Definition

Emphysema is defined as the pathological enlargement and destruction of lung alveoli. Along with chronic bronchitis, which describes the clinical manifestation of chronic cough with

sputum production, these two terms have traditionally been used to refer to the two phenotypes of chronic obstructive pulmonary disease (COPD). Recently, however, the Global Initiative for Chronic Obstructive Lung Disease (GOLD) has advocated defining COPD based on airflow limitation that is not fully reversible, is progressive, and is associated with an abnormal inflammatory response of the lung to noxious particles or gases. As patients with COPD usually have overlapping features of both emphysema and chronic bronchitis, the distinction is rarely of clinical significance.

Description

COPD remains one of the most common causes of morbidity and mortality globally. In the United States in 2000, it accounted for eight million outpatient visits, 1.5 million emergency room visit, and 673,000 hospitalizations. COPD is currently the fourth leading cause of death in the USA and is projected to become the third most common cause of death worldwide in 2020 (Global Initiative for Chronic Obstructive Lung Disease, 2008). One reason for this rise is the strong, dose-dependent relationship between cigarette smoking/exposure and the prevalence of COPD, although other genetic and environmental factors also play important roles, since many smokers never develop clinically significant disease. It has been known, for instance, that genetic defects causing severe deficiency of the protease inhibitor α_1 -antitrypsin lead to a form of early-onset COPD, especially in those who are also smokers. Other known risk factors include exposure to occupational dust and chemicals, indoor and outdoor air particle pollutants, as well as low birth weight. On a cellular level, it has been demonstrated that inhaled cigarette smoke and other noxious particles promote inflammation through the recruitment of neutrophils, macrophages, lymphocytes, and eosinophils. This in turn activates proteinases that degrade lung parenchyma and cause mucus hypersecretion, leading to impaired gas exchange, fibrosis of small airways, expiratory flow obstruction, and

hyperinflation (Barnes, Shapiro, & Pauwels, 2003; Eisner et al., 2010).

Patients with COPD typically present with cough, sputum production, and exertional dyspnea. The hallmark of the disease, expiratory airflow obstruction, may be present for years before medical attention is sought (Hogg, 2004). While early on the physical examination may be normal, most patients will demonstrate diminished air movement with a prolonged expiratory phase and wheeze on exam. Pulmonary function testing with spirometry is used to characterize the degree of airflow obstruction and provide prognostic information. When airflow obstruction becomes severe, cyanosis may develop as a manifestation of hypoxemia, and the patient may adopt pursed-lip breathing and the classic “tripod” position to recruit accessory muscles and improve expiratory flow. Another marker of poor prognosis is the development of pulmonary hypertension from chronic hypoxemia, which can result in right heart failure or cor pulmonale. Death from respiratory failure is unfortunately a common outcome for patients with end-stage COPD (Reilly, Silverman, & Shapiro, 2006).

Many patients with COPD will also experience episodic exacerbations, characterized by increased shortness of breath and changes in pattern and quantity of sputum. These are often triggered by viral or bacterial infections and, depending on severity, may require hospitalization for treatment. For exacerbations, inhaled β -agonists and anticholinergic agents, antibiotics, glucocorticoids, and supplement oxygen for hypoxemia are the mainstay of pharmacological therapy. Noninvasive positive pressure ventilation and conventional mechanical ventilation can be used to stabilize patients in severe respiratory distress. For treatment of stable COPD, only smoking cessation and oxygen therapy in those with chronic hypoxemia have been shown to improve survival. Inhaled β -agonists and anticholinergic agents can provide symptomatic benefit, while inhaled glucocorticoids can be used to reduce exacerbations. Pulmonary rehabilitation has also been shown to improve quality of life and exercise capacity as well as reduce

hospitalizations. Finally, in select patients with severe COPD but limited comorbidities, lung transplantation can be pursued and provides significant symptomatic and survival benefit (American Thoracic Society, 2004).

Cross-References

► [Chronic Obstructive Pulmonary Disease](#)

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Employee Appraisal

► [Job Performance](#)

Employee Assistance Programs (EAP)

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Synonyms

[Employer-sponsored assistance programs](#)

Definition

Employee Assistance Programs (EAPs) are programs offered to employees; they include policies and procedures for identifying or responding to employee difficulties that may or may not interfere with job performance (Walsh, 1982). These programs often provide counseling or treatment to those who require these services, and can also be provided to the employee's family members. EAPs are aimed to be preventative services, and these services can address psychological issues, alcohol, and drug abuse (Muto, Fujimori, & Suzuki, 2004). Other areas include, but are not limited to, health, marital, family, financial, legal, or stress issues that may influence job performance (EAPA, 2010). EAPs are beneficial in helping employees balance demands while meeting employer's goals of workplace productivity (Jacobson, 2010).

Description

Employee benefit assistance programs typically include programs that address a variety of personal and workplace issues that impact job performance such as stress management, weight reduction, workplace violence, and financial management.

EAPs were modeled after Alcoholics Anonymous (AA) programs, and both AA and EAPs understand the importance of acknowledging the problem as the initial step of treatment (Walsh, 1982). Since alcoholism has negative impacts on job performance, alcoholism was the first problem addressed by EAPs, followed by substance abuse. It was later recognized that many substance abuse problems have roots in psychosocial problems, which further expanded the outreach of EAPs. EAPs use the importance of retaining the job as a motivating factor to have employees seek help. That is, the services can help fix a problem or difficulty that could threaten employment.

The services offered by EAPs have many positive impacts on the employees receiving them, as well as the organization providing them. Reported benefits include a reduction in expenses associated with medical claims, accident benefits, mental health care costs, absenteeism, lost wages, medical costs, and employee turnover (Hargrave, Hiatt, Alexander, & Shaffer, 2008).

EAPs have a variety of components, including written policies and procedures, labor and management cooperation in program development, referral systems, program information conveyed to the work force, health insurance covering the treatment, and total confidentiality (Walsh, 1982). These factors are integral in the success of the EAP (Richard, Emener, & Hutchison, 2009). The policy statement, a statement in which the institution states what the philosophy and the intent of the program is, keeps the EAP on target of the goals. This statement should make it clear that human problems can interfere with work performance, but are inevitable; assistance is available to aid these problems, and the employee will not be terminated on the basis of that problem. The services should be administered through the EAP confidentially and professionally, which helps the employees feel secure in their recovery. The EAPs should be accessible, and employees should be able to receive the services in a timely and efficient manner (Richard et al., 2009).

There are various methods of delivery of services depending on the corporation and EAP model. In “internal” EAPs, the professionals

delivering the services are employed with the company offering the EAP, whereas “external” EAPs hire service professionals who are outside contractors from the company. “External” methods are most commonly found. However, a third method, “combination” or “hybrid” EAP, is a delivery system in which the professionals began as internal employees, and then expand services to other workplaces. The “hybrid” EAP is a way in which smaller companies can share the cost of an EAP. Additionally, services can be accessed in a variety of ways, including in-person, via phone, or via the Internet (Jacobson, 2010).

EAPs have become popular within businesses. Within USA state and local government in 2008, more than 75% of employees have access to EAPs. About 39% of employees working within the public sector, part-time, had access to EAPs, and 54% of full-time workers in the public sector had access. Of those working in the private sector, 15% of part-time workers and 28% of full-time workers had access to EAPs (U.S. Department of Labor, Bureau of Labor Statistics, 2008).

Cross-References

- Diabetes Education
- Education, Patient
- Exercise-General Category
- Exercise Testing
- Exercise, Benefits of
- Health Promotion and Disease Prevention
- Lifestyle, Healthy
- Lifestyle, Modification
- Smoking Cessation
- Substance Abuse: Treatment

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Employer-Sponsored Assistance Programs

- [Employee Assistance Programs \(EAP\)](#)

Employment

- [Job Classification](#)

Employment Status

- [Occupational Status](#)

Empowerment

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Definition

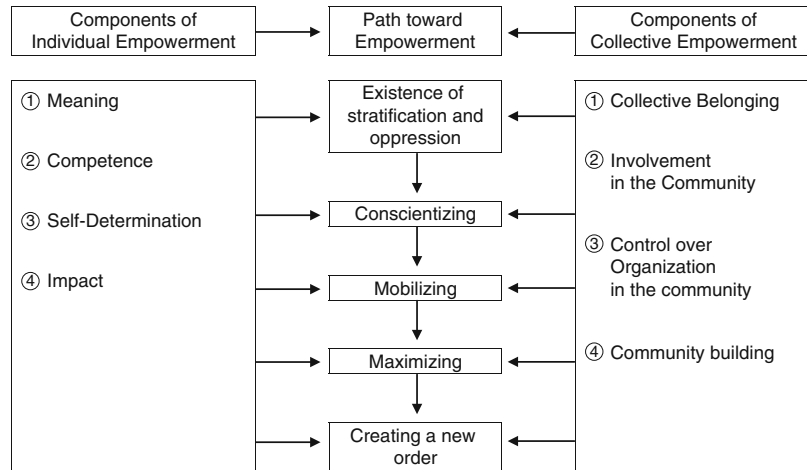
The origin of empowerment as a form of theory is traced back to the Brazilian educator Freire

(1971), when he suggested a plan for liberating the oppressed people through education. Empowerment is a form of power that helps people gain control over their own lives. It is described as a social process that fosters power in people, their communities, and in their society (Page & Czuba, 1999).

The process of empowerment can be synthesized into five progressive stages: an existing social disturbance, conscientizing, mobilizing, maximizing, and creating a new order, as seen in Fig. 1. Empowerment has two interrelated forms such as individual empowerment and collective empowerment. Each form has its own components. A set of four components, including meaning, competence, self-determination, and impact, are found in individual empowerment. A set of four components, including collective belonging, involvement in the community, control over organization in the community, and community building, are explored in collective empowerment. The goal of individual empowerment is to achieve a state of liberation strong enough to impact one's power in life, community, and society. The goal of collective empowerment is to establish community building so that members of a given community can feel a sense of freedom, belonging, and power that can lead to constructive social change (Hur, 2006).

The term, empowerment, has become a widely used word in the social sciences in the last decade across a broad variety of disciplines, such as community psychology, political theory, social work, education, women studies, and sociology. Community psychology is one of the disciplines in which the word *empowerment* is most frequently used. The typological approach to the study of empowerment is useful for field workers, social workers, community psychologists, and educators who help the disadvantaged (Hur, 2006). These people, including the disadvantaged, the aged, and the young, can actualize the latent powers that an individual or group possesses, or enable them and use their capacities and power more effectively (Weil & Kruzich, 1990). The process and components can be guidelines for practitioners who hope to develop the latent power of the “have-nots,” actualize

Empowerment,
Fig. 1 Paths toward and
components of
empowerment



their upward mobility, and finally establish a value of justice in a given society.

Cross-References

- [Behavior Change](#)
- [Behavioral Intervention](#)
- [Health Behavior Change](#)
- [Health Education](#)
- [Health Promotion and Disease Prevention](#)
- [Intervention Theories](#)
- [Lifestyle Changes](#)
- [Protective Factors](#)
- [Social Capital and Health](#)

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Endocrinologist

- [Diabetologist \(Diabetes Specialist\)](#)

Endocrinology

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Synonyms

[Hormone system](#)

Definition

Endocrinology is the study of the endocrine system and its diseases. The endocrine system includes hormones (chemical mediators) and the organs/cells which secrete them. Endocrinology includes the study of the biosynthesis, storage, chemistry, and physiological function of hormones and the tissues that secrete them. The endocrine system consists of different parts of the body that secrete hormones directly into the blood rather than into a duct system. Hormones have many different functions and modes of action. They may act locally or away from their site of origin. They often interact with other biological systems.

Cross-References

- [Diabetes](#)

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End-of-Life Care

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Synonyms

[End-of-life issues](#); [Terminal care](#)

Definition

End-of-life care is a general term used to describe all aspects of care received by patients with a terminal illness or terminal condition that has become advanced, progressive, and/or incurable. End-of-life care has become increasingly important in the past century as life expectancies have increased and causes of death have predominantly moved from acute illnesses (e.g., infections) to chronic and terminal illnesses (e.g., cancer and heart disease). The general goal of end-of-life care is to help patients achieve a “good death” as they define it. End-of-life care is provided through palliative care and hospice services and frequently incorporates complementary and alternative medicines (e.g., massage therapy, pet therapy, music therapy, aromatherapy, acupuncture, etc.). These services aim to improve patient *quality of life* through reducing pain and managing symptoms, addressing spiritual and emotional needs, and providing family/caregiver support.

Description

Issues for Patients (Advance Care Planning)

End-of-life care emphasizes the importance of patient autonomy through advance care planning,

which is the process of patients, healthcare professionals, and caregivers discussing and formally documenting the patients’ preferences for healthcare treatment as death approaches. The Patient Self Determination Act (PSDA) passed by the United States Congress in 1990 requires healthcare facilities that receive federal funding to educate patients and the community about advance directives. Advance directives are oral and written instructions about the patients’ goals and wishes concerning future medical care that becomes effective only when a person cannot speak for him or herself. Decisions are commonly made about desires for mechanical ventilation (e.g., respirator), nutrition, and hydration (e.g., feeding tubes), kidney dialysis, and antibiotic treatments. Advance care planning also involves making decisions about receiving cardiopulmonary resuscitation (CPR) when vital functions cease. Patients who do not wish to receive CPR can complete a Do Not Resuscitate (DNR) order, which is kept as part of their medical file. Finally, patients are able to appoint a durable medical power of attorney (sometimes referred to as a healthcare proxy). This is the person who will be responsible for making decisions for the patient about healthcare treatment after the patient lacks the capacity to do so for him or herself. Advance care planning should be formally documented as well as verbally communicated between patients, caregivers, and healthcare professionals to ensure that the patients’ wishes are known and understood. All states legally recognize some form of advance directives.

Issues for Healthcare Professionals

Healthcare professionals are responsible for many important aspects of end-of-life care. Healthcare professionals must formulate and communicate information to patients about their prognosis (i.e., how long the patient is expected to live). Developing an accurate prognosis is difficult to do considering the unpredictability of disease, the large number of life-extending technologies available, and the great number of unknown and unmeasurable variables that influence how and when a person will die. Communicating this information to

patients is equally difficult due to concerns about over- or under-estimating life expectancy, instilling or destroying hope, and cultural differences about discussing death. Healthcare professionals are also responsible for helping patients to engage in advance care planning and determining when specific treatments are not likely to benefit the patient (i.e., medically futile treatments). Healthcare professionals' major responsibility is to identify and manage symptoms, which typically become more severe as the illness or condition progresses. These symptoms commonly include: (1) pain, (2) increased sleep, drowsiness, or unresponsiveness, (3) decreased needs for food and fluids, loss of appetite, nausea or vomiting, (4) decreased socialization and increased withdrawal, (5) depression, (6) confusion about time, place, or identity (i.e., delirium), (7) changes in bladder or bowel control, (8) changes in temperature regulation (e.g., skin feels cool), and (9) respiratory changes (e.g., irregular and shallow breaths). Finally, healthcare professionals aid in assessing the patients' capacity to make healthcare decisions (i.e., capacity assessment).

Issues for Caregivers

Caregivers play an important role in end-of-life care as family members and friends are often responsible for most of the day-to-day care of patients during the end of life. The risk for caregiver stress is high as caregivers have to balance their normal daily activities, additional care giving responsibilities, efforts to help the patient adjust to the illness, and their personal emotional reactions to and fears about the illness. Even though family members report high levels of satisfaction with the care-giving experience, they also report more depressive symptoms and psychosocial stress than the general public. As the illness progresses, there are additional caregiving needs and the psychosocial distress of caregivers becomes more prevalent. Untreated psychosocial distress in caregivers is associated with poorer patient care, increased health problems for caregivers, and more severe grief reactions after patient death. Caregivers must learn how to care for the patient while continuing to

practice good self-care. Caregivers also have the additional stress of surrogate decision making when the patient lacks the capacity to make their own healthcare decisions.

Ethical Issues

End-of-life care is an area of medicine that frequently involves ethical dilemmas. The majority of laws related to end-of-life care are governed by individual states and there is wide variation in how the states approach these issues.

Early debates focused on determining when a patient is legally dead. Death was traditionally considered the point at which a patient's vital physical functions cease; however, advances in life support technology have made it more difficult to determine when someone's body is no longer functioning. The Uniform Determination of Death Act (UDDA), written by the President's Commission on Bioethics in 1981, confronts the complexities concerning the declaration of death. The UDDA states that a person can be declared dead when *either* the heart and lungs *or* the brain and brain stem stop functioning permanently, but specific guidelines are determined by individual states. Declaring the point at which a patient has died can be an important issue in organ donation.

One of the most prominent debates related to end-of-life care has been the issue of euthanasia (also referred to as "hastened death"). Euthanasia is an act where a third party, usually implied to be a physician, terminates the life of a person either passively or actively. Physician-assisted suicide is a specific form of euthanasia where a doctor provides a patient with a prescription for drugs that the patient can choose to voluntarily use to end his or her life. The main distinction between physician-assisted suicide and active euthanasia is that the physician is not the person physically administering the drugs. The Oregon Death with Dignity Act (1997) and the Washington Death with Dignity Act (2008) made it legal in these two states for patients to hasten their own death with a prescribed lethal dose of medication from a physician.

There are several unique patient populations which carry their own ethical concerns. First, until recently children with terminal conditions have been granted limited autonomy in making decisions about their end-of-life care. As recently as the 1960s, the consensus was that children should not be informed of a terminal diagnosis because they would not be able to understand and would find the news too upsetting. Parents have legal rights to make decisions for their children, but many healthcare professionals now feel that it is beneficial for children to be included in healthcare discussions and to be permitted to make their wishes known. Ethical dilemmas arise when parents and children disagree about healthcare decisions, when two parents with equal custodial rights disagree about healthcare decisions, or when parents refuse physician treatment or do not appear to be acting in the “best interest” of their child. Second, culturally diverse populations have been found to favor different treatment preferences (e.g., African Americans and Hispanics are more likely than European Americans to express a preference for life-sustaining treatment), to engage less frequently in advance care planning, to use services such as hospice less frequently, and to report higher levels of insufficient pain management. Many cultures do not prioritize patient autonomy and prefer to pass decision-making responsibilities to others in the family. Healthcare professionals must balance respecting cultural differences while still sufficiently providing end-of-life care and informing patients of their options.

Cross-References

- Capacity Assessment
- Complementary and Alternative Medicine
- Euthanasia
- Hospice
- Palliative Care
- Physician-Assisted Suicide
- Self-Care
- Surrogate Decision Making
- Symptoms

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End-of-Life Care Preferences

- DNR Order

End-of-Life Issues

- End-of-Life Care

Endogenous Morphine

- Endogenous Opioids/Endorphins/Enkephalin

Endogenous Opioids/Endorphins/Enkephalin

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Synonyms

Dynorphins; Endogenous morphine;
Endomorphins; Opiate neuropeptides; Opiate
peptides; Opiate receptors

Definition

Endogenous opioids are neuropeptides with morphine-like activity that are naturally synthesized within the body. These neuropeptides have widespread distribution throughout the central and peripheral nervous systems, and various endocrine and other tissues. Opioids function as neurotransmitters and hormones, with a wide variety of biobehavioral effects in health and disease. Their effects on physiological and psychological responses to intense aversive and appetitive stimuli suggest potentially important roles in the etiology and treatment of self-regulatory disorders of appetite, affect, and adaptation to stress.

Description

Classification of Opioid Peptides and Receptors

Endogenous opioids systems include several different neuroactive peptides that are linked, in turn, to a matrix of distinctive receptor systems. The opioid peptides are divided into basic subgroups, e.g., endorphins, enkephalins, and dynorphins, based on their biosynthetic parent molecules. A separate group of endomorphins has been identified, but these peptides are not yet well characterized. Opioid receptors are part of the family of G-protein-coupled receptors and

are classified into multiple receptor types and subtypes based on relative affinity for selective agonists and antagonists. For example, μ (mu) receptors demonstrate high affinity for morphine and endomorphins, while δ (delta) receptors are highly selective for enkephalins, and κ (kappa) receptors show high affinity and activity for dynorphins. Another putative receptor type, the ϵ (epsilon) receptor, has been postulated to explain beta-endorphin activity not mediated via the other receptor types.

Distribution of Opioid Peptides and Receptors

Endogenous opioids and receptors are localized in the central and peripheral nervous systems, including neuroendocrine stress pathways, and in brain areas mediating reward and reinforcement. For example, opioid peptides and/or receptors are found in afferent and integrative pain nuclei, as well as in the two major stress effector pathways, the hypothalamic-pituitary-adrenocortical (HPA) axis and the hypothalamic-sympatho-adrenomedullary (SAM) axis. Enkephalins have an abundant distribution throughout the limbic and sympathetic systems, while endorphin-containing cells are prominent in the hypothalamus and in the anterior pituitary. Dynorphins are widely distributed throughout both central and peripheral nervous systems. Opioid systems are intimately incorporated into peripheral organs including the heart and the gastrointestinal system. The diversity of opioidergic molecular representation yields, in turn, a diversity of functions, with important behavioral and physiological effects.

Role of Opioids in Stress, Neuroendocrine Reactivity, and Homeostasis

Endogenous opioids are important regulators of both the anterior and the posterior pituitary. Endogenous opioid mechanisms inhibit both the SAM and the HPA axes, suggesting opioidergic input to corticotropin-releasing factor neurons in the paraventricular hypothalamus. Opioids influence stress-induced pituitary release of adrenocorticotrophic hormone (ACTH) and prolactin, as well as release of growth hormone and luteinizing

hormone. In the posterior pituitary, endogenous opioids inhibit release of both vasopressin and oxytocin. Therefore, regulation of the HPA axis and other important neuroendocrine pathways is mediated, in part, via endogenous opioids.

Peripheral opioid peptides and receptors are especially prominent in pituitary systems intimately involved in maintenance of homeostasis during stress. For example, beta-endorphin is localized in anterior and intermediate pituitary and is co-stored and co-released with ACTH. Therefore, activation of the HPA cascade is associated with pituitary release of beta-endorphin into the systemic circulation, where it has critical roles in the integrated response to psychological stressors.

The SAM axis, including the peripheral sympathetic nervous system and the adrenal medullae, is subject to central opioidergic control in the hypothalamus and elsewhere (McCubbin, 1993). CNS opioids are capable of both excitatory and inhibitory functions, and these effects are especially pertinent to biobehavioral function and dysfunction. Opioids have been shown to inhibit sympathetic and adrenomedullary responses at multiple levels of the SAM axis. For example, peripheral enkephalins are found in autonomic ganglia and in the spinal sympathetic cell columns. Enkephalins have been shown to inhibit release of catecholamines from peripheral sympathetic nerve endings as well as from the adrenal medullae.

Opioids in Health and Disease

Endogenous opioids play important roles in motivational integration of appetitive and aversive behavior and are critical in the maintenance of visceral homeostasis. The importance of these basic mechanisms of adaptation suggests that opioid dysfunction could underlie a variety of disorders involving dysregulation of appetite, affect, and neuroendocrine reactivity.

Appetitive Mechanisms Maintaining Chemical and Behavioral Dependencies

Opioid input to mesolimbic dopaminergic and other CNS systems suggests a potentially

important role in appetitive reward and reinforcement mechanisms that maintain behavioral and chemical dependencies (Koob & Le Moal, 1997). Moreover, the important role of endogenous opioids in mediation of CNS reward systems may point to better treatment strategies in substance abuse and other disorders of appetite regulation (Reece, 2011). One overarching theory is that if opioids mediate the CNS reward mechanisms in dependency, then pharmacological opioid blockade may disengage brain mechanisms that reinforce and maintain a variety of different chemical and behavioral dependencies. For example, clinical trials are currently underway to examine the potential therapeutic effects of opioid antagonists, either alone or in combination with other drugs, in several appetitive disorders, including nicotine and alcohol dependence, and obesity. (Note: The efficacy of opioid antagonists in treatment of heroin/morphine dependencies operates via multiple complex mechanisms.) Therefore, opioid brain mechanisms may point to novel strategies for development of new behavioral and pharmacological treatments for dependencies and other diseases of appetite regulation.

Acute and Chronic Pain

Opioid systems contribute to important endogenous analgesic mechanisms, such as stress-induced analgesia and the hypoalgesia accompanying elevated blood pressure. These effects on pain sensitivity may be intimately associated with higher CNS integration of pain perception. For example, endogenous opioids do much more than simply inhibit pain perception; they may also have significant effects on regulation of affective responses to both painful and nonpainful aversive stressors. This observation reinforces the notion that endogenous opioid systems play an important role in the higher-level integration of affect in the appraisal of emotionally meaningful stimuli.

Endogenous opioidergic analgesia appears to be important for coping with both acute and chronic pain. Evidence suggests that chronic pain patients have reduced opioid levels in

plasma and cerebrospinal fluid. This is consistent with the opioid depletion hypothesis, which proposes that chronic pain is associated with progressive depletion of endogenous opioid analgesic neurochemicals and/or downregulation of opioid receptors (Bruehl, McCubbin, & Harden, 1999). This depletion of analgesic opioids results in dysfunction of an important endogenous mechanism for coping with chronic pain. Opioids may also have a role in the expression or maintenance of self-injurious behavior.

Depression and Posttraumatic Stress Disorder (PTSD)

Endogenous opioids play an important role as physiological mechanisms for coping with psychological stress, and these systems have been implicated in stress-related disorders, including depression and PTSD (Merenlender-Wagner, Dikshtein, & Yadid, 2009). Opioid blockers can reverse stress analgesia and performance deficits in learned helplessness, and can worsen symptoms of PTSD. Persons exposed to traumatic stress may utilize their endogenous opioid analgesic and/or affect regulatory mechanisms to cope. Thus, the role of opioids in HPA axis regulation, endogenous analgesia, and multiple CNS pathways provide a neurobiological rationale for role of opioids in regulation of affect and coping with traumatic stress.

Cardiovascular Disease

A biobehavioral link between opioids and risk for cardiovascular disease is found in work with the opioid antagonists, naloxone and naltrexone. These studies suggest that opioids can inhibit sympatho-adrenomedullary and blood pressure responses to psychological stress in young persons with normal circulatory risk profiles. However, young persons at increased risk for hypertension show reduced opioid inhibition of sympathetic, HPA, and circulatory responses to stress (McCubbin, 1993). This apparent dysfunction of inhibitory opioids may underlie exaggerated blood pressure reactivity to stress and its attendant cardiovascular health consequences. Moreover, there is some evidence to suggest

that opioid hypoalgesia is associated, at least in part, with blood pressure elevations and increased risk for hypertension development. Recent evidence points to gender differences in opioid effects on blood pressure control that are dependent, in part, on estrogen. The relationship between reduced opioid inhibition of the HPA and SAM axes, blood pressure dysregulation, and hypoalgesia requires additional work to better characterize these complex interactions.

Opioids and Behavioral Therapies

Behavioral control of endogenous opioid tone may become an important strategy in prevention and treatment of self-regulatory disorders of appetite and adaptation to stress. Interestingly, studies of aerobic fitness, relaxation, and systematic desensitization suggest that these forms of stress management operate, at least in part, via activation of endogenous opioid mechanisms (McCubbin et al., 1996). For example, opioid blockade with naltrexone can reverse the reductions in cardiovascular stress reactivity associated with aerobic fitness and progressive relaxation training. Thus, in persons at risk for hypertension who lack robust opioidergic inhibition of the SAM axis, some behavioral stress-management interventions can restore normal opioid inhibitory function. Behavioral prevention and treatment strategies that target normalization of endogenous opioid tone may become more common as sophistication of these peptide systems grows.

Summary

The endogenous opioid neuropeptides and receptors form a diverse set of basic neuroendocrine systems that modulate behavioral and physiological reactions to aversive and appetitive stimuli. These systems have become critical for understanding integrated responses to psychological stress in health and disease. Better understanding of these neuropeptide systems will provide insight into the developmental etiology and new

treatment strategies for self-regulatory disorders of appetite, affect, and adaptation to stress.

Cross-References

- [Addiction](#)
- [Affect](#)
- [Analgesia](#)
- [Appetite](#)
- [Autonomic Nervous System \(ANS\)](#)
- [Behavioral Therapy](#)
- [Blood Pressure](#)
- [Depression](#)
- [Exercise](#)
- [Homeostasis](#)
- [Hypertension](#)
- [Hypothalamus](#)
- [Obesity](#)
- [Pain](#)
- [Posttraumatic Stress Disorder](#)
- [Relaxation](#)
- [Smoking](#)
- [Stress](#)
- [Substance Abuse](#)
- [Sympathetic Nervous System \(SNS\)](#)
- [Systematic Desensitization](#)

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Endometriosis

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Definition

Endometriosis (EM) is a common, benign disorder defined by the presence of endometrial tissue outside of the uterus (Giudice, 2010). EM can be asymptomatic, but it may be associated with severe dysmenorrhea (painful menstruation or “cramps”), pelvic pain (intermittent non-menstrual or continuous pain in the pelvic area), dyspareunia (pain during sexual intercourse), and infertility in affected women. The prevalence of pelvic EM is 6–10% in the general population whereas it approaches 35–50% in women with pain, infertility, or both (Houston, 1984; Sensky & Liu, 1980). The etiology of the disease appears to involve a complex interplay of multiple genetic, environmental, immunologic, and potential psychological factors (Guo, 2009); however, the ultimate pathogenesis of EM is unknown to date. Surgical assessment, by laparoscopy or laparotomy, remains the diagnostic gold standard in order to diagnose EM. The extent of the disease is classified by the American Society for Reproductive Medicine (ASRM) revised classification system for EM (rAFS score, American Society for Reproductive Medicine [ASRM], 1997). The rAFS scoring system categorizes EM into four stages (I through IV), with the higher stages representing more extensive disease. While rAFS staging tends to correlate with infertility, the severity of EM does not show consistent

associations with pain ratings, suggesting that further mechanisms mediate pain perception in women with EM (Asante & Taylor, 2011).

The successful treatment of EM-associated symptoms typically requires medical as well surgical interventions: Medical therapies include agents that suppress ovarian function and limit the growth of endometriosis, such as androgens, progestagens, GnRH agonists, and contraceptive steroids. The treatment of EM-associated pain has been well studied and most major medical therapies appear to be superior to placebo. EM-associated infertility, however, does not respond to medical therapies alone. Surgical treatment (via laparotomy or laparoscopy) as well as assisted reproduction techniques were found to be beneficial in restoring fertility in EM (Giudice & Kao, 2004; Practice Committee of the American Society for Reproductive Medicine, 2004). Surgery commonly provides temporary pain relief, but symptoms recur in 50% of the women within 2 years. Because of the associated pain and due to the fact that so far there is no cure for EM, affected women often report higher levels of distress than healthy controls (cf., Kaatz, Solari-Twadell, Cameron, & Schultz, 2010). In line with this, increased rates of anxiety and depressive symptoms as well as impaired overall quality of life were found in EM. Also, women suffering from EM have an increased risk of several medical conditions, including hypothyroidism, fibromyalgia and chronic fatigue syndrome, autoimmune inflammatory diseases, allergies, and asthma (Sinaii, Cleary, Ballweg, Nieman, & Stratton, 2002). These data suggest a common immunological and endocrinological aspect to EM and these conditions, which in turn might further increase disease burden. As a consequence, a multilevel approach to EM should include an evaluation of psychological distress, and in some women psychological interventions can be helpful in order to reduce impairment.

Cross-References

- [Chronic Pain, Types of \(Cancer, Musculoskeletal, Pelvic\), Management of](#)

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Endomorphins

- [Endogenous Opioids/Endorphins/Enkephalin](#)

Endothelial Function

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Synonyms

[Blood vessel wall](#)

Definition

Blood vessels consist of three layers. The inner layer is the intima, which is made up from endothelial cells. The middle layer, the tunica media, consists of mainly smooth muscle cells, which are important for the maintenance of the vessel diameter. Finally, the outer layer, the tunica externa, consists of connective tissue. The endothelium is a dynamic organ with several functions, such as regulation of the vascular tone, platelet aggregation, thrombosis, and adhesion of leucocytes, which are vasoprotective.

Description

The peripheral vascular system consists of arteries, capillaries, and the veins. The arteries supply the organs with blood, the capillaries allow for the exchange of metabolites between the blood and the organs, and the veins facilitate the return of the blood to the heart. Blood vessels consist of three layers. The inner layer is the intima, which is made up from endothelial cells. The middle layer, the tunica media, consists of mainly smooth muscle cells, which are important for the maintenance of the vessel diameter. Finally, the outer layer, the tunica externa, consists of connective tissue. The relative thickness of these individual layers is dependent on the position of the vascular tree of the vessel wall. For example, in capillaries, the vessel wall mainly consists of endothelial cells to optimize metabolite exchange (Vander, Sherman, & Luciano, 2006).

The endothelium is a dynamic organ with several functions, such as regulation of the vascular tone, platelet aggregation, thrombosis, and adhesion of leucocytes, which are vasoprotective. However, when damage to the endothelial cells occurs, this can result in endothelial dysfunction, which is a precursor of atherosclerosis (Lerman & Zeiher, 2005). The activity of the endothelial cells can be influenced by sympathetic nerve activity, hormones, and inflammatory molecules among other factors (Levick, 2003). From a behavioral medicine perspective, endothelial function has been associated with health

behaviors such as physical activity (Green et al., 2003) and smoking (Toda & Toda, 2010). In addition, sympathetic activation through acute exercise or mental stress can influence vascular function (Joyner & Halliwill, 2000).

Assessing Endothelial Function

An important function of endothelial cells is the maintenance of vascular tone, which is emphasized by the release of several vasoactive substances by the endothelial cells. Therefore, it is not surprising that most in vivo endothelial function assessments are concerned with the capacity of the endothelium to vasodilate. A principal vasodilator released by the endothelial cells is nitric oxide (NO). Following the conversion from L-arginine under the influence of nitric oxide synthase, NO starts a cascade of conversions which leads to smooth muscle cell relaxation, i.e., vasodilation (Sandoo, Veldhuijzen van Zanten, Metsios, Carroll, & Kitas, 2010). It is outside the scope of this section to describe the mechanisms of NO and other vasoactive substances in detail.

Various methods are available for the assessment of endothelial function in the peripheral circulation. Most functional assessments examine vasodilation in response to a standardized stimulus, with an attenuated vasodilatory response indicative of endothelial dysfunction. As described above, a major contributor to vasodilation bioavailability of NO starts a cascade of events, which results in the relaxation of the vascular smooth muscle cells. Therefore, impaired vasodilation can be due to both reduced NO bioavailability in the endothelium or impaired capacity of the vascular smooth muscle to dilate. Consequently, most endothelial function assessments involve both measures of endothelial-dependent vasodilation (related to NO bioavailability) and endothelial-independent vasodilation (related to vascular smooth muscle function) (Sandoo et al., 2010). Given the difference in anatomy and function of arteries, the functional assessments vary depending on their position in the arterial tree. The microvasculature involves conduit arteries, such as the brachial and femoral artery, whereas microvasculature entails arterioles or resistance vessels. In addition to the functional assessment described below, the structure of the

vessel walls can be examined with intima medial thickness (for conducting artery, such as carotid) and nailfold capillaroscopy (for capillaries) (Sandoo et al., 2010).

Microvascular function can be assessed using iontophoresis or forearm blood flow. Iontophoresis assessment involves the administration of vasoactive substances through the skin by applying a small electrical current. The most commonly used substances are acetylcholine (ACh) for the assessment of endothelium-dependent vasodilation and sodium nitroprusside (SNP) for endothelium-independent vasodilation. Perfusion of the vessels in the skin is assessed using either laser Doppler flowmetry, when examining a single point, or laser Doppler imaging, when the area of interest is a larger area of skin (Turner, Belch, & Khan, 2008).

Forearm blood flow is most commonly used together with venous occlusion strain gauge plethysmography. For this assessment, venous outflow of the vessels is occluded, while allowing arterial inflow (Joyner, Dietz, & Shepherd, 2001). Changes in arm circumference are assessed using strain gauge plethysmography, with the slope of the increase in arm circumference reflecting of blood flow. The advantage of this assessment is that it can be carried out at several time points throughout a testing session, so immediate changes of blood flow in response to mental stress or exercise can be investigated using this method. Strain gauge forearm blood flow assessments are also carried out in response to intravenous infusion of vasoactive substances, such as ACh and bradykinin.

Macrovascular function can be assessed using flow-mediated dilation. Blood flow to the arm will be occluded for a period of 5 min by inflating a brachial cuff placed around the arm to at least 50 mmHg above systolic blood pressure. Release of the cuff will result in a sudden inflow of blood into the arm. The increase in shear stress as a result of the surge of blood (reactive hyperemia) will induce vasodilation in healthy arteries, which is dependent on NO production of the endothelium. Endothelial-independent vasodilation is assessed by investigating the vasodilation in response to the administration of glyceryl

trinitrate (GTN). Macrovascular dilation is most commonly quantified by recording the vessel diameter using high-resolution ultrasound (Corretti et al., 2002).

Finally, arterial stiffness is related to the compliance of the vessel wall and can be classified as both a structural as well as a functional measure of endothelial function. This assessment explores the capacity of the vasculature to accommodate pressure pulsations. Reduced elasticity will increase the afterload on the heart, which means that the strain on the heart is increased. Applanation tonometry is used to record the arterial pressure waveforms. For pulse-wave analyses, the waveforms of one artery are explored and this results into the calculation of the augmentation index, which is derived from the first and second systolic peak in pressure. For pulse-wave velocity, waveforms are recorded on two sites on the arterial tree and the combination of the transit time between the waveforms and the distance between assessment points will be used to calculate pulse-wave velocity. An increase in augmentation index and an increase in pulse-wave velocity are indicative of arterial stiffness (Sandoo et al., 2010).

It is worth noting that substantial training is necessary in order to carry out these vascular assessments to a sufficient standard. In addition, all these assessments are influenced by several factors such as timing of assessment, fasting, caffeine consumption, and smoking. Therefore, it is important that all assessments are carried out following published guidelines (Corretti et al., 2002; Turner et al., 2008).

Cross-References

- [Arteries](#)
- [Atherosclerosis](#)
- [Intima-Media Thickness \(IMT\)](#)
- [Nitric Oxide Synthase \(NOS\)](#)
- [Vasoconstriction](#)
- [Vasodilation, Vasodilatory Functions](#)

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Endothelial Nitric Oxide Synthase (eNOS)

► Nitric Oxide Synthase (NOS)

End-Stage Renal Disease

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Synonyms

Chronic kidney disease (CKD)

Definition

The kidneys serve four primary functions: (1) to clean the blood of toxins, (2) to remove excess fluid and waste, (3) to balance chemicals (i.e., sodium, potassium, phosphorus), (4) and to release hormones that control blood pressure, the production of red blood cells, and contribute to bone strength. End-stage renal disease (ESRD) is reached when the capacity of the kidneys declines such that they are no longer able to adequately perform these functions, ultimately requiring the affected individual to initiate treatment in the form of renal replacement therapy to sustain life.

Description

Cause, Symptoms, and Diagnosis of ESRD

ESRD most commonly manifests as a secondary condition resulting from poorly managed diabetes or hypertension. Chronic elevations in blood glucose and blood pressure cause damage to the small blood vessels in the kidneys, which over time can progress to ESRD. Other causes of ESRD include autoimmune diseases such as lupus, complications of infection such as glomerulonephritis, and genetic abnormalities such as polycystic kidney disease.

Many symptoms are associated with the progression of kidney disease to ESRD, including weakness, fatigue, lack of energy, appetite and weight loss, nausea and vomiting, metallic taste in the mouth, breath smelling like ammonia, changes in skin color, rash or itching, cognitive impairment, changes in urination, swelling, shortness of breath, feeling cold, and leg or flank pain.

According to the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI), chronic kidney disease (CKD) can

Note: Some of the data reported here have been supplied by the United States Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the author(s) and in no way should be seen as an official policy or interpretation of the U.S. government.

progress through stages of severity, with stage 5 typically denoting a diagnosis of ESRD and a need for treatment initiation. The stages of disease are determined by the level of kidney damage (i.e., pathologic abnormalities) and/or the degree of deficiency in the individual's estimated glomerular filtration rate (eGFR), a commonly used biomarker to diagnose ESRD. The eGFR is calculated based on serum creatinine, age, race, and gender; values less than 15 mL/min/1.73 m² are suggestive of stage 5 kidney disease, or ESRD. These values indicate that the kidneys are performing at less than 15% of normal functioning. In addition, increases in blood urea nitrogen (BUN) and protein in the urine (proteinuria) are markers of ESRD.

Prevalence of ESRD in the US Population

The Annual Data Report from the United States Renal Data System suggests that the number of individuals affected by ESRD increases annually, with a record high of 571,414 patients receiving treatment in 2009. There exist significant racial and ethnic disparities in ESRD, with African Americans nearly four times more likely to develop ESRD than Whites. Native Americans and Asians are at least twice as likely to be diagnosed with ESRD compared to Whites, and the rate of ESRD in the Hispanic population is 1.5 greater than that of non-Hispanics. With regard to age and gender, the ESRD rates are higher among older adults and males. Recent reports suggest that the growing number of new ESRD patients has been driven by a linear increase in diagnoses among individuals aged 45–64; in contrast, there has been minimal change in the incidence rates of patients age 65 and older over the last several years.

Treatments for ESRD

Hemodialysis is the most common type of treatment for ESRD, with 65% of the affected population (approximately 372,000 patients) utilizing this treatment modality. Individuals who participate in hemodialysis typically come to a hospital or clinic 3 days per week for 3–5 h treatments. During this time, they are connected to a machine via an insertion site such as

arteriovenous fistula or graft surgically configured in the forearm or a port catheter in the chest. The hemodialysis machine removes blood from the body, filtering accumulated toxins and removing excess fluids, and then returns the cleaned blood. This process is primarily directed by a nurse or dialysis technician, leaving the patient a relatively passive recipient of treatment. Hemodialysis can also be conducted in the home environment, though this is less commonly implemented due to expense and caregiver burden.

Peritoneal dialysis is an intervention for ESRD that requires the patient to be a more active participant in the treatment process. There are two forms of this treatment: continuous ambulatory peritoneal dialysis (CAPD) and continuous cycler-assisted peritoneal dialysis (CCPD). In CAPD, a permanent catheter is inserted into the patient's abdomen, which allows for a bag of sterile dialysis solution called dialysate to be connected to the body. The patient is responsible for performing "exchanges" which involve draining the dialysate into the peritoneal cavity via a sterile tube, allowing for the blood to filter through the peritoneal membrane leaving the excess fluid and toxins behind in the dialysate, and then discarding the used solution before reinitiating the procedure. Patients usually perform 3–4 exchanges throughout the course of the day while ambulatory and one longer overnight exchange while they are sleeping. In contrast, CCPD utilizes an automated cycler to perform the exchanges, with 3–5 cycles overnight while the patient sleeps and one long exchange during the day being the typical prescription. Recent reports indicate that approximately 6–7% of the ESRD population utilizes peritoneal dialysis as their treatment, which is a notable decrease from the 12–18% prevalence in the 1980s and 1990s. However, there is some evidence to suggest that the number of peritoneal dialysis users will increase in upcoming years.

Transplantation is often considered the preferred option for treatment of ESRD as it offers advantages including increased survival time and improvements in quality of life. Due to the continued shortage of donor organs,

contraindications to surgery in some patients, and concerns about rejection, however, this treatment is less commonly prescribed for ESRD compared to dialysis. Approximately 30% of the ESRD population undergoes renal transplantation with organs from either a deceased or living donor. According to the Organ Procurement and Transplantation Network (OPTN), an average of 17,000 renal transplants have been performed annually over the last 5 years, with approximately 65% from deceased donors and 35% from living donors. Survival of the renal graft across donor type is relatively high for renal transplant recipients (i.e., 1-year = 92%, 3-year = 82%, and 5-year = 71%), and living donor grafts tend to fare better than deceased donor grafts.

Adherence to ESRD Treatments

All patients undergoing treatment for ESRD are required to follow a lifelong regimen that necessitates ongoing behavioral involvement to ensure that the medical intervention remains safe and effective. For patients whose ESRD is treated with renal transplantation, adherence to an immunosuppressant medication regimen for the remainder of life is required to prevent the body from rejecting the transplanted organ. Individuals receiving hemodialysis as their method of ESRD treatment have an arguably more complex behavioral regimen to follow. Although patients undergo lengthy treatments several days per week, this does not fully compensate for normative kidney function; specifically, excess fluid and toxins build up and remain in the body between hemodialysis sessions. Fluid overload can lead to deleterious consequences, including congestive heart failure, pulmonary edema, cramping on dialysis, hypertension, fatigue, and decreased life expectancy. Similarly, buildup of chemicals that are dysregulated in ESRD can lead to complications such as myocardial infarction, stroke, heart arrhythmias, increased mortality, and bone demineralization. Thus, it is necessary for patients to restrict the amount of fluid ingested, and also their sodium, phosphorus, and potassium intake while their ESRD is being treated with hemodialysis.

Given the multifaceted and complex nature of the ESRD treatment regimen, the majority of patients have difficulty adhering to these recommendations. Research indicates that approximately 40–60% of ESRD patients do not adhere to one or more central aspects of the medical regimen. Adherence to fluid intake restrictions is most commonly measured by documented interdialytic weight gains (IWG). Individuals with ESRD are weighed before and after their hemodialysis treatments. The amount of weight gained *between* treatment sessions, calculated, for example, by subtracting the post-dialysis weight on a Monday from the pre-dialysis weight on a Wednesday, is considered a proxy for the amount of fluid the individual ingested during that time. One kilogram (kg) of weight is equivalent to 1 L of fluid; the recommended limitation is 1 L of fluid per day (including fluid in solid foods), which would equate to 2–3 kg of weight gained between sessions. Though patients tend to have the most difficulty with fluid restrictions, dietary adherence is also problematic. Sodium, potassium, and phosphorus intake is typically measured by serum levels drawn each month. There is modest evidence to suggest that in nearly half of cardiac-related ESRD patient deaths, nonadherence to dietary restrictions is the most significant contributor to mortality.

Researchers have also documented that patients experience the extreme restrictions on fluid intake as the most stressful and behaviorally challenging aspect of the ESRD hemodialysis regimen. There are a number of factors that likely contribute to this experience. First, individuals with ESRD tend to have increased thirst at baseline, often related to high blood glucose levels in those with diabetes and/or medication side effects. Second, the hemodialysis process itself, which rapidly removes excess fluid and toxins, leads to an electrolyte imbalance, increasing sodium appetite and thirst. Finally, contextual and behavioral factors impact patients' ability to follow fluid recommendations. For example, restricting fluid intake contradicts social norms about the health benefits of consuming large amounts of water, drinking has become habitual

for many individuals and habits are difficult to break, and there exist substantial environmental cues and social pressures to consume fluid in many different contexts. The fluid intake adherence problem often becomes cyclical in nature: increased thirst leads to greater fluid consumption, which leads to larger interdialytic weight gains and longer dialysis sessions, which further increases electrolyte imbalance and thirst, maintaining and increasing the severity of nonadherence.

Determinants and Interventions Related to ESRD Adherence

As might be expected based on reviews of the general adherence literature, a comprehensive understanding of the factors that contribute to nonadherence among ESRD patients has proven difficult to attain. Researchers have studied several factors thought to influence adherence in this population, and the results have been mixed. For example, some findings indicated that family support and marital adjustment were predictors of improved fluid intake adherence, while other studies found no evidence of an association between social support and fluid or dietary adherence among dialysis patients. The impact of cognitive and personality factors on adherence in ESRD has also been examined, including self-efficacy, health locus of control, perceived barriers, conscientiousness, and hostility. Higher self-efficacy expectations have been associated with improved fluid adherence in dialysis and better medication adherence in both dialysis and transplantation, whereas greater perceived barriers were related to poorer medication adherence. The findings relating health locus of control and adherence have been inconsistent. Personality characteristics such as conscientiousness and hostility have been significantly associated with adherence in ESRD patients in some work.

Some researchers have posited that the examining the interaction between patient characteristics or preferred style of coping with stress and the contextual features of the treatment regimen might help us to better understand adherence in

this population. For example, individuals who endorse avoidant coping styles or prefer to have less control/involvement in their treatment have been found to display better adherence to hemodialysis performed in a center or hospital where the contextual demands (i.e., staff-directed, passive patient role) match the individual's preferences.

Some researchers have theorized that difficulties with adherence are related to deficits in self-regulation skills, suggesting that building these skills through interventions focused on self-monitoring, goal-setting, self-reinforcement, and increasing individuals' ability to delay gratification may be an effective strategy. Educational, cognitive, and cognitive behavioral interventions have been cited most frequently in the literature, though the results have been mixed. A recent review of randomized controlled trials designed to improve adherence in hemodialysis patients found that interventions utilizing cognitive or cognitive behavioral techniques showed the largest effects and warrant future research.

Depression and ESRD

Mood disorders have been documented as one of the most common psychiatric diagnoses in patients with ESRD. The prevalence of depression varies based on the type of assessment used; approximately 20–45% of patients endorse symptoms of depression on self-report instruments, and 15–20% may be diagnosed with a depressive disorder following a clinical interview. While depression is recognized in a large number of individuals with ESRD, underdiagnosis and lack of adequate psychological treatment remain significant problems in this population. One of the difficulties in diagnosing depression in ESRD relates to the overlap in somatic depression symptoms with the uremic symptoms of kidney disease. Fatigue, loss of interest in sex, difficulty sleeping, loss of appetite, and problems with concentration and attention could be attributed to both depression and ESRD; thus, the etiology of these symptoms is often unclear. As a result, it has been suggested that assessing the cognitive or nonsomatic symptoms may enable

researchers and clinicians to more accurately identify depression in patients with ESRD.

Several factors have been studied in order to better understand contributors to depression in individuals with kidney disease. The research suggests that perceptions of control and of how intrusive the illness is in disrupting important life domains are related to depression in this population. More specifically, incongruence between beliefs about control or illness intrusiveness and the relevant contextual or situational factors are predictors of depression in ESRD. The effects of social support on moderating depression symptoms have also been examined, and the results have been inconsistent.

Depression has been found to have deleterious consequences for patients with ESRD and earlier stages of CKD, including increased nonadherence to treatment recommendations, morbidity, and mortality. Some research has also suggested that depression is associated with decisions to prematurely terminate dialysis treatment. Thus, adequate treatment of depression in ESRD is essential. A review of the literature suggests that pharmacologic treatment with certain serotonin-selective reuptake inhibitors may be safe and effective for patients with later stage CKD and ESRD. Cognitive behavioral therapy was also found to be one of the most promising interventions for depression in this population. Future behavioral medicine research is necessary to expand our understanding of ESRD, particularly as the prevalence of this chronic illness is projected to increase over time.

Cross-References

- Adherence
- Depression
- Health Behaviors
- Locus of Control

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Energy

- Affect Arousal
- Fatigue

Energy In

- Caloric Intake

Energy Intake

- Caloric Intake

Energy: Expenditure, Intake, Lack of

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Definition

Energy expenditure refers to the amount of energy an individual uses to maintain essential body functions (respiration, circulation, digestion) and as a result of physical activity. Total daily energy expenditure is determined by resting or basal metabolic rate (BMR), food-induced thermogenesis, and energy expended as a result of physical activity.

BMR is the minimum amount of energy that the body requires for essential organ and cellular function when lying in a state of physiological and mental rest. BMR accounts for typically 65–75% of total energy expenditure. Differences in BMR exist between genders and across ages. Females tend to have a lower BMR than males, and BMR decreases with age. These differences can largely be accounted for by differences in fat-free mass, which is proportional to BMR.

Food-induced thermogenesis refers to the increase in energy expenditure following the ingestion of food. This increase in energy expenditure is a result of digestion, absorption, and

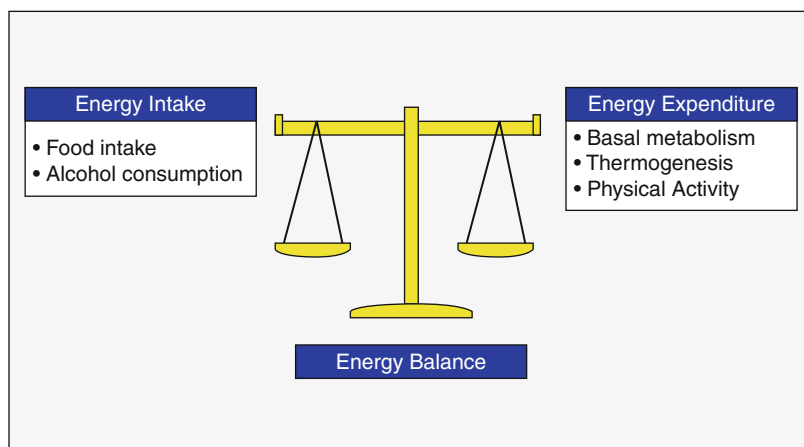
transportation of nutrients and accounts for approximately 10% of total energy expenditure.

Physical activity refers to energy expended when carrying out everyday tasks and exercise. It typically accounts for 15–30% of energy expenditure, but can vary greatly between individuals. For example, energy expenditure expended through physical activity would be greater in an individual who exercises regularly or is an athlete, compared to someone who is sedentary.

Energy intake is the amount of energy produced by an individual taken in from food consumption; this is typically measured in calories (kcal). Energy intake must be matched with energy expenditure to ensure *energy balance*. If food intake exceeds energy expenditure, through overeating or sedentary behavior, then energy storage occurs resulting in weight gain. This potentially can lead to an individual becoming overweight and at risk of obesity. Alternatively, a negative imbalance can occur where energy expenditure exceeds energy intake. This can occur as a result of undereating, possibly as a result of an eating disorder, or when an individual is involved in a high level of physical activity but failing to match this expenditure with food intake. A negative energy balance subsequently results in weight loss. Although a state of negative energy balance is desirable for overweight individuals in order to lose weight, in the long term if energy intake does not match energy expenditure, this may cause an individual to

Energy: Expenditure, Intake, Lack of,

Fig. 1 Energy balance: energy intake should be equal to energy expenditure in order to achieve energy balance



become underweight. The above information has been compiled from the following sources, where more detail of energy expenditure can be found (McArdle et al., 2001) (Fig. 1).

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Biographical Information



George Libman Engel was born in New York City in 1913. He completed his undergraduate studies in chemistry at Dartmouth College, graduating in 1934. He then studied medicine at the Johns Hopkins University School of medicine, graduating in 1938. He was an intern at Mount Sinai Hospital (New York City), a research fellow at Harvard Medical School, and a graduate assistant in medicine at the Peter Bent Brigham Hospital (now Brigham and Women's Hospital).

In 1942, Engel moved to Cincinnati at the invitation of John Romano, who left Harvard to become the chair of the department of psychiatry at the University of Cincinnati. Both Engel and Romano then moved to the University of Rochester Medical School in 1946.

When commencing his medical career, Engel believed strongly in physical explanations of disease processes, even though some colleagues were incorporating psychosomatics into clinical practice. However, during his time at the University of Cincinnati, he slowly but surely became "converted" to the psychosomatic school. During his career, he became a prominent member of the American Psychosomatic Society, being elected as president and also serving as the editor of its journal, *Psychosomatic Medicine*.

Major Accomplishments

Engel published numerous books and articles on the relation of emotion and disease and on the incorporation of these ideas into medical training and clinical practice. Under his direction, the program at the University of Rochester became a leading center in the development of psychosomatic theory and training. Over time, he developed the "biopsychosocial model," which posits that health and illness are consequences of the interaction of biological, psychological, and social factors. This model was described in his 1977 paper entitled "The need for a new medical model: a challenge for biomedicine," published in the journal *Science*. The abstract of this paper reads as follows:

The dominant model of disease today is biomedical, and it leaves little room within its framework for the social, psychological, and behavioral dimensions of illness. A biopsychosocial model provides a blueprint for research, a framework for teaching, and a design for action in the real world of health care.

The literature is now replete with work addressing the biopsychosocial model, both as a theoretical framework and an approach to clinical practice. As Borrell-Carrio, Suchman, and Epstein (2004) observed, "The biopsychosocial

model is both a philosophy of clinical care and a practical clinical guide. Philosophically, it is a way of understanding how suffering, disease, and illness are affected by multiple levels of organization, from the societal to the molecular. At the practical level, it is a way of understanding the patient's subjective experience as an essential contributor to accurate diagnosis, health outcomes, and humane care."

During the 1980s and 1990s, the biopsychosocial model and biopsychosocial medicine "became the watchword of progressive unification of the medical and behavioral sciences, including psychiatry, in a search for etiological and preventive factors in human health and disease" (Dowling, 2005). Perhaps not surprisingly, given its eminence, various authors since then have suggested modifications and emphasized the importance, too, of other approaches. For example, Kontos (2011) commented that recognizing that medicine is made up of heterogeneous tasks, "no one model, including the biopsychosocial model, tends to all of them." Nonetheless, a quote from Dowling (2005) reviewing Engel's life is an appropriate way to conclude this entry: "He would appreciate the fact that some of us have taken on a bit of his flintiness, attempt his wry humor, and retain his determination to see our patients as 'united, biopsychosocial persons' rather than as 'biomedical persons' divorced from their psychological and social dimensions."

Editors' Note: Dr. Engel passed away in 1999.

Cross-References

► [Biopsychosocial Model](#)

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Engineering Psychology

► [Human Factors/Ergonomics](#)

Enteritis Regionalis Crohn

► [Crohn's Disease \(CD\)](#)

Enterocolitis Regionalis

► [Crohn's Disease \(CD\)](#)

Environmental Tobacco Smoke

► [Secondhand Smoke](#)

EPA

► [Omega-3 Fatty Acids](#)

Epidemiological Studies

► [Hispanic Community Health Study/Study of Latinos](#)

Epidemiology

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Definition

Derived from the term epidemic, epidemiology is the study of the distribution and determinants of health-related states or events, particularly disease (communicable or noncommunicable). The discipline of epidemiology is eclectic, comprising facets of sociology, statistics, medicine, and demography. Although its development may be traced back to the scientific revolution of the 1600s, it was not until the nineteenth century that it was recognized as a subject area in its own right.

The goal of the discipline of epidemiology is disease control and prevention. As such, various methods can be used to carry out epidemiological investigations: descriptive studies (usually based on a cross-sectional design) can be used to investigate distribution of disease; analytical studies (e.g., case control, cohort, randomized controlled trial) can be used to examine determinants of disease.

Knowledge of the occurrence, etiology, and subsequent control of communicable diseases such as typhoid fever, smallpox, and cholera stemmed from early epidemiological studies, such as John Snow's investigation of the infamous 1854 cholera epidemic in London. The emergence of noncommunicable diseases such as coronary heart disease earlier last century led to epidemiology occupying a wider remit. Modifiable determinants of the growing epidemic of coronary heart disease were identified

from large-scale epidemiological investigations beginning with the Framingham, the Seven Countries and Whitehall cohort studies.

Today, a growing body of professionals from health education, environmental and occupational health, and health service administration, in addition to medical science students, are required to have some knowledge of the foundations of epidemiology. Further details can be found in Hennekens and Buring (1987) and Rothman (2002).

Cross-References

- [Medical Sociology](#)
- [Mortality](#)
- [Mortality Rates](#)
- [Occupational Health](#)
- [Social Epidemiology](#)

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Epigenetics

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Definition

Epigenetics is the study of changes in gene expression that cannot be attributed to variation in DNA sequence. The etymology of this term comes from the Greek “epi-,” meaning “above” genetics and refers to covalent modifications

of the DNA, its associated proteins, or mRNA transcripts.

Description

All somatic cells within an organism contain the same DNA sequence, but epigenetic patterns regulate the timing and magnitude of gene expression by restricting the areas of the genome available for transcription and translation. This allows cells with the same genome to differentiate into specialized cells that perform a variety of functions (Jaenisch & Bird, 2003).

Epigenetic regulation participates in vital developmental processes. For example, one of the two X chromosomes in each cell of a female is permanently silenced through a series of epigenetic changes in a process called X-chromosome inactivation (Jaenisch & Bird, 2003). Epigenetic mechanisms also regulate genomic imprinting, a process in which an organism's parents contribute distinct epigenetic patterns that result in expression of only the maternally or paternally derived alleles in their offspring. Failure of these regulatory mechanisms can lead to developmental disorders such as Prader-Willi Syndrome or Angelman Syndrome (Feinberg, 2007).

Previously established epigenetic patterns responsible for cellular differentiation, X-chromosome inactivation, and imprinting are generally maintained through mitosis. However, some aspects of the epigenome are labile such that they may respond to environmental conditions and change over the course of an organism's lifespan (Feinberg, 2007).

DNA interacts with packaging proteins known as histones, which can be posttranslationally modified and facilitate dynamic gene regulation. Both the core (H2A, H2B, H3, and H4) and linker (H1 and H5) histones can be modified through methylation, acetylation, phosphorylation, ubiquitination, sumoylation, or citrullination. Each element of this histone code has a specific function. For example, histone acetylation typically promotes gene transcription while histone methylation can promote or

repress transcription based on the where it occurs (Bannister & Kouzarides, 2011).

Histone modifications often correspond to changes in methylation of DNA at the 5' position of the pyrimidine ring of cytosines within CpG dinucleotides (also called CpG sites). DNA methylation is the most widely studied epigenetic modification. It is concentrated in repetitive elements of the genome such as Alu sequences to repress transcription of latent retroviral elements. CpG sites are overrepresented in the promoter region of many genes, and when they cluster in sufficient density, the region is called a CpG island. Methylation of cytosines regulates gene expression by influencing the recruitment and binding of regulatory proteins to DNA. Specifically, gene expression typically increases when CpG methylation of that gene decreases and vice versa (Jaenisch & Bird, 2003).

Epigenetic regulation of gene expression can also be accomplished by a variety of non-protein coding RNA molecules (ncRNAs), which are continuously being discovered and characterized. RNA interference (RNAi) is a process by which ncRNA molecules bind to messenger RNA (mRNA) to regulate its translation into protein. As part of this process, small microRNA (miRNA) can bind a complementary strand of mRNA and repress its expression by targeting it for degradation or by directly preventing its translation. Similarly, small interfering RNA (siRNA) promotes mRNA cleavage and posttranscriptional silencing of a gene through induction of the RNA-induced silencing complex known as RISC (Taft, Pang, Mercer, Dinger, & Mattick, 2010).

Many epigenetic changes can occur over the course of an organism's lifetime as part of normal development, randomly as the organism ages or in response to environmental insults. However, if epigenetic changes occur in germ cells that participate in fertilization, epigenetic changes can be inherited from one generation to the next and may persist through multiple generations. With these and other recent discoveries, the role of epigenetic mechanisms in health and disease is being illustrated (Richards, 2006).

Cross-References

- [DNA](#)
- [Gene Expression](#)
- [Methylation](#)
- [RNA](#)

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Epinephrine

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Synonyms

[Adrenaline](#)

Definition

Epinephrine is a major neurotransmitter of the sympathetic nervous system. Epinephrine partially mediates the body's reaction to stress by elevating heart rate, blood vessel tone, sweating, tremor, and blood pressure. Epinephrine is released primarily from the central region (medulla) of the adrenal gland in response to

stressful situations. An alternate name for epinephrine is adrenaline.

Epinephrine interacts with at least five major protein receptors to produce a plethora of biological responses, typically characterized by an elevation of blood pressure and mobilization of energy stores. The major receptor interactions are with the following: $\alpha 1$ to both constrict blood vessels, resulting in increased vascular resistance, and an elevation of blood pressure and activate sweat glands to promote nervous sweating; $\alpha 2$ receptors to reduce the release of other catecholamines, such as norepinephrine, but also to constrict blood vessels; $\beta 1$ receptors to elevate heart rate and renin secretion, both resulting in elevated blood pressure; $\beta 2$ receptors on smooth muscle, particularly in bronchioles to ease breathing, and on skeletal muscle to sensitize the muscle to other stimuli resulting in tremor; and $\beta 3$ receptors on adipose tissue to stimulate the breakdown of fat stores. The stimulation of both $\alpha 1$ and $\beta 2$ receptors also mobilizes energy stores by activating glycogenolysis.

The physiological actions of epinephrine primarily involve augmentation of the sympathetic nervous system to promote rapid heart rate, arterial constriction, higher blood pressure, mobilization of fuel stores, sweating, and dilation of bronchioles and pupils of the lung and eye, respectively.

Epinephrine is a catecholamine synthesized from norepinephrine primarily in the central portion (medulla) of the adrenal gland. The entire synthetic pathway involves conversion of an amino acid, tyrosine, to dihydroxyphenylalanine (DOPA), followed by conversion of DOPA to dopamine, and dopamine to norepinephrine and the final step is the conversion of norepinephrine to epinephrine. The enzymes involved in the pathway are the following: tyrosine hydroxylase, DOPA decarboxylase, dopamine β hydroxylase, and phenylethanolamine *N*-methyl transferase. The latter strictly controls the synthesis of epinephrine and is most abundant in the adrenal medulla.

In addition to the adrenal medulla, other tissues capable of synthesizing epinephrine are the following: brain stem, retina, and left atrium of the heart. The distinguishing feature of the tissues

synthesizing epinephrine is the presence of phenylethanolamine *N*-methyl transferase. The gene controlling synthesis of this enzyme is located on chromosome 17 in humans. The enzyme consists of 282 amino acids and has a molecular mass of 30,835 g.

The primary behavioral role for epinephrine involves mediation of stress responses such as tachycardia, vasoconstriction, hypertension, sweating, shaking, piloerection, and liberation of energy stores such as glucose and fatty acids. Epinephrine levels in the brain are depleted in Alzheimer's disease brains. Epinephrine has been shown to increase memory in humans but the effect is mimicked by exogenous epinephrine infusions which cannot penetrate the brain; therefore, the effect must be caused by peripheral actions of epinephrine and not central brain effects. Intracerebral epinephrine infusions in animals also can produce excitation or depression.

Cross-References

- Blood Pressure
- Catecholamines
- Heart Rate
- Norepinephrine/Noradrenaline

Epistasis

- Gene-Gene Interaction

Epstein-Barr Virus

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Synonyms

EBV; Human herpesvirus-4 (HHV-4); Kissing disease; "Mono" or mononucleosis

Definition

EBV was formally identified by M.A. Epstein and Y.M. Barr in 1964 while examining tissue from a Burkitt's lymphoma patient. EBV is a very common type of herpesvirus found in humans. About 95% of Americans will have contracted the virus by the age of 40. The virus is highly contagious and is difficult, if not impossible, to prevent. It is often called the "kissing disease" due to its ease of transmission between individuals through saliva. Children often acquire EBV through close contact with family members and the people around them who are likely to have the virus. In adolescents and young adults, EBV leads to infectious mononucleosis 30–50% of the time. Symptoms of active EBV, or infectious mononucleosis, commonly include swollen lymph nodes, swollen throat, and fever. Treatment is limited and focuses on minimizing symptoms of the infection. The incubation period from contraction to presentation of symptoms can range from 4 to 6 weeks. Symptoms of infectious mononucleosis can last up to 1–2 months, but EBV remains dormant in the body for the rest of a person's life. EBV is present in the saliva and blood of infected persons and remains in some bodily cells after contraction. Since it functions as a virus, the body will develop antibodies to help fight off the virus. A "mono spot" test, which looks for these antibodies, is often administered for a formal diagnosis. Additionally, an elevated white blood cell count is indicative of active infection in the body. At times of immunosuppression, such as during cancer treatment, patients may experience reactivation of the virus, with or without associated symptoms. In some people, EBV may play a role in the development of Burkitt's lymphoma and nasopharyngeal carcinoma. Other people may live with the latent form of EBV for a number of years without reactivation.

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Equilibrium

► Homeostasis

Equipoise

► Principle of Equipoise

Erectile Dysfunction

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Synonyms

Impotence

Definition

Erectile dysfunction is a sexual dysfunction characterized by the consistent inability to develop or maintain an erection of the penis firm enough for satisfactory sexual performance. Symptoms of erectile dysfunction include trouble getting an erection, trouble keeping an erection, and/or reduced sexual desire.

Description

In the United States, it is estimated that erectile dysfunction affects 20–30 million men.

The prevalence of erectile dysfunction of any degree is estimated to be approximately 39% in men 40 years old and up to 78% in men 75 years and older. Comorbid medical conditions such as obesity, diabetes, heart disease, or hypertension may increase the risk of developing erectile dysfunction. In men older than 50 years, approximately 40% of erectile dysfunction is due to atherosclerotic complications. The most common conditions associated with the development of erectile dysfunction include cigarette smoking, high blood pressure, lipid problems (cholesterol, triglycerides), and diabetes. Among diabetes patients, the prevalence of erectile dysfunction is approximately 50%, depending on age, duration, and severity of the diabetes. A high prevalence of erectile dysfunction is also observed with chronic renal failure, hepatic failure, sleep apnea, chronic obstructive pulmonary disease, multiple sclerosis, Alzheimer's disease, and endocrine disorders such as low testosterone and thyroid problems. Pelvic or perineal trauma such as pelvic surgery (major prostate, bladder, and bowel operations) and pelvic radiation therapy are associated with erectile dysfunction, as is direct trauma to the perineum, which can lead to vascular problems.

Pathophysiology

Erectile dysfunction can be classified as psychogenic, organic, or mixed psychogenic and organic. That is, psychologic, neurologic, hormonal, arterial, or cavernosal impairment factors alone or in combination may cause erectile dysfunction. The mixed psychogenic and organic form of erectile dysfunction is the most common. Common psychological factors include performance anxiety and personal and/or relationship distress, which often result in lack of sexual arousal, overinhibition, and decreased libido. Erectile dysfunction may occur despite experiencing sexual desire and maintaining the ability to have an orgasm and ejaculate. Psychiatric disorders such as depression and schizophrenia have been related to increased risk of erectile dysfunction. Neurogenic causes of erectile dysfunction include the presence of disorders such as Parkinson's disease, Alzheimer's disease,

stroke, and cerebral trauma, which often lead to decreased libido or failure to initiate nerve impulses or interrupted neural transmission that lead to an inability to develop an erection. Hormonal factors associated with erectile dysfunction include hypogonadism and hyperprolactinemia. Androgen deficiency may also result in loss of libido and decreased nocturnal erections. Vasculogenic factors include generalized penile arterial insufficiency and veno-occlusive dysfunction. Inadequate arterial flow may be the result of hypertension, hyperlipidemia, cigarette smoking, diabetes, and pelvic or perineal trauma. Impaired veno-occlusion is associated with old age, Peyronie's disease, structural damage to the cavernous muscle and endothelium, and poor relaxation of the trabecular muscle, as well as diabetes and pelvic or perineal trauma. Drug-induced erectile dysfunction may result from a number of antipsychotic, antidepressant, and antihypertensive drugs that affect central neurotransmitter pathways involving serotonin, androgen, and dopamine. Additionally, cigarette smoking is associated with vasoconstriction and penile venous leakage and chronic alcohol abuse is associated with hypogonadism and polyneuropathy. Finally, old age is associated with a progressive decline in overall sexual function such that older men report decreased penile sensitivity, decreased testosterone levels, less turgid erections, less forceful erections, decreased ejaculation volume, and lengthened refractory period between erections. Age-related declines may be exacerbated with comorbid medical conditions such as diabetes, coronary heart disease, and chronic renal failure that lead to neural and/or vascular dysfunction.

Diagnosis

Initial evaluation of a man presenting with erectile difficulties includes a thorough examination of medical, sexual, and psychosocial histories, physical examination, and appropriate laboratory tests. Psychosexual factors to consider include alterations of sexual desire, ejaculation, and orgasm, presence of genital pain, and lifestyle factors, such as sexual orientation, presence of spouse or partner, and quality of the

relationship with the partner. Risk factors including smoking, trauma, or surgery to the pelvic, perineal, or penile areas, and prescription or recreational drug use should be considered. A detailed medical history should be taken and evaluation may also include laboratory tests to detect and rule out medical conditions that may be the cause of or comorbid with erectile difficulties and that may contraindicate certain therapies. Testing of testosterone levels, vascular and/or neurologic functioning, and monitoring of nocturnal erections may also be indicated in some patients. A physical examination should be conducted of the abdomen, penis, testicles, secondary sexual characteristics, and lower extremity pulses. The purpose of the initial evaluation is to identify psychosocial dysfunctions and organic comorbidities that contribute to erectile dysfunction. Assessment of patient's (and partner's) goals of treatment and preferences should also be conducted.

Treatment

Treatment of erectile dysfunction should address all the contributing factors associated with erectile difficulties. Appropriate treatment options should be utilized in a stepwise fashion according to medical expertise and patient preference. Healthcare professionals should carefully assess patients' (and their partners') goals for treatment; patients should be made aware of the risk involved with increasingly invasive treatments so that well-informed decisions are made with regard to the likelihood of treatment efficacy.

Cross-References

► [Aging](#)

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Ergonomics

► Human Factors/Ergonomics

Ergotherapist

► Therapy, Occupational

Ergotherapy

► Occupational Therapy

Escape-Avoidance Coping

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Definition

Coping is a cognitive-behavioral process that takes place in the context of a situation or condition perceived as personally relevant, challenging, or that exceeds an individual's resources to adequately deal with a problem. Coping styles may be dysfunctional or maladaptive in various contexts. Particularly in various patient groups, it has been shown that patients tend to use significantly more maladaptive strategies than healthy controls. Maladaptive coping styles have been shown to be associated with clinical features (e.g., fatigue, impairment, illness burden, psychosocial problems, or psychiatric comorbidity).

One of the best examined maladaptive coping styles is escape-avoidance coping. Escape-avoidance coping involves disengaging or staying away from a stressful situation and its behavioral and cognitive/emotional consequences. Typical strategies in response to a stressful situation might encompass cognitive avoidance ("Refused to believe that it had happened"), avoidant actions ("Slept more than usual"), denial ("Refused to believe that it had happened"), or wishful thinking ("Wished that the situation would go away or somehow be over with it") (examples are items of the Ways of Coping Checklist which is the most widely used instrument for assessment of coping styles).

It should be noted that, according to Lazarus, coping strategies are not inherently adaptive or maladaptive, but their effectiveness depends on individuals' personal circumstances, goals, and expectations. Coping styles should be considered in the context of stress-related cognitions and their consequences in everyday life. Escape-avoidant coping in a stress context may result in an inadequate regulatory adaptation to stress

as well as in exaggerated or prolonged stress responses that may in turn be associated with increased neuroendocrine, autonomic and immune activation. Escape-avoidant coping (and other coping styles) must be considered in studies of risk factors, clinical course, pathophysiology, and therapy of illnesses relevant in behavioral medicine.

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Escitalopram

► [Selective Serotonin Reuptake Inhibitors \(SSRIs\)](#)

ESM

► [Experience Sampling](#)

Essential Fatty Acids

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Synonyms

[Dietary fatty acids](#)

Definition

Essential fatty acids (EFA) are fats that cannot be synthesized by the body and must be obtained through diet. The two types are omega-3 fatty acids from alpha linolenic acid and omega-6 fatty acid from linoleic acid. Omega-9 fatty acid is necessary yet “nonessential” because the body can manufacture a small amount on its own, provided essential EFAs are present. EFAs are used to support the cardiovascular, reproductive, immune, and nervous systems.

The body has a very limited capacity for making the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) from linolenic acid, so these are often classified with essential fatty acids. EPA is believed to play a role in the prevention of cardiovascular disease, while DHA is necessary for proper brain and nerve development.

The richest sources of omega-6 fatty acids are safflower, sunflower, corn, and sesame oil. The richest sources of omega-3 fatty acids are flaxseed, sardines, salmon, cooked soybeans, and halibut.

The current ratio of omega-6 to omega-3 fatty acids in the typical American diet is approximately 11:1. However, the recommended ratio is 4:1. High doses of supplemental EPA/DHA have been shown to lower triglycerides in patients with elevated triglycerides. The American Heart Association recommends two servings of fatty fish a week to increase intake of EPA and DHA.

Cross-References

- [Fat, Dietary Intake](#)
- [Fat: Saturated, Unsaturated](#)

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www.heart.org

Estrogen

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Synonyms

Gonadal female hormones; Sex hormones; Steroid hormones

Definition

Estrogens represent a group of steroid hormones that primarily influence the female reproductive tract in its development, maturation, and function. There are three major hormones – estradiol, estrone, and estriol – and estradiol is the predominant one (Blair, 2010).

The major sources of estrogens are the ovaries and the placenta (the temporary organ that serves to nourish the fetus and remove its wastes); additional small amounts are secreted by the adrenal glands, by the male testes, and by intracrine synthesis in several peripheral cells/tissues (i.e., adipose tissue, which is also an important source of estrogen in postmenopausal women; macrophages in inflamed tissues) (Cutolo et al., 2004; Simpson, 2003).

Cholesterol is the parent molecule from which all ovarian steroid hormones are formed.

Cholesterol is converted to pregnenolone, and pregnenolone is converted to progesterone. The steps in the conversion of progesterone to the main estrogens – estradiol and estrone – include the intermediate formation of several androgens (male sex hormones): dehydroepiandrosterone, androstenedione, and testosterone (Blair, 2010).

Practically, androgens are precursors of estrogens: they are converted to estrogens through the action of an enzyme known as aromatase (Chumsri, Howes, Bao, Sabnis, & Brodie, 2011). The ovaries are the richest source of aromatase. Estradiol, the most potent estrogen, is synthesized from testosterone. Estrone can be formed from estradiol, but its major precursor is androstenedione. Estriol, the weakest of the estrogens, is formed from both estrone and estradiol.

At its target tissues, the free hormone penetrates the cell surface and then binds to a protein known as an estrogen receptor in the cytoplasm of the cells (Gibson & Saunders, 2012). The estrogen-receptor complexes enter the cell nucleus, where they influence the rate at which particular genes are transcribed.

Recently, chemicals like xenoestrogens, which can mimic endogenous hormones or interfere with endocrine processes, may affect normal estrogen signaling (Singleton & Khan, 2003).

Bone metabolic actions of estrogens are related to bone development and bone maintenance including the stimulation of bone formation and the closure of bone epiphyses, which causes linear growth to cease at the end of puberty, and the maintenance of bone throughout the reproductive years, which limits bone resorption and preserves bone strength (Callewaert, Sinnesael, Gielen, Boonen, & Vanderschueren, 2010).

However, estrogen replacement therapy to treat menopause is not recommended, since The National Cancer Institute found in 2003 a very significant drop in the rate of hormone-dependent breast cancers among women, related to the fact that millions of women stopped taking

hormone therapy in 2002 after the results of a major government study found the treatment slightly increased a woman's risk for breast cancer, heart disease, and stroke (Rossouw et al., 2002).

Estrogens exert enhancing activities on the immune humoral response (B-cell activities) and are considered among risk factors involved in the higher frequency of autoimmune diseases in females (Schmidt et al., 2009). Estrogen administration is contraindicated in patients with active autoimmune diseases (i.e., systemic lupus erythematosus); therefore, progestogen-only pills offer a convenient and readily reversible method of contraception that is suitable for women with contraindications for estrogens (Ahrendt, Adolf, & Buhling, 2010).

Increased intracrine synthesis (action of local aromatases) and levels of peripheral estrogen metabolites (i.e., alpha-hydroxylated) are observed in fluids of patients affected by autoimmune diseases (i.e., synovial fluid of rheumatoid arthritis patients of both sexes) and in tissues affected by cancer (i.e., both breast and prostate cancer) (Cutolo, Sulli, & Straub, 2011; Cutolo, Straub, & Bijlsma, 2007; Nelles, Hu, & Prins, 2011).

Cross-References

► Immune Function

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Ethical Issues

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Synonyms

[Clinical ethics](#)

Definition

Ethical issues arise in the situation where values conflict. There are several ethical issues in the area of behavioral medicine. One of typical ethical issues is the problem of informed consent in the clinical settings and the research involving human subjects.

Ethics of behavioral therapy is a topic of ethical issues in behavioral medicine to be proposed. Ethics has been a priority among behavior therapists. If the application of a technique can inflict pain or clients are relatively powerless or are involuntarily the subjects of treatment, ethical concerns arise. The aversion technique is one of major techniques causing behavioral modification. However, using an aversion procedure becomes one focus of ethical criticism in behavioral therapy. In the case that clients cannot offer informed consent due to lack their competency, desirability of treatment outcome goals has to be weighed against the rights of the client, because using an aversion technique opposes nonmaleficence which is major principle of biomedical ethics. Behavior therapists ethically ought to give positive consideration to reduce the target behavior through nonaversive means before applying an aversion procedure. Only when the target behavior has been conclusively shown to be impervious to other means, aversion therapy should be used.

Cross-References

► [Informed Consent](#)

Ethics

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Definition

Ethics is the study or examination of morality and moral life. The concepts of ethics fall into two main categories. The first category comprises notions having to do with morality, virtue, rationality, and other ideals or standards of conduct and motivation; second, notions pertaining to human good or well-being and the “good life” generally. Several major approaches to the study of morality are encompassed under the broad term “ethics.” Perhaps, the best-known approach is normative ethics, which attempts to identify those moral norms, values, or traits that should be accepted as standards or guides for moral behavior and moral judgment. Famous ethical theories of normative ethics are deontology, consequentialism, or virtue ethics. Deontology treats moral obligations as requirements that bind us to act, in large measure, independent of the effects our actions may have on our own good or well-being and, to a substantial extent, even independent of the effects of our actions on the well-being of others. Consequentialism contrasts with deontology. In consequentialism, all moral obligation and virtue are to be understood in terms of good or desirable consequences. Virtue ethics is conceiving what is admirable about individuals in terms of traits of character, rather than in terms of individual obedience to set of moral or ethical rules or requirement.

Cross-References

- [Ethical Issues](#)
- [Informed Consent](#)

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Ethics Committee

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Synonyms

[Research ethics committee](#)

Definition

An ethics committee is a committee dedicated to the rights and well-being of research subjects and makes decisions regarding whether or not proposed research studies are ethical to permit to go ahead.

The emphasis on ethical research arose out of concern regarding unethical experiments on humans that occurred during the Second World War. This led to the “Nuremberg Code,” which continues to inform current day ethics statements. This includes the ten basic principles that must be observed when performing medical experiments in order to satisfy moral, ethical, and legal concepts (BMJa, 1996). The Nuremberg Code was informed the Declaration of Helsinki, which was devised in 1964 in order to meet the needs of the

biomedical community (BMJb, 1996). This has been revised six times; the most recent version was written in 2008. The Declaration of Helsinki stipulates that research protocols should be reviewed by specially appointed committee independent of the investigator and the sponsor. It also stipulates that research that does not directly benefit the patient is restricted to healthy volunteers or for individuals where the experimental design is not related to their illness. Importantly, it also states that any research that does not have ethical approval should not be accepted for publication. Researchers are now increasingly assessed for Good Clinical Practice as developed by the International Conference on Harmonization (<http://www.ich.org/home.html>), which developed from the Declaration of Helsinki.

In the UK, most research concerning human subjects is required to be approved by ethics committees prior to being conducted. This is overseen by the National Research Ethics Service (<http://www.nres.npsa.nhs.uk/>), which has the following dual mission:

- To protect the rights, safety, dignity, and well-being of research participants
- To facilitate and promote ethical research that is of potential benefit to participants, science, and society

A list of national ethics committees specializing in the ethical aspects of the life sciences, biotechnology, agriculture, food safety, and health can be found at: http://ec.europa.eu/research/biosociety/bioethics/bioethics_ethics_en.htm.

Links for key documents relating to ethics committees can be found at the following site: <http://www.privireal.org/content/rec/documents.php>.

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Ethnic Differences

► [Minority Subgroups](#)

Ethnic Identities and Health Care

► [Health Disparities](#)

Ethnic Identity

► [Ethnicity](#)

Ethnic Minorities

► [Ethnicity](#)

Ethnicity

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Synonyms

[Ethnic identity](#); [Subethnic groups](#)

Definition

Although there is no standardized definition for ethnicity, it has generally been agreed upon that ethnicity encompasses, but is not limited to, elements such as shared cultural background, customs and practices, values and norms, and common language or religious traditions that are usually maintained across generations and tied to

a collective sense of identity (Dein, 2006; Lee, 2009). Moreover, ethnicity is a complex and dynamic concept that is dependent on both context and time (Boykin & Williams, 2010; Dein, 2006; Lee, 2009).

Description

The concept of ethnicity is commonly used interchangeably with the term “race” within the health literature, although both concepts are different from one another. A clear distinction between the two terms is that race is a scientifically unfounded taxonomy that categorizes individuals based on phenotypical characteristics (e.g., skin color, facial features) and geographic origin; it is a socially and ideologically constructed category (Sheldon & Parker, 1992; Williams, Lavizzo-Mourey, & Warren, 1994). Moreover, race has poor predictive validity for biological differences, and the amount of genetic variation that exists for any one particular ethnic group is larger than that found between “racial” groups (Sheldon & Parker, 1992), providing evidence for the lack of biologic or genetic basis for racial categorizations (Lin & Kelsey, 2000). On the other hand, despite that ethnicity is sometimes used in research as a fixed term, a distinguishable feature of it from that of race is that ethnicity is a much broader concept that also captures notions of self- and group identity (Sheldon & Parker, 1992). Although the fluidity of boundary demarcations as it relates to ethnicity (as can be noted, for example, throughout the different U.S. Decennial Census forms) is a limitation of the concept, many social scientists advocate for the use of “ethnicity” over “race” in order to avoid biological reductionism. Indeed, many researchers argue that ethnicity as a concept can better capture the environmental, cultural, behavioral, and sociopolitical experiences that affect health and illness (Dein, 2006). The term “ethnicity” is more commonly used in other countries (e.g., the UK and Canada) compared to the United States (Boykin & Williams, 2010). Significantly, despite that both majority and minority social groups have an ethnicity, the term “ethnicity”

has mostly been used (erroneously) to refer to ethnic minorities (Sheldon & Parker, 1992).

Ethnic and racial health disparities have been widely documented. However, the focus on ethnicity (and race) as fixed demographic categories and etiological factors has limited researchers' ability to adequately identify and delineate underlying mechanisms of these disparities (Sheldon & Parker, 1992). For example, despite that scientists are increasingly using ethnicity (and race) in biomedical and genetics research, when ethnic (or racial) differences are found, researchers typically fail to define the mechanisms through which these social categories operate in their statistical models or in actual life (Dein, 2006; Williams et al., 1994). Such a practice runs the risk of erroneously attributing noted differences in health status to ethnic minorities themselves, which may further contribute to pathologizing already socially marginalized groups (Sheldon & Parker, 1992; Williams et al., 1994). Similarly, ethnic differences in disease processes and/or health outcomes are usually attributed to culture, particularly to aspects of diet, lifestyle, and behavioral practices (Sheldon & Parker, 1992). However, researchers have noted that ethnic differences in health are not only due to behavioral and cultural factors but also due to larger social processes and structures, including historical, political, socioeconomic, environmental, and contextual factors, as well as discrimination and racism (Boykin & Williams, 2010; Pierce, Foliaki, Sporle, & Cunningham, 2004; Sheldon & Parker, 1992).

Methodological assessments of ethnicity in health research have some limitations. For example, a common methodological approach is that ethnic groups are usually grouped together to represent an ethnicity based on their national origin. However, ethnic differences may exist within national origin groups based on a number of factors, including cultural and linguistic ones. For example, whereas Mexican persons might be grouped together, differences exist in ethnic groups in Mexico (e.g., indigenous persons who might also speak a different language). This may apply to many other national origin groups that are typically collapsed into one ethnic category.

Likewise, although there are certainly some advantages to grouping all Latino or Asian subgroups into one ethnic category, for example, this practice can simultaneously obscure the heterogeneity that exists among subgroups across social, contextual, political, and historical contexts, which in turn may come to differentially affect the health of such groups.

Given the diverging definitions, classifications, and use of ethnicity across geographic contexts and time, understanding disease processes and outcomes as well as health/health service disparities will require further and more explicit clarification and assessment of ethnicity (and race), as well as of mechanisms through which both ethnicity and race may come to affect health (e.g., discrimination, social class, access to care) (Boykin & Williams, 2010; Lin & Kelsey, 2000).

Cross-References

- [Ethnic Identity](#)
- [Health Disparities](#)
- [Hispanic Community Health Study/Study of Latinos](#)
- [Minority Subgroups](#)

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Ethnicity Subgroups

► Minority Subgroups

Etiology/Pathogenesis

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Definition

The terms “etiology” and “pathogenesis” are closely related to the questions of *why* and *how* a certain disease or disorder develops. Models of *etiology* and *pathogenesis* therefore try to account for the processes that initiate (*etiology*) and maintain (*pathogenesis*) a certain disorder or disease.

Etiology

Etiology (consisting of two Greek terms for “origin” and “study of”) refers to the study of the causes of a mental or physical disease. As parts of the *etiology* of a respective disease, only causes that directly initiate the disease process (and therefore necessarily temporarily have to precede the onset of the disease) are considered as *etiological* factors. *Etiological* factors can thus be considered as *necessary conditions* for the development of a disease. The *etiology* of a certain condition is mostly defined not only by one but rather by the interplay of many different conditions (biological, environmental, etc.). As an

example, the *etiology* of the common cold is based on an infection by Rhinoviruses causing a viral upper respiratory infection (e.g., Eccles & Weber, 2009). Additionally, multiple environmental and immunological factors modulate the infectious *etiology* of the common cold (Eccles & Weber, 2009). In the realm of mental disorders, dysregulations of the endocrinological stress system, especially the hypothalamic-pituitary-adrenal axis (e.g., caused by early traumatic experiences and early life stress), are considered as *etiological* factors relevant for the development of certain disorders (e.g., depression, posttraumatic stress disorder, somatoform disorders) (Ehlert, Gaab, & Heinrichs, 2001). However, in many complex mental and physical disorders, the exact *etiology* is still either entirely or partly unknown (e.g., depression, obesity). Especially regarding mental disorders, the causes of certain symptoms and syndromes remain vague and speculative. An exception is the diagnosis of a posttraumatic stress disorder, in which case the *etiology* is unambiguously defined by the occurrence of a traumatic event.

Pathogenesis

Pathogenesis, in turn, refers to the process and factors associated with the perpetuation and maintenance of a respective mental or physical disorder. Factors associated with the *pathogenesis* also comprise behavioral changes (e.g., avoidance of normal physical activities in chronic pain conditions) that may maintain and even worsen a specific condition (e.g., physical inactivity often aggravates chronic pain conditions). Accordingly, *pathogenetic* factors, as opposed to *etiological* factors, do not necessarily have to precede the onset of a certain mental or physical disorder. As an example, a depressive disorder might initially develop as the result of early dysregulation in the stress system paired with acute adverse or stressful life events, but might be maintained and even exacerbated due to cognitive and behavioral *pathogenetic* factors (e.g., social isolation, lack of physical activity, and ongoing self-blame).

Cross-References

- [Pathophysiology](#)
- [Somatoform Disorders](#)

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Euthanasia

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Synonyms

[Assisted suicide](#); [Physician-assisted suicide](#)

Definition

Euthanasia is broadly defined as the practice of ending a life as a means of relieving pain and suffering. Assisted suicide refers to actions by which an individual helps another person voluntarily bring about his or her own death. Despite the fact that physician assisted suicide (PAS) is illegal in most of the states in the USA, medical practitioners often receive requests from patients and their families to perform euthanasia, and many clinicians honor these requests. The reasons for these requests have not been well studied, but it appears that it involves a complex combination of physical and psychosocial symptoms and concerns. Euthanasia is currently legal in a small number of US states

(Montana, Oregon, and Washington) and a limited number of European countries. The American College of Medical Quality (2001) has published guidelines for physicians confronted with a patient's request for physician-assisted suicide.

Euthanasia and PAS remain extremely controversial due to the moral, ethical, and religious issues that surround them. There are strong arguments for and against the legalization of PAS and euthanasia in the USA. One concern regarding the practice of euthanasia and PAS is the established association between depression and requests for euthanasia. Research suggests that euthanasia requests from depressed patients are often transitory, while in nondepressed, severely ill patients, the desire to hasten death tends to be enduring.

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Evidence-Based Behavioral Medicine (EBBM)

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Evaluation of Potential Public Health Impact

- [RE-AIM Guidelines](#)

Evaluations

- [Attitudes](#)

Event Sampling

- [Diaries](#)

Event-Related Optical Imaging (EROI)

- [Brain, Imaging](#)
- [Neuroimaging](#)

Everyday Problems

- [Daily Stress](#)

Evidence Hierarchy

- [Hierarchy of Evidence](#)

Synonyms

[Evidence-based behavioral practice](#); [Evidence-based medicine](#); [Evidence-based practice](#); [Evidence-based psychological practice](#)

Definition

Evidence-based behavioral medicine (EBBM) is that branch of the evidence-based practice (EBP) movement that addresses behavioral interventions to promote health and mitigate the impact of illness. Evidence is comprised of research findings derived from the systematic collection of data through observation and experiment and the formulation of questions and testing of hypotheses. Evidence-based practice is an approach that aims to improve the process through which high quality scientific research evidence can be obtained and translated into best practical decisions to improve health. The evidence-based practice movement establishes consensus on the standards used to conduct, report, evaluate, and disseminate research results so as to increase their uptake and impact on practice and policy. Best available research is defined as best in quality, according to consensually accepted scientific standards for different kinds of questions, and most contextually relevant. Evidence-based practice entails the use of conscientious, explicit decision making that integrates consideration of best available research evidence, client characteristics, and resources. Many practical decisions relevant to evidence-based practice concern the selection of

an assessment or intervention. Whereas the treatments evaluated in evidence-based medicine usually involve drugs or devices, those appraised in evidence-based behavioral medicine more often comprise non-drug, non-device, behavioral or psychosocial interventions.

Description

History of Evidence-Based Practice

The evidence-based practice movement began as an effort to distinguish valid health practices from illegitimate ones. By now, all major health professions endorse evidence-based practice, and the Institute of Medicine identifies EBP as a core competence for all twenty-first-century health professionals (Greiner & Knebel, 2003). The EBP movement emerged from evidence-based medicine (EBM) and can be traced to three influences on the history of medicine in the twentieth century: the Flexner Report, the Cochrane Collaboration, and the clinical epidemiology group at McMaster University.

First, the Flexner Report, commissioned by the American Medical Association and the Carnegie Foundation and published in 1910, represented a major effort to reform medical education by placing it on a scientific foundation. To prepare the Report, Abraham Flexner, a research scholar at the Carnegie Foundation for the Advancement of Teaching, surveyed 155 medical schools that were in operation in the United States and Canada. Flexner severely criticized the training offered by many medical schools. He described a curriculum that was not based on science, lax clinical training, and a predominant profit rather than public service motivation for many schools' existence (Flexner, 1910). The Flexner Report established an educational quality standard that many existing medical schools could not meet. In consequence, by 1935, more than half of all medical schools had been closed (Beck, 2004).

A second main catalyst for the EBM movement arose from British epidemiologist, Archibald Cochrane's efforts to establish a rational, systematic basis for determining health care coverage (Cochrane, 1972). Cochrane argued that because

resources for health care are inevitably limited, it is essential that scarce dollars only be allocated for procedures of demonstrable worth. His conclusion that Randomized Controlled Trials (RCTs) offer the most reliable, unbiased method to evaluate the effectiveness of treatments led others to formulate a hierarchy of evidence. According to this evidence hierarchy, findings from high quality RCTs are given greater credence than those from observational studies, case studies, and expert opinion when making determinations about whether a treatment works. To aggregate and disseminate findings from RCTs, Cochrane's followers established the worldwide network known as the Cochrane Collaboration (www.cochrane.org), whose contributors track, critically appraise, synthesize, and disseminate RCT findings via the internet.

A third engine that drove EBM forward was the group of clinical epidemiologists working at Canada's McMaster University in the 1990s under the leadership of David Sackett and Gordon Guyatt. This group's ambitious agenda was to close the research-to-practice gap by socializing physicians to engage in lifelong learning about new research findings (Sackett & Rosenberg, 1995a, 1995b). The McMaster team was motivated by evidence that clinicians primarily implement practices learned during training but neglect alternative, new, and often more efficacious treatments (Isaacs & Fitzgerald, 1999). In order to encourage physicians to routinely ask questions and consult research, the group developed methods that allowed practitioners to find, appraise, and apply research results during the actual clinical encounter. They encountered resistance from clinicians who felt that an exclusive emphasis on research devalued the importance of clinical expertise to quality care provision (Haynes et al., 1996). To overcome that barrier and encourage clinical implementation, Gordon Guyatt renamed the approach "evidence-based medicine," in place of the earlier phrase "scientific medicine" (Guyatt et al., 1992). Instead of a single circle (research), subsequent models of evidence-based medicine have used a "three circles" or "three legged stool" model of EBM.

That is to say, they depict evidence-based practice as tying together research, patient characteristics, and expertise (Haynes et al., 1996; Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996).

From EBM to EBBM

A necessary precondition for EBBM was to consider carefully how well the core principles of evidence-based medicine apply to research on behavioral (non-drug, non-device) interventions. That evaluation was undertaken initially by the Society of Behavioral Medicine's EBBM Committee, established in 2000 with support from the National Institutes of Health (NIH) Office of Behavioral and Social Science Research (OBSSR) under Acting Director, Peter Kaufmann. The EBBM Committee, first chaired by Karina Davidson, defined its scope to include behavioral interventions that prevent disease, promote health and adherence to treatment, or change biological determinants of behavioral conditions (Davidson et al., 2003). Initial efforts were dedicated to familiarizing behavioral medicine researchers with the CONSORT guidelines that support comprehensive, transparent reporting of RCTs in medical journals (Schulz et al., 2010a). Partly as a result of the Committee's efforts, the CONSORT guidelines were adopted by journals that publish behavioral medicine RCTs, including the *Annals of Behavioral Medicine*, *Health Psychology*, *International Journal of Behavioral Medicine*, and *Journal of Consulting and Clinical Psychology*. Additional efforts to improve the quality of behavioral medicine clinical trials addressed a frequent weakness in their analytic approach, i.e., failure to use the intent to treat principle whereby all randomized participants are included in study analyses according to the condition to which they were assigned (Pagoto et al., 2009; Spring, Pagoto, Knatterud, Kozak, & Hedecker, 2007).

Still other efforts of the EBBM Committee addressed common fears and misperceptions about what evidence-based practice entails (Spring et al., 2005). One frequent misunderstanding is that the approach neglects all but RCT evidence. Actually, the principle is that the optimal research design depends upon the

question being asked. For example, a prognostic question about the likely course of a patient's condition is answered more effectively by an observational cohort study than by an RCT. Also addressed was the misperception that evidence-based practice equates to cookbook treatment and the false belief that RCTs inevitably exclude complex patients in real world settings.

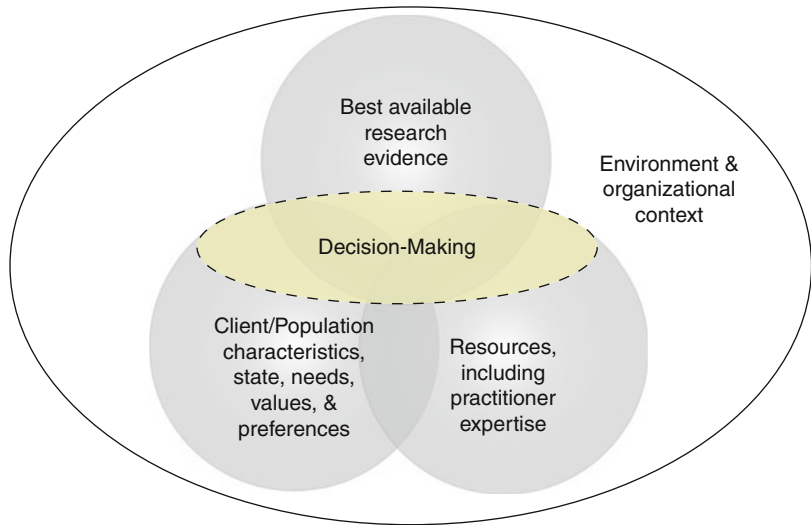
From EBBM to EBBP to, Simply, EBP: The Conceptual Model

By 2006, the U.S. health care crisis had arrived. With it came the need for and promise of a better integrated system of care that addresses mental as well as physical health and prevention as well as care of the sick, and that accomplishes all this by the coordinated efforts of an interprofessional team. A horizon scan made apparent the need to upgrade and harmonize the approach to evidence-based behavioral practice across the health professions that offer behavioral interventions. Accordingly, OBSSR sponsored the Council on Evidence-Based Behavioral Practice (EBBP), chaired by Bonnie Spring, and its scientific and practitioner advisory boards. Composition of these groups was determinedly interprofessional, combining representatives from medicine, nursing, psychology, social work, public health, and information sciences (www.ebbp.org). The Council's first task was to formulate a conceptual model that could accommodate the diverse historic traditions as well as the individual and population level behavioral interventions that different health professions implement.

Medicine's initial conceptual model of evidence-based practice had emphasized a single parameter: research. EBM was defined simply as "the conscientious and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett et al., 1996). Subsequent EBM definitions emphasized the need to balance considerations in addition to research: For example, "Evidence-based medicine requires the integration of the best research evidence with clinical expertise and the patient's unique values and circumstances" (Strauss, Richardson, Glasziou, & Haynes, 2005).

Evidence-Based Behavioral Medicine (EBBM),

Fig. 1 The three circles of interprofessional evidence-based practice (Source: Spring & Hitchcock, 2009)



E

The EBBP Council worked to integrate the historic conceptualizations of evidence-based practice developed in medicine, nursing, psychology, public health, and social work (Satterfield et al., 2009). The aim was to develop a new, harmonized conceptual model suitable to be shared by the more diverse interprofessional health care teams of the future, whose members all require core competency in EBP (Greiner & Knebel, 2003). Because the shared conceptual model supports jointly held vocabulary, foundational assumptions, and practice principles that unite the team, a unified model of evidence-based practice supplants the need to have separate models for different disciplines or for behavioral versus medical interventions (Satterfield et al., 2009; Spring & Hitchcock, 2009).

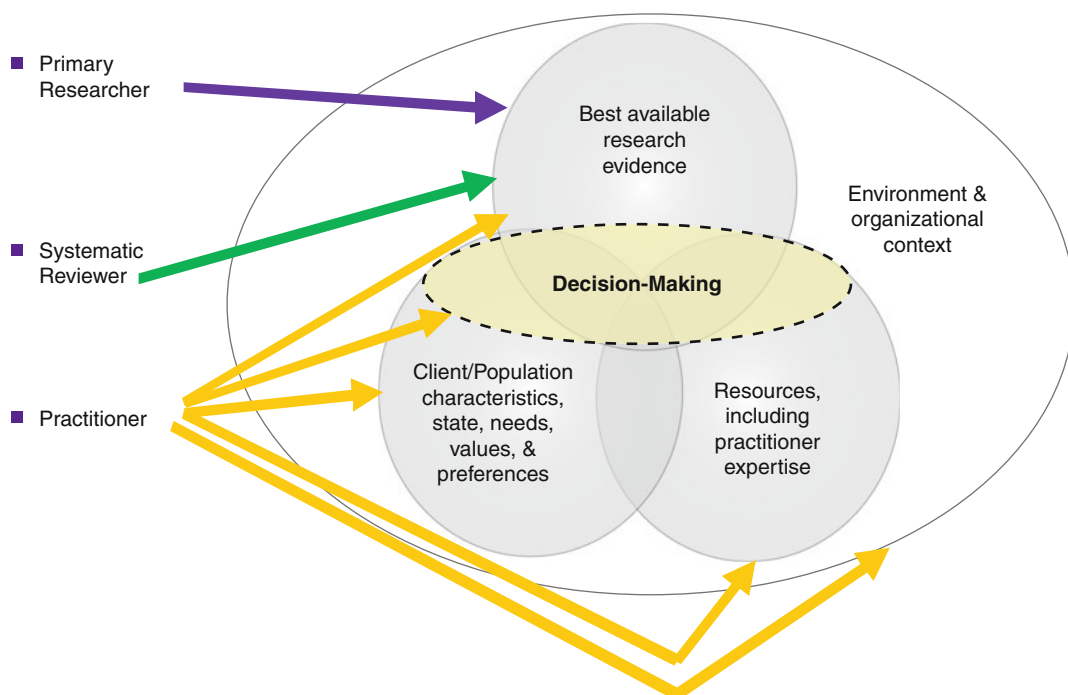
The interprofessional model of evidence-based practice appears in Fig. 1.

Note that the model depicts three circles (data strands) that need to be integrated in EBP and that evidence-based decision making is shown as the skill that knits these strands together. As in all prior EBP models, best available research evidence remains a circle, occupying the top position because it reflects the cumulative, unbiased body of knowledge about what is effective for the health issue. The client's characteristics, including current state, prior history, values, and preferences, are a second key data strand that

needs to be integrated by engaging the client in shared decision making. The third data strand involves resources because these can constrain the available treatment options. Resources include influences such as insurance coverage, other financial resources, available trained interventionists, community facilities, and time or capability to access treatment. The surrounding, outer circle acknowledges that, inevitably, EBP occurs in a particular organizational and environmental context that will influence what interventions are endorsed and how readily they can be implemented.

Health Professionals' Roles in EBP

It is no understatement to say that "it takes a village" to sustain the infrastructure of evidence-based practice. As shown in Fig. 2, health professionals can play three different and essential roles in relation to EBP. First, as primary researchers, they directly contribute to creating the evidence base. They develop new interventions, and they design, conduct, analyze, and report research that evaluates the efficacy and effectiveness of treatments. If random assignment to treatments is feasible, they will usually conduct RCTs. If it is not, as is often the case for policy interventions, they may use alternative designs, such as intermittent time series to evaluate whether a treatment works.



Evidence-Based Behavioral Medicine (EBBM), Fig. 2 Health professionals' roles in EBP

In the second role, as systematic reviewers, health professionals are evidence synthesizers. They aggregate primary research that was conducted by others to create and disseminate research syntheses that can be accessed efficiently and used by practitioners. The research synthesizer role is a critical underpinning in the infrastructure of EBP. Because of the rapid pace at which the scientific literature proliferates, few full-time practitioners can stay comprehensively abreast of new research, while also managing their patient care responsibilities. Systematic reviewers play a critically important role in EBP. By culling and analyzing the full body of new and old studies that address clinically important questions and disseminating their findings to clinicians in the form of pithy summaries, they make the EBP enterprise feasible for practitioners. To accomplish this, systematic reviewers first develop a comprehensive and unbiased protocol to locate the primary research that addresses a practical question. Having acquired the relevant studies, they critically appraise, extract, and synthesize the data to provide an answer. Depending

upon the heterogeneity of the interventions and study designs included in the review, they may synthesize and report the findings solely qualitatively or also quantitatively, using meta-analysis. Systematic reviewing is itself a sophisticated and evolving form of research methodology that is increasingly used as the basis for health policies, including practice guidelines.

Finally, in the third role as practitioners, health professionals play the most complex and challenging role in EBP. The clinician extracts and uses data from each of the three EBP circles. Clinicians are research consumers: They access research evidence and appraise its quality and relevance for their context. For efficiency in a busy practice context, clinicians are advised to turn first to the secondary, synthesized, critically pre-appraised sources of evidence such as systematic reviews or the evidence-based practice guidelines to be found on www.guidelines.gov. However, in some instances, there may be no applicable treatment guidelines or systematic review, requiring the clinician to search the primary literature to locate relevant original

research. Moreover, the health professional adopting the practitioner role interacts more directly than either primary researchers or evidence synthesizers with the remaining two circles of the EBP model: client characteristics and resources. To simplify the practitioner's complex job, the 5-step evidence-based practice process, shown in Fig. 3, maps out a recommended series of steps that practitioners can follow in order to address each of the three circles.

The Five Steps of Evidence-Based Practice

Evidence-based practice entails both a conceptual model (shown in Fig. 1) and the 5-step process shown in Fig. 3. Each step represents an integral part of the EBP process and a competency to be mastered by the clinician. Note that assessment is assumed to precede the onset of the EBP process and to recur throughout it, rather than being considered a formal step. Step 1 is to ask questions that are formulated and structured in a manner that facilitates finding the relevant research. Step 2 is to acquire the best available evidence regarding the question. Step 3 is to critically appraise the evidence on two parameters: its validity and its applicability to the problem at hand. Step 4, Apply, is the most complex phase in the EBP process and the step that links most directly to the conceptual model depicted in Fig. 1. Apply is the step during which the practitioner engages in evidence-based decision making that balances and integrates best available research evidence, client characteristics, and resources to determine a treatment approach. Moreover, to increase the likelihood of treatment uptake and adherence, it is important for the decision-making process to be shared with the affected individual(s) and/or group(s). Choosing and collaboratively applying the best research-supported intervention represents a beginning rather than an end to the EBP process. The treatment supported by best available evidence will be the one that has proved cumulatively most effective for the average patient in an average environment. But what matters most for the evidence-based practice process is the single ($N = 1$) patient under the clinician's care. Step 5, the final step in the EBP process is to assess that client's response to the



Evidence-Based Behavioral Medicine (EBBM), Fig. 3 Five steps of evidence-based practice (Source: www.ebbp.org)

intervention, analyze progress, and, if warranted, adjust the course of treatment.

Educational Resources

The www.ebbp.org website created by the NIH-sponsored EBBP project offers access to information, tools, and training modules that facilitate research-to-practice translation for behavioral medicine. Nine online modules are available free of charge, covering a mixture of content relevant to learning objectives in research or practice. Free registration in the online portal conveys access to pre- and post-tests for each module and enables learners to stop and save their progress on a partially completed module. Of particular relevance to primary researchers are the learning modules about Randomized Controlled Trials, as well as the module on Critical Appraisal. The Critical Appraisal module offers an overview of the strengths and weaknesses of alternative research designs for evaluating whether a treatment works. A module on Systematic Evidence Reviews provides an introduction to research synthesis for learners interested in exploring that activity. The module on Searching for Evidence offers useful tips about search strategies for practitioners as well as primary researchers. Its overview of the many available online research databases is of particular relevance for systematic reviewers.

The remaining modules are geared particularly toward those trying to conduct research to

practice translation in behavioral medicine. Of these, three are oriented toward clinicians who work with individuals or practitioners who work with communities or populations. The EBBP Process module provides an overview of how to perform the 5-step evidence-based practice process. The learner is given a choice about whether to work with either an individual or a community. Two separate modules on Shared or Collaborative Decision Making illustrate how to engage individuals or communities, respectively, in the Apply step of the evidence-based practice process. These Process and Shared Decision-Making modules are highly interactive and experiential, giving learners an opportunity to experiment, make mistakes, and ask experts while practicing new learning in a safe environment. Finally, the Stakeholder and Implementation Modules are intended to be used by both researchers and practitioners wishing to engage in collaborative translational research about evidence-based practice. Featuring a series of interview clips with academic researchers, clinicians, and community advocates, the Stakeholder module presents a glimpse of widely varying worldviews about research. The final Implementation module presents a conceptual model of implementation science and offers two different case studies of successful implementation of evidence-based behavioral programs: one involving in-person training and the other involving internet-delivered training.

The resources at www.ebbp.org are meant to be used by either individual learners or by instructors as part of a course on research methods, interventions, or evidence-based practice. In addition to tools provided by the EBBP project, other online tutorials about evidence-based practice are made available by both University of North Carolina and Vanderbilt University.

Cross-References

- [Research to Practice Translation](#)
- [Translational Behavioral Medicine](#)

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Evidence-Based Behavioral Practice

- [Evidence-Based Behavioral Medicine \(EBBM\)](#)

Evidence-Based Medicine

- [Clinical Trial](#)
- [Evidence-Based Behavioral Medicine \(EBBM\)](#)

Evidence-Based Practice

- [Evidence-Based Behavioral Medicine \(EBBM\)](#)

Evidence-Based Psychological Practice

- [Evidence-Based Behavioral Medicine \(EBBM\)](#)

Excess Weight

- [Overweight](#)

Excessive Drinking

- [Binge Drinking](#)

Executive Control

- [Executive Function](#)

Executive Control Resources

- [Executive Function](#)

Executive Function

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Synonyms

[Executive control resources](#); [Supervisory attentional system](#)

Definition

Executive function (EF) is an emergent quality of cognitive function that arises from the operation of several brain structures situated at least partly

in the prefrontal cortex of the human frontal lobes. These cognitive operations are minimally reducible to the ability to inhibit prepotent responses, hold items in working memory, and direct attention. These core abilities in turn potentiate a variety of behavioral tendencies that include the capacity to avoid impulsive responding, the ability to remain mindful of and effectively pursue goals, the ability to avoid distraction, and the capacity to delay gratification.

Description

Interest in EFs emerged predominantly from the study of “frontal lobe” patients, or individuals who have sustained damage to the frontal lobes of the brain. Such individuals were initially observed to demonstrate intact general cognitive abilities, but evidenced specific impairments in several areas of function that were thought to be central to notions of personality and everyday social functioning. Early clinical descriptions of these patients in the neurological literature led to more specific formulations of the operations of the frontal lobes (see Stuss & Knight, 2002) and to vigorous inquiry regarding the nature of the concept of executive function itself in cognitive psychology.

EFs are thought to be a set of related cognitive operations that are housed within the frontal lobe of the brain, and they are specifically associated with the operation of the prefrontal cortex. As a group of related cognitive processes, EFs exhibit both unitary and diversity of function and so can be understood in relation to both their general level of operation, or the operation of the specific subfacets (Miyake et al., 2000). Some of the subfacets of general EF include behavioral inhibition, working memory, and task switching abilities. However, there are several conceptualizations of the structure of the executive system, which give prominence to one or more of these components (see Shallice, 1988).

Executive functions are frequently measured using a variety of neuropsychological tests. These include, but are not limited to, the following: the Stroop test, the go-no go test, trails B, digit symbol

(subtest of the Wechsler Adult Intelligence Scales), Tower of London/Hanoi, Iowa gambling task, stop signal, and the flanker task. Many of these have been used for decades and represent a class of tasks with similar characteristics, rather than single tasks with exactly specified parameters. For example, the Stroop task involves viewing a series of color names (i.e., the word “red”) displayed one at a time. The respondent is required to name the color of font – ignoring the word itself – as quickly and accurately as possible. On some trials, the font color matches the word (i.e., the word “red” is presented in red font; “concordant trials”), and on other trials, the font color is inconsistent with the word itself (i.e., the word “red” is presented in blue font; “discordant trials”). The dependent measure may be any number of parameters including the reaction time on correct trials, error rate, or ratio of reaction times on discordant versus concordant trials. The actual modality of presentation of the stimuli and responses varies depending on the specific requirements of the researcher, as do the number of trials. The Stroop test is thought to measure predominantly the inhibition facet of EF, though strong performance would naturally also correlate with working memory and attention as well.

In addition to such “behavioral” measures of EF, there is considerable interest in measurement of the activation of the underlying brain structures that give rise to EFs. Such approaches to imaging EF engagement include functional magnetic resonance imaging (fMRI), electroencephalogram (EEG), positron emission tomography (PET), and functional near-infrared spectroscopy (fNIRS).

Individual differences in EF are subject to both strong dispositional influences and potential for state-like fluctuation. For instance, EFs are among the most sensitive cognitive functions to the adverse effects of chronic health conditions, as well as the effect of both natural and pathological aging processes (e.g., Alzheimer’s disease and other dementias). Nonetheless, in the absence of disease-related cognitive decline, individual differences in EF among cognitively intact individuals are subject to substantial genetic loading (the latter including both genetic and gene x environment interactions).

Interest in EFs in the field of behavioral medicine has increased partly as a function of the significance of EFs for self-regulatory processes in health behavior performance, emotional regulation, and mortality (Hall & Fong, 2007).

Cross-References

- [Behavioral Inhibition](#)
- [Cognition](#)
- [Disinhibition](#)
- [Working Memory](#)

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Exercise

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Synonyms

[Leisure physical activity](#); [Physical activity](#)

Definition

Any bodily movement produced by skeletal muscles that results in an expenditure of energy (Caspersen, Powell, & Christenson, 1985).

Description

The term exercise is often used interchangeably with the term physical activity but is more appropriately used to refer to leisure physical activity performed for fitness or pleasure.

Domains of Physical Activity

The way people spend their time can be categorized into five domains: sleep, leisure, occupational, transportation, and household (SLOTH; Pratt, Macera, Sallis, O'Donnell, & Frank, 2004). Physical activity can occur in each domain but is not likely to occur during sleep. Most efforts to promote physical activity have focused on leisure physical activity, which is activity engaged in during free time, often for fitness or pleasure. This includes working out, playing sports, and recreational walking. Occupational physical activity is any movement resulting in energy expenditure that occurs while working. A person working in manual labor likely engages in more occupational physical activity than someone working a desk job. Transportation physical activity is activity engaged in for the purpose of getting from one place to another, such as walking or bicycling to a destination (e.g., grocery store). Transportation walking declined drastically during the twentieth century and is viewed as a promising domain for physical activity promotion (Handy, Boarnet, Ewing, & Killingsworth, 2002). Household physical activity includes household chores, such as washing dishes, and is not typically a focus of physical activity promotion.

Types of Physical Activity

There are four primary types of physical activity (Sallis & Owen, 1998). Aerobic activity (also called cardiovascular exercise) involves large muscle movement for a sustained period of time. Examples include walking, running, bicycling, and swimming. Aerobic activity is often the focus of physical activity promotion efforts. Anaerobic activity involves muscles working against an applied force, such as resistance training and weightlifting. Bone-strengthening activity involves weight-bearing

exercises that strengthen the body's bones, such as squats and body extensions. Flexibility exercises, such as stretching, are those that increase the range of movements of joints and muscles.

Physical Activity Intensity levels

Movement is commonly classified into four intensity levels based on the amount of energy used by the body per minute of activity. Sedentary activity refers to no or little body movement and often involves sitting (for more information, see “► [Sedentary Behaviors](#)”). Light-intensity physical activity refers to slight body movements that lead to energy expenditure but are not strong enough to be considered moderate or vigorous. Moderate-intensity physical activity is the primary intensity level promoted in behavioral medicine. Moderate-intensity physical activity is often defined as activity during which a person's heart rate is 50–70% of his or her maximum heart rate (obtained by subtracting the person's age from 220). This generally includes brisk walking, dancing, gardening, and bicycling. Vigorous-intensity physical activity occurs when a person's heart rate is 70–85% of his or her maximum heart rate. Examples of vigorous-intensity activities include race walking, jogging, running, and hiking (Centers for Disease Control and Prevention (CDC), [2010](#)).

Benefits of Physical Activity

Considerable evidence suggests that regular physical activity reduces the risk of many adverse health outcomes, such as cardiovascular disease, type 2 diabetes, some cancers, and mortality (Blair et al., [1996](#); Haskell, Blair, & Hill, [2009](#)). Physical activity is also beneficial for mental health and quality of life and has been successfully used as a treatment for mental health disorders such as depression (Dunn, Trivedi, & O'Neal, [2001](#)). Most health benefits occur with at least 150 min a week of moderate-intensity physical activity; additional benefits occur with more physical activity, and some physical activity is better than none (U.S. Department of Health and Human Services, [2008](#)). For more information on health-related benefits of physical activity, see “► [Physical Activity and Health](#), ► [Physical Activity](#).”

Physical Activity Recommendations

The US Department of Health and Human Services produced physical activity guidelines for children/adolescents, adults, and older adults (U.S. Department of Health and Human Services, [2008](#)). The recommendations are as follows:

- Children and adolescents should engage in at least 60 min of physical activity daily, including vigorous-intensity physical activity at least three days a week. As part of their 60 min or more of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least three days of the week and bone-strengthening physical activity on at least three days of the week.
- Adults should engage in at least 150 min of moderate intensity, or at least 75 min of vigorous-intensity physical activity per week. Aerobic activity should be performed in episodes of at least 10 min. Adults should also do muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on two or more days a week.
- Older adults (\geq age 65) have the same guidelines as other adults, except when older adults cannot do 150 min of moderate-intensity aerobic activity a week because of chronic conditions, they should be as physically active as their abilities and conditions allow.

Prevalence of Physical Activity in the United States

Nationally representative data showed that in 2007, 64.5% of US adults met the US Department of Health and Human Services physical activity guidelines. Women, older adults, people of racial/ethnic minority, less educated people, and those who were obese reported lower amounts of physical activity (Carlson et al., [2008](#)). This data is based on how much physical activity people report they are doing. Objective physical activity rates were measured in 2004 using physical activity monitoring devices. Results were that fewer than 42% of children, 8% of adolescents, and 4% of adults met physical activity guidelines (Troiano et al., [2008](#)). Although physical activity prevalence rates vary drastically when measured

with self-report versus physical activity monitors, prevalence rates found using each method point to a need for increasing physical activity.

Cross-References

- [Aerobic Exercise](#)
- [Benefits of Exercise](#)
- [Exercise Testing](#)
- [Physical Activity and Health](#)
- [Physical Activity Interventions](#)
- [Physical Inactivity](#)

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Exercise and Cancer

- [Cancer and Physical Activity](#)

Exercise Testing

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Synonyms

[Physical fitness testing](#); [Stress testing](#)

Definition

Exercise testing is a method used to evaluate a number of physiological parameters and conditions, such as heart and lung capacities and pathologies, as well as physical ability. Clinical exercise tests, which evaluate vital organ functioning, are typically designed to incorporate large muscle groups, and these tests use modalities such as treadmills or cycle ergometers. Maximal exercise testing protocols are structured to be progressive to the point of exhaustion, whereas submaximal exercise tests are conducted at a lower exercise intensity in a single-stage or multistage protocol and are terminated at a predetermined point.

An individual performs an exercise test, and data is collected by the test administrator. The collected data/information can then be analyzed to assess the nature of the physiological measure or disease/condition that the test was specifically designed to evaluate. Exercise tests can not only be used as diagnostic tests, such as in the case

of evaluating heart conditions, but are also an important part of designing safe exercise programs for patients with a chronic disorder. In addition, exercise tests can also be used to monitor the improvements or detriments resulting from the individual's treatments or physical training: an exercise test is conducted before the treatment to establish a baseline and then conducted again after the treatment; the effects of the treatment can then be evaluated.

It is also important to note that, in the case of exercise testing batteries, where more than one exercise test will be administered at a given time, the order of the tests may alter the results. For example, nonfatiguing exercise tests and exercise tests requiring muscular coordination should be conducted before fatiguing tests so as to not tire out the individual prematurely. By carefully selecting the order of the tests in the exercise testing battery, one can ensure more accurate results.

Cross-References

- ▶ [Exercise](#)
- ▶ [Graded Exercise](#)
- ▶ [Isometric/Isotonic Exercise](#)

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Exercise Tolerance Test

- ▶ [Maximal Exercise Stress Test](#)

Exercise, Benefits of

- ▶ [Isometric/Isotonic Exercise](#)

Exercise-General Category

- ▶ [Isometric/Isotonic Exercise](#)

Exhaustion

- ▶ [Fatigue](#)

Expanded Attributional Style Questionnaire (EASQ)

- ▶ [Optimism and Pessimism: Measurement](#)

Expectancy

- ▶ [Nocebo and Nocebo Effect](#)

Expectancy Effect

- ▶ [Placebo and Placebo Effect](#)

Experience Sampling

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Synonyms

[ESM](#); [Experience sampling method](#)

Definition

The experience sampling method (ESM) is an attempt to provide a valid instrument to describe variations in self-reports of mental processes. It can be used to obtain empirical data on the following types of variables: (a) frequency and patterning of daily activity, social interaction, and changes in location; (b) frequency, intensity, and patterning of psychological states, i.e., emotional, cognitive, and conative dimensions of experience; (c) frequency and patterning of thoughts, including quality and intensity of thought disturbance (Csikszentmihalyi & Larson, 1987).

ESM represents a valuable way of assessing clinical phenomena in real-world settings and across time. It can be used in various settings. In ESM studies, participants are required to fill in questions about their current thoughts, feelings, and experiences when prompted by an electronic device (e.g., a wristwatch, PDA). Entries are typically made at fixed or random intervals over a period of days (a week is a typical period). Briefing, debriefing, which sampling procedure to use, adherence, data management, and analytical issues must be considered carefully in the study design phase to ensure optimum data collection and hence optimum results from the study.

A growing body of research suggests that momentary assessment technologies that sample experiences in the context of daily life represent a useful and productive approach in the study of behavioral phenotypes, and a powerful addition to mainstream cross-sectional research paradigms (Myin-Germeys et al., 2009). These authors described momentary assessment strategies for psychopathology and presented a comprehensive review of research findings illustrating the added value of daily life research for the study of (1) phenomenology, (2) etiology, (3) psychological models, (4) biological mechanisms, (5) treatment, and (6) gene-environment interactions in psychopathology. They concluded that variability over time and dynamic patterns of reactivity to the environment are essential features of psychopathological experiences that

need to be captured for a better understanding of their phenomenology and underlying mechanisms (Myin-Germeys et al.).

The last decade has seen an increase in the number of studies employing the ESM in clinical research (see Trull & Ebner-Priemer, 2009). Further research is needed to examine the optimal equipment and procedure for different clinical groups. Consider for example psychiatric studies. Despite its theoretical advantages, using this methodology in psychiatric populations is challenging (Palmier-Claus et al., 2011).

Cross-References

- [Adherence](#)
- [Gene-Environment Interaction](#)
- [Phenotype](#)

References and Readings

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Experience Sampling Method

- [Experience Sampling](#)

Experimental Analyses

► Hypothesis Testing

Experimental Designs

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Definition

There are two fundamental types of study design: experimental and nonexperimental (Piantadosi, 2005). Piantadosi defined an experiment (an experimental design) as a series of observations made under conditions in which the influences of interest are controlled by the research scientist. In contrast, in nonexperimental studies, the research scientist collects observations but does not exert control over the influences of interest.

The classic example of an experimental design is the randomized clinical trial, in which the subjects (participants) are randomized to one of two or more experimental groups, thus receiving the intervention given to all members of each group. The simplest form of this design contains an experimental group receiving the intervention of interest (e.g., a behavioral intervention to lower blood pressure) while a second group receives a control intervention. The results obtained for each group are then compared to examine any statistically significant and clinically significant differences between the groups.

Two commonly used designs are the crossover design and the parallel groups design. In the first, each subject will receive each intervention, while in the second different groups of subjects receive just one of the interventions. When possible, the crossover design is preferable since each subject acts as his or her control subject.

Cross-References

- [Crossover Design](#)
- [Nonexperimental Designs](#)
- [Parallel Group Design](#)
- [Randomized Clinical Trial](#)

References and Readings

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Experimental Group

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Definition

As noted in the ► [Experimental Designs](#) entry, experimental designs are those in which the influence(s) of interest are controlled by the research scientist. An experimental group is a group of subjects who receive a particular treatment or intervention. Experimental subjects are randomly assigned to one of the treatment groups so that many potential influences that cannot be controlled for (e.g., sex, height, and weight) are likely to be as frequent in one experimental group as they are in the other.

It should be noted that the term “treatment group” is related to the term “experimental group,” but they are not synonymous. Experimental groups can be thought of as a subset of treatment groups, i.e., groups formed by research scientists before administering the treatment or intervention of interest. Treatment groups can be formed retrospectively. For example, a research scientist may wish to collect follow-up data for patients who received two kinds of intervention for the same illness or condition. A simple example might be to determine the percentages of patients still alive 10 years following the

cessation of Treatment A and Treatment B, two treatments given for the same serious condition. Such individuals could be classified as Treatment Group A and Treatment Group B. A meaningful comparison in this case would require the identification of groups of patients who were as similar as possible in every other regard except which treatment they received, a challenge common to many retrospective research strategies.

Cross-References

► [Experimental Designs](#)

References and Readings

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Explanations

► [Attribution Theory](#)

Explanatory Models of Illness

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Definition

This term refers to the manner in which patients explain their health conditions and consequences. Much theoretical work has been done in health psychology/behavior medicine on this topic, and it has been applied to prediction of patient coping and adherence with treatments and to prediction of disease outcomes. An important part of appraising an illness is making sense of it, and patients often search for causes to which they attribute the onset of an illness. As such,

these “explanations” reflect patients’ explanatory models of illness, in contrast with scientifically based models of illness. One may contrast explanatory models that attribute diseases to physical causes with those that attribute disease to psychosocial causes. They first may include one’s genetic profile, an underlying pathophysiological process (e.g., inflammation), injury, or infectious agents, to mention but a few examples. The second include “stress,” often a generic term referring to a life event or events, one’s mental state (e.g., depression, anxiety, anger) or psychosocial context such as exposure to violence, poverty, or solitude, to mention but a few examples. Murdock (1980) found that among 139 societies worldwide, the prevailing causal attribution of illnesses was psychosocial.

One of the most scientifically tested explanatory models of illness is the Common Sense Model of Leventhal, Diefenbach, and Leventhal (1992). This model is a self-regulation model – people react to and regulate their behavior in light of an illness. The model’s core is a patient’s illness representation – a set of cognitions which guide patients in coping with, making sense of, and adapting to an illness. These cognitions include illness identity (label of a condition and its symptoms), cause (perceived or attributed cause, not necessarily biomedically-based), timeline (expected duration of an illness), consequences (physical and social consequences), and curability/controllability (extent of doctor and patient control over the illness). Illness representations, the core of patients’ explanatory model, are dynamic and change over the course of one’s experience with an illness. This model has been tested in relation to coping and outcomes of arthritic patients, psoriasis, multiple sclerosis, cardiac surgery, to name but a few examples (e.g., Hale, Trehan, & Kitas, 2007). Other investigators have proposed that explanatory models of illness are part of a cultural context of making sense of illness, deriving from one’s personal and social experiences. Yet, these models can often exacerbate rather than ameliorate, especially medically unexplained somatic symptoms (Kirmayer & Sartorius, 2007). Thus, while explanatory models of illness are pivotal to

understanding how people understand and cope with their illnesses, these can have important implications for their well-being. Hence, explanatory models of illness can also be targets of therapeutic interventions.

Cross-References

- [Common-Sense Model of Self-regulation](#)
- [Illness Perceptions Questionnaire \(IPQ-R\)](#)

References and Readings

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Explanatory Style

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Definition

This term refers to the manner in which people explain events in their lives and is considered a trait characteristic. Stemming from the pioneering work on learned helplessness by Overmier and Seligman (1967), this phenomenon became important for its relevance to learning and to the understanding of the etiology of depression. Animals initially exposed to uncontrollable stress generalized their lack of control to a controllable stressful situation, manifesting what was termed “learned helplessness.” Such

animals even continued to receive adversities (e.g., small shocks) with little attempt to control them, though they were in a novel but controllable situation. However, when extrapolating similar studies to humans (mostly using uncontrollable noise stress), it was found that not all people developed learned helplessness. In an attempt to explain this outcome, Abramson, Seligman, and Teasdale (1978) found that people exposed to uncontrollable stress, and who attribute this stress to internal and stable causes which have global effects on their lives, develop learned helplessness and later depression. This pattern of cognitions including internal, stable, and global attributions for negative events was termed “explanatory style.” This theoretical change reflected the consideration of a situation \times personality interaction in relation to outcomes.

In 1986, Sweeney, Anderson, and Bailey (1986) reviewed over 100 studies with various methodologies on explanatory style and depression. They found that following a negative uncontrollable stressor, people attributing its cause to an internal (rather than external cause), a stable (rather than unstable) cause, of global implications (rather than specific implications), had greater risk of depression. Conversely, people attributing a positive event to external and unstable causes of specific implications are also at risk for depression. The construct can be assessed in several manners, namely, by the Attribution Style Questionnaire (Peterson et al., 1982) or by using the Content Analysis for Verbatim Explanations (CAVE, Schulman et al., 1989) to analyze written texts.

The concept of explanatory style has received important predictive validity, some of crucial relevance to behavior medicine. For example, a study by Peterson, Seligman, and Vaillant (1988) found that a negative explanatory style predicted risk of physical illnesses, over a 35-year follow-up period. In that study, explanatory style was based on open-ended questions, completed by Harvard University students when they were at age 25. Pessimistic explanatory style predicted more risk of poor physical health at the ages of 45–60, after controlling statistically for baseline physical and mental health.

Another study found that a negative explanatory style predicted higher risk of nonfatal and fatal myocardial infarction (MI) in the Normative Aging Study (Kubzansky, Sparrow, Vokonas, & Kawachi, 2001). In contrast, Tomakowsky, Lumley, Markowitz, and Frank (2001) found that a negative explanatory style predicted a smaller decline in CD4 counts but more subjective symptoms in HIV patients. Thus, more evidence supports the notion that a negative explanatory style predicts poor health; though in some samples, this is not the case. A negative explanatory style can also serve as a framework for cognitive interventions in treating depressive people, given the relative consistent role of explanatory style in depression and given its clear structure and functions.

Cross-References

► [Depression: Symptoms](#)

References and Readings

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Expression Pattern

► [Gene Expression](#)

Expressive Writing and Health

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Synonyms

[Written disclosure](#)

Definition

Expressive writing is a form of therapy in which individuals write about their thoughts and feelings related to a personally stressful or traumatic life experience. Expressive writing is sometimes referred to as written disclosure, because writers are instructed to disclose personal information, thoughts, and feelings. Unlike communicative forms of writing, expressive writing is personal, free flowing, and informal, often without concern for style, spelling, punctuation, or grammar.

Description

Origins

Expressive writing resembles journaling, which had its heyday the 1970s following the publication

of Ira Progoff's book, *At a Journal Workshop*. In the late 1980s, researchers James Pennebaker and Sandra Klihr Beall conducted one of the earliest controlled scientific investigations into the therapeutic effects of expressive writing. In that study, college students in an expressive writing intervention condition wrote for 15 min on 4 consecutive days about the "most traumatic or upsetting experiences" of their lives, while their counterparts in a control group wrote about superficial topics. Students who wrote about the facts and their associated feelings surrounding a life trauma evidenced short-term increases in arousal and negative mood, but also evidenced fewer health center visits months after the writing intervention relative to controls. Subsequently, dozens of studies have investigated the potential power of writing to bring about benefits in behavioral, psychological, and physical health outcomes. In the 1990s and early 2000s, investigators began to focus more on understanding how expressive writing influenced such a broad array of outcomes ranging from preventing depressive symptoms and health center visits for illness to altering immune functioning and working memory. Work on identifying theoretical mechanisms continues to this day, but mostly current research focuses on testing the efficacy of expressive writing for mitigating problems in an ever widening range of populations, including children and various high-risk or clinical populations (Lepore & Smyth, 2002).

Expressive Writing Interventions and Variations

Expressive writing interventions are usually quite brief, consisting of several 15- to 20-min writing sessions spread over multiple days. Benefits have been observed in interventions using just a single writing session or as many as 8 weekly sessions, but there is some evidence that effects are most powerful when the writing sessions last at least 15 min and are repeated at least three times. Typically, investigators instruct participants to write about nonspecific traumas of their choosing, but a growing number of studies have focused on evaluating the potential benefits of writing about specific traumas and stressful life

events (see [Box 1](#) for sample instructions). Whereas writing about major upheavals can be broadly beneficial, focused writing about a specific topic also appears to confer benefits. For example, writing about an upcoming graduate school examination has been shown to reduce depressive symptoms, and writing about breast cancer resulted in greater declines in physical symptoms when compared with control writing.

Whereas the core instructions of writing about one's deepest thoughts and feelings surrounding a traumatic or stressful life event are apparent in most expressive writing studies, investigators have experimented with the procedure in an effort to isolate mechanisms of action or to improve upon the intervention. For example, the writing might be private or shared with an investigator, conducted in a single writing session or multiple sessions, possibly include booster sessions, focus on past or ongoing events, consider either positive or negative aspects of life stressors. In addition, there have been variations in location of writing (e.g., home versus laboratory), as well as mode of writing (e.g., longhand versus typing). It appears that the beneficial effects of expressive writing are robust, resulting in benefits despite variations in instructions, settings, and procedures. The effects of expressive writing are somewhat stronger when people write at home or in a private setting, the outcomes are measured within a month after writing rather than later in time, the writing focuses on recent or previously undisclosed stressors, and the instructions provide directed questions, information on switching topics, and specific examples of what to disclose in writing. Some variations in the writing instructions have little or no effect on the benefits of writing, including the spacing between the writing, the positive or negative valence of the writing, whether the writer or the experimenter selects the topic of writing, or the mode of writing.

Effects of Expressive Writing

As shown in [Box 2](#), the effects of expressive writing interventions are quite broad. Scholars have examined the impact of expressive writing on physiological functioning, self-reported health

Box 1. Sample Expressive Writing Instructions**A. Writing About Self-identified Stressors**

For this writing exercise, please write for 15 min about your very deepest thoughts and feelings about the most traumatic experience of your life or an extremely important emotional issue that has affected you and your life. In your writing, really let go and explore your deepest thoughts and feelings. You might tie your topic to your relationships with others, including parents, lovers, friends or relatives; to your past, your present or your future; or to who you have been, who you would like to be, or who you are now. You may write about the same or different issues, experiences and topics each day. All of your writings will be confidential. Don't worry about spelling, grammar or sentence structure. The only rule is that once you begin writing, you continue until the time is up.

B. Writing About Specific Stressors

For this writing exercise, please write for 15 min about your deepest thoughts and feelings concerning your cancer. For example, you might write about the various ways the cancer has changed your life, what your life was like before the diagnosis, after diagnosis, during treatment and now. For some people, dealing with a cancer diagnosis is just one of many stressors in their life. You do not have to limit your writing to how cancer has affected your life. You may focus on other highly upsetting experiences in your life. The most important thing is that you should explore your very deepest emotions and thoughts. All of your writings will be confidential. Don't worry about spelling, grammar or sentence structure. The only rule is that once you begin writing, you continue until the time is up.

and health behaviors, psychological well-being, attitudes, and general life functioning. Meta-analytic reviews have revealed modest but significant effects of expressive writing across diverse outcomes and populations (Frattaroli, 2006; Frisina, Borod, & Lepore, 2004). Recent work has extended earlier investigations by studying the effects of expressive writing on outcomes as varied as emotional intelligence, workplace incivility, homesickness, caregiving stress, and gay-related stress.

Both objective and subjective indicators of physical health have been examined in response to expressive writing. Some of the most striking effects of expressive writing interventions are on physiological outcomes, including immune parameters (e.g., IL-8, CD8, T-helper lymphocytes, T-cytotoxic lymphocytes, Epstein-Barr antibodies), HIV viral load, and liver functioning. What is not yet clear is whether the changes in the immune parameters and other biomarkers are

clinically meaningful. The evidence linking expressive writing to other theoretically plausible and objective biological outcomes has not always been positive, with some studies failing to find significant effects on outcomes such as blood lipids, blood pressure, lung capacity, heart rate, strength, joint condition, and body composition. Effects on self-reported physical health are fairly robust. Expressive writing reduces health-care utilization, pain, somatic illness symptoms (e.g., upper respiratory illness symptoms), disease severity ratings, and illness behaviors. However, with the exception of some studies that have found effects of writing on a healthy diet, most analyses have failed to show effects on health behaviors, including physical activity, substance use, sleep, and adherence to medical treatment. Thus, health behaviors are not likely mediators of the health benefits of expressive writing interventions.

In general, the effects of expressive writing on psychological health and well-being are weaker

Box 2. Observed Benefits of Expressive Writing

- A. Physical health and physiological functioning.
 - 1. Objective measures
 - Immune parameters
 - HIV viral load
 - Liver functioning
 - 2. Subjective measures
 - Health care utilization
 - Pain
 - Disease severity ratings
 - Illness behaviors
- B. Psychological well-being.
 - Depression
 - Positive attitudes
 - Positive mood
- C. Role functioning and related outcomes.
 - 1. Work-related behaviors
 - Re-employment
 - Absenteeism
 - Incivility in the workplace
 - 2. Social relationships
 - 3. Cognitive functioning
 - Working memory
 - Reaction time
 - 4. School outcomes
 - Grade point average
 - Adjustment to college life
 - Adjustment to high school

than for physical health. Studies of psychological well-being have included assessments of depression, positive and negative mood, anger, aggression, grief, distress, anxiety, post-traumatic stress and growth, dissociation, adjustment to school, coping, cognitive schemas, and emotion regulation. Consistently strong effects have been observed for depression and positive attitudes and mood; effects are equivocal for post-traumatic growth and for anxiety, with some studies showing heightened anxiety in response to writing and others showing reductions in anxiety. There is no evidence that expressive writing has reliable effects on coping, cognitive schemas, or self-regulation.

As research on expressive writing has blossomed, scholars have extended outcomes beyond physical and psychological well-being to include broader indicators of functioning. There is strong evidence that expressive writing interventions affect work-related behaviors such as reemployment, absenteeism, and incivility in the workplace; the quality of social relationships, including forgiveness; cognitive functioning such as working memory and reaction time; and school outcomes, such as grade point averages and adjustment to college life.

Who Benefits from Expressive Writing?

One way to understand who benefits from expressive writing is to examine the kinds of populations that respond favorably to the intervention. Many of the early studies on expressive writing focused on nonclinical populations. Indeed, healthy college students have been the subjects in numerous expressive writing studies. In the past 15 years, though, an impressive number of clinical trials have been conducted involving high-risk and clinical populations, and even youth. Another way to understand who benefits from expressive writing is to look for subgroups of writers in intervention studies who benefit relatively more or less than other writers in the intervention.

Expressive writing interventions have been applied to populations confronting a wide range of clinical health problems, including cancer, arthritis, asthma, post-traumatic stress disorder, HIV infection, cystic fibrosis, chronic pain, and sleep disorders. There is evidence of benefits of writing in clinical populations, but it is mixed. For example, one expressive writing intervention study showed improvements in lung function and physician-rated disease severity, respectively, in participant with asthma or rheumatoid arthritis. However, these findings have not been replicated in follow-up studies. Perhaps the most frequent clinical population targeted for expressive writing interventions has been cancer survivors. The results have been mixed. Some studies have reported select benefits in cancer populations, such as reduced postoperative medical illness visits in good prognosis breast cancer survivors,

better sleep quality among renal cancer patients, and reduced pain perception among prostate cancer survivors; yet just as many studies have reported absolutely no significant benefits of expressive writing. In only a few trials with clinical populations, specifically participants with post-traumatic stress disorder, have possibly serious adverse effects been identified. It is possible that for psychiatric populations writing should be guided by a therapist and used only as an adjuvant to more traditional therapies. The vast majority of studies with clinical populations suggest that it is a safe intervention, if not particularly powerful and reliable. The quality of the interventions, writing instructions, measured outcomes, settings, and time to follow-up vary tremendously from one clinical trial to the next, so the evidence of the efficacy of this intervention with clinical populations is still inconclusive.

Although most expressive writing interventions are conducted with adults, there are a growing number of randomized clinical trials that have been conducted with children and adolescents. Approximately half of these trials have been conducted with clinical populations outside of the school context; the remaining trials have been conducted in a school context with general populations of youth. The findings with youth have not been as promising as findings with adults. Across studies, effects of writing on internalizing symptoms have been equivocal, with fewer than half of the trials reporting improvements on measures of psychological well-being. With respect to indicators of physical health, no study has reported improvements in somatic complaints due to writing, but several studies with small samples have reported improvements in functional ability and declines in medical and emergency room visits. Some of the equivocal findings with youth may be due to use of writing with youth who do not have the cognitive capacity to process their stressful experiences. Additionally, youth who are not dealing with significant stressors may see their anxiety increase in response to writing interventions. Because writing uses few resources and fits into normal school activities, there is a potential for writing interventions to have a large impact on

school populations provided that it is used with youth who have experienced significant stress and have the cognitive capacity to process their stressful experiences.

Individual studies and meta-analytic reviews have investigated whether specific subgroups of writers benefit more or less from the intervention, or whether identifiable factors alter or moderate the effects of expressive writing on outcomes. One problem with such analyses is that they cannot establish cause-effect relationships because other unmeasured variables might explain any observed differences between subgroups. Nonetheless, as evidence on subgroup differences and moderators accumulates, it might suggest feasible targets for intervention and methods for improving upon the intervention. Analyses in this vein have shown that a number of factors do not appear to alter the effects of expressive writing, including participant age, ethnicity, education level, severity of stressor or trauma, baseline psychological health levels, negative affectivity, and level of inhibition or prior disclosure status. One caveat, however, is that not all studies that have examined individual moderators have had adequate representation within all the levels of the subgroups, so it is possible that future research will derive different conclusions. Other factors do appear to make a difference, but the evidence is mixed, since effects fail to replicate or have not yet been investigated in multiple studies. There is some evidence that the individuals who benefit the most are male, have higher stress or physical health problems prior to writing, have lower optimism, perceive that they are socially constrained in talking about their stress, have no difficulty in identifying and labeling emotions, and do not habitually repress negative emotions.

How Does Expressive Writing Work?

There are two dominant theoretical models to explain the array of beneficial effects of expressive writing, the disinhibition model and the self-regulation model. Relatively few studies have directly tested the theoretical mechanisms explaining the benefits of expressive writing, and evidence on the validity of all of the

mechanisms is mixed (Lepore & Smyth, 2002; Sloan & Marx, 2004).

The disinhibition model is based on the notion that individuals inhibit or avoid thoughts, reminders, and feelings of traumatic life events because they are distressing and can evoke negative social responses. Inhibition potentially influences health via the chronic physiological strain and arousal caused by the work of inhibition. Expressive writing theoretically counteracts the adverse effects of inhibition by encouraging individuals to disinhibit themselves by disclosing their deepest trauma-related experiences and associated thoughts and feelings. Numerous writing studies have challenged this model. For example, individuals writing about non-inhibited future events, such as an upcoming graduate school entrance examination, reported significantly lower depressive symptoms than controls. In addition, the benefits of expressive writing appear to be equivalent whether individuals write about previously disclosed or non-disclosed traumas, or write about positive or negative aspects of past traumas.

The self-regulation model is based on the notion that individuals who have excessively high or low levels of control over their emotions have an elevated risk for health problems due to the pathophysiological effects of emotion dysregulation. Research supports the notion that emotion regulation relates to health outcomes. For example, there is evidence that the inhibition, or non-expression, of anger is associated with heightened physiological arousal, which appears relevant to cardiovascular health. However, there is also evidence that individuals with little control over their expression of anger have heightened levels of physiological arousal and risk for cardiovascular disease. Individuals who are optimally regulated in their expression of anger may be at the lowest risk for health problems. According to the self-regulation model, individuals experiencing stressful life events need to strike a balance between emotionally overreacting and underreacting. Expressive writing is thought to facilitate emotion regulation processes by directing attention, facilitating habituation, and aiding in cognitive restructuring.

Briefly, by directing attention to different aspects of a stressful experience and one's emotional response and thoughts, expressive writing increases habituation (desensitization) to the negative thoughts and feelings associated with the stressor and potentially allows for the creation of new and less-threatening appraisals and feelings to be attached to the memories of the stressor. Consistent with this theory, there is evidence that expressive writing desensitizes individuals to stress-related thoughts. In addition, there is evidence that expressive writing can reduce stress-related intrusive thoughts, which may be symptomatic of incomplete cognitive processing of stressors. This evidence, however, is not consistent across studies.

Additional research is needed to better understand how expressive writing results in positive social, behavioral, and health outcomes. Although scholars have posited a variety of plausible social, psychological, and biological mechanisms, empirical evidence does not strongly support or rule out any particular explanation. All of the identified mechanisms may be sufficient to influence the outcomes linked to expressive writing, either directly or indirectly. It is likely that there is no single mechanism of action given the diversity of outcomes studied and the mixed evidence on each mechanism.

Cross-References

► [Stress](#)

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Ex-Smokers

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Synonyms

Former smokers; Past smokers; Previous smokers

Definition

The term ex-smoker refers to an individual who has given up (i.e., quit) cigarette and/or tobacco smoking. Ex-smokers were previous current smokers, but are no longer smoking.

Tobacco smoking is defined as the practice of burning and inhaling tobacco, and cigarette smoking is the most common form of tobacco smoking. National surveys define a current smoker as an individual who has smoked at least 100 cigarettes in their lifetime and currently smokes on at least some days.

Description

Cigarette smoking is the most important modifiable risk factor for chronic disease; yet, there is not a consensus in the way smoking status is classified. The harmful effects of cigarette smoking on various health outcomes have been determined by comparing individuals who are (1) current smokers, (2) ex-smokers, and/or

(3) never smokers. Therefore, the definition of an ex-smoker is important for making cross-study comparisons regarding the health consequences of smoking and cessation. Most national surveys ask whether a person has a history of smoking 100 lifetime cigarettes *and* whether they currently smoke on some days. Respondents who indicate “yes” to the first question and “no” to the second are categorized as ex-smokers. Other research specifies a time period of smoking cessation needed for ex-smoker classification; however, that time (e.g., 1 day, 1 week, 3 months, 5 years, etc.) varies across studies. Nonetheless, results of studies comparing current smokers with ex-smokers have shown unequivocally that quitting smoking, for even a relatively short time period, decreases the risk of chronic disease.

Because there is unquestionable evidence that cigarette smoking is the leading preventable cause of multiple cancers (e.g., lung and esophageal), heart disease, and stroke, attention has focused on the specific effect quitting smoking has on health. The evidence shows that quitting, even after an extended period of smoking, decreases the risk of associated illnesses. Moreover, the disease risk decreases as the number of years since quitting increases. The 1989 US Surgeon General’s report indicated that after 10 years of smoking cessation, the risk of lung cancer is decreased by almost 50% (Centers for Disease Control and Prevention, 1989). Still, ex-smokers continue to have an increased risk of developing a chronic disease compared to never smokers. In comparing the three groups on chronic disease risk (i.e., current smokers, ex-smokers, and never smokers), ex-smokers have a reduced risk compared to current smokers, but they have approximately twice the risk compared to never smokers (Ebbert et al., 2003). The absolute risk of lung cancer remains higher among ex-smokers than never smokers even after smoking cessation (Halpern, Gillespie, & Warner, 1993). However, the excess chronic disease risk for an ex-smoker is reduced to that of a never smoker after 15 years of abstinence. Additionally, Thornton, Lee, and Fry (1994) found that recent ex-smokers were similar to current smokers in the prevalence of chronic

disease risk factors (e.g., low vegetable consumption); and ex-smokers who were smoke-free for 20+ years (i.e., long-term ex-smokers) were similar to never smokers. Compared to current smokers, ex-smokers are more likely to engage in healthy lifestyle behaviors (e.g., attempting to lose weight, cutting down on fatty foods, and increasing vegetable consumption; Thornton et al., 1994), which may further reduce chronic disease risk.

Relapse prevention is important for ex-smokers, considering that approximately 90% of people who quit return to smoking within one year (Brandon, Tiffany, Obremski, & Baker, 1990; Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992). Although the risk of relapse after a long period of time (i.e., 6–12 months) is relatively low, smoking even one cigarette after quitting is likely to lead to a full relapse. Even with the vacillating status of many ex-smokers, approximately 10% of those who relapse are able to quit again permanently in the future (Wetter et al., 2004). Therefore, interventions for relapse prevention among ex-smokers have been designed and evaluated. A systematic review by Agboola, McNeill, Coleman, and Bee (2010) found that bupropion and nicotine replacement therapy (e.g., the nicotine patch, nicotine gum, and nicotine lozenge) are efficacious in preventing relapse among ex-smokers who quit smoking using such aids. Self-help materials may also be useful in preventing relapse among ex-smokers who quit smoking on their own (Brandon et al., 2004).

In summary, ex-smokers reduce their risk of chronic disease the longer they abstain from smoking. Because exposure to smoke causes significant harm to the body, ex-smokers still have an increased risk of several diseases compared to those who have never smoked. Over time, however, successful ex-smokers are comparable to never smokers on several risk factors for chronic disease.

Cross-References

- Smoking and Health
- Smoking Cessation

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Extended Life Orientation Test (E-LOT)

- Optimism and Pessimism: Measurement

External Locus of Control

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Synonyms

Helplessness; Low self-efficacy

Definition

External locus of control is the belief that one's behavior will not lead to valued reinforcement that is available in the environment and therefore not under one's control. The occurrence of reinforcement is believed to be a function of factors out of one's control such as luck, chance, or randomness.

Description

External Locus of Control

External locus of control anchors one end of a continuum of the locus of control construct with the other end anchored by internal locus of control. The construct developed out of work by E. Jerry Phares and Julian Rotter in the 1950s at Ohio State University and was influenced strongly by Alfred Adler's earlier work on striving for superiority. Feelings of inferiority were thought to be associated with externality. Rotter published his initial paper containing the external locus of control construct in 1966 that included the now famous Internal-External Locus of Control Scale (I-E) to measure the locus of control construct. It has subsequently become one of the most frequently cited papers ever published in psychology. The construct was embedded in Rotter's social learning theory and reflects his strong belief in the importance of theoretical frameworks. Some research over the years has been criticized because of the tendency to use

the scale and the construct in a manner disconnected from their theoretical home.

External locus of control is defined as the belief or expectation that one's behavior will not lead to valued reinforcement that is available in one's environment; rather, the occurrence of reinforcement is a function of factors out of one's control such as luck, chance, or randomness. In Rotter's terms, external locus of control is a generalized expectancy, meaning that across a range of situations, people who are externally oriented, would have the expectation that control over reinforcements lies outside of their control. In its simplest form, the potential for any behavior to occur is a function of the expectation for reinforcement and the value of that reinforcement. Early in his work, Rotter represented that by the equation $BP \text{ (behavior potential)} = f(E \text{ (expectation)} \times RV \text{ (reinforcement value)})$.

External locus of control is commonly measured or assessed by the Internal-External Locus of Control Scale. The original scale has 29 items, including 6 filler items, in a forced choice format that requires subjects to agree or disagree with statements. High scores are in the direction of externality. Two examples of "external items" are: *I have often found that what is going to happen will happen* and *Getting a good job depends mainly on being in the right place at the right time*.

Not surprisingly, since creating new tests seems to be one of the things that psychologists do best, many scales have been spawned to measure the construct of locus of control since Rotter's original scale was published. Some of these have been developed as a result of dissatisfaction with the forced choice format and other methodological issues. Others have been developed for use with specific populations or environments such as with children, medical patients, and organizational settings.

Many dissertations and published research papers have included the external locus of control construct. This widespread interest probably reflects our almost natural inclination to be interested in our fate and factors that influence it. Examples of some of the research results on externality are that external locus of control has

been related to low self-efficacy, low self-esteem, helplessness, depression, low achievement motivation, low risk-taking, less independent thinking and greater conformity, and less creativity.

Of particular interest to researchers has been the question of the role that external locus of control plays in the maintenance of health and the adjustment to illness. For the past 30 years, numerous patient populations, both acutely and chronically ill, have been studied to learn about the impact of externality on their illness experiences. The findings generally lend support to the notion that externality influences illness experiences, but the results have not been consistent across patient groups. For example, externals have been found to ask fewer questions of health-care staff and have less information about their illnesses. But other research has found that at least with certain chronic illnesses, such as, diabetes, externals are about as informed as internals. An interesting line of research pursued the idea of matching treatment approaches in a congruent manner with locus of control orientation. For example, it has been found that there is little difference in cardiac rehabilitation outcomes when externals who are in a highly structured and regimented program are compared to internals who are involved in a more self-directed program. However, the inconsistency in research outcomes and very modest association of locus of control to health and illness behaviors clearly suggests that many factors, including the nature of the illness itself, interact with locus of control and influence health behaviors. This conclusion, that many variables interact with locus of control, also holds for health maintenance behaviors for which it may be intuitive to think that externals would be less likely to engage in preventive measures.

A notable contribution to this literature, and the subject itself of considerable investigation, is the Multidimensional Health Locus of Control Scales by Wallston. The MHLC is a group of three scales intended to assess beliefs about health status control and beliefs about control over illness and disease. Numerous other disease-specific scales (e.g., cancer, diabetes, pain) to measure external locus of control have been developed in recent years.

Cross-References

► [Locus of Control](#)

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Extrinsic Religiousness (Religiosity)

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Definition

Extrinsic religiousness (initially and still sometimes referred to as extrinsic religiosity) is characterized as religion that primarily serves other more ultimate ends rather than central religious beliefs per se. Thus, individuals described by extrinsic religiousness use their religion to fulfill more basic needs such as social relations or personal comfort, but “the embraced creed is lightly held or else selectively shaped to fit more primary needs” (Allport & Ross, 1967, p. 434).

Description

Extrinsic religiousness was first described by Gordon Allport and colleagues in the 1960s (see Allport & Ross, 1967) when investigating the possible reasons for discrepant findings in the area of religiousness and prejudice. At that time,

some studies demonstrated that religiousness was positively associated with prejudice, whereas other studies found the opposite. Allport hypothesized that one's religious orientation, or sentiment, may provide guidance in sorting out these findings. The construct of religious orientation was later clarified by Gorsuch (1994) to be a motivational variable.

Extrinsic religiousness has often been measured by the Religious Orientation Scale (Allport & Ross, 1967). More recently, Gorsuch and McPherson (1989) developed the I/E-Revised scale as a more psychometrically sound instrument. Based on previous work (Kirkpatrick, 1989), Gorsuch and McPherson anticipated, and subsequently verified, two subscales on the extrinsic scale, extrinsic-personal (Ep) and extrinsic-social (Es). A prototypic Ep item is "What religion offers me most is comfort in times of trouble and sorrow" and for Es "I go to church mainly because I enjoy seeing people I know there." Scholars in the psychology of religion have debated the relative strengths and weaknesses of the religious orientation construct (e.g., Kirkpatrick & Hood 1990; Masters, 1991), but it remains the most empirically investigated and heuristic construct in this area of work. Investigators attempting to determine the relations between religion and health have also turned to religious orientation. Smith, McCullough, and Poll (2003) in a meta-analytic study found that extrinsic religiousness was associated with higher levels of depressive symptoms. Similarly, Masters and Bergin (1992) provided a narrative review of the literature and found extrinsic religiousness to be related positively with depression, anxiety, and obsessive-compulsive symptoms, whereas McCullough and Willoughby (2009) reported that extrinsic religiousness may be negatively related to self-control. Recent investigations found extrinsic religiousness related to greater laboratory-induced cardiovascular reactivity in older adults (Masters, Hill, Kircher, Lensegrav Benson, & Fallon, 2004), and Masters and Knestel (2011) found that among a random sample of community dwelling adults, those characterized by extrinsic religiousness were more likely to be divorced, reported overall worse

health, higher body mass index, greater cigarette use, and a higher number of daily drinks of alcohol than did those characterized as intrinsically religious. There were no differences in the percentages of individuals who were classified as extrinsically religious based on religious denomination. Nevertheless, it is not entirely clear how extrinsic religiousness may interact with religious denomination, and some have suggested that the construct, as currently conceptualized and measured, is more congruent with Protestant notions of religiosity and perhaps most appropriately applied to this religious group (Cohen, Pierce Jr., Chambers, Meade, Gorvine, & Koenig, 2005).

Cross-References

► [Intrinsic Religiousness \(Religiosity\)](#)

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Eye Tracker

► [Eye Tracking](#)

Eye Tracking

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Synonyms

[Eye tracker](#); [Gaze tracking](#)

Definition

An eye tracker is a computerized system used to record the activity of eye movements and visual overt attention, hence making it possible to study human behavior. Data obtained from an eye tracker session is useful for testing everything that could be visually observed.

Description

Eye tracking as a means of measuring and monitoring eye movements is widely used in different fields of human behavior research, for example, cognitive psychology, psycholinguistics and reading research, neurophysiology, ophthalmology, usability and human-computer interaction studies, and market research.

Eye Movement Measurement Methodologies

There are four eye movement measurement techniques (Duchowski, 2003) as follows:

- Electrooculography (EOG) – eye movement recording method commonly used in the 1970s. It is based on measuring potential differences of electrodes placed on the skin close to the eye.
- Sclera Contact Lens/Search Coil Lens – an old and very precise eye movement-measuring method based on a contact lens placed on the eye with a reference object, for example, wire coil, attached to the lens.
- Photo-oculography (POG) or Video-oculography (VOG) – a number of eye movement-recording methods based on measurement of different features of the eyes such as shape of the pupil, position of the limbus, etc. The above mentioned methods mainly measure the position of the eye relative to the head.
- Video-Based Combined Pupil-Corneal Reflection (Remote Eye Tracking) – noninvasive eye tracking methods providing measurement of position of the eye in space (not relative to the head). This technique is widely available and most suitable for eye tracking in real time.

Basic Operating Principles of Remote Eye Trackers

Remote eye trackers, that is, Pupil-Corneal reflection eye trackers, use infrared diodes to generate reflection patterns on the corneas of the studied person's eyes. The system uses image sensors to collect images of the eyes and

Eye Tracking,**Fig. 1** Remote eye tracker
Tobii T60XL

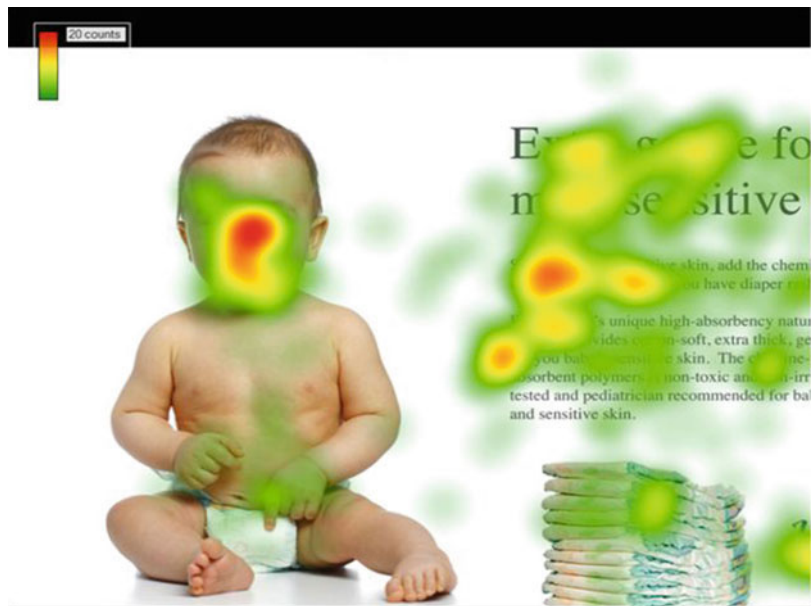
the reflection patterns. Sophisticated image processing algorithms identify relevant features, including the eyes and the corneal reflection patterns. Complex mathematics is used to calculate the position of each eyeball and finally the gaze point, in other words, where and on what the person is looking. The development of eye trackers is based on present neuroscience knowledge. Here the brain's physiological and functional processes represented of the Mango- and Parvo-cellular pathways are of great importance (Duchowski, 2003).

The performance of an eye tracker can be described in terms of gaze accuracy and precision, and track robustness. Accuracy describes the angular average distance from the actual gaze point to the one measured by the eye tracker. Gaze precision describes the spatial variation between successive samples collected when the person fixates at a specific point on a stimulus, for example, an image on the screen (Duchowski, 2003). Sampling rate and Latency are also important characteristics: the first one determines how fast the movement of the eye is measured; the second determines how fast the gaze point information from the eye tracker is obtained (important for gaze contingency and interaction).

The most commonly used systems for investigation of eye movements are categorized into eye tracking systems for human-computer interaction and diagnostic use of eye movement analysis. The interactive systems include selective and gaze-contingent systems and the latter are either screen-based or model-based. Examples of eye tracking systems usage are shown in Figs. 1–3.

Applications

Eye tracker systems are used to study human visual behavior by measuring gaze parameters like (a) fixation duration in milliseconds (gaze time and/or gaze fixation time), (b) average number of fixation points lasting between 200 and 300 ms, (c) saccade duration in milliseconds, that is, quick, simultaneous movements of both eyes, (d) proportion of left-to-right saccades, (e) proportion of saccade regressions and proportion of vertical saccades, (f) pupil dilation, (g) number of blinks, (h) smooth pursuit, (i) occurrence of nystagmus, (j) attention, and (k) inattention priority. The recorded data is statistically analyzed and graphically rendered and applied to measure visual search efficiency, priority, navigation usability, and real observing

Eye Tracking,**Fig. 2** Head-mounted eye tracker Tobii glasses**Eye Tracking,****Fig. 3** Example of a result of a marketing study: heat map

time of signs, letters, pictures, and figures in various communication systems or revealing inattention during work or driving.

Eye tracking is used to answer an endless array of *scientific research* questions regarding animal habits, for example, for studying chimpanzees' face scanning patterns (Kano & Tomonaga, 2010) and human visual habits. The human research is performed in the fields of behavioral medicine; linguistics; ophthalmology; cognitive, developmental, and behavioral psychology; and neurophysiology sometimes integrated with electroencephalography (EEG) in real time. For

example, eye tracking technology is applied in developmental research, used as a diagnostic tool, for example, to children suffering from dyslexia, attention deficit hyperactivity disorder (ADHD), and autism, for oculomotor differential diagnosis in neurological disorders, discriminating between Parkinson's and Alzheimer's disease, diagnosis and treatment of neurological disorders, for example, mild traumatic brain injury, schizophrenia, and occurrence of macular degeneration, and in linguistics studies. Studies of fatigue and gaze attention are helpful to understand the effectiveness of work performed by

Eye Tracking, Table 1 Examples of the use of eye tracking systems for scientific investigation of human eye behavior, media and marketing research, usability studies, and as an assistive device

Human scientific research	Human eye behavior studied		References
	Subject	Study summary	
Human scientific research	Neuroscience developmental research	The <i>speed of gaze fixations</i> was investigated during manual feeding and self-propelled feeding demonstrated on video films among 6-month- and 10-month-old babies and adults. The gaze had faster goal fixations when manual feeding was performed. The gaze direction among 10-month babies demonstrated that they were able to understand when the spoon was directed to their mouth and not to an adult feeding herself. Tobii X120 eye tracker, Tobii technology. Retrieved 20110525 http://www.tobii.com ¹	Kochukova and Gredebäck (2010)
	Neuroscience developmental research	A comparative study revealed that children with developmental dyslexia when reading sentences in a Cyrillic alphabet language had more than five times longer <i>gaze fixations</i> to the target words, affecting the reading frequencies and length compared to matched children without reading problems. Tobii X120 eye tracker, Tobii technology. Retrieved 20110525 http://www.tobii.com ¹	Hristova, Gerganov, Georgieva, and Todorova (2010)
	Linguistic research Brain physiology	Seven eye movement variables were investigated: (a) fixation duration in milliseconds, (b) average number of fixations lasting between 200 and 300 ms, (c) saccade duration in milliseconds, i.e., 7–9 letter spaces, (d) proportion of left-to-right saccades, (e) proportion of saccade regressions, i.e., occurrences of re-reading, and proportion of vertical saccades, and (f) total time for reading three sets of words and three sentences. The aim was to understand which variable (a–f) would best discriminate between 6 years and 12 years old children with the diagnoses reading disability and attention deficit hyperactivity disorder (ADHD) compared to a control group of “normal” developed children. There were significant differences between the control group and the disability groups, who showed <i>atypical eye movements</i> for all variables apart from <i>saccade duration</i> . However, the results do not yet support the use of these eye movement variables to distinguish between the groups of participants with reading disorders and ADHD. The View Point Eye Tracker apparatus from Arrington Research ^a	Deans, O’Laughlin, Brubaker, Gay, and Krugay, and Krug (2010)

(continued)

Eye Tracking, Table 1 (continued)

Subject	Human eye behavior studied	Study summary	References
Linguistic research Brain physiology	Visual real gaze time, gaze fixation time, Search efficiency	An experimental study among people with and without dyslexics showed that both phonological and visual brain processes influence the eye movements, i.e., the <i>visual gaze and fixation time</i> when producing automatic naming. However, linear mixed effects analyses demonstrated that dyslexia readers need longer latencies, i.e., time used from observing words to response when performing the tasks	Jones, Obergón, Kelly, and Branigan (2008)
Linguistic research Brain physiology	Attention Glance behavior Eye behavior investigation	The direction of visual <i>attention</i> was investigated among people learning a foreign language. Less inaccurate initial word-referent mapping supports the learning	Fineva and Chritiansen (2011)
Cognitive and behavioral psychology Oculomotor diagnosis in brain damage	Saccadic duration and direction	Ten people with developmental surface dyslexia, who read a short passage, showed an <i>altered pattern of eye movements with more frequent and smaller rightward saccades as well as longer fixation times</i> . The authors concluded that the cause is connected to the brain process and not to a deficit of the function of the oculomotor system	DeLuca, DiPace, Judica, Spinell, and Xocolotti (1999)
Cognitive and behavioral psychology	Saccade performance	Saccadic eye tracking is an effective differential tool among people suffering from Parkinson's dementia disease and dementia with Lewy bodies. The sensitivity was 60% and specificity was 77–88% when reflexive saccade execution and complex saccade performance are used. Tobii X120 eye tracker, Tobii technology http://www.tobii.com and electro-oculograph	Mosimann et al. (2005)
Cognitive and behavioral psychology Oculomotor rehabilitation	Search efficiency	The aim was to improve the reading profile among people with acquired brain damage suffering from error scanning or hemianoptic dyslexia. The training program during 8 weeks included single- and multiple-line-simulated reading and visual tracking, i.e., <i>eye movement fixation, saccade performance, and gaze pursuit</i> . Infrared eye movement technology ¹	Ciuffreda, Han, Kapoor, Ficarra, and Ficarra (2006)

Behavior medicine	Eye behavior investigation of attention. Saccadic behavior	Smoking cues in movie clip affect smokers' attention behavior compared to nonsmokers. The smokers gaze more quickly, more often, and for longer time to the smoking-related cues	Lochbuehler, Voogd, Scholte, Engels, and Engels (2011)
Ophthalmology and vision science	Attention in saccadic search	Attention measured as <i>saccadic search</i> to attributes may be rendered in size, color, or orientation. The study result revealed that size, color, and orientation are not alike in dynamic attribute processing over time which has been the common conclusion drawn from earlier studies. Tobii 1750 eye tracker at 50 Hz sampling rate ^a	Yu (2010)
Assistive devices	Gaze eye pointing	Eye tracking systems are used to <i>control computers</i> by eye pointing and hence used as assistive devices among people with complex motor and language disabilities. MyTobii (PI0) ^a	AbiltyNetGate (2011)
Market investigations	Search efficiency	The efficiency design of websites was compared using a three-layer hierarchical model for analyzing <i>eye-movement</i> data. Consumers switch frequently between attribute-based and product-based acquisition during moment-to-moment decision making of buying a product (e.g., a computer)	Shi, Wedel, and Pieters (2010)
Marketing/Advertising investigations	Search priority	Using eye tracking technology consumers buying behaviors in pub environments were measured in terms of <i>eye movement and gaze preferences</i> . The buying decision process among the consumers was reviled. The results showed that factors in the pub environment, like where the beer taps were placed, the impression of bartenders and various point-of-sale-advertising influenced the consumers' choice of beer	Press release from Carlsberg Sweden (a producer of beer) (2011)
Usability investigations Human factors ergonomic	Navigation usability	The usability, i.e., <i>eye-movement navigation and orientation</i> of five e-reading book devices was tested using an eye tracker. Among the results it was obvious that the mean duration of visual fixations differed significantly between the reading devices	Siegenthaler, Wurtz, and Groner (2010)

^aInformation used in the references

truck chauffeurs, captains, police officers, and air traffic controllers. Moreover, eye tracking provides unique methods to perform *marketing and media research*, for example, evaluate how users and consumers experience and perceive different media like websites and communication messages or make decisions about attractive products in shops and restaurants. The eye tracking technology is extensively used for *usability* studies, on websites, computer applications, games, and other human-made objects. Individually adapted eye tracker systems are used as assistive devices for people with complex motor and language disabilities, making them able to communicate, receive information, and play games by using eye pointing as demonstrated in video filmed cases (AbiltyNetGate, 2011). The recent technological development in the eye tracking field promises that eye movement will be the future way of controlling computers (Norrby, 2008; Wolverton, 2011) and other apparatus in home and work. Among these endless numbers of possible eye tracking applications some publications, emphasizing the various gaze parameters, are shown in Table 1.

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Cross-References

- Cognition
- Social Marketing

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