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Psychology and the Internet: A Social Ecological Analysis

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ABSTRACT

This paper proposes a research strategy based on a social ecological analysis of the Internet and its psychological impact as an option to generate original research to answer the following question: What is the psycho-environmental meaning of the Internet? This paper has two objectives: first, to analyze Computer Mediated Communication (CMC) linked to the use of the Internet from a social ecological approach, and second, to propose some relationships among variables from a social ecological perspective, which can help to clarify the variability and magnitude of the psychosocial effect associated with the Internet. This article is divided into three sections. The first briefly describes the origins and development of the Internet. It identifies some technological features and specifies some of the cutting-edge breakthroughs that have facilitated its expansion. The second section proposes a conceptual scheme from the social ecological perspective, which analyzes the subject–environmental binomial associated with the Internet. It identifies the basic assumption, the conceptual richness, and possibilities for research on the Internet, using a social ecological approach. Finally, the last section describes the scope and limitations of this perspective, and discusses its heuristic utility for the development and consolidation of a new area in psychological research: "digital psychology or cyber psychology."

FROM THE MYTHICAL Tower of Babel to the more recent digital transmission developments, the human being has demonstrated a basic need for communication and information. In the 1960s, Marshall McLuhan[85] said "information is power." McLuhan's vision was a premonition of the impact that access to digital information would have. Dissemination of the Internet, defined as "a large network of computers, a vast collection of information, and a global community of people,"[58] and its components (www, e-mail, asynchronous discussion forum, newsgroups, synchronous chats, multiuser dungeons-MUD, Media-

MOO) have facilitated the appearance of new ways of accessing information and of interpersonal communication. Therefore, together with the potential repercussions associated with the Internet's development, there is a new conceptualization of the world and the use of power.

The impact of the Internet on human functioning has been documented by different disciplines, such as sociology,[24,71,133] politics,[28,50,110] economics,[31] engineering,[63] and most recently, psychology.[6,17,21] In this regard, some of the variables that have been documented include visual perception,[46,92] interpersonal communi-

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cation,[25,84,86,113] learning,[16,33,77] sexual behavior,[26,27,108] and, particularly, clinical effects in terms of possible addiction.[39,88,99,136]

Similarly, the different levels of psychological analysis that have been documented are intrapersonal, interpersonal, and transpersonal.[37] On the intrapersonal level, there are psychodynamic postulates,[41,68] that analyze the level of disinhibition that the Internet promotes, and the alterations that occur in the therapeutic process while substituting face-to-face sessions with written language.[56] In fact, it is assumed that "the self in cyberspace is fragmented and multiple."[101]

On the interpersonal level, the implications of the Internet for human functioning are vast, varied, and sometimes controversial. As an example, a study by Kraut et al.[72] showed that the use of the Internet in an adolescent and adult sample was associated with a decrease in family communication with a reduction in the size of the social network, and also, with an increase in the frequency of depression and loneliness. The Internet has also been used, however, for the development [(http://www.thefutureofbusiness.com/login.cfm) on April 3, 2000] and expansion of business [(http://www.alphacomnetworkmarketing.com/) on April 3, 2000] for health promotion [(http://www.monash.edu.au/health/) on April 3, 2002], for political propaganda and criticism [(http://www.stile.lut.ac.uk/~gyobs/GLOBAL/t0000006.html; http://www.pscw.uva.nl/sociosite/TOPICS/Activism.html) on April 6, 2001], for the development of new educational technologies [(http://www.du.org/; http://www.tapr.org/~ird/Wadbrook/ telementoring/WebQuest.htm) on March 2, 2002], and for scientific dissemination and production of knowledge [(http://scv.bu.edu/; http://www.unesco.org/; http://ajanta.sci.ccny. cuny.edu/~jupiter/pub/com/index.html) on March 16, 2002] among other applications.

From the transpersonal focus, defined as "experiences in which the sense of identity or self extends beyond the individual to encompass wider aspects of humankind, life, psyche, and cosmos",[128] it is argued that the Internet permits the development of consciousness.[100] This type of development is a nonverbal and nonlineal process, which integrates cognition with emotion. From this perspective, the Internet makes it possible to actualize the "Collective Unconscious," and the "self-organizing" of individual intelligence.[38] This implies a co-evolution of technology and human consciousness.[37]

In spite of the proliferation of information about the Internet, there is a paucity of scientific evidence analyzing the components, manifestations, and consequences for psychological functioning with the cybernetic environment represented by the Internet. Little[75] gave the name "environmental experience" to emotional experience linked to a particular place and identified three basic dimensions in the environment: as a source of stimulation, information, and action scenario. It is, however, still necessary to answer the following questions: What is the optimum level of stimulation in the Internet for the user to have efficient, direct access to particular sites with minimum cost in terms of tension? How can the information to be found on the Internet be organized so that it is visible and has an impact on the different audiences that access the network? Which behavioral patterns are linked to the use of the Internet with respect to age, sex, schooling, and culture? In short, what is the psycho-environmental meaning of the Internet? This paper therefore proposes a research strategy based on a social ecological analysis of the Internet and its psychological impact.

This paper has two objectives: first, to analyze Computer Mediated Communication (CMC) linked to the use of the Internet from a social ecological perspective,[15,18,23,119] and second, to propose some relationships among variables from a social ecological perspective, which can help clarify the variability and magnitude of the psychosocial effect associated with the Internet.

This article is divided into three sections. The first briefly describes the origins and development of the Internet. It identifies some of its technological features and specifies some cutting-edge breakthroughs that have facilitated its expansion. The second section proposes a conceptual scheme from the social ecological perspective, which analyzes the subject–environment binomial associated with the Internet. It identifies the basic assumption,

the conceptual richness, and possibilities for research on the Internet, using a social ecological approach. Finally, the last section describes the scope and limitations of this perspective, and discusses its heuristic utility for the development and consolidation of a new area in psychological research: "digital psychology or cyber psychology."[123]

A HISTORICAL CAPSULE: ORIGIN AND DEVELOPMENT OF THE INTERNET

In 1965, Thomas M. Roberts used a low-speed dial-speed telephone line to wire a TX-2 computer in Boston, on the East coast of the United States, with a Q-32 computer in Los Angeles, on the West coast. It was the first Wide Area Network (WAN).[70] Four years later, the Advanced Research Program Agency (ARPA) promoted the first network installation code, called ARPANET, between Massachusetts Institute of Technology (MIT), University of California, Los Angeles (UCLA), and the British National Physical Laboratory (NPL). During the first 2 years, more than 20 universities and government research centers were connected to the web. The growth of ARPANET during the 1970's was slow, however, even though there was a considerable expansion in the use of personal computers (PCs).

In 1989, ARPANET became the Internet, and was conceived as a decentralized web of computers, in which all nodes have the same hierarchy within the web. In 1990, the first web browser software for a Next computer was released. Three years later, in 1993, the University of Illinois released the Mosaic Web browser for the PC, Mackintosh, and X-Windows.[58] In less than one decade, the number of host computers with Internet connections grew from a little more than 1,000 in 1984, to more than one million. It is currently estimated that there are 62 million Internet users in the U.S. alone, and it is calculated that by 2003, this number will increase to 85 million.[127]

From a technological conception,[70] the Internet can be found to contain four central aspects: (1) topology, (2) communication media, (3) access to band-width, and (4) management.

1. *The Internet topology is of an "open architecture" type.* This facilitates access to the web for all computers. Connection takes place through specific interfaces that are determined according to the users' requirements.
2. *Communication media.* The Internet is based on binary language for storage and transmission. Transfers are made through small information blocks, called packages. Since these packages are small, transmission is quick and allows all computers inside the web to have the same hierarchical status.
3. *Access to band-width as a transmission service.* This service is offered by the big communication companies, such as America On Line (AOL), MCI, UUnet, AT&T, and AGIS, and Internet Service Providers (ISPs) depend on such companies.
4. *Management.* The first coordinator of Internet activities was created at the end of the 1970s by the International Corporation Board (ICB), and the Internet Configuration Control Board (ICCB), in conjunction with the European Internet Research Group. As a consequence of the rapid growth of the Internet, different organizations have appeared such as the Internet Society (IS), created in 1992 by nongovernmental scientists and educational professionals. Internet Engineering Task Force (IETF) was established in 1986, with the purpose of defining new engineering protocols to facilitate the development and application of the Internet in different fields of human activities. The Internet Architecture Board (IAB) is the supervisor of the Internet Society which proposes the technical aspects and the standards with which the Internet must comply.

Even though the above classification is useful for understanding the technological aspect of the Internet, it differs from a social ecological analysis in three basic respects: (1) Consideration of the human being as recipient and transmitter of CMC; (2) the human–machine interaction, which occurs within a specific sociocultural context; and (3) the examination of the psychosocial processes implicated in CMC, specifically linked to diffusion of the Internet.

An analysis of the human–environment interaction with respect to the Internet encourages basic neurophysiological research, as well as the study of the psychosocial and economic consequences of Internet usage. For example, because cyberspace alters the temporal, spatial, and sensory components of human interaction, it is necessary to document the extent to which the direction and magnitude of such alterations can affect the neurophysiological and psychosocial functioning of the human being. In constructing spatial meaning, the physical, social, and cultural characteristics associated with the Internet favor the recreation of meanings and the types of interaction between the human being and the cybernetic environment. Since "the environment is emotional territory,"[54] it is pertinent to ask how the characteristics of the Internet, conceived of as a cybernetic environment, promote, maintain or make difficult the manifestation of specific behavioral patterns, such as behaviors of exploration, tolerance to frustration, creativity, perception, information decoding and storage, decision making, attribution and reconstruction of meaning of environment.

Issues such as technological or economic analyses related to the Internet are not given systematic coverage in the ensuing discussion, because they are not part of the psychological framework and can be found in other specialized sources.[1,22,32,80] The core issue in this work is a social ecological analysis of the interaction between the human being and the physical, psychological, and social environment associated with the Internet.

SOCIAL ECOLOGICAL SCHEME OF THE INTERNET

Social Ecology was conceptualized by Alihan[4] as a way to transcend the biotic conception of human organization and develop a more comprehensive view. This approach assumes a biological as well as a cultural interaction and places emphasis "on man in a total social system . . . Its interest, moreover, lies not only in man's relationship to his fellow man, but also in the relationship among the organized components of a system"[15] as could be the case of the Internet.

According to Stokols,[119] five essential postulates characterize the social ecological approach.

Multiple dimensional analysis of people–environment relation

One of the key concepts associated with the Internet from the social ecological approach is space, or environment. From the environment conceptualized as "vital space,"[74] to the cyberspace notion,[123] the environment concept has been a heuristic construct. An analysis of people–environment transactions allows us to understand some of their instrumental or symbolic meanings.[120] For example, conceived as a tool, the environment can promote productivity in work setting,[124,125] and learning or socialization in school environments,[42,49,52] It also can increase stress from crowding as a result of perceiving social, and/or physical information overloading, together with a loss of personal control over the situation.[14,105] The environment can promote the experience of physical or social isolations,[5] contributing in an indirect way to loneliness.[34,57] In contrast, however, the environment can also be considered as a human development setting,[20] with emotional,[64] affective,[60,61] and symbolic[83] components.

The dynamic interaction between the context and the subject's characteristics

In this instance, mention should be made of the perceptual particularities of virtual reality, such as the Internet and some of its variations like video games.[109] According to Suler,[123] virtual reality (VR) has two facets of analysis. On the one hand, there is a sensory–motor reaction associated with direct, physical stimulation of the senses. In Suler's words, "VR is an attempt to exactly recreate the world as we consciously experience it with our eyes, ears, skin, body." There is also, however, a facet of pure imagination which creates new, fantastic environments. In such an environment, people experience a type of "reality", which has no direct association with the physical world. Specifically, it is in this aspect of the Internet—

where the imaginary appears real and reality seems fantastic—that the study of the interrelationship between human beings and the environment offers a potential contribution.

The system's conceptualization from which a binomial human–environmental relationship is analyzed

From a systemic analysis, we can identify functions of mutual interdependence between different levels of sociophysical interaction. A clear example of a systemic notion is Bronfenbrenner´s[18] theory of development. He identifies four levels of environmental interaction as settings for the individual's development: micro, meso, exo, and macro systems. The microsystem is the reciprocal relationship between subject and environment. At this level, the use of the Internet accomplishes the reciprocal feature because it is based on interactivity between user and computer. Furthermore, at this level, it is necessary to take into account that interaction occurs in a particular sociophysical setting (e.g., house, office, school). According to this perspective, it must be considered as a system composed of many interactive subsystems. In this way, an e-mail interaction established between two persons within synchronous or asynchronous time and space could have a potential impact on the interaction these subjects establish with their family subsystem, within real time and space. Bronfenbrenner states,[18] "such larger systems must be analyzed in terms of all possible subsystems (i.e., dyads, triads, etc.) and the potential second and higher order effects associated with them."

Within the mesosystem, a mutual relationship between settings is essential. The potential interdependencies that occur between diverse settings now make analyses possible using CMC. For example, changes in the properties of systems associated with ecological transitions within real and synchronic settings have been proven in psychological development studies.[2,3,116] In contrast, distance learning initiatives demonstrate that, through the Internet, students can acquire knowledge, interact in social terms, and can substitute physical encounters with virtual settings.[43,117] Now we can raise some research questions: What effects will the transitions taking place within the Internet's different modalities have on a subject's psychological adaptability? Does the same emotional and cognitive adaptation occur whether a subject surfs the web, interacts in a chat-room, or establishes an interpersonal communication via e-mail?

The exosystem refers to the dynamic interrelationships established between formal (e.g., health systems, government agencies, transport systems) and informal (e.g., school, home, social groups) systems. These systems have a potential effect on the physical functioning and psychosocial adaptation of the subjects. The "digital divide" [(www.pbs.org/digital) on April 3, 2002] represents an example of how the exosystem's characteristics facilitate or impede the social diffusion and cognitive appropriation of the new technologies. Clearly, subjects residing in rural areas within developing countries or low-income communities in the U.S. have fewer opportunities to access the Internet, compared with high-income citizens living in developed countries. This situation is not related to the cognitive capacities of particular individuals. Indeed, the social impact of this "digital divide" can have repercussions on an individual level by reducing the opportunities of information for poor people, thereby reproducing vicious circles of continuous poverty.

Finally, the macrosystem considers the ideological, cultural, and subcultural profile that influences the subject's psychosocial development. It is interesting to note that in 1997, among the 15 countries with the highest Internet usage, Brazil only had 0.86% of the users of the Internet, whereas the United States had 54.70%.[58] None the countries of the Middle East, Africa, India, nor the majority of the Latin American countries show a significant percentage of Internet usage. This profile is evidence of the underlying economic inequalities associated with the "digital divide". In this regard, we must ask whether the associated pathologies of Internet usage—such as cyberaddiction and cybersex—are products of electronic access, or merely symptoms of industrialized societies.

Interdependency between subjects and their sociophysical milieu

The fit or congruence between the subjects' characteristics and the features of their context is crucial for their optimal functioning. For example, the use of the Internet by people who are either introverted or shy will be a medium that masks their social inabilities.[136] In contrast, the use of the Internet by people who prefer to socialize face-to-face may represent an opportunity for them to increase their social network.[113] With both introverts and extroverts, the consequences are similar; that is, an increase in their social network. The underlying psychological processes between these groups are different, however. In the case of introverts, the Internet is used as a medium to compensate their lack of social contact; extroverts, on the other hand, use the Internet as a way to optimize[11] their social characteristics. In spite of this, not every introvert uses the Internet frequently, and not every extrovert avoids the Internet. For this reason, the context features in terms of availability, access, and frequency of use are relevant.[66] It would be interesting to conduct studies where the covariation between personality features and the user's Internet preferences could be clarified.

The adoption of an interdisciplinary focus

It is necessary to take a multidisciplinary approach that allows the identification of significant and relevant dimensions oriented to the optimization of the Internet. Optimization here is understood as a "cyclical process whereby individuals not only adapt to the existing situation, but also opt to maintain or modify their milieu in accord with specified goals."[122] Among the relevant dimensions related to the Internet, we can identify the following: complex interactions (intrapersonal, interpersonal, and transpersonal), multiplicity of physical and virtual environments, temporal scope (synchronic vs. asynchronic), social components (idiosyncratic vs. cross-cultural) and variations of the settings (www, chats, e-mail, video games).

In this way, the contribution of neurophysiology is essential to detect the quality of neural receptor reactions to a different visual–space organization. For example, it was shown[93,102] that significant eye movements depend on a rough, brief mental representation, which labels potentially important points in visual space. Moreover, these eye movements have an actualization mechanism that compensates changes occurring in the environment, and those caused by the subject's own movement. Consequently, it is important to document how the sharpness and memory of sights that are seen are associated with efficient discrimination of information via the Internet.[35,59]

On the other hand, psychology would explain the cognitive processes arising from Internet usage[81] such as attention, memory, and learning, in combination with more complex processes, like emotional reactions.[67,90,97,104] In addition, the particularities of the social construction and reconstruction of interpersonal[131] and social[67,107] interaction, which occur in the different settings of the Internet, represent fertile ground for different psychological research areas, including different social disciplines, such as economics, sociology, and anthropology.[65]

It is clear that the Internet not only represents a setting for technological innovation, but it also provides a space for social transformation and self-awareness. Figure 1 shows a scheme that describes some properties of the Internet from a social ecological conceptualization. The type of environment, which can be physical or digital, is combined with the two categories or components of intellectual functioning postulated by Baltes, Staudinger & Linderberger[11]: mechanical and pragmatic cognition. According to these authors, "the mechanics of cognition are constructed as an expression of the neurophysiological architecture of the mind. In contrast, the pragmatics of cognition are associated with acquired bodies of knowledge available from and mediated through culture."[11] This combination of two environmental dimensions and two types of cognition gives rise to different interaction processes.

The utility of the social ecological approach depends on the degree to which it allows the convergence of different theories with the purpose of generating an integrated explanation
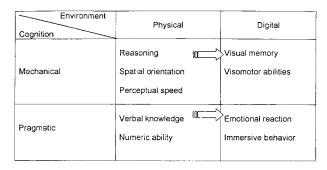
Environment / Cognition	Physical	Digital
Mechanical	Reasoning →	Visual memory
	Spatial orientation	Visomotor abilities
	Perceptual speed	
Pragmatic	Verbal knowledge →	Emotional reaction
	Numeric ability	Immersive behavior

FIG. 1. Generative scheme of social ecological research on the Internet.

of a phenomenon from the micro to the macro level. Although this article emphasizes the cognitive aspect of the man–environment interaction, it is important to remember that the social ecological approach considers different levels of analysis that fluctuate from the micro level (e.g., human information processing mechanisms in the family context) to the macro level (transactions between groups and the social context that have some impact on social development or on health policies aimed at communities or different populations).

In relation to the Internet analysis, concepts like contextual variables,[121] multidimensionality and multidirectionality,[8,9] system equilibrium,[62] amplification and deviation[82] permit the charting of differing trajectories of interaction between the subject and his/her sociophysical environment. Such interactions occur at an atomic or individual level (e.g., interaction between subject and computer through video games, or surfing the web), as well as, at a molecular or social level, in dyads or in groups (e.g., e-mail, chats, list discussions).

The speed at which information processing is performed, the information storage capacity, the short-term transformation, and also, the ability to automatically inhibit or intentionally suppress the processing of goal-irrelevant information are some of the characteristics of the mechanics of cognition,[11] and they are continually active when the subject interacts with the Internet. In the World Wide Web, for example, the amount and type of information is so diverse and complex that the assumptions of the behavior-setting theory[12,135] are useful to predict the stress level that such settings produce. Within this context, it is not only the physical

settings that can lead to stress by stimulation overload, but the digital setting can also activate sensory receptors and produce "informational overload." Indeed, the identification of the crowding threshold via the Internet and the coping mechanisms, which the subject uses to reduce, control, or suppress the stimulation level, are research issues from the social ecological perspective.

On the other hand, Kevin Lynch's[79] contribution, regarding the meaning of environmental structural characteristics (paths, nodes, landmarks, routes) as a way for both adults and children[44] to organize and recognize their surroundings, is a useful way to examine the structural characteristics of the Internet and the "affordance"[36] level associated with its variations. In other words, and according to Heft and Wohlwill,[47] if the structural properties of the environment give it a specific quality and affordance level, then the functional meaning of the environment must also be available to the subject who perceives it. Therefore, the structural and functional properties of the Internet have an unknown affordance level. In this regard, work developed in MIT opens up possibilities to identify new, original interactions between the subject and physical, virtual, and holographic environments.[78]

In terms of the mechanical process associated with the digital environment at an individual level, visual–motor and visual–memory abilities can be studied through the practice and development of video games. In this regard, it has been reported that some video games improve perceptual motor skills and cognitive functioning in both children and the noninstitutionalized elderly.[30] In this way, Silvern[112] suggested that arcade video games may provide children with an interesting mix of what Piaget[96] termed "practice games," "symbolic games," and "games with rules." Such games can improve the hand and eye coordination of children, facilitate social interaction, and develop skills including pattern and rule generation, hypothesis testing, and generalization.

At a social level, both the mechanical and pragmatic processes linked to the Internet have repercussions at an economic level, in community and organization development, and in drawing up health and social develop-

ment policies. For example, according to Economist,[32] "the biggest economic impact of the Internet is likely to come from business-to-business (B2B) e-commerce. Gartner Group forecasts that global B2B turnover could reach US$4 trillion in America in 2003, compared with less than US$400 billion in online sales to consumers." The appearance of virtual communities creates communication bridges that reduce physical distances and foster the establishment of social and even affective bonds. Wellman and Gulia[133] argue that "these computer-supported social networks (CSSNs) come in a variety of types such as electronic mail (e-mail), bulletin board systems (BBSs), Multi-User dungeons (MUDs), newsgroups, and Internet relay chat (IRC). All CSSNs provide companionship, social support, information, and a sense of belonging."

In relation to the pragmatics of cognition, verbal knowledge and numerical ability are processes that are acquired through socialization and life experience. Within this context, the social ecological approach allows the study of diverse settings where socialization and life experience occur. In this regard, it has been reported[134] that the transmission of experience through which numerical and linguistic knowledge are acquired changes from culture to culture (e.g., educational systems). Some experiences are universal (e.g., personalized learning); whereas others are idiosyncratic, based on the subject's characteristics (e.g., personality traits).

In parallel, the pragmatic knowledge associated with the digital environment is linked to emotional aspects such as the affective states,[72] emotional reactions,[7,40] and interpersonal relationships[84] that occur and that can be established through the Internet's variations.

In addition, the digital environment facilitates an immersion experience, understood as an "experience of being surrounded by the computer-synthesized environment".[76] In this way, the environment moves beyond a three-dimensional context. It can be recreated in a virtual way or it can be transformed in a digital manner to produce an experience of immersion, whose characteristics and consequences are unknown.

SCOPE AND LIMITATIONS

Even though the social ecological approach offers a constructive option for the generation of research on Internet usage and development, it also presents some theoretical and methodological limitations in its implementation. In theoretical terms, the appearance and social application of the Internet is too recent to have developed a research tradition that supports a theoretical construction.[115] In this way, it is important to promote systematic, crucial research[98] to permit the identification and evaluation of moderator–mediator variables[13] between the subject and his/her interaction with the Internet.

In methodological terms, the qualitative techniques employed[29,73] serve to identify CMC's phenomenological particularities, taking into account criteria of reliability and validity.[69] It is also necessary to systematically promote the generation of structural modeling and its empirical tests[89] in order to identify latent variables[51] and to describe specific relationships between psychosocial factors[126] associated with the use of the Internet. In addition, the psychometric aspects of questionnaires applied via the Internet have particular relevance. Even though there are studies showing the Internet as a medium that can be used to collect empirical data,[48,55,114,118,132] it is important to document the construct validity[91] underlying each questionnaire, and to treat data interpretation with care in order to avoid inappropriate generalizations.

The scope of the study of the Internet from a social ecological approach is associated with individual, interpersonal, and sociocultural levels. In individual terms, the scope of the Internet implies a conscious expansion of the human being as a cognitive entity.[37] The easy, rapid access to information, and the possibility to recreate, manipulate, and/or alter existing information allow the human being to use a kind of power whose future consequences are unknown.

The interpersonal scope of the Internet is linked to a reconceptualization of personal, situational, and social factors that promote a tendency towards attachment.[87,106] A profile must

therefore be drawn up and an analysis made of the social impact of the use of the Internet, including, for example, the manifestation of bonds of attachment,[45,129,130] therapeutic adherence,[111] and the establishment of e-business (http://www-3.ibm.com/e-business) from the perspective of the characteristics of CMC.

The digital era, and specifically the development of the Internet, is redefining human identity, therefore, the sociocultural impact of the Internet will depend on the specific context considered. For example, according to a report published in the *New York Times* (November 11, 1999), the number of the Internet users in the U.S. is projected to reach 177 million by the end of 2003. Globally, the number of Internet users will reach 502 million the same year, compared to 142 million in 1998. This implies that the Internet's realm is growing 48% per year on average. The Internet's social penetration is evident: whereas developed countries have a higher level of access to the Internet, developing countries have a rate of connection of less than 1%.[58] This information reveals one of the Internet's social paradoxes. On the one hand, the Internet offers extensive communication opportunities throughout the world; on the other, it ratifies and worsens economic and technological inequalities between countries and cultures. In this sense, it is not only important to make the Internet "affordable" in cognitive terms,[36] but it must also be available in social and economic terms.

Some of the questions that will need future clarification in order to contribute to the optimal and constructive uses of the Internet are: What kind of visual–motor and perceptual factors lead to the immersion of a subject in the WWW? What motivates a subject to spend countless hours "surfing" the web? Are the mental maps generated by direct experience within the physical environment the same as those generated by virtual reality? How does a subject optimize the information accessed through the web? What perceptual (i.e., size, form, texture, color) and cognitive (i.e., design, complexity, content) characteristics facilitate the subject's preference for a specific variation of the Internet? What is the frequency and magnitude of dysfunctional behaviors—such as suicide and depression—among Internet users? How do the Internet users in industrialized countries optimize informational resources and adapt cognitively in comparison with those residing in the developing world?

CONCLUSIONS

The social ecological approach represents a constructive approach[94,95] for generating research on the interaction between human behavior and Internet usage.[119a] The five theoretical assumptions that distinguish this approach are: (1) multidimensional conceptualization of the phenomena; (2) emphasis on the dynamic interaction between subject and context; (3) an accent on the interdependency of the subject and his/her milieu; (4) adoption of the systems theory; (5) an interdisciplinary orientation. The levels of analysis from a social ecological approach vary from the micro-environment (e.g., the nuclear family system) to the macro-environment associated with cultural particularities.[19] Its unit of analysis considers atomic components—such as neurophysiological functions or discrete pieces of behavior—and also molecular units where behavioral profiles are considered to be complex, multidimensional processes,[122] such as wisdom,[10] or attachment.[3] Finally, the social ecological analysis of the Internet is related to a time continuum which fluctuates from synchronic to asynchronic[53] within a physical or digital environment-interactive mode. The magnitude and direction of the Internet's impact on the physical, psychological, and social functioning of the human being is a challenge to scientific research that will be clarified in the near future with interdisciplinary collaboration.

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