"SELF-HII": Strength + Endurance + Longevity through gameplay with humanistic intelligence by Fieldary Human Information Interaction

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***Abstract*---In 1995 Gershon founded the field of HII (Human Information Interaction). I build upon his seminal work by creating a new multiscale framework for (1) sensing, and (2) being sensed by, any measurable or generable classical or quantum scalar, vector, spinor, or tensor field, such as being able to sense and be sensed by water, sound, light (real or virtual) -- and in some cases even being able to sense sensing itself (i.e. the *sightfield* of a camera -- visualizing vision and seeing sight itself).**

I call this FHII (Fieldary Human Information Interaction) and apply it to physical fitness by way of *serious games*. Physical fitness training normally builds strength or endurance. Strength usually deals with a short-term (short time period), and is somewhat related to power, as measured in Watts (Joules per second). Endurance usually deals with a longer-term, and is more closely related to energy, as measured in Joules (Watt seconds). I argue that the time-scale of endurance is really only medium-term, when considering an average human lifespan. Therefore I present a third category of physical fitness I call Longevity, along with a new quantity I call "actergy" ("total action"). Actergy has units of Joule seconds, the same units as Plank's constant, angular momentum, and action. These three units:
(1) Joules per second, (2) Joules, and (3) Joule seconds, suggest (1) Differential, (2) Proportional, and (3) Integral, forms of kinesology. Their three related forms of fitness training:
Strength + Endurance + Longevity (SEL), can operate within the Fieldary Human Information Interaction space.

I present a unified framework for this: SEL-FHII ("⬡ Φ", pronounced "selΦ", i.e. either "selfeye" or "selfie") training that combines all three time scales (differential, proportional, and integral) with ideas in HI (Humanistic Intelligence).

Combining *wearable computing* and IoT (Internet of Things), we can contextualize the otherwise disparate fields of/in Serious Games, SELFHII, Sonelization, Entertainment, and Media, across these multiple scales, as a form of urban design, whether at the environmental scale of countries, cities, and streets, or the invironmental scale of Digital Eye Glass and the individual body (e.g. clothing as a building built for a single occupant).

In particular, thinking beyond traditional gaming consoles, we can achieve longevity through gameplay at the intersection of cyberspace and the real world.

I. Serious Games, HI, SELFHII, and Sonelization

Gaming, especially Serious Gaming [1], [2], [3], [4], [5], has emerged as an important discipline, with many truly useful applications. Exercise and physical fitness is one such important application [6], at the intersection of gaming and kinesiology.

Another serious and useful application of gaming technologies is HII (Human Information Interaction) and Information Visualization [7], [8], [9]. This work goes beyond the more traditional field of HCI (Human Computer Interaction) [10], to address information itself, as separate from its "container", i.e. thinking beyond the 20th Century McLuhanesque "Medium is the Message" framework:

> "It was a grey day in Darmstadt in 1995 at the WWW conference. I was getting sick & tired of hearing endless discussions on how many times one needs to click a mouse to get something on the screen. I then realized that, in spite of the fact that a good HCI is a must, we need to understand something more fundamental than that -- how humans interact with information regardless the medium they use. So after coining the term Human Information Interaction (HII) an area that includes also relevant research done before outside the HCI community, I immediately organized the first Workshop on HII at that same WWW meeting. A number of similar workshops followed in other conferences. The idea was not to bury HCI but rather supplement it with something essential that is generally ignored by the HCI community." -- -- Nahum Gershon [9]

The disciplines of Gaming and HII have also begun to merge, in areas like Spatial Narratives and Storytelling for Information Visualization. See for example the seminal work by Caitlin Fisher (York University's Augmented Reality Lab) and by Gershon and Page [11], as well as in theatre and the arts [12]. Much of this work also touches on gender-issues [13], [14], [15], and other issues surrounding Technology and Society, such as Priveillance (privacy, sur/sousveillance, etc.) [16], [17], [18], [19]. Much of this work also connects with themes inherent in modern digital interactive society, as addressed by artists such as Federico Solmi who is

> "often inspired by feelings such as anxiety or a desire for justice and permeated with the disquieting signs of our time. ... His approach is childish in the most genuine sense: he reacts and takes personal revenge against the things he perceives as unacceptable. ... The video installation Douche Bag City (2010) is a hybrid creation composed of fifteen video animations: it is both baroque and contemporary, technological and archaic. 'a wall street tycoon, legendary scam artist, tabloid superstar, ...'" [20]

Visualization involves in interplay between the human and computer, each of which are regarded as an "information processing system":

> "Visualization provides an interface between two powerful information processing systems -- the human mind and the modern computer. Visualization is the process of transforming data, information, and knowledge into visual form making use of humans'

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> natural visual capabilities. With effective visual interfaces we can interact with large volumes of data rapidly and effectively to discover hidden characteristics, patterns, and trends. In our increasingly information-rich society, research and development in visualization has fundamentally changed the way we present and understand large complex data sets. The widespread and fundamental impact of visualization has led to new insights and more efficient decision making.” -- Gershon 98 [7]

We see here, in fact, the general idea that the human and computer are both powerful “information processing systems” that can be inextricably intertwined to use each other as part of a computational feedback loop. This concept is known as Humanistic Intelligence and will be described in further detail in the next couple of pages.

This large body work in Gaming, HII, etc., is not limited to visualization and vision, but can be extended to sensing and being sensed by any field (classical or quantum), such as sound/audition/hearing, with, for example, concepts such as sonel mapping in which principles of photon mapping (e.g. vision and light/illumination) are applied to acoustic modeling [15]. Similarly, principles like HDR (High Dynamic Range), can also be applied to any field rather than being limited to lightfields and imaging. See for example, work in applying HDR to audio and seismic wave fields [21]. Other related work includes “electric feel sensing” [22] (allowing a human to touch and be touched by electric fields, i.e. bidirectional Field-Human-Interaction) and WaterTouch [23], allowing a human to touch and be touched by hydraulic wavefronts, vibrations, and caustics in and of water (i.e. bidirectional Field-Human-Interaction with water), as shown in Fig 1 which itself forms the basis for gameplay (e.g. games like Fluid-SIMON [24]).

Related work also extends to gaming, music, and the arts [26], including such contributions as the game of FMA (“First Mover Advantage”) [27] which introduced also the concept of WOIP (Water Over Internet Protocol) -- again, allowing a human to touch and be touched by water, and allowing water waves to effectively “ripple” from one space to another, over the Internet, as well as the author's wearable technologies, such as the soundfield shirt of the early 1980s [25] (Fig 1).

Gaming has another useful property, in that it teaches us boundaries, social norms, and, to some degree, aspects of safety pertaining to predation avoidance, and the like. Bertozzi writes:

> “Predation play is a reminder that, for many living beings, life is a struggle for survival in a world filled with others who want to kill them and/or take their property and territory. This kind of play teaches an explicit lesson about power, and specifically the power of life and death: who has it, who wants it, and who can keep it. Part of the civilizing process is that individuals give up management of the use of violence to the state (Elias, Dunning, Goudsblom, & Mennell, 2000). Elias considers sport as one of the mechanisms through which the state mediates and designates the amount of violence permitted by individuals—as long as it is contained within play (1971).” [28]

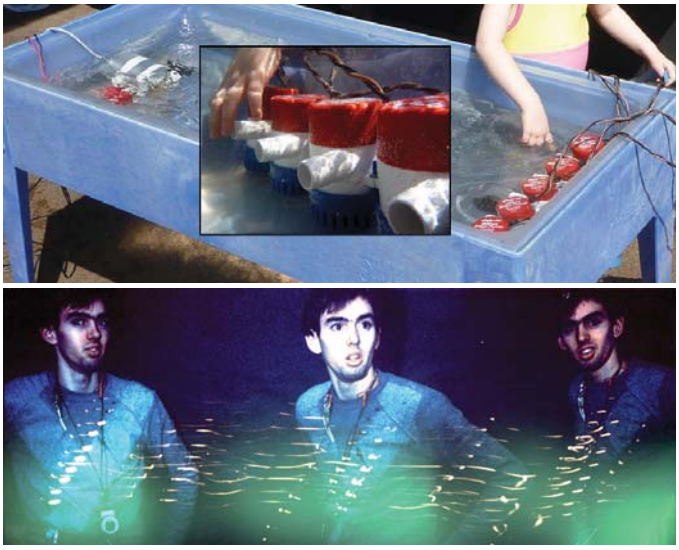

Fig. 1. Interacting with fields: **Top figure** (with inset underwater photo at center): “**ΦTable**”: An array of computer-controlled submersible water pumps creates wavefronts and caustics visible to an overhead camera forming a closed-loop Fluid/Fieldary User Interface. **Bottom figure**: Author's Sound-Field Shirt and other wearable technologies for interacting with electroacoustic fields. During a series of performances and public gallery exhibitions in the 1980s, long exposure photographs were made to make visible otherwise invisible soundfields [25], as well as “bugginess” fields (degree of acoustic feedback to hidden listening devices).

In this paper, we will build upon Bertozzi's concept of “predation play” while moving predation gaming from violence to veillance, i.e. the evolution from guns and security forces to surveillance and sousveillance technologies as a new form of security/suicurity [29] upon which to base predation play -- surveillance, sousveillance, and veillance fields [30] such as sightfields [31] as new metaphors for sport.

We can look at gaming, especially serious gaming, as a multisensory experience for HII across multiple sensory fields and at multiple scales of interaction -- not just the desktop, but from the level of “bits and atoms” (in the Negroponte sense) to the physical and informatic universe of the World Wide Web as a Fieldary Tangible User Interface (in the Ishii sense) [32].

In the 1970s, author S. Mann formulated a vision for modern computing in which the boundary between cyberspace and the real physical world would dissolve [Campus Canada 1987]. In 1991, Mann was accepted into the Massachusetts Institute of Technology and brought this vision to MIT, founding the MIT Wearable Computing project as its first member. In the words of the MIT Media Lab's Founder and Director, Nicholas Negroponte:

> “Steve Mann was, uh, building wearable computers in high school, and I think its [a] perfectly good example, that here’s a young man that brought with him an idea... And when he arrived here a lot of people sort of said wow this is very interesting... I think it’s probably one of the best examples we have of where somebody brought with them an extraordinarily interesting seed, and then it sort of, you know, it grew, and there are many people now, so called cyborgs in the Media Lab and people working on wearable computers all over the place.”
> -- -- *CBC Television, interview with Nicholas Negroponte, 1996*

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and

> "Steve Mann is the perfect example of someone ... who persisted in his vision and ended up founding a new discipline." -- Negroponte, 1997 -- *Bangor Daily News - Sep 26, 1997. and Toronto Star, 2001 Jul. 8, 02:32 EDT, Page D3, `Wearable computer' pioneer Steve Mann keeps one eye locked on the future, by Eric Shinn*

This vision went beyond wearable computing, more broadly proposing a computational relationship between everyday objects ("Things That Think", and then "Internet of People, Places, Things, and Stuff").

Although HI (Humanistic Intelligence) specifically grew out of wearable computing [33][34], we argue for its more general applicability to industrial design, urban design, architecture, and the like. In fact wearable computing itself may be regarded as a form of urban design, merely at a smaller scale (e.g. clothing as a building built for a single occupant). Humanistic Intelligence is an integral part of many university-level courses and projects [35], [36], [37].

Manfred Clynes coined the word "cyborg" to denote an intraction between human and technology that becomes so second-nature that it no longer requires conscious thought or effort [38]. His favorite example is that of a person riding a bicycle: we become so accustomed to the bicycle that it no longer feels like an apparatus that is separate from our own mind and body [39].

II. From ancient alphabets to Cyborg Symbols of HI

In HI, we denote the human by the Old English (Runic/Fuþark) letter "ᛗ", which comes from the Old English alphabet. (The letter ᛗ was present in the following alphabets: Elder Fuþark, Anglo-Saxon Fuþorc, and Younger Fuþark). This letter, by itself, means "human" or "person", and when used with other letters, denotes also the "M" sound [40][41].

The Old English alphabet is not the oldest alphabet. Writing (written language) was invented independently by the Chinese, Mayans, and Egyptians. Egyptian hieroglyphics evolved into the world's first (consonantal) alphabet, by Semitic-speaking people of northern Egypt about 4000 years ago, evolving into the Phoenician alphabet: a set of 22 discrete symbols, each representing a sound by a picture of an object whose word made that sound [42]. For example, the fourth letter of the Phoenician (or Paleo Hebrew, or Hebrew) alphabet by itself means "door" (" ד " for " דלת "), and thus the hieroglyph picture of a door was used to represent the "D" sound in any word that had a "D" sound in it. (Modern alphabets have lost these acrophonetic roots; in amateur radio we re-acrophonetize ABCD... as Alpha, Bravo, Charlie, Delta, ...)

We use the letter "teth" ("tet") from the earliest alphabets (e.g. Phoenician, etc.), ⊗, to represent "Technology", such as the bicycle in the Manfred Clynes "cyborg" example. The letter ⊗, by itself, means "wheel", and derives from a heiroglyph of a wheel with four spokes (this letter evolved into the Hebrew letter ט, and the Greek letter Θ or θ).

In the 1980s I took the bicycle metaphor a step further, and made my bicycle becomes context-aware, by fitting it with various sensors: sightfield (cameras), soundfield (microphones), and radar (electromagnetic fields and "electric feel sensing" [22] actuators). These field sensors and actuators accessed the same sensory context as I, the rider did. The bicycle was also fitted with computational apparatus that allows it to provide the rider with situational awareness.

The result is something we call Humanistic Intelligence [33][34] -- intelligence that arises by having the human being in the feedback loop of the computational process, as illustrated in the following diagrams:

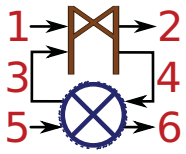

Fig. 2: The six signal flow paths of Humanistic Intelligence: **(1) unmonopolizing** of the human's attention (i.e. "gets out-of-the-way" when the human wishes), and outputs data transparently so that the user can choose to ignore or pay attention to it at will with zero advance notice; **(2) unrestrictive** of the human (i.e. comfortable to wear and does not implede the human's ability to directly affect his or her environment; **(3) Observable** to the human, i.e. information is output from the technology in a sousveillant manner, transparently, so that the human can choose to ignore it or pay immense attention to it while giving zero advance notice (e.g. swithching back and forth at will without having to wait for a bootup or startup delay); **(4) Controllable** to the human, e.g. receives input on zero advance notice, without having to wait for a bootup or startup delay; **(5) Attentive** to the human's environment, and to other humans in the environment, providing, for example, context-awareness; **(6) Communicative**, e.g. the technology can facilitate communication with other humans or with the human user at a later point-in-time.

Humanistic Intelligence has three basic modes of operation, as shown below:

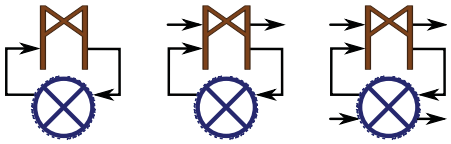

Fig. 3: The three operational modes of Humanistic Intelligence: **(a) Constancy**: by signal flow path 3, the technology can be observable by the human at any time that he or she wishes. The technology is constantly making information available transparently, i.e. *by way of sousveillant computing* to the human in a way that is not monopolizing against the human's will, but provides the user freedom to observe with zero advance notice required. By signal flow path 4, the technology is constantly under the human's control whenever the human wishes it to be so. **(b) Augmentation**: by signal flow paths 1 and 2, the technology is unmonopolizing and unrestrictive, i.e. it gets out-of-the-way whenever the human wishes it be out-of-the-way. This allows the user to do other things while using the technology. In this sense the technology can *augment* the human's mind and body. **(c) Mediation**: by signal flow paths 5 and 6, the technology is *context-aware*, in that it can sense at least the same context that the human can sense, and ideally be even more *attentive to its environment* and also it can be *communicative to the environment* (e.g. it can affect other elements of the environment, such as, for example, communicating to other humans when the human operator wishes it to do so).

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It is this third mode that is the most useful and most important, of which the second mode is merely a special case. Thus for example, Augmented Reality is a special case of Mediated Reality. Underscoring the importance of technology being able to function as an intermediary for human interaction with the environment, we may re-draw Figure 3(c) as follows:

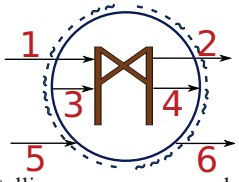

Fig. 4: Humanistic Intelligence as a personal "capsule" or encapsulation, is equivalent to that shown in Fig 3(c) but emphasizes the unique capabilities of Mediated Reality (Augmediated Reality). The technology allows the user to selectively admit or attenuate inputs from the real world. For example, auto-darkening eyeglasses (or welding helmets) facilitate *Diminished Reality* where desired. More generally, HDR (High Dynamic Range) eyeglasses allow a person to see in complete darkness while AT THE SAME TIME being able to look directly at the electric arc of an electric arc welder. Other examples include computer-controlled clothing that allow the wearer to modulate heat loss/gain.

Here the "wheel" is drawn without the 4 spokes. A plain circle, (i.e. without spokes), corresponds to the letter "Ayin" in the oldest alphabets (Phoenician, ancient Semetic alphabets, etc.), which means (and evolved from a hieroglyph for) "eye". In some sense this is appropriate as it represents the contextual awareness of successful embodiments of Humanistic Intelligence that share the same point-of-view as the human. Technology embodying HI "Shares the same physical and situational context as the user."[35].

III. The Environment and the Invironment

HI (Humanistic Intelligence) arose in the creation of wearable computing as a field or discipline of study. We argue for its more general applicability to industrial design, urban design, architecture, and the like. In fact wearable computing itself may be regarded as a form of urban design, merely at a smaller scale (e.g. clothing as a building built for a single occupant).

The word "environment" comes from the Old French word "viron" which means "circle". Thus "environment" means "encirclement", i.e. that which surrounds us or encircles us. The environment is not limited to nature, but can include also the "classroom environment" and the "urban environment", etc.. The environment is that which is beyond our body, skin, and clothes. See Fig 5. The Greek word "στέφανος" ("stephanos") means (1) "that which surrounds or encompasses", [i.e. the environment] or (2) crown or wreath. [Henry George Liddell, Robert Scott, A Greek-English Lexicon]

In this context we may rethink Humanistic Intelligence as an interplay between the invironment and the environment, mediated by Fieldary Human Information Interaction:

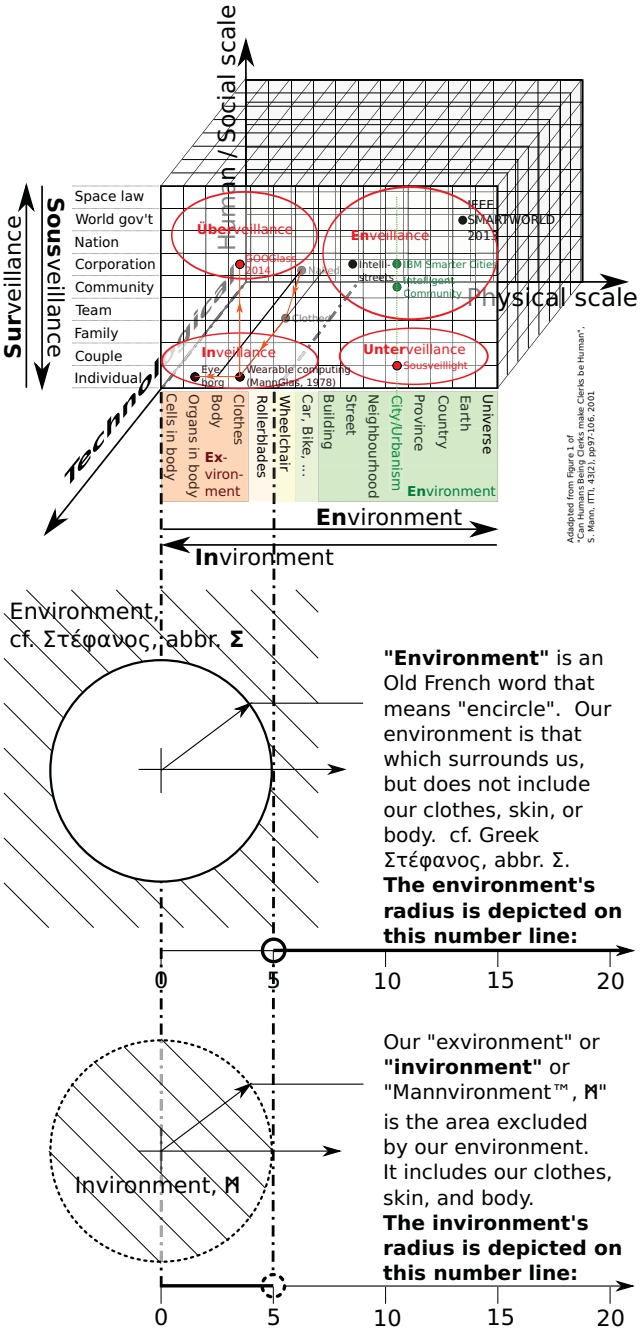

Fig. 5. The word "environment" comes from the Old French word "viron" which means "circle". Thus the "environment" is that which surrounds or *encircles* us. If we think at the scales of urban design (streets, cities, countries, ... the world), we can conceptualize the environment as a circle of some radius, R, which defines a boundary between us and our environment. This boundary and beyond may thus be represented from and including the point R (denoted as the closed circle) out to infinity on the numberline. The compliment of the *environment* is the "exvironment" or "invironment", i.e. that which excludes the environment. On the numberline, the "invironment" is the half open interval from 0 to, but not including, R, which denotes our body, skin, and clothes.

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The numberline of Fig 5 defines an axis that we call "the vironment" (both the invironment and the environment). This axis defines the axis of the Physical Sciences, from atoms (and sub-atomic particles) to the Universe.

When we also consider information or informatic scale, (Little Data versus Big Data, etc.), so that near the origin we have "bits" and "atoms" in the MIT (e.g. Nicholas Negroponte) sense, and outwards from there we have a physical/virtual space.

We can also consider *Social Scale* as in the Social Sciences. See Fig 6. Meriam Webster defines gene as "part of a cell that controls or influences the appearance, growth, etc., of a living thing". Genes form the "code" of life for cells, such as skin, muscles, neurons, retinal ganglion cells, etc., in the living human body. Thus genes form a point near the origin of the human/social (individual/collective) scale.

More generally, consider, starting at the origin, and expanding outwards:
Genes (<1 person), Bemes (=1 person), Memes (>1 person):

- Genes are smaller than a single human person, and exist at the scale smaller than one single whole person;
- Bemes [43] are of and pertaining to a single individual, and exist at the social scale of exactly one single but whole person;
- Memes only exist in a society, as a whole, i.e. within a social culture of more than one single person:

> "Bemes are fundamental, transmissible, mutate-able units of beingness very much in the spirit of memes. The difference is that memes are culturally transmissible elements that have common cultural meanings whereas bemes are highly individual elements of personality, mannerisms, feelings, recollections, beliefs, values, and attitudes." -- -- Rothblatt [44]

The concept of bemes is modeled after the concept of memes, which itself is modeled after the concept of genes:

> "We need a name for ... the idea of a unit of cultural transmission, or a unit of imitation. 'Mimeme' comes from a suitable Greek root, but I want a monosyllable that sounds a bit like 'gene'. I hope my classicist friends will forgive me if I abbreviate mimeme to meme. If it is any consolation, it could alternatively be thought of as being related to 'memory', or to the French word même." -- -- Richard Dawkins [45]

We can thus see Humanistic Intelligence as a general multiscale framework for understanding systems that mediate the interplay between one or more humans and their environment, to touch and be touched by any field through sensory or effectory multiscale spaces of Vironment, Virtuality, and Veillance. These sensory and effectory accesses to fields can also include the sensing of sensing itself, or the effect of effects themselves. Among such self-referrential Fieldary User Interfaces are included abakography ("dusting" [25]), as shown in Fig 7, leftmost, and a series of "sightpainting" performances (Fig 7, rightmost).

IV. Veillance in the context of Bertozzi's "Predation Play"

The concept of "predation play" [28] creates a variety of interesting gaming scenarios.

Whereas much of gameplay, including much in the way of "predation play", involves guns and shooting, the author's variation on predation play is is, instead of shooting with guns, we shoot with cameras. The camera becomes a metaphor for shooting. In this way we **transition "from violence to veillance"** as a gaming metaphor. One such example uses a toy gun (concept and design by author S. Mann) where the barrel of the gun became a surveillance camera, operating within the 3D AR (Augmediated Reality) environment of abakography [48]. See Fig 8

Another Fieldary Predation Play game, called "**Security Blanket**" involves the use of a "lightfield" camera-blanket. A blanket is covered with an array of veillance systems (i.e. a blanket with an array of modern security systems and technology). This reverses the usual "shooting" metaphor to one of camera-as sheild. The shield also "shoots back" in the photographic/vidoegraphic sense. See Fig. 9.

Both of these games operate well within the Meta-View Spaceglasses 3D AR (Augmediated Reality) world, and provide a multiscale (body, clothes, corridors, alleys, streets, cities, countries, worlds) functionality as games extend throughout neighbourhoods, and can operate like scavenger hunts, and the like, also across multiple physical scales and cyberspace.

Thus by adhering to the principles of HI, as well as multiscale thinking (Fig. 6), we were able to achieve new kinds of gaming scenarios that engaged people of all ages, languages, and world views.

V. Loomstone: A tour guide to life

> "Yes, there are two paths you can go by, but in the long run
> There's still time to change the road you're on."
> -- -- "Stairway to Heaven", Robert Plant, vocalist, Led Zeppelin

Loomstone is a "tour guide to life", in which there is a game scenario that shows two paths through visual reality:

- the wide path leading to McDonald's for a "Big Mac" (Supersize Me [49]), then to 7-Eleven for a "Big Gulp", and then to the local tavern for a bottle of whiskey. The wide path is mostly straight and gently curving, leading to the elevator, and then to the taxi stand.
- The narrow path is more winding, through variations in terrain, and leads to the stairs, and down to the bicycle rack. Instead of leading down the center of the sidewalk, it leads up and down along the edge of the cement planter, etc., so as to provide variation in terrain, and improved health and fitness.

Loomstone is part of the Mannfit™ System which emphasizes Longevity in the following continuum (each being the time integral of the one before it): **Strength** (akin to power in Watts); **Endurance** (akin to energy in Watt seconds, i.e. Joules), and **Longevity** (Actergy in Joule Seconds, same units

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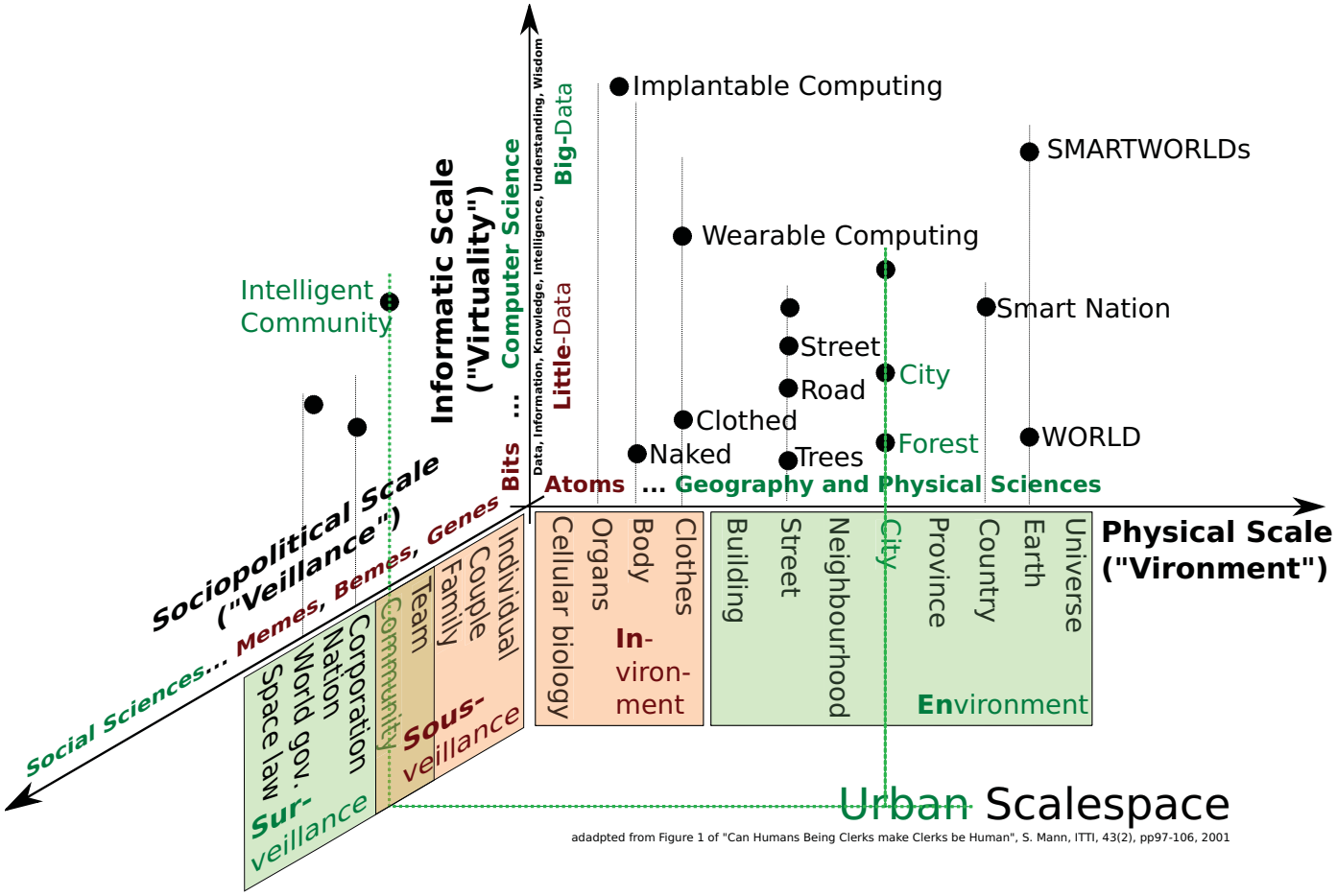

Fig. 6. The three axes: from Bits, Atoms, and Genes (near the origin) to the Physical Sciences, Social Science, and Computer Science (along the whole axis), i.e. "Physical Scale", "Sociopolitical Scale", and "Informatic Scale".

as the Lagrangian action of field theory, and same units as Plank's Constant).

Other important related work includes Ron Baecker's Technologies for Aging Gracefully [50], and earlier work from his group on wearable camera systems [51], on mitigating the effects of aging. As an alternative to mitigation, the MannFit System looks at the situation more proactively (i.e. delaying aging).

Loomstone provides a multiscale (buildings, streets, cities, country, etc.) visual tour guide, along with a consequential interpretation of the "just desserts" of eating dessert. This comes in the form of a tombstone displayed in the user's eyeglasses, in which the tombstone bears the user's birth date, and estimated date of death, that would result from repeating a given behavior on a daily basis. See Fig. 10 (leftmost). The virtual tour guide recommends some Actional Fitness™by way of a Fieldary User Interface (rightmost). Rather than psychiatric approaches to addition[52], [53], Loomstone provides a more immediate visual reality-check on a bottle of whiskey, by showing the user where it leads.

VI. Conclusion

We have presented a unified framework for gaming, FHII (Fieldary Human Information Interaction), Information Visualization, including haptic, soundfields, lightfields/sightfields and visual environments, that can work across multiple spatial, social, and technological scales.

The three axes (physical/spatial, social, and technological/informatic) define a field in which we can think beyond traditional gaming consoles, and instead think at the intersection of cyberspace and the real world, using concepts from wearable computing and IoT (Internet of Things), and re-contextualizing them at any scale, from "bits, atoms, and genes, bemes, and memes", through urban design: computational clothing, buildings, streets, cities, countries, and the "smart world". In regards to the spacetime continuum, we also considered not just scale, but also time-scale, in regards to integral kinesiology, i.e. physical fitness training for strength, endurance, and longevity.

We successfully demonstrated examples of gameplay based on these concepts.

References

[1] C. C. Abt, *Serious games*. University Press of America, 1987.

[2] F. Bellotti, B. Kapralos, K. Lee, P. Moreno-Ger, and R. Berta, ``Assessment in and of serious games: an overview," *Advances in Human-Computer Interaction*, vol. 2013, p. 1, 2013.

[3] D. Rojas, B. Kapralos, S. Cristancho, K. Collins, A. Hogue, C. Conati, and A. Dubrowski, ``Developing effective serious games: the effect of background sound on visual fidelity perception with varying texture resolution." in *MMVR*, 2012, pp. 386--392.

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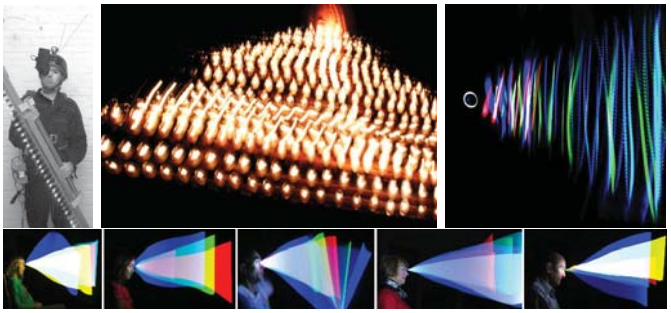

Fig. 7. Fieldary Human Information Interfaces: **Top left**: Author S. Mann wearing early 1980s wearable computer with sensory and effectory wand [46], [47], [25]. The computer featured numerous sensors, effectors, and phenomenizers, for sensing and affecting various fields, phenomenology, etc.. **Top center**: “Ayinograph”, a self portrait depicting the “sightfield” of the author's right eye, made with the device pictured at left. A visual acuity test is performed that requires high central foveal vision simultaneous with moderate peripheral visual acuity, and the results are displayed on the wand. Alternatively, the sightfield was measured using “eyeshine” (the retroreflective nature of human vision), or VEP (Visual Evoked Potentials), with the results also displayed on the wand. **Top right**: Early example showing the “sightfield” of a hidden camera using video feedback, in a manner analogous to the way that an audio bug sweeper uses audio feedback to find audio listening devices (“bugs”). Modified television receivers were swept through the space and glowed more intensely when seen by a hidden camera, thus not only revealing the camera, but, more interestingly, its sightfield! Pseudocolors are for HDR (High Dynamic Range), using (filters) to visualize strong feedback in red, weak in blue, and other colors in between [46], [25]. Early embodiments were associated with an athletic physicality -- imagine trying to do a large-scale mid-air 3D painting with a 50-pound weight attached to the brush! This work brought a new kind of fitness to the author's attention -- like doing brain surgery and arm wrestling at the same time -- simultaneous strength+endurance + precision+accuracy+stability+dexterity + fine motor control. In other embodiments, a light bulb was connected to a long cord and swung through a space containing hidden cameras. The bulb was connected plate-to-plate across two 6BQ5 valves (push-pull), fed from further stages of amplification, connected to a modified television receiver with dynamic range compressor. This system was also used with the wand to sequence through the lamps, thus the wand being named “Sequential Wave Imprinting Machine” “S.W.I.M.”, for visualizing not just sound or radio waves, but also visualizing vision itself. Bottom row: “soul portraits™”: the eye is the window to the soul, and its sightfield a medium of artistic expression in portraiture, as well as a new way to measure and visualize central+peripheral visual acuity.

[4] B. Kapralos, C. Johnston, K. Finney, and A. Dubrowski, ``A serious game for training health care providers in interprofessional care of critically-ill and chronic care patients,'' *Journal of Emerging Technologies in Web Intelligence*, vol. 3, no. 4, pp. 273--281, 2011.

[5] V. T. Pandeliev and R. M. Baecker, ``A framework for the online evaluation of serious games,'' in *Proceedings of the International Academic Conference on the Future of Game Design and Technology*. ACM, 2010, pp. 239--242.

[6] G. Baradoy, ``A physiological feedback controlled exercise video game,'' 2012.

[7] N. Gershon, S. G. Eick, and S. Card, ``Information visualization,'' *interactions*, vol. 5, no. 2, pp. 9--15, 1998.

[8] N. Gershon and S. G. Eick, ``Information visualization,'' *IEEE Computer Graphics and Applications*, vol. 17, no. 4, pp. 29--31, 1997.

[9] W. Jones, P. Pirolli, S. K. Card, R. Fidel, N. Gershon, P. Morville, B. Nardi, and D. M. Russell, ``It's about the information stupid!: why we need a separate field of human-information interaction,'' in *CHI'06 extended abstracts on Human factors in computing systems*. ACM, 2006, pp. 65--68.

[10] R. M. Baecker and W. A. Buxton, ``Readings in human-computer interaction,'' *Morgan & Kaufman*, p. 670, 1987.

[11] N. Gershon and W. Page, ``What storytelling can do for information visualization,'' *Communications of the ACM*, vol. 44, no. 8, pp. 31--37, 2001.

[12] J. Parker, ``Games are art: Video games as theatrical performance,'' in *Games Innovation Conference (IGIC), 2013 IEEE International*. IEEE, 2013, pp. 203--208.

[13] E. Bertozzi and S. Lee, ``Not just fun and games: Digital play, gender and attitudes towards technology,'' *Women's Studies in Communication*, vol. 30, no. 2, pp. 179--204, 2007.

[14] E. Bertozzi, ``you play like a girl! 'cross-gender competition and the uneven playing field,'' *Convergence: The International Journal of Research into New Media Technologies*, vol. 14, no. 4, pp. 473--487, 2008.

[15] B. Kapralos, M. Jenkin, and E. Milios, ``Sonel mapping: acoustic modeling utilizing an acoustic version of photon mapping,'' in *Haptic, Audio and Visual Environments and Their Applications, 2004. HAVE 2004. Proceedings. The 3rd IEEE International Workshop on*. IEEE, 2004, pp. 1--6.

[16] K. Michael and M. Michael, ``No limits to watching?'' *Communications of the ACM*, vol. 56, no. 11, pp. 26--28, 2013.

[17] S. Bronitt and K. Michael, ``Human rights, regulation, and national security,'' *IEEE Technol. Soc. Mag.*, vol. 31, no. 1, pp. 15--16, 2012.

[18] K. Michael, G. Roussos, G. Q. Huang, R. Gadh, A. Chattopadhyay, S. Prabhu, and P. Chu, ``Planetary-scale RFID services in an age of uberveillance,'' *Proceedings of the IEEE*, vol. 98, no. 9, pp. 1663--1671, 2010.

[19] S. Mann, J. Nolan, and B. Wellman, ``Sousveillance: Inventing and using wearable computing devices for data collection in surveillance environments.'' *Surveillance & Society*, vol. 1, no. 3, pp. 331--355, 2003.

[20] M. Costantino, ``Federico Solmi and the phenomenology of the enemy,'' in *Catalog for A Song of Tyranny, the Italian Cultural Institute of Madrid*, 2013.

[21] S. Mann, R. Janzen, and T. Hobson, ``Multisensor broadband high dynamic range sensing...'' in *Proc. Tangible and Embedded Interaction (TEI 2011)*, 2011, pp. 21--24.

[22] S. Mann, ```VibraVest'/`ThinkTank': Existential technology of synthetic synesthesia for the visually challenged,'' in *Proceedings of the Eight International Symposium on Electronic Art*. Chicago: ISEA, September 22-27 1997.

[23] S. Mann, R. Janzen, and J. Huang, ``Watertouch: an aquatic interactive multimedia sensory table based on total internal reflection in water,'' in *Proceedings of the 19th ACM international conference on Multimedia*. ACM, 2011, pp. 925--928.

[24] S. Mann, M. Georgas, and R. Janzen, ``Water jets as pixels: Water fountains as both sensors and displays,'' in *Proc. 8th IEEE International Symposium on Multimedia (ISM'06)*, 2006, pp. 766--772, digital Object Identifier 10.1109/ISM.2006.158.

[25] S. Mann, ``Wearable technologies,'' Night Gallery, 185 Richmond Street West, Toronto, Ontario, Canada, July 1985. Later exhibited at Hamilton Artists Inc, 1998.

[26] J. Heerema and J. Parker, ``Music as a game controller,'' in *Games Innovation Conference (IGIC), 2013 IEEE International*. IEEE, 2013, pp. 72--76.

[27] S. Mann, ``Hydraulikos: nature and technology and the centre for cyborg-environment interaction (cei),'' in *Proceedings of the Sixth International Conference on Tangible, Embedded and Embodied Interaction*. ACM, 2012, pp. 29--32.

[28] E. Bertozzi, ``The feeling of being hunted: Pleasures and potentialities of predation play,'' *Games and Culture*, vol. 9, no. 6, pp. 429--441, 2014.

[29] S. Mann, ``Personal safety devices enable "suicurity"," *Technology and Society, IEEE*, vol. 33, no. 2, pp. 14--22, 2014.

[30] R. Janzen and S. Mann, ``An extromissive information-bearing formulation of sensing, to measure surveillance and sousveillance,'' *Proc. IEEE CCECE2014*, pp. 1--10, 2014.

[31] S. Mann, ``The sightfield: Visualizing computer vision, and seeing its capacity to" see"," in *Computer Vision and Pattern Recognition Workshops (CVPRW), 2014 IEEE Conference on*. IEEE, 2014, pp. 618--623.

[32] H. Ishii and B. Ullmer, ``Tangible bits: towards seamless interfaces between people, bits and atoms,'' in *Proceedings of the ACM SIGCHI Conference on Human factors in computing systems*. ACM, 1997, pp. 234--241.

[33] S. Mann, ``Humanistic Intelligence (H.I.),'' *Proceedings of Ars Electronica*, pp. 217--231, Sep 8-13 1997, invited plenary lecture, Sep. 10, http://wearcam.org/ars/ http//www.aec.at/fleshfactor, Republished

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Fig. 8. **Leftmost**: “Liberty Leading the People” metaphor with a veillometer making visible the otherwise invisible sightfield (time-reversed lightfield) of surveillance. **Second from left**: Sweeping along a linear track and using pseudocolor HDR. The other pictures show Mann's Cameragun and its “shooting” metaphor of the sightfield for gameplay scenarios.

Fig. 9. **Security Blanket**: Flexible lightfield camera as sousveillance-based gaming. Leftmost, Stephanie (age 8) inspects one of her camera covers which are used to “conspicuously conceal” the security systems of the “security blanket”. The covers were blow-molded four-at-a-time and then the sewing holes were laser-cut. After sewing the blanket together, the game play begins. The objective of the game is to wrap the American Girl doll, “Isabel”, in such a way as to afford her maximum protection from predation, in the gaming sense [28]. Two different attempts are shown. The efficacy of the wrapping is measured automatically, using a continuously running overhead surveillometer [30] to measure the veillance flux vector field (time-reversed lightfield). This provides automatic scoring in the game play, where the score is based on the effective security provided by the security blanket, as measured by integrating the vector veillance field. Any number of players can play by taking turns wrapping Isabel to see who can provide the most security with the security blanket.

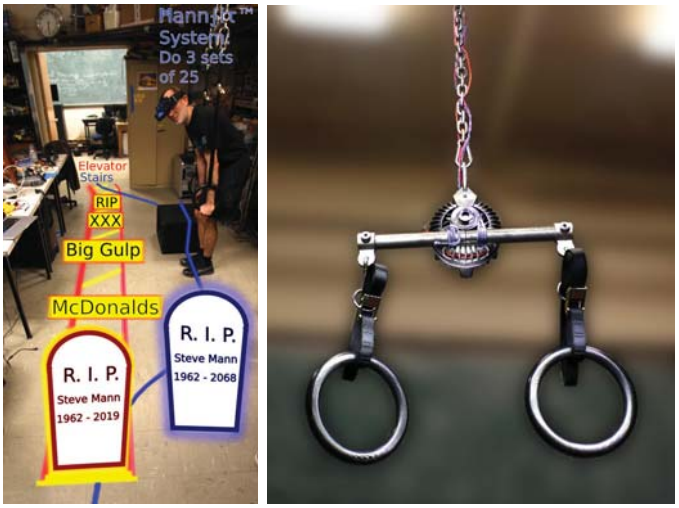

Fig. 10. Loomstone app: Two paths are traced through reality: a wide path and a narrow path, each with its own estimate of the date of death of the person playing the game. A tombstone looms closer or further depending on the activity of the player in the game of real life. The narrow path at the right features a Fieldary User Interface with the author's active fitness bar, connected to a three-phase electric machine (an automobile alternator that the author modified by removing the six diodes and connecting wires directly to each phase inside). With a supplied field current through the rotor's brushes, to the field windings, the three phase stator windings both sense and supply current to create a tactile virtual and AR (Augmediated Reality) world where the user can touch and be touched by physical terrain in the virtual world. Fields such as elevation, turbulence, “nastiness”, and “justice”, are conveyed visually as well as through the tactile/physical/exertion transfer function of the fitness bar physically connected to the rotor of the electric machine.

in: Timothy Druckrey (ed.), Ars Electronica: Facing the Future, A Survey of Two Decades, MIT Press, pp 420--427.

[34] ------, ``Humanistic intelligence/humanistic computing: `wearcomp' as a new framework for intelligent signal processing,'' *Proceedings of the IEEE*, vol. 86, no. 11, pp. 2123--2151+cover, Nov 1998.

[35] C. Poellabauer, ``Mobile computing (cse 40814/60814), fall 2014 - university of notre dame, 203 debartolo hall, http://www3.nd.edu/~cpoellab/teaching/cse40814/lecture9-wearables.pdf,'' MW 8:00-9:15am 2014.

[36] U. B. Dr. Holger Kenn, Microsoft EMIC, ``Wearable computing, vak: 03-799.01, monday 13-15, place: 1.51 tab (eco5),'' MW 8:00-9:15am 2014.

[37] S. Mann, ``ECE516, http://wearcam.org/ece516.''

[38] M. Clynes and N. Kline, ``Cyborgs and space,'' *Astronautics*, vol. 14, no. 9, pp. 26--27,and 74--75, September September 1960.

[39] M. Clynes, ``personal communication,'' 1996.

[40] D. Freeborn, *From Old English to standard English: a course book in language variation across time*. University of Ottawa Press, 1998.

[41] I. Senra Silva, ``A note on the meaning of os in the old english rune poem,'' *Epos: Revista de filología*, no. 22, p. 393, 2006.

[42] M. C. Howard, *Transnationalism in Ancient and Medieval Societies: The Role of Cross-border Trade and Travel*. McFarland, 2012.

[43] M. Rothblatt, ``Are we transbemans yet?''

[44] ------, ``On genes, memes, bemes, and conscious things,'' *The Journal of Personal Cyberconsciousness*, vol. 1, no. 4, 2006.

[45] D. Richard, ``The selfish gene,'' 1976.

[46] ``Impulse,'' vol. 12, no. 2, October 1985.

[47] C. Ryals, ``Lightspace: A new language of imaging,'' *PHOTO Electronic Imaging*, vol. 38, no. 2, pp. 14--16, 1995, http://www.peimag.com/ltspace.htm.

[48] S. Mann, R. Janzen, T. Ai, S. N. Yasrebi, J. Kawwa, and M. A. Ali, ``Toposculpting: Computational lightpainting and wearable computational photography for abakographic user interfaces,'' in *Proceedings of the IEEE CCECE*. IEEE, 2014.

[49] M. Spurlock and J. McElroy, *Don't eat this book: fast food and the supersizing of America*. Penguin Audio, 2005.

[50] J. M. David, A. Benjamin, R. M. Baecker, D. Gromala, and J. Birnholtz, ``Living with pain, staying in touch: exploring the communication needs of older adults with chronic pain,'' in *CHI'11 Extended Abstracts on Human Factors in Computing Systems*. ACM, 2011, pp. 1219--1224.

[51] M. Crete-Nishihata, R. M. Baecker, M. Massimi, D. Ptak, R. Campigotto, L. D. Kaufman, A. M. Brickman, G. R. Turner, J. R. Steinerman, and S. E. Black, ``Reconstructing the past: personal memory technologies are not just personal and not just for memory,'' *Human--Computer Interaction*, vol. 27, no. 1-2, pp. 92--123, 2012.

[52] B. C. Ballon and W. Skinner, ``“attitude is a little thing that makes a big difference”: Reflection techniques for addiction psychiatry training,'' *Academic Psychiatry*, vol. 32, no. 3, pp. 218--224, 2008.

[53] B. Ballon, M. Kirst, and P. Smith, ``Youth help-seeking expectancies and their relation to help-seeking behaviours for substance use problems,'' *Addiction Research & Theory*, vol. 12, no. 3, pp. 241--260, 2004.

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