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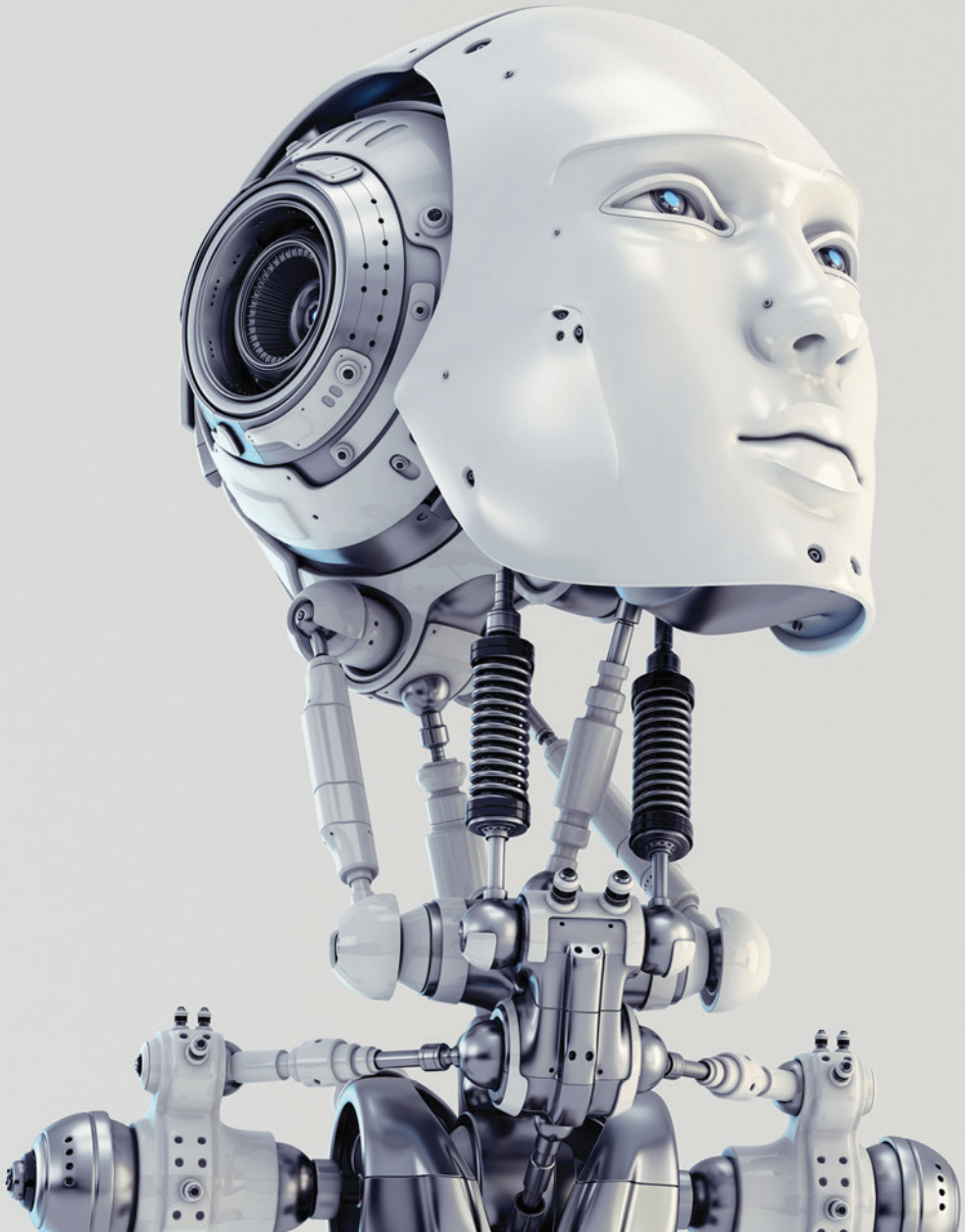

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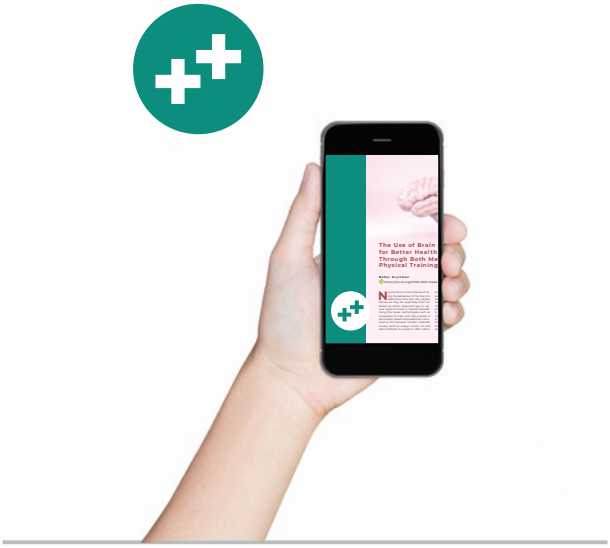

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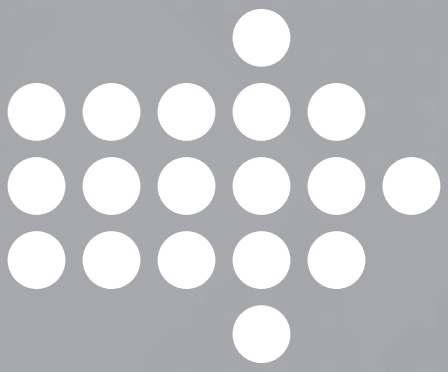

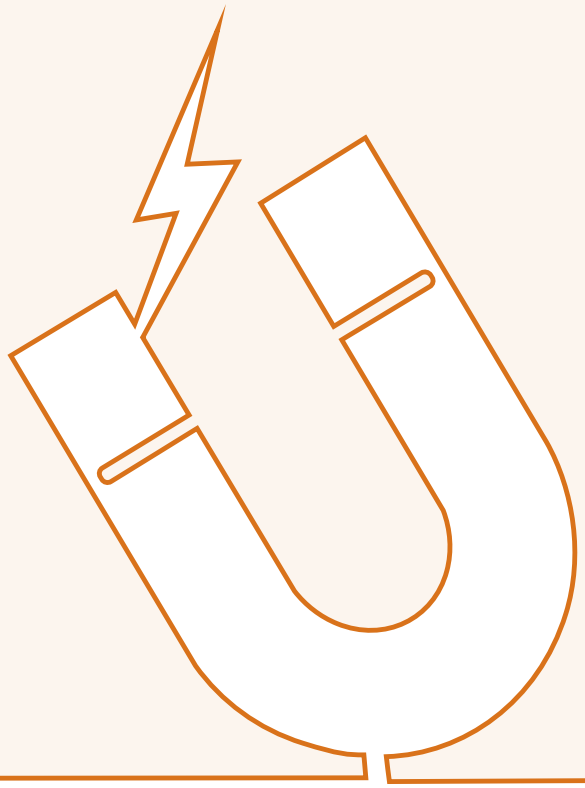

Photo-Magnetic Imaging: The Wave of the Future of Medicine

Salih Emre Gulener

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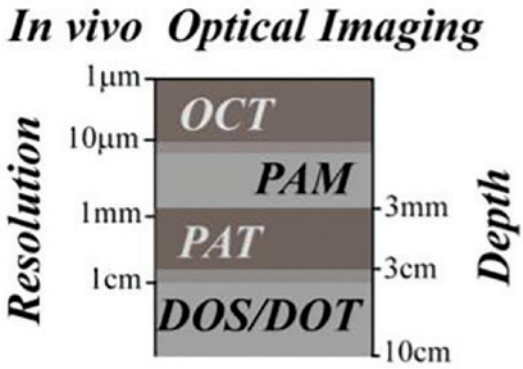
MRI. The most common example of the concept of magnetic imaging, the process is, despite many years of progress in many scientific fields, remained somewhat unchanged, relatively speaking, due to the difficulty in creating a functioning machine that can avoid the pitfalls that are magnetic interference from a long distance, or the occurrence that is the lack of safety when an accident might occur, such as the case of a blacksmith rendered accidentally blind when the silver nanoparticles that had embedded themselves in the membrane over years of his trade were rendered super-heated by the MRI scan that left him blind (!) Primarily, MRI is also poor at tissue scanning, a needed concern to tack-

les many progressive forms of illness such as cancer, which can be solved by the newly developing method that both avoids such dangers and is also without the several drawbacks of an MRI: Photo-Magnetic imaging renders images both a safe process because it uses simple laser-reading capability similar to that used to read a disk, and ensures that no actual contact is required with any parts of the machine as similar processes that emulate the magnetic portion of the process, such as DOT or PAT, require.

Beginning with Thayer to introduce us to the subject's pros and cons of older methods with a short descriptive piece, we start with why and how the process is especially applicable in the modern today that uses increasingly automated algorithms that do much of the work for us in the medical context of both number calculations and implementation of testing for various maladies of the flesh.

PMI: What it is Not

"While MRI and CT provide excellent anatomic images at high resolution, their contrast mechanisms have no direct link to tissue metabolism, leading to high detection but also high false positive rates in cancer imaging. Optical imaging modalities offer functional information because their contrast arises largely from tissue hemoglobin and deoxyhemoglobin content, without the use of exogenous contrast agents."[i] The available optical modalities consist of mechanisms of varying resolution and depth penetration, plus their contrast mechanisms. Seen in the comparative Figure 1-1 below are OCT, PAM, PAT, and DOT with respective resolutions and penetration depths; the two are usually inversely proportional.



OCT : Optical Coherence Tomography
PAM : Photo-acoustic Microscopy
PAT : Photo-acoustic Tomography
DOS : Diffuse Optical Spectroscopy
DOT : Diffuse Optical Tomography

Figure 1-1.
Optical imaging modalities.[ii]

OCT

Uses imaging modality that can provide ultra-high resolution (~1μm) images, but is hampered by a usable image depth of just a few millimeters because it uses single scattered photons for imaging. Figure 1-2 shows a spectacular sFD-OCT image of a retina, with all individual layers of the retina seen in this image depth of less than a single millimeter.[iii]

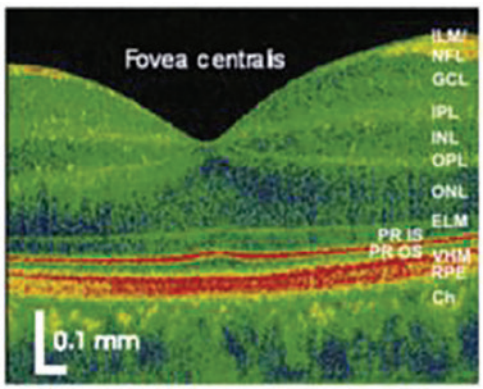


Figure 1-2.
OCT image of human retina.[iv]

DOS

Is a form of spatial information resource that uses a source detector separation (for depth discrimination) and mechanical scanning through the ben-

efit that is multiple laser wavelengths to recover tissue chromophore concentrations. Able to work well for relative concentrations with high fidelity such as in imaging primary tissue chromophores, but the resolution is very low. Therefore, it is very useful for not only in-vivo biopsy, but also therapy monitoring treatments as well.[v]

DOT

At the farthest end of the spectrum from OCT is DOT with a usable depth of 10 cm, but an extremely low resolution of only (>5mm). A key difference between the two extremes of the scale is OCT measuring scattering while DOT measures both absorption and scattering. As a consequence, DOT measurements can be carried out in multiple wavelengths to draw up optical absorption maps that are useful for tissue chromophore concentrations. Essentially a form of DOS with more advanced localization, DOT has been a helpful tool for breast cancer imaging via use of dynamic, contrast-enhanced imaging or even for fluorescent imaging.[vi] Figure 1-7 shows a sample image from a breast MR-DOT study.

The spatial resolution of DOT has been improved by hybridization, an earlier version, in essence of PMI, through coupling with higher resolution modality such as MRI or ultrasound DOT.

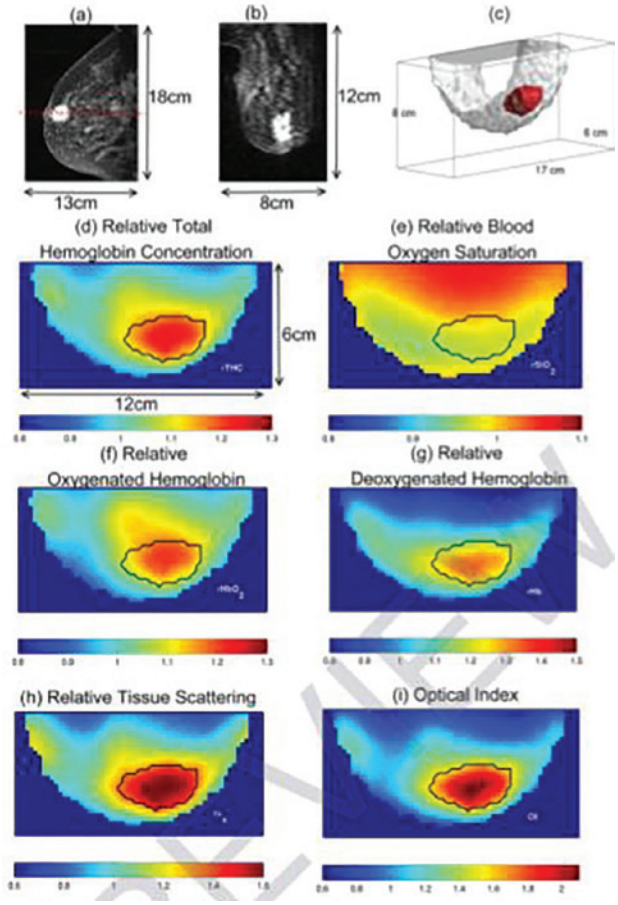


Figure 1-7.
DOT: breast cancer imaging.[vii]

PAT/PAM

"Photoacoustic imaging (tomography and microscopy, PAT/PAM) is another hybrid imaging approach that can provide the same absorption information as DOT at higher resolution (~1 mm), but lower penetration depth (~3 cm)"[viii], through use of PAT use of a pulsed laser is used to irradiate tissue to read the produced ultrasound-frequency sound waves. Because ultrasound scatters much less than near infrared optical wavelengths it has much better spatial resolution.

Using the photoacoustic effect for imaging that depends on absorption of electromagnetic energy leading to acoustic waves, two conditions that inhibit widespread use exist: The first, thermal confinement dictates that thermal diffusion be minimized during excitation, thus limiting PAT to pulse lengths of microsecond or less duration. The second that is stress confinement is more restrictive because the pulse must be short enough to build thermoelastic pressure, limiting excitation pulses to less than 100 nanoseconds.

Reconstructing the images from computed tomography, the inverse source problem of reconstructing pressure density of acoustic waves is severely hampered by the assumption that the

medium is assumed acoustically homogeneous, although this method is also very useful for scaleability.

Through alteration of ultrasonic frequency for either penetration depth or resolution, higher equating to higher resolution. Additional use of the technology has led to its use through various other mediums as a form future-oriented form of reading/writing of information, such as the use of gold nanoparticles/nanocages as bringing molecular imaging abilities to PAT through specific targeting of the appropriate frequencies of excitation via multiple lasers (discussed in the final section as a meams of current and future development potential).

Because the above methods all lack certain qualities deemed necessary for an all-rounder successful imaging tool for medical use or for other purposes involving what is primarily the efficiency of laser technology as a very miniaturizeable but efficient means of data processing, we can now look to the example of verified PMI as a successful candidate for use through the work of Nouizi et al.

PMI: A Better Solution to Meet Medical Needs

DOT being used as an imaging tool for breast cancer monitoring and functional brain imaging is, despite progress, still delayed because of poor spatial resolution due to the high-scattering nature of biological tissues. Although great deal of progress has been made in the alternative that is PAI, thick tissue imaging is needed for clinical usage in this regard due to the lack of depth penetration of ultrasound waves. As a solution, the authors present their solution of PMI as a usable standard by bypassing conventionally restricted optical measurements via magnetic resonance thermometry (MRT) "to measure internal spatiotemporal distribution of temperature variation induced by the local absorption of light when the medium is illuminated with a laser."[ix]

Despite its similarity to PAI's laser illuminating temperature measurements, PMI differs by use of non-contact MRT measurements and slow heating process achieved in a much longer timeframe of tens of seconds instead, by using high-resolution optical absorption

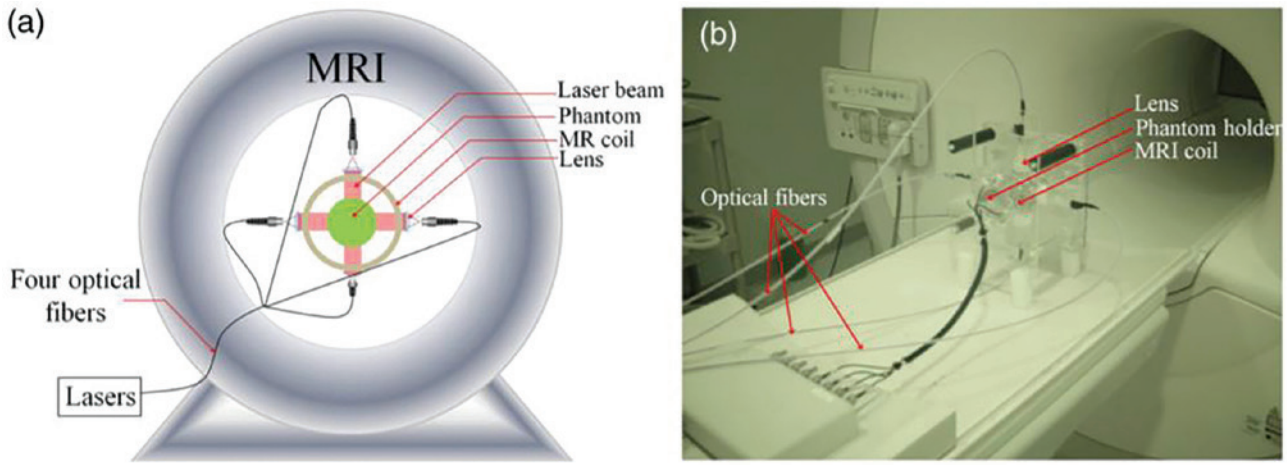


Figure 1.
(a) A schematic of PMI setup showing the phantom and the optical instrumentation inside the MRI bore. (b) The picture of the PMI interface sitting on the MRI bed. It consists of a specially designed RF coil with four windows for illumination and four ports that hold the collimation optics.[xi]

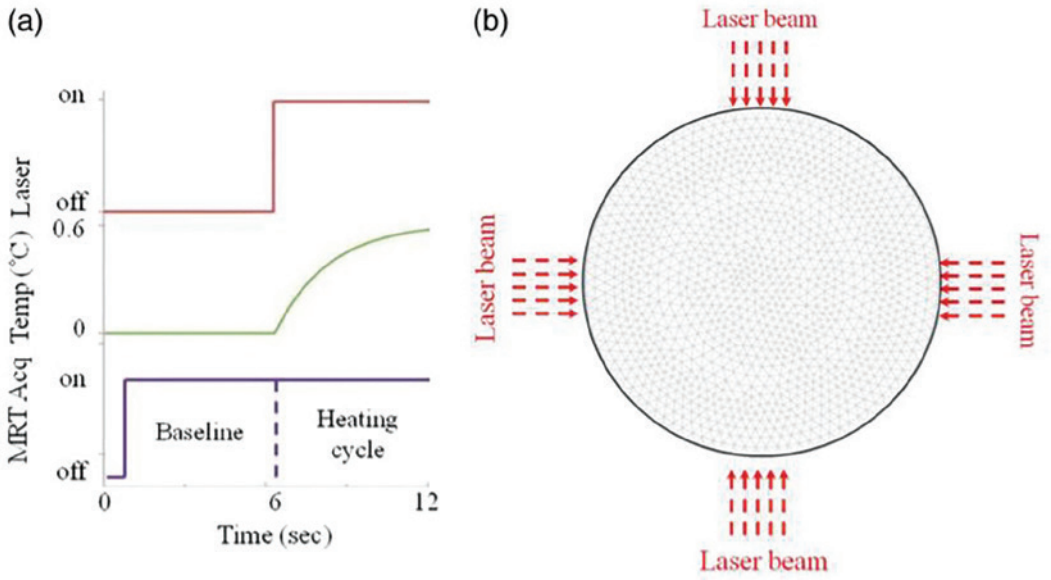


Figure 2.
(a) Timeline of PMI data acquisition showing the laser status, sample temperature at any particular point and the MRT acquisition for different cycles. (b) An illustration for the mesh of the cross section of the phantom and the collimated laser illumination beams directed onto the sample from four sides.[xiv]

maps through modeling of light propagation and tissue heat. Since quality of reconstructed PMI images directly depends on quality of temperature measurements, the choice of parameters is critical, with several options for absolute/ relative temperature inside a medium such as the diffusion coefficient, magnetization transfer, or proton resonance frequency (PRF).[x]

In this study, the authors display their model of a four-port illumination PMI system with a safe laser power level applicable for future clinical use for diagnostic purposes. The results are then evaluated using functions of resolved inclusions through their absorption contrast, size, and depth via a phantom test for each category.

Test Results

"The first step in the experimental validation of our technique is the validation of the forward problem. For this purpose, a PMI temperature map is first acquired using a mice-sized 25-mm diameter cylindrical agarose homogeneous phantom with an optical absorption coefficient of 0.01 mm−1, to mimic biological tissue. A 5-mm inclusion is embedded inside the phantom, 6- mm deep under the illumination site in order to mimic heterogeneous medium having a higher absorption area. The inclusion is placed a bit off-center and its optical absorption is set to be eight times higher than the background. Meanwhile, using the forward solver, the temperature map is simulated on an identical synthetic phantom having the same size, optical, and thermal properties. This simulated temperature map is then compared to the temperature map obtained by MRT."[xii]

Noting that we need a testing phase for calibration to correctly compare initial and final results observed, which was defining two parameters: Laser output as function of power and shape of the illumination beam used. "...laser power is measured at the output of each of the four collimation lenses

using a power meter", while "PMI measurements are performed on a homogeneous phantom with known optical and thermal properties"[xiii] to produce a very true result between theoretical versus real test maps.

Because the aim of the study is to produce immediate pre-clinical results, the test used was mice-sized 25-mm diameter phantoms mimicking small animals, with current noise level low enough for successful PMI imaging use, as the tested PMI can resolve inclusions as small as 1-mm diameter but also recover their absorption coefficients with clinically valid standard of accuracy.[xv]

The key measurement for PMI being local temperature increase as related to photon density decreasing drastically with depth in turbid media, PMI probing depth depends on the sensitivity of MRT. Therefore, the key strength of PMI is that as long as temperature change is detectable by MRT, the resolution is preserved at any depth (currently with a sensitivity of 0.1 Celsius). Supported with the test data as displaying recovery of 3-mm diameter inclusions buried at different depths successfully with only a 7% error rate for the recovered absorption coefficient. The size phantom experiment also performed very well, with only 32% error in the absorption coefficient for a 1 mm inclusion located 6 mm in depth. Overall, the depth possibility was shown to be up to 25-mm diameter sample successfully using four-port illumination, with probing depth possibly increased if the number of illumination ports is increased, perhaps through a light guide concept for homogenous illumination as yielding more optimal results because of perfect coverage.[xvi]

In addition, multiwavelength illumination via PMI through a medium can also reveal high-resolution images of tissue chromophores such as oxy and deoxy-Hb, water, and fat, through various methods, among them the use of exogenous contrast agents such as gold nanoparticles. The discussion of our next and final section via Luk et al., these tweaked models that make use of factored-in additions to an already good model allow not only even better progress in imaging, but also allow mutli-puerpose scans that can examine for various depths off image at once, an innovative approach that saves both time and cost in implementing often expensive (when brand new) systems of better medical machinery in an office environment.

Gold Nanoparticles: Rich in Health, Not Wealth

Adding gold nanoparticles to PMI allows us to tune their absorption peak by modifying their surface plasma resonance, a very useful feature that is what allows the multiple levels of light absorption read/write ability that can not only store a vast amount of data, currently being looked into as the next generation of storage media, but also allows a large and varied number of differing levels of information from different wavelengths to be read at the same time, each with its own corresponding laser frequency.

Currently already used as imaging probes for cancer imaging due to the innate elemental properties of gold rendering it inert and slow to leave the body, its accumulation in tumour cells makes them much easier to 'spot', especially because tumour cells by default possess both enhanced permeability and retention effects relative to non-cancerous cells. These same particles could also be used, via the same properties, as delivery agents for can-

cer in a similar vein, with results again easily measured as a progress image through PMI maps.

For the purpose of this experiment looking at such effects in a cell, a turbid agar phantom was used to mimic bio-tissue, while an agent having an absorption peak at 808 nm was used to tune the absorption of the inclusions embedded in the phantom, with PMI giving an impressive and almost clinically expert-level accuracy reading of 90%. This was achieved by using the positions of the inclusions containing gold nanorods, reconstructed at MR resolution through use of the absorption coefficient.

During the first iteration of the reconstruction algorithm, a homogeneous optical absorption assumption is made to simulate the internal induced temperature within the subject. The difference between the MRT measured and the homogeneous simulated maps is used to reconstruct the first iteration optical absorption map. The reconstructed optical absorption will replace the homogeneous assumption and be used in the second iteration of the reconstruction algorithm and so on. The iterative reconstruction algorithm is terminated when the change in the reconstructed map after two successive iterations is less than 5%. Figure 1(b) shows the experimental setup of PMI.

Results of 'Striking' Gold

Figure 3(a) shows a T1 weighted anatomical MR image of a 25 mm diameter phantom:

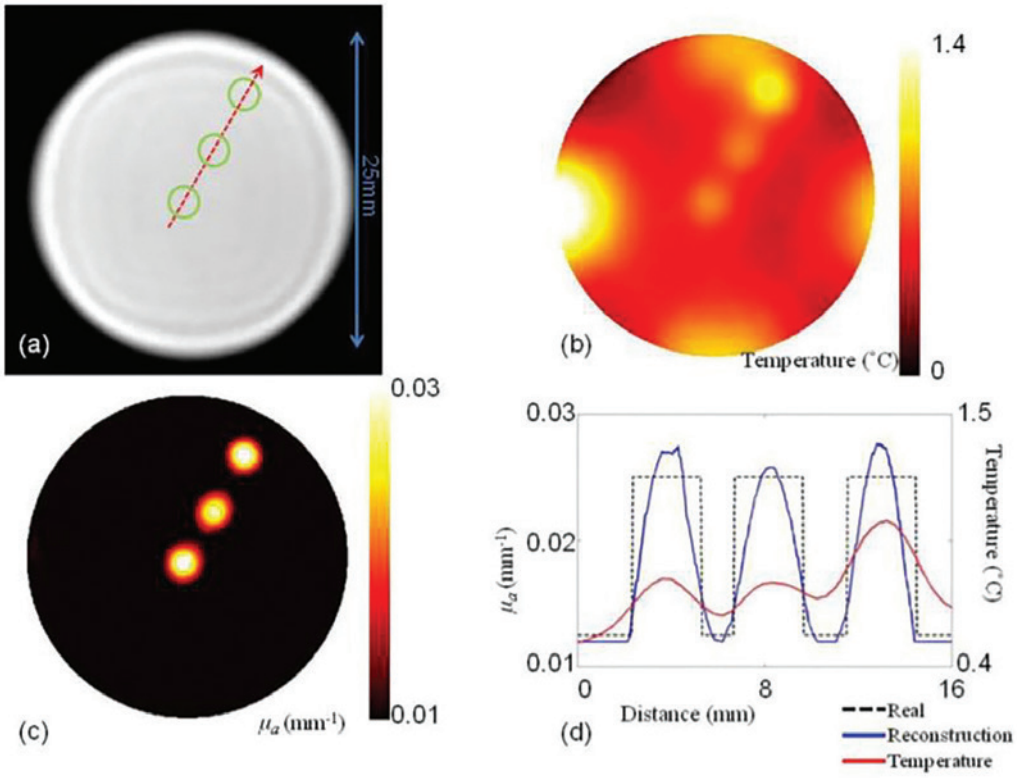


Figure 3.
(a) A TI weighted image of the 25mm diameter agar phantom. Three inclusions containing gold nanorods are embedded in the phantom. Their optical absorption coefficient is set to 0.026 mm^{-1}. (b) The MRT temperature map measured on the agar phantom. (c) The FEM based PMI reconstructed absorption map. (d) The temperature and reconstructed absorption profiles across the inclusions along the red arrow in figure 3(a).[xvii]

With absorption coefficient set to 0.01 mm-1 and reduced scattering coefficient set to 0.8mm-1, with three 3 mm diameter inclusions are embedded from the surface of the phantom inward and gold nanorods used to induce an absorption contrast of two times, the resulting MRT temperature map after 24 seconds of illumination is shown in Figure 3(b). Although all the inclusions have the same optical absorption, their temperature change, induced by photo-thermal effect, differs due to being different distances from the four laser light sources, with temperature change proportional to photon density.

Temperature-to-reconstructed absorption profiles are plotted in Figure 3(d), with FEM reconstruction algorithm accurately compensating for the depth dependence of the temperature increase by recovering more than 80% of the true optical absorption value of the inclusions, with optical absorption coefficient directly proportional to the concentration of gold nanorods in inclusion alongside accurate recovery of both position and size of the inclusions (Fig. 3c).

Conclusion

As we can see from the results, the process of standardizing PMI as an ideal alternative for older methods that have restrictions related to depth or resolution that make them limited, non-optimized candidates for use in overall every field of scanning used in medicine, but in particular the hot topic and urgent need that is earlier cancer diagnosis as a known lifesaver, to create a system that achieves one day perfect results is a complicated process. Aided by the addition of factors that boost the overall detection of cancer cells such as gold nanoparticles that both allow more accurate results and also allow an inclusive scam of the body that can make use of the reflective frequencies of the gold at various wavelengths as a way to detect multiple issues with a single scan. Although further work exists in the form of both the model for PMI being advanced into a full multi-wavelength system that can provide quantitative concentration of gold nanoparticles as a means of multi-purpose use for clinical applications, there is bright hope for the future reliance on the metal so pure, a source of both physical and now bodily health.

Endnotes

i Thayer, D. A. (2011). Photomagnetic Imaging: A Novel Optical Imaging Modality. University of California, Irvine.
ii Ibid.
iii Ibid.
iv Ibid.
v Ibid.
vi Ibid.
vii Ibid.
viii Ibid.
ix Nouizi, F., Luk, A. T., Thayer, D., Lin, Y., Ha, S., & Gulsen, G. (2016). Experimental validation of a high-resolution diffuse optical imaging modality: photomagnetic imaging. Journal of biomedical optics, 21(1), 016009.
x Ibid.
xi Ibid.
xii Ibid.
xiii Ibid.
xiv Ibid.
xv Ibid.
xvi Ibid.
xvii Ibid.

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[1] Luk, A. T., Nouizi, F., Marks, M., Kart, T., & Gulsen, G. (2016, March). Monitoring gold nanoparticle distribution with high resolution using photo-magnetic imaging. In Optical Interactions with Tissue and Cells XXVII (Vol. 9706, p. 97060M). International Society for Optics and Photonics.

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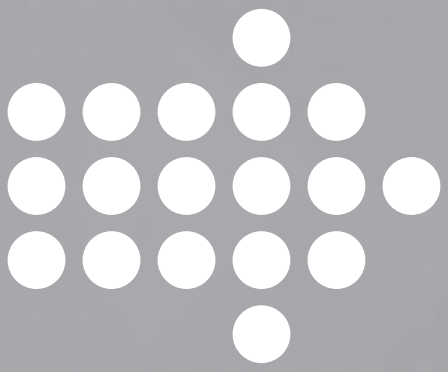

Neuroscience Organization for Leadership Practices and Future Selection

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Defined as the science of the brain, neuroscience has traditionally been used exclusively in the fields pertaining to its usefulness as either an agent in psychological studies, or via its more direct use as a brain treatment centre that identifies and attempts to come up with either chemical or mental methods to deal with mental illness or physical problems. However, it can also flourish as the fairly new field for which it is now sometimes mentioned in a layperson fashion as activities such as quizzes to find one's personality type as either an introvert, leader etc. Making more scientific use of these profiles, we see that neuroscience is a helpful tool in scouting for both new leaders, and in defining general concepts that are of benefit to society as a whole.

Before giving examples of more specific uses such as the complicated additions neuroscience through either finding leader neurotypes, we must first examine the general methods and feasibility of the sector to determine where and when certain parts of it be best used to tackle certain problems as they happen, through the work of Lindebaum.

Neuroscience Data as Concrete for Management Planning

Wanted by the People and the Government-Demand

Consistent with newer developments in neuroscience that include the debunking of the right/left brain myth, several neuroscientific advocates in management studies have proclaimed 'a biological turn in order to understand the underlying processes concerning markets and organizations' or desire for a 'more biologically informed view of business and organizations', with empirical studies now existing on genetic and neurological foundations of customer orientation or the quest for a leadership 'gene' (without neglect of environment).[i]

Further indicators of the desire for such information are seen in former President Obama's Brain Initiative announced in April 2013, the allocation of $100m worth of research funding to five federal research agencies, with contributions from other places significantly exceeding that of the White House. Likewise, the EU-funded the Human Brain Project has secured excess of €1b in 2013 for development of a computer simulation of the brain, while US funding for Humanities has decreased as of 2009, amounting to less than 0.5 percent in 2011 versus grants for science/engineering research/ development. Here, we see that one of the two reasons for advancement in scientific fields is that availability of funding is a legitimate demand force that exercises influence over what is achieved in the sciences.

The second one involves publication bias as novel theories cause large surges in both subscription rates and sales of single issues of journals, even more prominently in fields that are usually out of full comprehension for the average reader, leaving them hungry for the 'latest news' on something that they often only understand in a superficial manner before then jumping to 'helpful' conclusions that are shared widely. Additionally, because these cash grab articles are fast-tracked for profit purposes, while real articles often wait on a long backlog, publication bias here tends to further exaggerate myths by making real knowledge arrive much later, usually far after incorrect information has been spread around and is almost never corrected-we could point to many such myths, such as the "danger" of swallowing harmless chewing gum.

Supply of Information

The theories themselves are usually sourced from with several noticeable traits existing. The first is questionable validity of the fMRI data, a second the use of imprecise motherhood statements, while third is the use of "ethically devoid theoretical and empirical advances mirroring the 'pretense of knowledge'" in the sciences.[ii] The use of fMRI data had indeed become more common now in management research due to management scholars having enough confidence to rely upon 'objective' data not found in traditional research methods.

Validity of fMRI

Because neuroscientific imaging technologies capture both 'controlled' and

'automatic' processes of social cognition, they are considered completely unbiased representatives in science, black sheep that can make no mistakes even if we wanted them to. As a fairly recent example, a fMRI study on 'Machiavellianism' and 'mentalizing' by Bagozzi and colleagues used prior research suggesting that 'mentalizing' (by reading the desires, intentions, and beliefs of other people) is found in several specific brain regions, with three of the used sources being review articles, the other having a sample of 12 participants alone.

Specifically, it is reported that real "estimated statistical power of fMRI studies using human subjects is only 8 percent, owing to small sample sizes and inconsistent analytical strategies"[iii], while an average scientifically valid correlation must usually possess a percentage nearing or surpassing 80% (!) For management theories, this means that any significant progress must be derived from means that do not solely use fMRI data for results, and that "a complete theory requires the identification of which factors (constructs, variables or concepts) are logical constituents of the explanation of the phenomenon under investigation."[iv]

Motherhood Statements

A second characteristic of the supply of such articles is the use of 'motherhood statements' that use unclear conceptual and theoretical directions when trying to explain precise details as practical or relevant. For instance, the Chartered Institute for Professional Development suggests "'how HR [Human Resources] can use neuroscience to boost learning and development, cut staff turnover and enhance customer service', adding that one way to achieve this is to help 'staff to gain knowledge of how the brain is structured [which] can help learners build self-awareness and improve their personal effectiveness.'"[v] As a very questionable statement, "as if structural knowledge of the brain alone – without any deeper understanding of how the brain holistically functions – could ever explain such complex issues such as self-awareness or effectiveness in the context of a particular work setting or situation" could possibly be accepted as any form of fact without several more examples of research from various other fields.

Lastly, the pretense of knowledge as expertise makes it fairly obvious that organizational neuroscience is firmly embedded within the positivist paradigm in a usual cycle of assumed "key tenets of reality as real and apprehensible as well as findings being objectively true, respectively."[vi] Let us consider here the instance of Becker and colleagues (2011) when they argue that 'neural mechanisms are largely homogenous across all individuals' and that 'all brains are organized in a similar fashion' (!)[vii]

Bad consequences for Good management

The above bodes badly for quick and 'innovative' business solutions, and also impacts show in employment interviews, shown through meta-analysis results of structured interviews having higher validity d a higher validity (.27 versus .19), but that this is then butchered when affected by such publication biases (down to .21).[viii] For McDaniel and colleagues (2006), it was found that such adjustments led to many practitioners using unnecessarily complicated and long interviews for "neural validity" purposes to choose employees-this could even lead to future employee selected via expensive fMRI technology if unchecked.

First studies following the logic of 'objective' and 'rigorous' data have existed for about a decade now, although Button and colleagues (2013) somewhat obviously conclude that 'unreliable research is inefficient and wasteful'.[ix]

For future research

For realistic and usable results in the field, our author recommends direct replication alongside representatively large sample sizes to ensure real results for real management through larger samples that make use of various different methods to achieve similar and linkable results in a socially valid construction of various piecemeal parts for a sturdy tapestry.

Verified by study demonstrating significant inconsistencies in terms of analytical strategies via Car's (2012) finding that "of 241 fMRI studies examined, 223 unique analytical strategies were employed, so that almost no analysis was used more than once. Relevant factors here concern definitions of key variables, the statistical model employed, adjustments undertaken (or lack thereof) to account for potentially confounding factors, and the usage of filters to exclude some observations from the analysis."[x]

This is especially true of the limited variability found in small sample studies, of which fMRI is almost always, minor adjustments making an otherwise non-significant result significant instead. We now turn to the more specific example for practical use, of how sound data can possibly determine leaders in a more realistic framework using scientific principles for validity and accountability via Waldman et. al.

Determination of Leadership: All in the Mind?

For this application, the subset of social cognitive neuroscience holds the most relevant use for us, with Ochsner and Lieberman (2001) having defined it as "an emergent, interdisciplinary field that seeks to understand human interactions at the intersection of social, cognitive, and neural spheres of science"[xi], while newer findings display that the brain might support leaders in many aspects of cognitive behavior.

Here, we use as our basis inspirational leadership as a type that is most commonly referred to and looked for in general terms, but especially in times of crisis, and often defined by both charisma and an understanding of emotional empathy and strong qualities in both speech and behavior.

What Is Inspirational Leadership?

Collectively labeled as neo-charismatic by House and Aditya (1997)[xii], the general framework of theories all hold that "outstanding leaders go beyond simple performance - versus - reward transactions and have a deep impact on their followers and their organizations, including the potential to be a major force in realizing new visions and change."[xiii] However, other definitions do also exist, such as the functional one of Barbara Kellerman (2004) suggesting that "good" leadership "is less about the ability of leaders to inspire followers and more about mutual leader and follower responsibility", in particular that "effective leaders should emphasize shared power with followers and supportive networks, and should surround themselves with people who tell them the truth."[xiv]

Neuronal Coherence and Inspirational Leadership

Commonly defined through coherence, brain activity is here tracked through communication between different but connected areas of the brain. Therefore

suited to finding inspirational leaders due to their shared qualities that endear them to the people, the measure works by associating high percentage levels with better results.

A Study of Business Executives

Waldman now uses a case study done to link our ideas for better leaders qEEG assessment of 50 diverse individuals who "held leadership positions in a large metropolitan area located in the western United States."[xv] Holding interest through all sample members being in top levels of the business, this includes "physicians, lawyers, deans, politicians, developers, company executives, entrepreneurs, and community activists", with the average member reporting that "their modal salary reported was $125,001 plus."[xvi]

qEEG Assessment of Coherence

Coherence measures using NeuroGuide™ software examined data from 19 electrodes placed on the scalp, and reported (as coherence values) pairwise comparison of activity patterns from 171 possible combinations of electrode locations. Focus on the three electrodes the right frontal regions of the brain, Fp2, F4, and F8, derived a right frontal brain coherence index was derived by averaging the coherence scores obtained from the three electrodes in the region. Further, the system examined coherence associated with high-frequency beta rhythm (20 –30 Hz) due to association with an alert/active mental state.[xvii]

Vision Statements

Participants were asked to talk about their goals during their qEEG assessment, asked as

(1) "Can you please describe your current plans for your organization, as well as plans for the future?"

(2) "As you look toward the future, can you formulate a vision statement for your firm?"

Coded from 1 to 3 for personalized to vision that uses singular pronouns and dominance through winning at all costs, such as "My vision is to be the number-one supplier of essential office products and services, regardless of what that product line is within the markets that I service" versus statements that scored 3 as more socialized visions using empowerment values, role of team for success and "positive contributions to employees, customers, the community, and the environment."[xviii] Illustrated as "To also provide an environment at work that is fun, rewarding, fulfilling, and with opportunities to grow and expand for our associates, and also to be a player in the community"[xix], statements coded as 2 contained both, showing the overall spectrum of what might constitute an inspirational (if not likeable) leader in three very different ways. with both personalized and socialized elements.

Findings

Values for coherence of 3%-71%, with an average 23.7% show that participants have various degrees of coherence within the brain, with three results found. As predicted, right frontal coherence corresponds to highly socialized visionary communication, socialized vision correlated to follower perceptions of inspirational leaders, and that right frontal coherence was only marginally applicable to perceptions of inspirational leadership.[xx]

That is, right frontal coherence is linked to coding of socialized visionary behavior instead of generalized behavioral measure involving perceptions of inspirational leadership.

Case Examples

Leader #1 is a 52-year-old leader of a private non-profit, community-based corporation that provides health and human services to Hispanic communities. Evaluation ranked him very high on inspirational/charismatic leadership and he showed a highly socialized vision that was positive and socially responsible. Furthermore, he tended to have a great deal of thought and reasoning behind the ideas put forth. Concomitantly, the qEEG analysis revealed high frontal right hemisphere coherence (69%) for this individual.[xxi]

Leader #2 is a 48-year-old senior executive in an engineering/construction firm. Despite personal success at navigating the corporate ladder, his response was a non-socialized view of the future: "to produce good products." He then became frustrated and apologized for the (self-perceived) less-than-adequate responses. Overall, his vision seemed to be difficult to construct, with his coded socialized vision score very low. He also had one of the lowest scores recorded for follower ratings of charismatic leadership, with a low coherence of 17%.[xxii]

In short, traditional attempts to observe leader behavior, clinically or through survey methodology, can go only so far in terms of our understanding of leadership processes and their outcomes. However, there are associations for general traits that resolve into qualities that people look for in certain occupations as a thereby somewhat indirect but valid means of determining the perfect leader, chef, etc. through narrowed behaviours via neural coherence used here.

Current thinking also suggests that the brain is relatively "plastic" in adapting to new situations, with attention deficit disorder (ADD) and anger management issues now routinely engaged in neurofeedback therapy activities for correction purposes successfully.[xxiii] For immediate results, deficiencies can therefore be corrected to improve potential even further through data-driven psychology help: One participant was a manager who reported anger management problems, and was successfully treated through neurotherapy habits that pinpointed the cause of injury as a childhood baseball injury that had affected part of the brain. The individual was able to then rearrange neuropathways in the affected area, create new pathways with healthy neighboring neurons to largely correct the issue. This corrects issues, but only indirectly. For complete advancement of our hypothesis, we must address leaders via direct use to actively develop and nurture potential greatness through both early detection and training.

For example, it may be possible to "rewire" right frontal pathways to achieve greater coherence to enhance the potential for effective leadership at the source for more realistic and permanent research gains and corresponding real-world results, the overall goal being to deal with each individual as an individual that seeks to gain better abilities for their life and work (as a leader). Seemingly far-fetched, neurofeedback allows "peak performance" as business executives and top athletes use it to coach themselves into the ideal mindset for the task at hand, by letting the brain focus on the moment, verified scientifically as improving performance (known as "spacing out" or "being in the zone", and also exists in fields such as musical performance).[xxiv]

We may find that maximum results need also more traditional approaches such as 360- degree feedback and executive coaching for rounded effect

that allows non-restrictive application in all situations, including social ones. [xxv] Of particular promise may be the future integration of genetics as influencing brain process, with empirical work demonstrating that samples of twins show that "about 30% of the individual differences in leadership role occupancy can be attributed to latent genetic factors"[xxvi], although these are also affected by the resultant social environment one finds themself in.

Conclusion

The view of neuroscience as the answer to all our problems is a complicated one. Although it may not in fact have instant answers to all problems ranging from phobias to the pursuit of better behaviour, there is hope in the form of usable aspects that make direct use of reliable data and processes of the mind to produce achievable and consistent results, both as temporary and perhaps one day permanent fixes. Ranging from the use of observable but previously not scientifically proven concepts that hold sway such as mental coaching to less common and more permanent solutions of rewiring the brain through social or even chemical or electrical processes, we then define a good business leader as one that can not only have a brain that is good at understanding others, but that can also adapt to situations and differences efficiently in order to maintain that inspirational standard.

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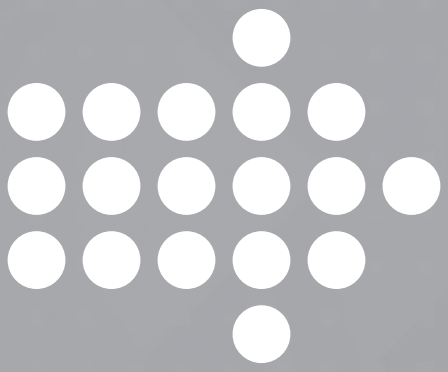

Using AI Technology Applications to Close the Gap Between General Usability, and the Practical Uses of Reading Materials and the Outdoor Navigation for Blind Users

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Although "recent statistics from the World Health Organization estimate the number of visually impaired or blind people to be about 2.2 billion"[i], sight is usually taken for granted, with even the blind often stating that it is not so big a deal, and that they grew up learning to deal with it through methods such as hearing practice and work-arounds. However, this still does not hold true for many forms of written sign placed above eye level such as bus stops, and the buses themselves as displays that show routes and numbers as a similar problem. Similarly, there is also the newer issues of both the non-tactile methods of modern information-gathering such as smartphones and other touch displays found in service places such as McDonalds that do not have an option for Braille—obviously 'impossible' although a simple touch-to text program would solve the problem, they have existed for years

(!) in some form of keyboard for blind office workers. Or, alternatively, a more obvious solution as not yet implemented for physical media would resemble a form of Google Translate for words-the touched spot is read aloud through a worn or held sensor such as a glove or special phone stylus.

Beginning with a general overview of how such systems unintentionally leave out blind users as published by Branham and Roy, later expanded through apps that allows users to navigate both road directions, and read material through either spoken or other forms of comprehension.

Blinded by Forgotten Design Oversights: A Summary

Over the last five years, Voice-Activated Personal Assistants (VAPAs) have become the most convenient form of sightless assistance for blind users for both general navigation and interactive purposes via smart devices. With an estimated 90.1 million active monthly users of mobile voice assistants and 45.7 million users of smart speakers in the US alone[ii], interest has peaked for the use of such technologies as adaptive methods that can be well-suited to tackle older problems of blind interaction that formerly depended upon very limited fixes such as braille-often limited to only being placed on a surface if it is thought of during the design process, and wholly impossible for general distance-based signage. Blind users, interestingly, comprise a large minority customer base of technologies such as Amazon Echo[iii], despite remaining issues with the limitations of the current provided usability, strongly suggesting that more developed voice assistants may hold nearly limitless potential as blind-assistive tools for an also very reasonable cost.

Technologies for the Blind

Usually made up of conversion of visual information to an accessible format such as speech, products such as screen reader software convert "graphical information from a visual display into synthesized speech or Braille output"[iv], some being advanced enough to produce real-time information about the environment, closer to the ideal for daily use; some mobile navigation aids give orientative assistance through visual vision translated to instructions as understood by lack of sight (such as distance, relative speed).

Concerns?

Always existing as privacy concerns, VAPA users are no exception as users are most commonly "unaware of the degree to which voice interaction data being collected is kept confidential, which can make them reluctant to share sensitive data with VAPAs",[v] or the other common problem that is discussing more private concerns to a voice-based system that, apart from not being good at identifying words spoken at low volume or softly, also speaks back queries as more or less direct questions in a rather audible fashion. For this concern, multiple studies have determined that "people are less confident about using voice-based technologies in public due to concerns about disclosing sensitive information."[vi]

Aspects Needed for Customer Assurance

Discoverability-Currently Low!

Despite VAPAs as very common, actual usage is limited to short durations due to the unnatural tendencies of current systems in handling anything other than simple queries, and the voice-only modality means that users rarely un-

lock the real potential of such systems during daily use-the opposite of meeting a person several times. Limited discoverability compromises learnability for a new user as well, and means that the form of communication between machine and person sets unrealistic expectations when the user might want to ask a complicated question or make a 'confusing' statement that a normal person would understand with little issue.

Hands-Free Use

A critical advancement for text-to-speech technologies such as VAPAs, the ability to multitask is especially important for blind users because they must otherwise always be an extra amount of preoccupied mental capacity in navigating the regular street that our brains do on auto-pilot through the benefit of sight. However, there is also the occasional need to do a touch interaction during a task sequence that diverts attention away from truly immersive use as would be needed in such a case if a screen is used, leading to both user and researcher preference for use of speech as the primary modality rather than tactile feedback-this second one navigates the road being walked on instead, as above.

Speech Recognition for Certain Groups

Often "disregarded as a technological limitation which will improve over time"[vii], the main issue, apart from the differences of non-"standard" accents and fast speech in a natural setting is that speech patterns change with age: Seniors are affected at a higher percentage due to, says research, that older adults "have a slower speech rate with longer inter-syllabic pauses and lower speech intelligibility"[viii] in general, with usual VAPAs being oriented to somewhat young, or at least younger, users as more technologically fluent.

Challenge: Session Length

VAPAs activate and later time-out after a certain inactivity period. The currently too-short time given together with no feedback that actually lets the user know if the period is active are both major hurdles, one a simple user adjustable timeframe function, and the other not too difficult to solve through use of a simple sound signal as used by smartphone notifications. For the blind, they reported frustration with the inability to input complicated commands as would be needed when the screen is not pressed for any input.

Challenges and Preferences of Blind Users

Additional issues involve the "human-like conversational nature of VAPAs to be "verbose" and "irrelevant""[ix] for advanced users, as they find it greatly limits both speed and efficiency. Preferring customizable speech rate, clarity and intensity of vocal output according required task is much more realistic, akin to whispering in a library. Such a change would also solve the problem of lack of more complex speech input in current commercial interfaces, with dictation errors currently not having an edit option, a problem for long text sequences; they must be repeated entirely instead as usually no button option is available for manual correction either.[x]

FINDINGS FROM GENERAL STUDY OF EXISTING SYSTEMS

More Naturalized Conversation

A way to solve the inefficiency aspect above, the informality and shorthand nature of realistic speech is one of the

main obstacles to be overcome: Replicating the way people "naturally ask each other for things" pays little attention to unneeded grammatical accuracy through use of normal speech conventions such as 'wanna' or 'gotta' for text-to-speech use.[xi]

Make Conversations Personal

Personal VAPAs use the exercise agency and tailored specifics by the user to, rather than be given some defined set of instructions, possess smart defaults via alternative phrasings that use smarter design as benchmark speech such as a response to

"User: 'Make my room warmer,'

Cortana should say: 'I've raised your room temperature to 72 degrees' instead of

'Sure, what temperature?'"[xii]

Relevant defaults vary on natural context just as speech and its input levels do in regards to volume and specificity of meaning versus vagueness, such as a ride sharing app automatically defaulting to the last requested ride type" unless otherwise stated to it, with such defaults also possessing a minimum and expected safety net found in other methods, such as a guide not walking towards a fight or a busy intersection.

Interpret Users' Varied Phrasing Correctly

"Intent" is a term used by Amazon, Google, Microsoft, and Alibaba when referring to "representation of the action that fulfills a customer's spoken request"[xiii] is ideally adapted by the AI of the system flexibly to function as a real or almost real person for speedy use as a VAPA.

"Avoid assuming that people will say precisely the words that you anticipate for an intent. While the user might say 'plan a trip,' he or she could just as easily say 'plan a vacation to Hawaii.'"[xiv] Such a guideline suggests at most around 30 alternate utterances per intent as a realistic but perhaps also achievable goal, in addition to VAPAs understanding differences in subtle variations and mispronunciations in user speech.

Respond to Requests of Varied Completeness

The common sentence fragments and partial thoughts are what make up much of normal speaking, and must accordingly also be accounted for, ranging from no intent to multiple intents at once

in one sentence. Full intent is the complete spelling out of the wanted result, with the middle that is partial intent being adequately detected and automatically filled. But what of a "no intent"? Here, VAPAs should not dismiss the request given or ask for a repeat, but most effectively instead walk the user through the correct terms needed to state what it is they request from a small list of options as demonstrated below through partial and no intent:

"User: Hey Cortana, ask Mileage Wizard if I have miles.

Mileage Wizard: Miles to travel?" (Partial Intent)

"User: Hey Cortana, ask Mileage Wizard.

Mileage Wizard: Do you want available miles, used miles, or discounts?" (No Intent)

The VAPA should handle situations of its own uncertainty as above via re-wording as a person would to solve this problem, as well as being able to filter the excess caused by users being overly specific to avoid system errors.

Maintain Transparency and Provide Responses for Errors

VAPAs should therefore be "transparent, honest, and helpful" in disclosing

the error to the user and offering alternatives, such as "I can't reach your preferred florist right now to place your order. Should we wait a few minutes and try again, or order from another florist?"[xv] with repeat attempts only necessary if an error persists repeatedly or takes a long time by communication standards to reply, perhaps a threshold of about 5-20 seconds based on context. Explained should also therefore use correspondingly simple language as the rest of the AI does, including avoidance of technical jargon-unless perhaps the user specifies to turn off this potential feature.

IMPLICATIONS FOR DESIGN

Preferences as Instantly Adjustable

The authors hereby suggest that "the length of conversational turns be customizable according to user preference" to avoid discussed issues of non-correctable speech input and lack of complex instructions, as well as changing the context of conversational standards according to the requested information, just as social circumstances allow for. To illustrate, currently asking Alexa for forecast takes over 20 seconds (!), whereas we could instead desire a brief general one such as "User: Alexa, give a brief weather update. Alexa: 47 degrees, partly sunny. Low, 42. High, 57."[xvi] as a more normalized and less mechanical form of interaction between person and interface.

Adjustable Speech Speed

Prior work proves that the blind comprehend speech at faster speeds more efficiently than the general population, and as such tend to find regular text-to-speech or otherwise very slow for practical purposes. Currently, there is no adjustable system for such an option change, although implementation is a very simple matter indeed: "User: Alexa, increase voice speed. Alexa: Voice speed increased to 85%."[xvii]

Creatable Shorthand

VAPAs sometimes being the only accessibly convenient way for certain non-touch services means that this is more than needed motivation to ay to memorize or define more complex commands via their own intrinsically easy to memorize shorthand codes, such as "User: Alexa, define new command. 'Weather, brief' equals 'give a brief weather update.' Alexa: OK. 'Weather, brief' equals 'give a brief weather update.'"[xviii]

Outdoor Navigation: A Somewhat Slippery but Improvable Slope

Walking canes now exist that use sensors and issue a buzz, but only work at a distance of 2-3 feet with a knee-level limitation. Because the buzzer might not be heard in loud and potentially dangerous situations such as a busy road, the proposed system combines several aspects from other applications to completely scan the nearby area for orientation purposes.

IMPLEMENTATION

1) Real time images from the rear camera of the mobile handset are sent to the connected laptop.
2) The images captured by the mobile camera first transfer to the app on the phone before being sent to laptop for further processing for conclusions.
3) The system then tests using APIs and SSD algorithms to determine confidence accuracy of the tested image, with "98% accuracy for certain classes like books, cups, remote."[xix]
4) After testing the generated output on the laptop is translated into spoken form via wireless connection to the mobile phone.

The system runs using a friendly chatbot that ensures customer non-frustration and includes additive but useful functions such as currency recognition in real-time for easy payment and text recognition for reading of non-braille information, such as found in maps or signs.[xx]

This system can be layered with the final section that is accurate 'reading glasses' as usable in real-time in conjunction with other helpful aspects such as currency recognition and realistically textured speech use and questioning to form a useful AI app for blind users, the reading glasses designed and discussed below via Khan et. al.

Glasses: Not your Everyday Spectacles

The authors here design and explain their ironic but useful idea of glasses for giving sight to the blind. The novelty of the proposed design is as listable through 1) "Hands free, wearable, low power, and compact design, mountable on a pair of eyeglasses, for the indoor and outdoor navigation with an integrated reading assistant" and a 2) "Complex algorithm processing with a low-end configuration" that has the benefit of a 3) "Real-time, camera-based, accurate distance measurement, which simplifies the design and lowers the cost by reducing the number of required sensors."[xxi]

The current design can detect both stationary and moving objects and via speech feedback, and also aids via "an in-built reading assistant that is capable of reading text from any document."[xxii]

DESIGN

The device takes the form of a pair of eyeglasses with feedback through headphones. Camera and sensors provide the distance measurement, with Fig. 2 showing the device prototype. The use of multiple strategies for object detection has allowed thorough and a very accurate setup. One is TensorFlow, which makes use of API, frameworks and libraries, such as OpenCV and Haar cascade classifier, to also detect faces and eyes, in addition to the implementation of distance measurements.[xxiii] For text, Tesseract as free OCR engine for various operating systems extracts it from images while eSpeak as an open-source speech synthesizer provides the auditory feedback for object type and distance. For 40–45 inches away the ultrasonic transducer uses a voice alarm system as eSpeak simultaneously informs about the distance away of obstacle.

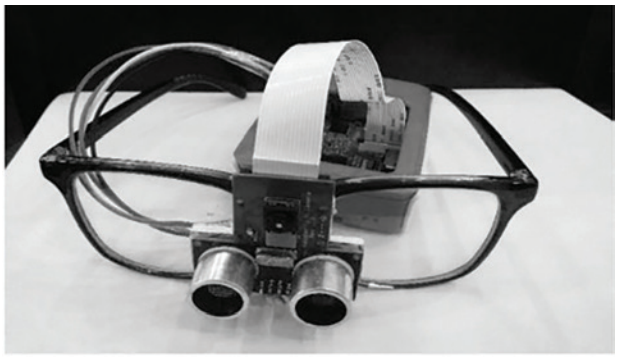

Figure 2.
Proposed prototype. Raspberry Pi with the camera module and ultrasonic sensors mounted on a regular pair of eyeglasses.[xxiv]

System Workflow

The recorded videoframes are processed through a convolutional network to build a feature representation of the original image which is then pretrained on Image-Net to learn the image extraction process using SSD. Next, the model manually "defines a collection of aspect ratios for bounding boxes, at each grid cell location" and predicts offsets for "bounding box coordinates and dimensions."[xxv] Here, distance measurements are processed through both depth information and ultrasonic sen-

sor, and the additional bonus exists that the reading sensor works fully operationally at the same time (!)

However, the accuracy of Tesseract API as text reader is hindered by non-ideal reading conditions such as heavy lack of light or general and background, usually working perfectly on good or only slightly dimmed light on white backgrounds-perhaps improved through a database of common signs and names in the local area as a memory database for at least directional signs that cannot be easily illuminated by a phone flashlight when the hour runs into evening or night.

SYSTEM EVALUATION

Object Detection

Drawing a bounding box on an object to predict the object type based on the training set, there is also a given probability of correctness to thereby factor in possible error rates-no prototype starts out perfect. However, there is the benefit of the app being able to read multiple objects in a frame, all simultaneously, with their own given accuracy reading and distance.

The percentages for accuracy are outlined below in Table I for 22 unique cases but commonly found cases of objects found both inside or outside, usually showing almost perfect accuracy for single objects, with at least 80% accuracy when the user is 15-20 m away.[xxvi] Reliability is further ensured and increased via the ultrasonic sensor that separately confirms distances, with multiple objects being solved by use of objects as higher priority when more dangerous/closer, while the to-be-improved model currently suffers from some failure rate due to shape and color variations of objects and ambient lighting.[xxvii]

Test Cases	Actual Object (s)	Predicted Object (s)	Failure Case (s)
1	Person	Person	None
2	Mouse	Mouse	None
3	Person	Person	None
4	Notebook	Notebook	None
5	Cell Phone	Cell Phone	None
6	Person, Chair, Mouse	Person, Chair, Mouse	None
7	Cell Phone, Notebook	Cell Phone, Laptop	Laptop
8	Notebook, Person	Notebook, Person	None
9	Pen, Mouse, Keyboard	Pen, Mouse, Keyboard	None
10	Bottle, Cell Phone	Bottle, Cell Phone	None
11	Clock, Backpack	Clock, Backpack	None
12	Bottle, Cup, Chair	Bottle, Cup, Chair	None
13	Chair, Person	Chair, Person	None
14	Laptop, Bed, Cup	Laptop, Bed, Cup	Bed
15	Person, Chair, Cup	Person, Chair, Cup	None
16	Person, Bench, Chair	Person, Bench, Chair	None
17	Cell phone, Cup	Cell phone, Cup	None
18	Knife, Cell phone	Knife, Cell phone	None
19	Knife, Spoon, Banana	Knife, Spoon, Banana	None
20	Apple, Orange, Banana, Bowl, Knife, Spoon	Banana, Bowl, Knife, Spoon	Orange, Apple
21	Bicycle, Person, Chair	Bicycle, Person, Chair	None
22	Person, Bicycle, Car, Motorbike	Person, Bicycle, Car, Motorbike	None

Table 1.[xxviii]

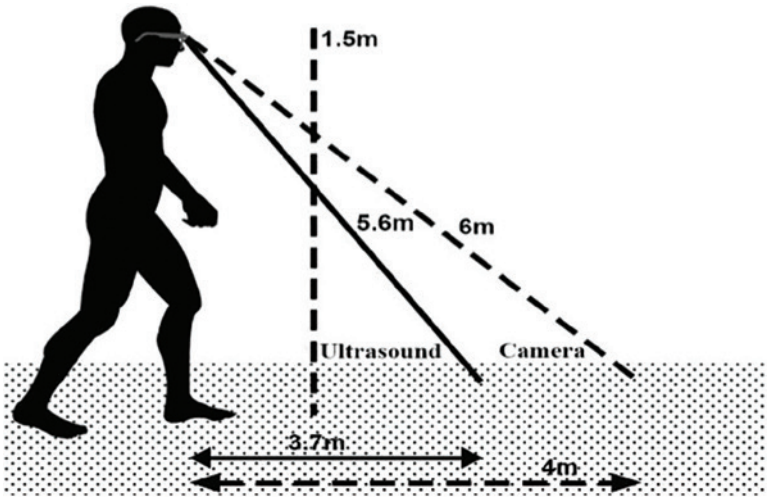

Figure 11.
Demonstration of the distance measurement using camera and ultrasonic sensor.

Distance Evaluation

If distance measured drops below 40 cm, the user will receive a warning voice alert stating that the object is 40 cm, measured in a range of 2–120 cm by sonar waves and displayed successfully via the rectangular aforementioned bounding boxes, whose function revolves around encapsulating objects as detected in the application.[xxix]

Evaluation of Reading Assistant

Tested under various conditions of ambient lighting conditions in multiple forms of text size, font, color, and background, the OCR engine works most successfully when more light is present, and a well-illuminated background yields better performance as well. Shown in Table III (below), the "performance of the reading assistant is tested under three different illuminations: bright, slightly dark, and dark, using the green and black-colored texts, written on white pages. When the text color is black, the device performed accurately in bright and even in a slightly dark environment but under the dark condition, it failed to read the full sentence. For the green-colored text, the reading assistant had no issues in the brightly lit environment but failed to perform accurately in slightly dark and dark conditions."[xxx]

Test Cases	Text	Text Color	Paper Color (Background)	Ambient Lighting	Performance
1	What can I do for you?	Black	White	Bright	Reads Accurately
				Slight	Does not Read
2	What can I do for you?	Black	White	Dark	Accurately
					Does not Read
3	What can I do for you?	Black	White	Dark	Accurately
4	I am doing well.	Green	White	Bright	Reads accurately
				Slight	Does not Read
5	I am doing well.	Green	White	Dark	Accurately
					Does not Read
6	I am doing well.	Green	White	Dark	Accurately

Table 3. **Performance of the Reading Assistant**[xxxi]

Experimental Setup

Primarily tested in controlled indoor settings imitating real environments, the device also works well in outdoor settings when tested by the test participants that were 60 completely blind individuals (male: 30 and female: 30) as volunteers.

Criterion

Participants rated three factors that were ease-of-use, mobility, and preference compared with the cheaper sensor-using white cane. Using a scale of 0–5 divided as 1) worst (score: 0–2); 2) moderate (score: 3); 3) good (score: 4 and 5), the total output is also a measure of recommendability to somebody else, with the rating split into a totaled score of "not helpful (total score: 0–8)," "helpful (total score: 9–15)," and "very helpful (total score: 16–20)", with the labels determined via participant pre-discussion.[xxxii]

The Results

The average scores of 14.5 rates the device as rather helpful, possibly very helpful with a few modifications made to it, especially usability being somewhat less than it might be due to this being a non-extensive prototype. However, mobility and preference still scored high versus a white cane, even though the still early pretrained model could be taught again using more objects for a more accurate database. Other than the lack of readability for non-bright spaces caused by software rather than the model, the current limitation is that the reading assistant has yet to function when texts contain tables or pictures, a serious gap that the completed model must address-possible via Google Translate type technology addition at a cheap enough cost.

The cost is also extremely reasonable at about 70 dollars versus similar market devices as much more expensive, or the

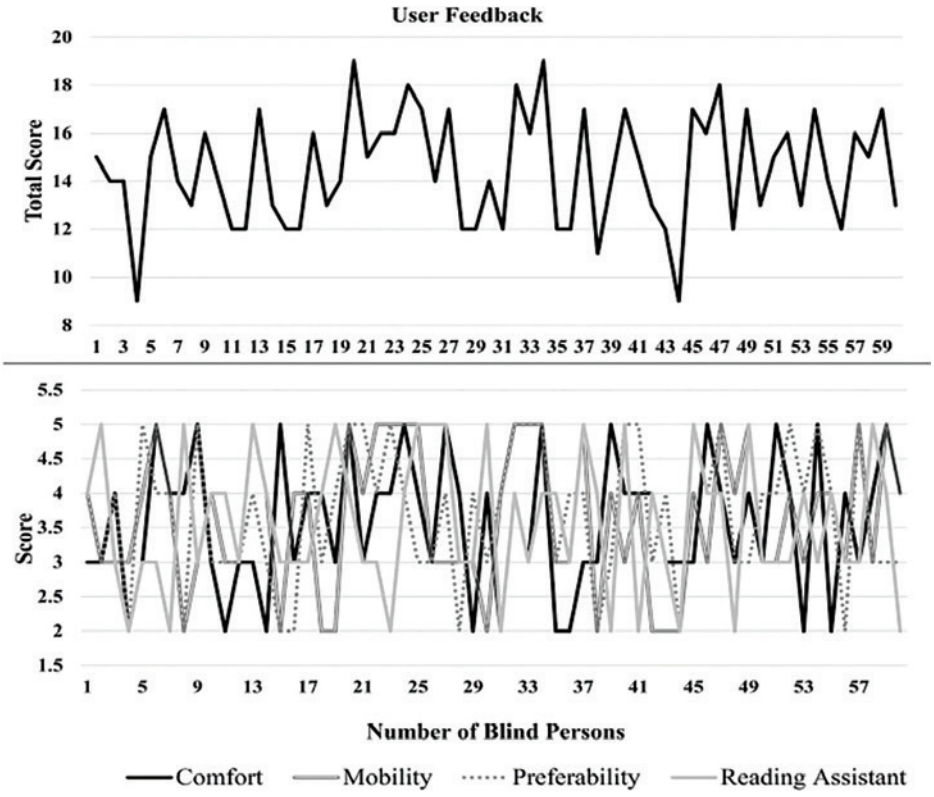

Figure 15.
User rating for the proposed device tested in the indoor setup of Fig.13.[xxxiii]

use of service dogs as non-readers and non-talkers that cost up to $4000 plus require care as a pet does (costs below).

Conclusion

To the use of AI technology as an assistive means of navigating blind users through both written non-braille text from signs to maps or any else at a distance to the forms of obstacle avoidance that are useful, especially outside, for object avoidance via warnings, we see that digital systems need not only a strong guideline of function to work as real representative ways of assistance, from more natural speech to thorough alternative options and proposed smart lines of questioning as adjustable to both social and external context as defined by the user, we have learned that it is not simply a question of if a pair of smart glasses 'see' or so not see, but that the concept behind them and the person wearing them both known and can make use of the relevant ways of directing questions correctly to each other in a true communicative fashion that not only avoids danger, but enriches overall travel and use of smarter technologies.

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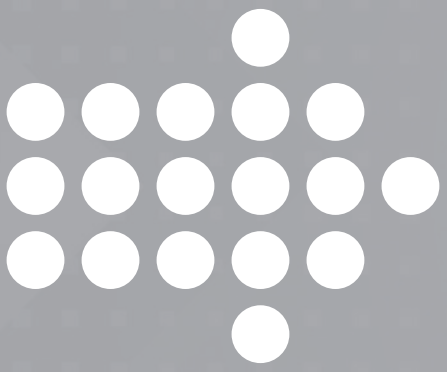

AI as the New Guideline of Environmental Law: Benefit or Confusion?

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For law, what is the environment? Definable as the shared area that we humans share with other plants and animals, in a loose manner of speaking, we can say that such a definition is helpful because it considers the other life around as a whole unit to be nurtured and protected. Indeed, the current change being undergone aims to do precisely that by aiming for not only pure sustainability through making the now common AI also completely green in energy usage, as well as other common objects such as cars, but also intends to also regulate these existing forces to do no harm to anybody or anything, as is the goal of any national, or, more broadly, any international law. Because laws built around a society always take into account the ex-

isting circumstances, it seems only appropriate that AI become the new standard for any international laws made henceforth, particularly in regards to the green initiatives and new baseline that it will itself be a key part of on a global scale through models that generate better strategies for environmental sustainability and ethical standards.
To bring forth the potential and also possible snags that might occur with AI as the new base of operations in environmental law, it would do well to first examine the process of how the global international law regarding the environment first emerged roughly a decade ago, as thoroughly explained by Yang and Percival but summarized here in the interest of space constraints.

Global Environmental Law Just Before AI: Mostly Successful

Although many countries began the process of following the US after it started the fairly recent process of overall sustainability, the irony is that such systems existed separately in other countries prior to US steam boating. However, the same overly pressuring market forces of wealthier nations meant that such measures could only be fairly undertaken after a say so from the main sources of trade and commerce allowed it. Interestingly, the US or even other nations such as Britain or other wealthier nations have much that could also be copied from other nations' exemplary solutions to diversify international laws for environment to not only encompass all possible situations, but also make use of AI in a manner that is agreeable to every country found on the globe we all call home.
We may cite the example of "China's environmental contracting system between central and local governments and its requirement that polluters bear the burden of disproving that they have caused nearby harm…".[i] Although this article was a work of 2009, with some of the above existing in the form of US law not requiring that companies prove lack of harm, the other aspect that is a united form of communication that welds the smaller plane of individual laws that vary (sometimes wildly and completely contrary to logic) across states to the country that is the entire US as a whole, particularly in regards to laws involving punishments or other measures taken to reinforce or dissuade certain behaviors, especially in terms of the environment. "To be sure, some of the most important innovations in U.S. environmental law-the creation of national parks, environmental assessments, and public access to information-have been widely adopted and uploaded into international treaties."[ii] However, because this is due to the aforementioned cause that is the US generally leading most debates in light of its status as a major world power that holds the largest economy, this makes perfect sense.
To shed light on the various means by which this period before AI involvement prepared grounds for later melding of law with technological advancement on a grand scale, although not yet achieved can exist in the future, will require that we examine the few main assets that make up the bulk of what is usually considered a common enough and large threat to general health and safety of those that live anywhere on Earth. For this, we can cite the use of the regulation of chemicals and products produced every year as possibly unregulated danger sources.

Chemicals: What Is IN That?!

Beginning on paper trials as of 1997, a U.S. environmental NGO "publicized that basic toxicity data was unavailable

for the vast majority of thousands of high production volume (HPV) chemicals produced or imported into the country in volumes of more than one million pounds per year."[iii] The next year, the EPA responded by launching a voluntary testing program via the industry trade associations to conduct testing on the effects of high-volume chemicals used or produced in the United States. In 2005, the program broadened to be "inclusive of chemicals whose volume qualified them for screening"[iv] as well.

Advancing the need for progress a bit further via its history as somewhat more green and less industrial, Canada adopted a protective framework as of 1999 through the New Substances Notification Program; the 23,000+ chemicals in use at the time nationally would now need categorization via the Domestic Substances List by 2006. The categories as such were deemed to be possibly toxic elements that were broken down into: Persistent and/or o bio-accumulative, and the additional factor that is a high chance of everyday exposure by ordinary people. The categorization found that over 85% of said chemicals were not a cause for alarm, while the remainder immediately became subjects of analysis for either replacement or modification to comply with the new regulatory standard.[v]

In Europe, the Union's REACH program (Registration, Evaluation, Authorization and Restriction of Chemicals) is the global standard as currently stands. The provisions of REACH have established a "comprehensive registration scheme for 30,000 chemicals with sales of over one ton per year"[vi] while also tiering the substances according to risk posed. Also extending to importers as required registries, this was the most significant impact on global environmental standards in a field other than climate change efforts, with chemicals that were deemed a few hundred or so, primarily consisting of artificial forms of color agents, have since been completely replaced in all EU products.

Meanwhile, the large booming economy that is China had adopted in a set of regulations covering new chemical substances by requiring both registration and toxicity testing, with the law requiring that testing be performed in China by Chinese laboratories, though procedures are simplified for chemicals that have been listed as in use in at least four other countries.[vii] Similar laws have also been enacted in the past by more or less all of Asia, primarily Japan and Korea as large market factors that influence much of the current global trade.

To give an example that has unified the globe against hazards, we can make use of asbestos as the most infamous criminal. Once touted as a miracle substance for fire-retardant properties in many fabrics and other applications, the harm caused by the tiny particles stuck in the lungs rendered it a modern death trap. Used as one of the banned substances that make their way to poorer nations even now, used in India and processed by hand in factories with inadequate protection (which is anything short of a professional gas mask), globalization greatly cut down the more general use of many of these substances from these countries as well, or at bare minimum has allowed the public a chance to now use their knowledge of the danger to better protect themselves. Eighteen years after U.S. court approved EPA regulations phasing out nearly all uses of asbestos, many other countries with less developed systems of environmental law followed suit; the product is so acutely dangerous that even the World Trade Organiza-

tion (WTO) has upheld prohibitions on its import despite claims by producers that such bans violate free trade laws.[viii]

Towards the Current System for Integrated Consistency

Apart from deliberate copying of laws already in place and shown to work well as a good global standard of progress, we can also point out the effect of convergence through independent regulatory evolution as a large contributor. Here, we can state that involvement of civil society in environmental and other concerns has been reflected in increased activism at the state and local levels when national governments fail to address critical issues. A display of this may be made via the exemplary rulings of California in regards to greenhouse gases and general sustainability[ix], with similar local sets of best implementable practice a perfect means of implementing the ideal of sustainability across the globe-this recalls the older state of the cleaner pre-industrial era where local factors came first in everything, trade being a need only for what was lacking, a somewhat secondary need that developed later.

This is proven by the example of the millions of people that live in the Riachuelo-Matanza watershed, the river being heavily polluted with sewage and industrial wastes from factories and leather processing. Eventually, a lawsuit was "brought forth by community activists who complained of living alongside an "open sewer," the Court's decision prompted the national government to establish a commission with representatives of three jurisdictions that will spend $1.8 billion over the next fifteen years to clean up the area. An emphasis will be placed on improving the conditions affecting the area's seven million residents, including the poor living in thirteen slums along the river, by providing potable water and sewers. Additionally, the number of environmental inspectors will be increased from 3 to 250." However, the sad truth is that until societal change is prepared for great progress such as AI as it is now, little occurs on a significant scale.

There is no greater argument for this then the interview conducted after the case was decided with Chief Justice Lorenzetti, who argued that "the function of the Court is to make noise."[x] Noting that the Court had ruled against polluters of the river as far back as 1887 (!) and that an amendment to the Argentina Constitution in 1994 now provided the public with a right to a healthy environment, we see that any legal tradition must be firmly backed by the people to have a real hope of success, which is now made possible through the combination that is modern forms of media as providing easy information to the public who can then propel judiciary use of constitutional provisions relating to the environment to intervene when other branches of government fail to take proper action.[xi]

Moving on to the active effects of these now common and effective regulations of 2021 and beyond, we observe Ai, Peng and Xiong's research that uses the vast but now critical landscape that is China to reflect on how progress is a gradual slope that occasionally contain small leaps forward, eventually adding to a national and later global achievement of noteworthy size.

Regulation as Affecter of Innovative Change in Business-Politics

Although "China, as the world's second largest economy, has made remarkable achievements in economic growth over the past 4 decades, but its long-

term extensive economic development model has resulted in a serious waste of energies and environmental pollution."[xii] The 2019 national eco-environmental quality outline from the Ministry of Ecology and Environment of the People's Republic of China revealed the average concentration of air quality among 337 cities at prefecture level and above in the mainland as averaging a currently dismal 36 (μg/m3) compared to the upper safety limit of 10 μg/m3 given by the WHO. China also has the current highest production of excess CO2 in the world, with a measured 9.8 gt, 70% of it coming from industrial emissions alone.[xiii]

To offset these "market failures," the Chinese government has developed a system that implements interventional market mechanisms that indirectly change supply and demand between enterprises and the public to force producers to find innovative solutions that benefit both private profit and social betterment; 2012 to 2019 saw dozens of reform documents, laws, and regulations that aimed to control the problem of pollution via reforms that regulate emissions licensing and the system of trade by converting the existing pollution discharge fee into environmental taxes instead for at least better redistributive use of funds, and by providing subsidies for emission reduction equipment purchased.

However, there is good news that has ever since made a very significant impact on the situation: the Environmental Protection Law, implemented in 2015 and known as the "strictest environmental protection law in history,"[xiv] for good reason, states that environmental supervision departments have legal permission to impose "daily penalties" on polluting enterprises, place corporate legal persons in administrative detention or even prosecute them under charges of criminal liability. However, the effect of politics on business, especially between large corporations and governments attract attention as the usual suspects of paid permission to flout existing rules, unfortunately the one but also very major area where global law has not yet reached the environment with due satisfaction.

Other than this specific context however, there exists a play between politics and businesses that ensures that (1) Political connections have a significant and positive impact on a firms' innovation input and social responsibility that is then linked to the degree of innovation that results in better results for sustainable technology, (2) Political connections tend to mitigate any knowledge spillover, thereby alleviating external resource constraints that would limit or halt creative outlet for solutions due to lack of finances. However, these same factors also tend to create cycles of unequal resource allocation that cause profit margins to rise for the affiliated political group at the expense of actual innovation, usually a trend seen in smaller and less stable firms that have more to lose if business runs dry.[xv]

Because China is currently transitioning from a planned one-party standard economy to a free-reign market one, neither financial nor legal system is currently organized to international standards, thus enterprises must instead seek informal systems that can offer some sort of protective impediment against institutional barriers and funding problems. In such a state, social connections become much more critically important than any form of bank or contract, as the basis of trust is now the main factor in the success or fall of a connected workplace. Be-

cause these connections also include government assistance or a multitude of various other factors, the authors conducted their study to determine the relationship between the aforementioned politics and trust as a measurably quality that holds up to quantitative scrutiny when tested in the real world that now revolves around greener systems of production.

Sample and Data

The end of 2015 determined the Hebei Province as the test case for the new national standard of strict green standards. Using a system of published data that uses the concept implemented by the state of examining a company's history to determine their overall impact and corresponding small or large correctional needs in terms of supervised pollution reduction and energy saving as of 2016, the study uses this data to measure A-share firms from the China Stock Market Accounting Research (CSMAR) database from 2016–2019, the first year being the beginning of supervisory guideline monitoring. A total of 1821 industrial enterprises comprised the initial sample, from which 221 firms with complete financial information "that have disclosed environmental protection information for four consecutive years" were used, while the corresponding political affiliations stem from sub-database of "executive resume" and proportion of "the total amount of the top 5 suppliers and customers"[xvi], with 884 observations obtained for each variable of industrial companies.

The Results

"Table 1 reports the descriptive statistical results of the main variables. From 2016 to 2019, the average value of GTI of 221 listed companies is 0.345, the maximum and minimum values are 4.001 and 0, respectively, and the standard deviation reaches 0.738, indicating that there is a great gap in the level of GTI among the firms. The mean value of ERI is 0.271, and the standard deviation is 0.605, suggesting that firms suffer different levels of environmental regulation intensity. The result also shows that PCs vary in the sample firms, but business BCs fluctuate within a narrow range.

Variable	Mean	Std.Dev	Min	Max	Observations
GTI	0.345	0.738	0.000	4.001	884
ERI	0.271	0.605	0.000	6.835	884
PC	0.131	0.147	0.000	0.940	884
BC	0.286	0.124	0.032	0.883	884
Size	22.737	1.228	19.138	27.971	884
Lia	0.423	0.178	0.035	1.073	884
Roa	0.065	0.075	-0.302	0.680	884
Equ	0.154	0.106	0.012	0.607	884
Age	2.386	0.665	1.000	3.296	884

Table 1.
Descriptive statistics for the main variables.[xvii]

Table 2 presents the empirical results of model (1)–model (2). Model (1) and model (2) show the direct impact of environmental regulation and social connections on GTI from 2016 to 2019. It is found that a negative correlation exists between the ERI and GTI (−0.173), and the square item of ERI positively influences GTI (0.030), respectively, at the significant level of 5% and 10%, which represents there is a U-shaped nonlinear relationship between ERI and GTI. The turning point of U shape is 2.883 (0.173/ (2 × 0.030)) that is within the value interval from 0 to 6.835. Based on the above evidence, H1 is validated. The result is consistent with the literature that environmental regulation has a U-shaped relationship with GTI. Innovation offset effect will gradually come after ERI approaches 2.883. Since the average ERI level is 0.271, stricter ERI will stimulate the GTI of listed companies. At present, the implementation of the new "Environmental Protection Law" and strict supervision system force enterprises to increase pipe-end pollution control costs, which has a crowding-out effect on green innovation technology investment. However, the government shows the intention to further strengthen the ERI. In 2019 as an example, the Ministry of Ecology Environment revised more than 20 ecological environmental laws and administrative regulations, completed 21

Variable	Model (1)		Model (2)	
	Coefficient	T-Value	Coefficient	T-Value
ERI	-0.173**	-1.99	-0.181**	-2.09
ERI²	0.030*	1.93	0.027*	1.74
PC			-0.341***	-3.39
BC			0.596**	2.42
Size	-0.199**	-2.47	-0.246***	-2.99
Lia	0.619**	2.09	0.637**	2.13
Roa	0.659*	1.81	0.716**	1.99
Equ	-0.575*	-1.76	-0.510*	1.66
Age	-0.030	-0.22	-0.017	-0.13
Constant	4.825***	2.67	5.720***	3.10
Yearly effect	Yes		Yes	
Firm effect	Yes		Yes	
F-statistic	7.70		6.78	
F/PROB	0.0000		0.0000	
Sample size	884		884	

Table 2.
Empirical results of the impact of ERI, PC, and BC on GTI.[xviii]
Note:***, **, and * denote 1%, 5%, and 10% significance levels, respectively.

departmental rules and regulations, and formulated and revised 96 national ecological environment standards. Meanwhile, this year, legal authorities handled the 162,900 cases of administrative punishment, with a fine of CNY 11,918 million.

Model (2) suggests that political connections have a negative impact on GTI at the 1% significance level, partially explained by the fact that enterprises may overinvest in political relations in order to obtain government resources, thereby crowding out investment in innovation and negatively affecting GTI. Referring to Cai's research, using the costs of entertainment and travel (ETC) as a measure of corporate corruption, the study finds that the average ETC of the sample companies for the period of 2016–2019 was CNY 14,838,824.08, CNY 16,507,817.77, CNY 16,659,430.72, and CNY 17,077,900.58, respectively, reflecting the growth in investment on political relationships to some extent. Business connections are positively correlated with GTI, significantly at the 5% level because of the information effect and resource effect on knowledge acquisition and influence of cognitive capitals on cooperation between enterprises, which enhance the ability of green innovation.

Model (3), which is significantly positive at the 10% level, indicates that PC reinforces the negative and positive effects of ERI on GTI. The result confirms our expectation that, in the initial implementation, crowding-out and compliance cost effect play the main role; with the increasingly stringent regulation, the political connection provides more scarce resources, and compensation for the innovation exceeds the crowding-out cost.

In model (4), σi (−0.177) is significantly negative at the 10% level, reporting that business connection weakens the negative and positive effects of ERI on GTI. It suggests that, in the early days, industrial information, rich social channel, and mutual commitment in strong supply-customer relations improve the firm's ability to resist risks; knowledge exchange and resource sharing ensure the stability of the firm's performance and normal technological innovation. However, under the continuous impact of strong regulation, the social network between the commercial partners locks in an inflow of the new knowledge of the innovation.

Model (5) shows the combined effect of PC and BC on the relationship between ERI and GTI. The empirical result stresses the fact that PC reinforces the negative and positive effects of ERI on GTI and BC negatively moderates the relationship of them. The coefficient of ERI2 × PC (0.004) is slightly lower than the coefficient value of ERI2 × BC (0.006), which indicates that BC has a greater impact on the relationship of ERI and GTI than PC does. One reason may be that political ties lack an effective mechanism to ensure long-term cooperation with the enterprises, which results from officials' priority for promotion and job rotation across different departments and geographic locations."[xix]

Finally, we turn to Vöneky as our question of "How?" How much and how do we go about actually regulating something as complicated as AI when it is used in a field that is in general agreement without it? If a mistake were to occur at a factory that produces green energy but causes an explosion that releases a huge cloud of toxins, who do we blame? The producer of the AI for less than meticulous checking of their product, the factory owner for

lack of diligence, or perhaps employees on duty for not noticing the sudden change and taking responsive action? Of importance when AI develops a decade into the future and begins running entire operations by itself, we here Vröneky as she strategizes how to provide a coherent solution to AI that both matches and works well with the current system of innovative globality, while making small adjustments if need be.

Innovation: A Need for a Stable System of Rules

Vröneky begins by stating that because "they are tools with a specific quality and power, because AI systems can be used for multiple purposes, and will imitate and replace human beings in many intelligent activities, shape human behavior and even change us as human beings in the process in intended and unintended ways"[xx], AI is also something that must be adaptably shaped to meet our expectations, just as other technology has. For our purposes, the key problem of AI as a force for regulation of business opportunity and laws surrounding them is the imbalance that can be caused by having more resources than those around you; such a situation would worsen the already huge gap between wealthy and poor, as well as further monopolize assets to the domain of the largest few hundred entities that already run almost all of the current infrastructure, whether it be digital or physically defined.

Mention of "plausible risk scenarios may show that the fear of the potential loss of human oversight is not per se irrational. They support the call for a "human in the loop", that – for instance – a judge decides about the fate of a person, not an AI system, and a combatant decides about lethal or non-lethal force during an armed conflict, not an autonomous weapon. But to keep us as persons "in the loop" means that we need state-based regulation stressing this as a necessary pre-condition at least in the areas where there are serious risks for the violation of human rights or human dignity."[xxi] Agreeing on this point, we also hold fast to her belief that an 'expert' AI must perform a task that contains simple non-ethics-based values as well as or better than a human expert to ensure consistent quality that can be afforded a small number of mistakes[xxii], as long as, in our estimation, they are minor and not a cause of any possible alarm, either on-site or later on.

Specific Rules and Regulations

Dividable into two branches as either legally binding rules known as hard law or non-binding (international) soft laws, AI is already in principle somewhat accounted for in the existing framework of accounting: The General Data Protection Regulation (GDPR) that aims to protect personal data of natural persons also applies to the processing of this data, even if purely done by automation, as a valid violation of human rights if breached, with informed consent being a requirement for use of consumer data-the hallmark of dataset-using AI learning algorithms.

According to Art. 22 of the GDPR, data subjects possess right of "not to be subject to a decision based solely on automated processing"[xxiii] that produces legal effects in regards to the use of our own data. 62 Like every regulation and law, the GDPR has leeway in certain cases for practical use, such as in consumer products available on the market, via future brain technol-

ogy for instance. In other cases, such as self-driving cars as used for the defined purpose as legal, with such definitions being set by the company that produces them, we see that there exists both a general coverage of and rules for legally binding laws that work are can be later worked into existing models of national and international law; there is no need to reinvent a functioning wheel, but simply upgrade it to a tire instead via external improvement.

The result is that shared interest by both public and other entities will quickly bring about the needed adjustments as has occurred with other human rights in the appropriate time and place, even at the international level, if the situation truly calls for it, as did the implementation of climate regulations in the 1950s-1960s, thereby solving the current problem that is a lack of a coherent, general and also universal means of AI regulation as demand for rules adapts to the pace of changing technology within the next decade or so.

Content of New Regulations: Initial Draft

The OECD has currently recommended the first summarized compendium, if we may dub it that, that simplifies and explains how AI ought to be regulated to hopefully ubiquitous agreement. Adopted by 43 countries including AI powerhouses such as the US, South Korea, Japan, UK, France, and Germany, and about 7 others besides, the principles state that the notion of trustworthy AI as defined by the EU requires these 7 points to be met:

1) Human agency and oversight
2) Technical robustness and safety
3) Privacy and data governance
4) Transparency
5) Diversity, nondiscrimination and fairness
6) Societal and environmental well-being
7) Accountability

Although these are fair and just in theory, the actual wording is very 'soft' in terms of realistic enforceability, and must be revised if added into actual practice as international laws, it is stated that "AI actors should, based on their roles, the context, and their ability to act, apply a systematic risk management approach to each phase of the AI system lifecycle, on a continuous basis to address risks related to AI systems, including privacy, digital security, safety and bias."[xxiv] Because problems of discrimination and unjustified bias might become a key issue of AI laws, risk management is completely useless as a means of preventing anything here.

Disadvantages: Legitimacy of System as Is?

Because AI experts are employed, paid, or closely linked to AI corporations, the input actually needed for production of such international standard consultation becomes automatically slanted with bias, the solution being, according Vröneky, use of independent experts with no (financial) links to corporations, experts who work independently for corporations, and also civil society and NGO members, all being synthesized to produce the best overall result, with similar success being noted in social circles used in the soft sciences being a very convincing benchmark.

Secondly, the actual legitimacy of recommendations must adhere to general rules of good for all that involve, among others, "investment in AI research and

development, fostering a digital ecosystem for AI, shaping an enabling policy environment for AI, building human capacity and preparing for labor market transformation, and international cooperation for trustworthy AI."[xxv]
Concluding that the OECD recommendations "lower the threshold too far and shift the focus too far away from States as main actors of the international community – and as those obliged to protect human rights – towards private actors", and that therefore the legitimate regulation of AI systems comes from the practice as implemented in standard law: Which ethical paradigm seems to be the most convincing in regard to framing AI proceedings, inclusive of actual use of human rights as traditionally defined just a decade beforehand as upheld and defended by international courts, with the relevant exceptions regarding non-absolute individual rights that already exists being factored in?

Conclusion

From the use of AI laws as a simple additive equation that enriches traditional ones that keep safe the dignity of those mentioned (at least theoretically) to the devices that are environmental law as implementable through strict measures of control and affected by politico-social environment as is found in more structurally traditional societies based on mutual acquaintance such as China, to the separate but equally if not more important distinction that is making sure that existing laws and always renewed more or less in line as new information makes us more aware of previously unknown dangers such as asbestos or e-waste, it remains a problem that environmental law, especially at the international level, has lagged behind in the area of smarter technologies such as AI, although the latter now more or less pervades every walk of life. However, possible solutions of not immense difficulty exist if we but put in some regulatory and activism efforts in amassing both public support and state action towards a second age of human rights, one that not only completes the deficiencies that exist in current practice, but improve on newer models of thinking and risks.

Endnotes

i Yang, T., & Percival, R. V. (2009). The emergence of global environmental law. Ecology LQ, 36, 615.
ii Ibid.
iii Ibid.
iv Ibid.
v Ibid.
vi Ibid.
vii Ibid.
viii Ibid.
ix Ibid.
x Ibid.
xi Ibid.
xii Ai, Y. H., Peng, D. Y., & Xiong, H. H. (2021). Impact of Environmental Regulation Intensity on Green Technology Innovation: From the Perspective of Political and Business Connections. Sustainability, 13(9), 4862.
xiii Ibid.
xiv Ibid.
xv Ibid.
xvi Ibid.
xvii Ibid.
xviii Ibid.
xix Ibid.
xx Vöneky, S. (2021, July). How Should We Regulate AI? Current Rules and Principles as Basis for "Responsible Artificial Intelligence". In Legal Theory and Interpretation in a Dynamic Society (pp. 279-310). Nomos Verlagsgesellschaft mbH & Co. KG.
xxi Ibid.
xxii Ibid.
xxiii Ibid.
xxiv Ibid.
xxv Ibid.

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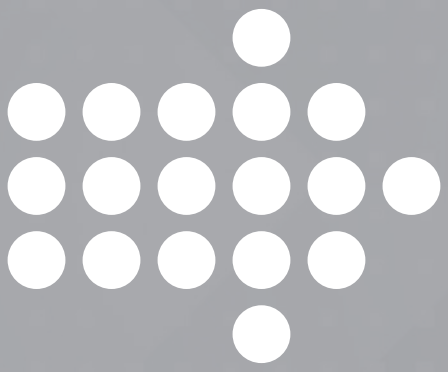
[1] Ai, Y. H., Peng, D. Y., & Xiong, H. H. (2021). Impact of Environmental Regulation Intensity on Green Technology Innovation: From the Perspective of Political and Business Connections. Sustainability, 13(9), 4862.

[2] Vöneky, S. (2021, July). How Should We Regulate AI? Current Rules and Principles as Basis for "Responsible Artificial Intelligence". In Legal Theory and Interpretation in a Dynamic Society (pp. 279-310). Nomos Verlagsgesellschaft mbH & Co. KG.

[3] Yang, T., & Percival, R. V. (2009). The emergence of global environmental law. Ecology LQ, 36, 615.



HCI to Aid Motor Disabilities Via the Standards of Education, Neural Networks and Technology

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Motor impairment, known colloquially as 'having trouble getting from one place to another' or 'arms and legs not working properly' is a disability that causes significant problems for users in regards to use of non-automated interactive technologies, such as a cellphone or computer that lacks accurate speech-to-action recognition-that is to say, any device currently on the market and for the foreseeable next few years or more. Seeing as this is the case, there must a more efficient way to allow those with lacking motor skills to contribute as students, through the technology that now pervades all of society, as well as also allowance of other causes of such disability that may occur either early such as educational troubles or start later in life, such as Parkinson's. There is also use of newer methods of AI such as Neural

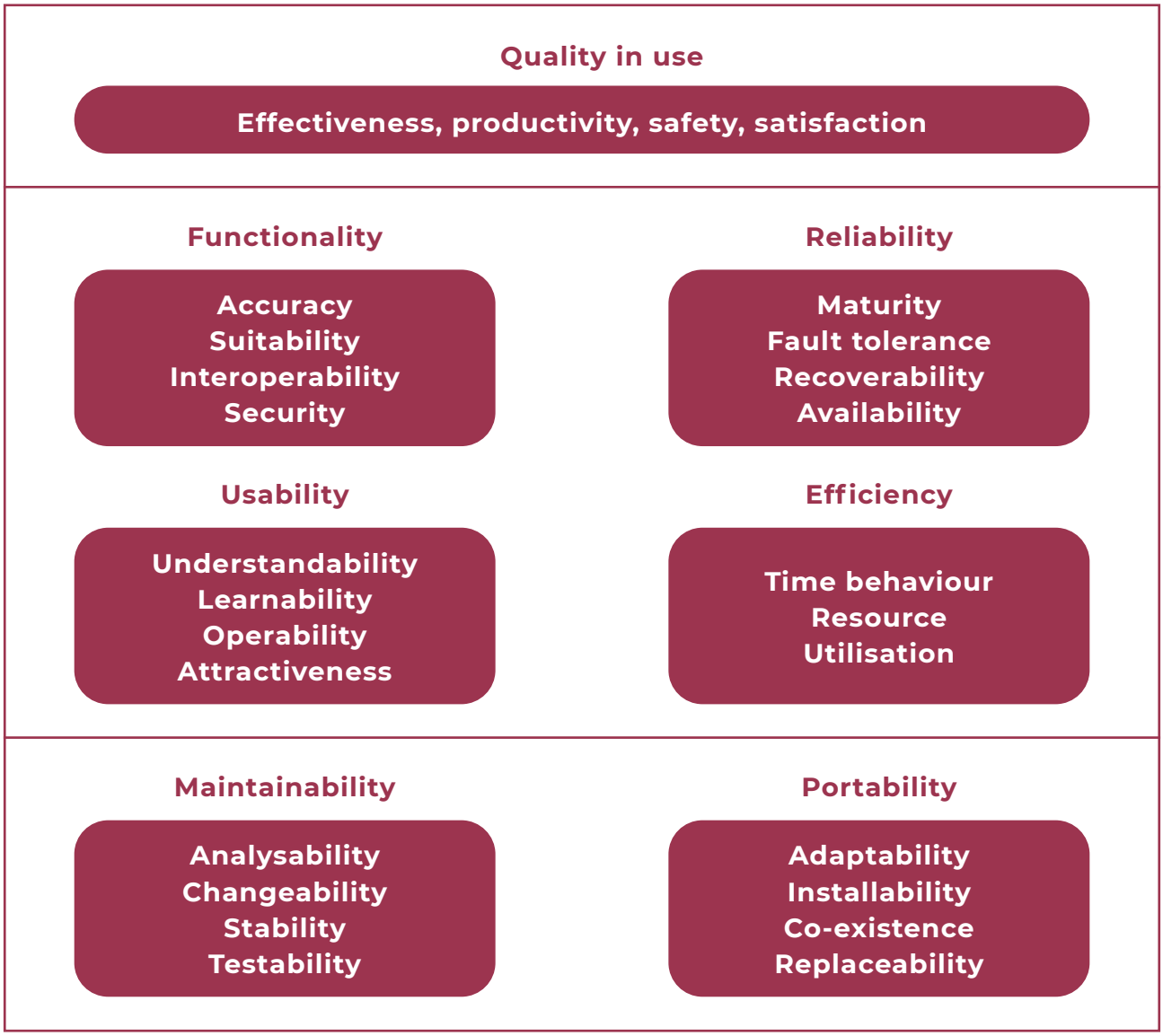


Image 1.
ISO/IEC FDIS 9126-1 quality model.[ii]

Networks that make use of the actual brain function to ensure advanced developments in motor-skill technologies that were unheard of just fifteen or ten years ago. Beginning first the standards of the field followed by one of the initial examples of the technology as a springboard, we will then continue afterwards with, first, how such newer forms of the technology can assist in students in education, followed by usage in areas of other illnesses that tend to, but not always, more commonly affect non-students instead.

Standards for HCI: Usability

As defined by Bevan, "Standards related to usability can be categorized as primarily concerned with the following.

1) The use of the product (electiveness, efficiency and satisfaction in a particular context of use).
2) The user interface and interaction.
3) The process used to develop the product.
4) The capability of an organization to apply user-centered design."[i]

Stage	Document type		Description
1	**AWI**	Approved work item	Prior to a working draft
2	**WD**	Working draft	Preliminary draft for discussion by working group
	CD	Committee draft	
3	**CD TR or TS**	Committee draft technical report/specification	Complete draft for vote and technical comment by national bodies
4	**CDV**	Committee draft for vote (IEC)	Final draft for vote and editorial comment by national bodies
	DIS	Draft international standart	
	FCD	Final committee draft (JTC1)	
	DTR or DTS	Draft technical report/ specification	
5	**FDIS**	Final draft international standart	Intended text for publication for final approval
6	**ISO**	International standart	Published document
	ISO TR or TS	Technical report or technical specification	

Table 1.
Types of ISO documents and stages in development.[v]

"The ISO/IEC 9126 (1991) has recently been replaced by a new four-part standard that has reconciled the two approaches to usability (2000). The new level of quality assurance "describes the same six categories of software quality that are relevant during product development: functionality, reliability, usability, efficiency, maintainability and portability (Figure 2). Usability falls under a similar process: "the capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions."[iii]

Although ISO 9241 provides "requirements and recommendations relating to the attributes of the hardware, software and environment that contribute to usability, and the ergonomic principles underlying them", designers without usability experience have great difficulty applying these types of guidelines because they lack understanding of the "goals and benefits of each guideline, the conditions under which the guideline should be applied, the precise nature of the proposed solution, and any procedure that must be followed to apply the guideline."[iv]

Most standards bodies such as ISO welcome individual participation if the relevant skills are found, possible at either the national or international level. Most technical work takes place in the international domain, where drafts are circulated to participating national member bodies for comment, although the technical work is carried out by volunteers.

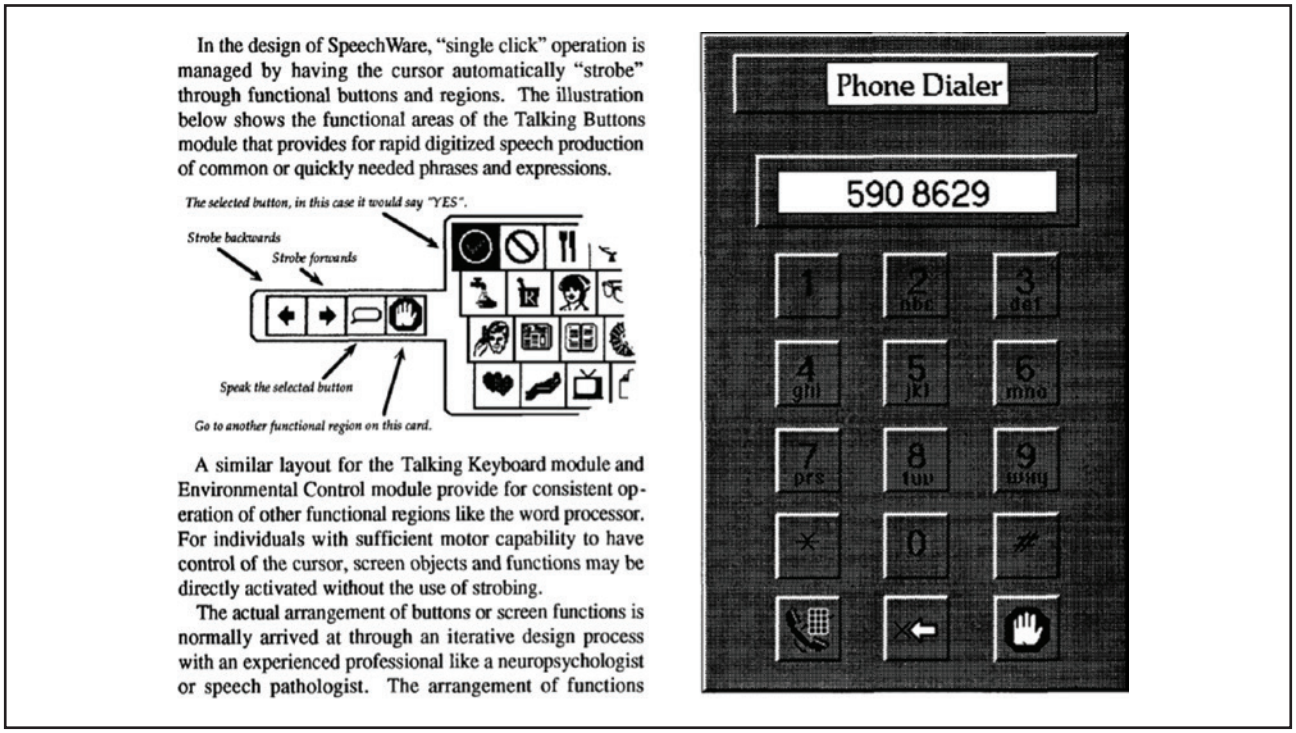
Such standards theoretical standards as given in the quality chart above, although useful, often fail to reflect the reality of useful solutions in the real world. To avoid design constraints, most of the international standards for the software user interface described in this paper specify the principles to be used, rather than the specific implementation, and standards of technologies go quickly out of date via new developments.

As seen from older standards of ISO, as of 20 years ago in a simpler market, issues of specificity and inner consistency existed. Because this still remains the case to some degree even today, perhaps it is more important to instead ensure that design standards, especially for the non-average user, are instead practically made to cover the needs of the range of issues faced by them in day-to-day scenarios, as seen in both the initial model given below, and through the many later ones designed more recently for specific circumstances.

A First: SpeechWare

"A number of unfortunate conditions like Amyotrophic Lateral Sclerosis (ALS), stroke, or head injury can result in an expressive language deficit which may include accompanying motor or cognitive difficulties. An habilitative communications package that is microcomputer based can be more readily customized to meet each unique person's needs. In addition [,] the microcomputer offers large enough storage capacity that such user desired features as digitized speech, word processing, fax communication, and reading assistance can be accommodated."[vi]

This is how Chute and Quillen defined their process for SpeechWare, developed back in 1992 (!) Resembling what we now might associate with a beeper or early mobile phone screen, the programming was the step towards the age of more automatic means of handling assistive technology that allowed more user independence then was possible in earlier years, and was also



In the design of SpeechWare, "single click" operation is managed by having the cursor automatically "strobe" through functional buttons and regions. The illustration below shows the functional areas of the Talking Buttons module that provides for rapid digitized speech production of common or quickly needed phrases and expressions.

The selected button, in this case it would say "YES".

Strobe backwards

Strobe forwards

Speak the selected button

Go to another functional region on this card.

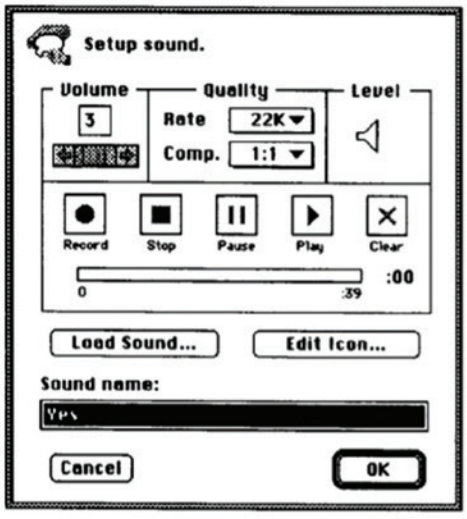
A similar layout for the Talking Keyboard module and Environmental Control module provide for consistent operation of other functional regions like the word processor. For individuals with sufficient motor capability to have control of the cursor, screen objects and functions may be directly activated without the use of strobing.

The actual arrangement of buttons or screen functions is normally arrived at through an iterative design process with an experienced professional like a neuropsychologist or speech pathologist. The arrangement of functions

Image 2.[vii]

non-expensive even for the time period, ensuring both general accessibility and simple use, just as the newer computers of the time did as well.

"Speechware... sells for $49.95 to cover the cost of production of disks and documentation. The major expense to implement Speechwan: is in a computer system and the effort involved in iterative design alterations to successfully customize the software. Speechware effectively handles some reliability issues like power failures and system dialogs by ensuring "single click user recovery control. An Administrator's interface provides for routine maintenance by a family member or significant other and does not require specialized programming or technical knowledge. Even the User's interface... is designed to offer editing of synthesized speech modules so that privacy and independence from others is possible. A training tutorial and help stack are included in the package."[viii]



SpeechWare was originally developed through a research collaboration between Drexel University and Moss Rehabilitation Hospital [1]. It is used as a model system for graduate training in the application, customization, and use of ProsthesisWare type programs for persons with disabilities [2]. The focus of this research has been to deter-

Image 3.[ix]

Making use of an intuitive interface that could use some customization, they make reference to older studies that attempted, rather unsuccessfully, to try to teach the disabled management of such tasks through a computer device that used repetition or strategies such as mnemonic devices instead. Realizing that these studies did not work, they instead achieved a system to cheaply and easily connect such user not only to a phone, but also to use of e-mail access as well, years before e-mail was commonly used. Their only qualm regards the lack of customization to suit individual need, but that would easily be solved by later versions of similar technologies later on.[x]

To correctly match technology with devices, it is crucial that we first know exactly what the problem is. A method of making use of newer EEG signals as measured by AI neural Networks has provided a break in more easily and quickly diagnosing motor issue(s) that are neurological in origin, as carried out by Vrbancic and Podgorolec.

Diagnosing Motor Problems: EEG Signals as Solution

From mild neurological issues to some as debilitating as lateral sclerosis leading to full-body paralysis, EEG enlightens the researcher about the state of the brain. The signals given off by the brain are measured as voltage at different points as the basis of EEG. "These signals, which are generally time varying and non-stationary in nature, can be scrutinized using various signal processing techniques."[xi] The scope of EEG signal analysis and classification approaches is very broad, but the general process involves first filtering the raw EEG signals from electrodes. Afterwards, the signals can be turned into spectrograms for each EEG channel,

measured during a pre-defined task of study. The results can then be sent to a professional for classification and analysis. The success of newer forms of Deep Learning AI as approaching or sometimes even surpassing human experts on interpretation of such imaging technologies has therefore inspired the study of the fully automatic screening process to be described.

Method

The research data was collected via first Pre-processing the recorded EEG signal to "reduce signal noise and transforming the filtered signal to the time-frequency domain using Fast-Fourier Transformation (FFT)." The signal was then plotted on a spectrogram for separate channels, before being fed to the AI as input. The filter used to remove excess noise ranges from below 0.5 and above 7.5 Hz, leaving only the range most commonly linked to brain disorders (via waves of either delta or theta frequency being left in).[xii]

"Convolutional Neural Network (CNN) is one of the most competitive neural network architectures for image classification tasks, in some cases even outperforming human performance." Containing stacked convolutional layers, usually composed of several feature maps with different weight vectors so that multiple features can be extracted at each location. Each convolutional layer is commonly followed by an additional layer, which performs a local averaging and subsampling.[xiv] Training was done by channel, giving 8 trained models which were then ensembled through algebraic combination rules via majority vote –if more than half of channels were classified as wrong, the model classified the subject as being impaired, each training consisting of 50 repetitions with one iteration. The method, although it uses the most computing resources, justifies this through its excellent yet still fully automated results (as seen below).

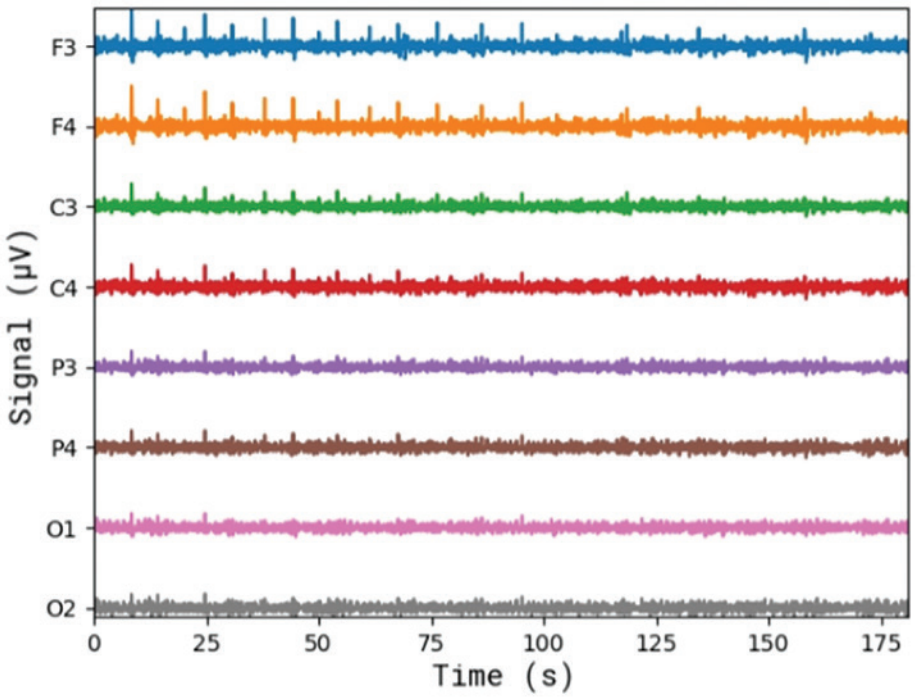


Image 4.
EGG signal of a single recording session for each channel with bandpass filtering applied.[xiii]

		Metric			
		Accuracy	Sensitivity	Specificity	F1 score
Method	LDA	46.15 %	50.00 %	44.44 %	48.11 %
	CART	61.54 %	50.00 %	66.67 %	62.54 %
	LR	61.54 %	0.00 %	88.89 %	52.75 %
	NB	61.54 %	0.00 %	88.89 %	52.75 %
	KNN	69.23 %	0.00 %	100.00 %	56.64 %
	SVM	69.23 %	0.00 %	100.00 %	56.64 %
	Our CNN	69.23 %	25.00 %	88.89 %	65.64 %

Table 2.
The classification results of traditional methods in comparison with our proposed method.[xv]

Almost as good as the state-of-the-art classification approach that achieves 74 % overall accuracy – 81.7 % accuracy on unimpaired and 61.5 % accuracy on impaired persons – the method was less than less than 5 % behind. However, the other method is not fully automated, and no tuning was done, default values only. The literature reports that "even a small amount of parameter adjustments and fine-tuning can achieve a significant growth in performance of CNN", so the greatest result would reasonable be expected if the model was tweaked to perfection.[xvi]

We conclude this paper with two differing but critical fields of health that greatly affect society: Education of the young and care of the elderly with mobility impairments. Beginning with educational tools and ending with Alzheimer's, we dive into the use of technology as school aid.

Assessing Reading: The First Milestone

"...There is a strong continuity between the skills already developed by students when they start school and their later academic performance. Students who present difficulties at the beginning of reading are very likely to continue having reading problems during their school years."[xvii] Students with motor problems are usually difficult to evaluate, since tests make "use of manipulation of cards and cuts of letters and figures."[xviii] Overall, it tends to be unclear whether difficulty is caused by physical limitations, test anxiety, or insufficient knowledge in such cases. "Since positive emotional stimuli facilitate reactions to conflict situations, we developed a game that, in addition to promoting the acceptance of tests, also improves the execution of the assessments. Players act spontaneously when

playing a game (card or computer) and also use all the knowledge acquired when motivated by a challenge."[xix]
The software was "implemented using a game-like design controllable by a peripheral device without needing fine movements."[xx] The test was first used on non-impaired students to check for accurate literacy level before being used for the study, as were volunteers, with moderate mobility issues, the criteria unable to use a keyboard or a joystick but able to push a button."[xxi]

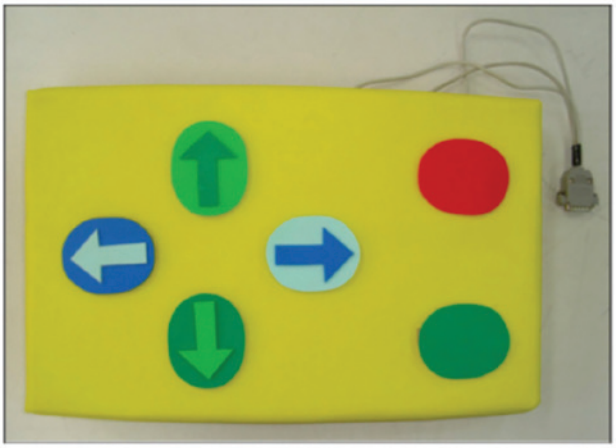


Image 5.
The adapted peripheral device. The peripheral device, used to assist users with upper limb motor impairments, contains six micro switches emulating key board characters. The device contains four direction keys, a green button emulating the "enter" key and a red button emitting a "Q" character, used in this application to exit the test.[xxii]

Both tests check for similar knowledge, so the testing was randomized by having one control group (G1) take the card test first, the other (G2), the computerized game., G1 and G2. Three common card-based tests used in Brazil for preschool knowledge were used as testing: They use "block and cursive letters, numbers, squiggles, picture of objects, letters or a syllable of an object name. The tests involved were differentiation of letters versus other symbols/numbers, the same word in upper/lowercase with different fonts, and lastly cards with a spelled word, minus one syllable.
The computer test was a "Rescue the explorer" theme via NPCs and a main character completing three phases to rescue the other explorer kidnapped by a dragon and abandoned on a desert island. First a stone path containing letters, numbers and squiggles are spread on the floor, walked across only through letters-with visual confirmation of correct answer. Physical therapists reported that there were no complaints regarding tiredness from any student with mobility issues when using the peripheral device. The computerized test also offers these advantages: "error tolerance, time performance tolerance and feedback during or after the assessment of the participant."[xxiii] "Although students with physical disabilities also acquire relevant knowledge before beginning the formal process of literacy learning in schools, ...they are often not evaluated correctly due to their physical limitations."[xxiv]
It was found that all students reacted positively and remained entertained throughout the entire computer game, although the card game led to boredom and a need for refocus in some cases. It was also found that those with restricted physical mobility performed no worse than those that were not, although gaps did emerge in the teen control group, with the impaired group often having trouble with recognizing handwriting (not so much a surprise when they cannot practice it themselves).

Limitations

The participants were classified as light or moderately disabled, and could

push buttons but had trouble with finger movement. A headset may be developed to allow more severe cases of mobility issues to also benefit from the use of the model's game. Turning to our final example, we now examine how similar technologies may be used to tend to not only those at school that are young, but also the (sometimes) not quite so elderly that might be afflicted with a disease such as early onset Parkinson's.

At Home: Assisting Early Parkinson's Patients

Although the best standard of rating Parkinson's is the Unified Parkinson's Disease Rating Scale (UPDRS), it does not focus on early impairments or rank from slight to heavily impaired. Another issue is that clinical trials tend to measure progress at 3-month intervals, preventing visible observation of the often smaller but significant shifts that happen on a shorter time-span. Therefore, this study has made use of motor tasks that can be tested weekly with a home-based computer module, termed the At-Home Testing Device (AHTD).[xxv]

For feasibility, volunteer patients were asked if they would adhere to unsupervised testing for 6 months, and that they let the data be stored and transmitted to a central computer. Guessing that patients would easily make use of the research computer, and thereby committed to the program. The long-term goal of the study is to successfully detect changes in motor function from the homes of the individuals before the usual 3 month wait needed of a regular trial study office visit. If the initial testing is found relevant, the AHTD computer could be used as a clinical tool to allow those with travel limitations to also participate in trials and also benefit from earlier diagnosis. The entry criteria for the study were patients diagnosed within the last 5 years with at least two of the following symptoms: "rest tremor, bradykinesia and rigidity without evidence of other forms of parkinsonism."[xxvi] To ensure consistency, volunteer patients could not be on symptomatic therapies for PD during the study.

At Home Tele Monitoring Device-AHTD

The AHTD is a self-contained testing apparatus that has a testing panel on a base that contains a "two-key keyboard for finger tap[xxvii] ping, two buttons placed 173 mm apart for reaction time/movement time and repetitive hand tapping assessments, an eight-peg pegboard, control buttons, and a docking station for the actiwatch device (Cambridge Neurotechnology, Cambridge, UK) measuring tremor. The upper panel contains an LCD screen for displaying instructions and examples of testing requirements as well as a speaker for audio."

Image 6.
Photograph of the ATHD (details discussed in text).[xxviii]

There were no significant complaints during the study, although the tremor recorder band. At did cause a wrist rash in one instance. Overall, patients

Satisfaction with training (out of 100)	
Overall satisfaction	96.5 (91-100)
Satisfaction with instructions	98 (90-100)
Satisfaction with practice	95 (92-100)
Satisfaction with practice time	94.3 (89-100)
Satisfaction with data transmission	84.4 (81-100)
Satisfaction at end of study	87.2 (80-100)
Data transmission/decryption	
Failed transmissions/decryptions	1.5 %
Patient compliance	
Failed to take test at all	9.4 %
Out of window for exam date	4.9 %
Cumulative missing data by test	
Digitography (finger tapping)	15.4 %
Reaction time/movement time	7.8 %
Pegboard plugging	9.3 %
Tapping	21.2 %
Tremor	20.0 %
Voice (sustained phonation)	13.5 %
Voice (picture description)	9.6 %

Table 3.
Feasibility outcomes.[xxx]

rated the system very good with an average score overall of 87.2%. Patient compliance met the pre-specified criterion of acceptability (‡90%) with 9.4% of tests missed. Total problem rates out of 100% are given in the list below, most of which occurred due to hand tapping (21%), tremor (20%), and finger tapping (15.4%). The tremors and finger tapping issues were corrected during the study, for decreased rates of issues at 8.7% (tremor) and 10.5% (finger tapping).[xxix]

The study went so well that several patients requested a continuation of the program. There was worry that a weekly need for testing would cause lack of patient participation, but there were no such issues and data storage/transmission errors were below predicted rates. Because training was brief and tests taken without intervention, this and similar machinery can be improved by the study as medically supervised.

Interestingly, most of the tests did not show any changes in results, suggesting that “motor functions required for the selected tests may not deteriorate in early PD. In the context that the UPDRS motor exam worsened, especially in the first 3 months, most of these tests did not appear to be better proxies of progressive parkinsonism. Tremor change by actigraph measure, however, was significantly correlated with change in UPDRS, and change with the AHTD detected differences even within the first month of testing.”[xxxi]

Detection of subtle and early changes that predate but correlate with worsening UPDRS scores the goal of the study: No test detected a statistically significant decline, although finger taps, tremor, and the speech task involving picture description without distraction showed decline over time, and, unexpectedly, progressive improvement in reaction time. The improvement may mean that learning or practice of motions may work as a kind of preventative cognitive exercise. The weekly routine, however feasible, is less useful for actual test results, although the frequent tests may be more helpful as a way to enable more repetition, although there is a risk that patients may forget to take the test; an automatic alarm facilitates reminding, and patients reported that they liked this feature.

"Although cost is difficult to guess for standardization, the NIH has indicated strong support for the concept of ''large simple studies'' that allow patients to be enrolled from wide geographical areas and to travel minimally."[xxxii] If future work registers" declining function and correlates or even pre-dates changes in UPDRS scores recorded at more interspersed office visits, direct incorporation into clinical trials can be actively considered" a means of better treatment and early diagnosis of Parkinson's disease, thereby ensuring better care for elderly patients.

Conclusion

We have seen the age of SpeechWare, to the later use of computer games as learning for children in Brazil with upper mobility issues that makes reading progress in school more difficult, although they actually a similar level of knowledge in regards to early familiarity with reading and writing in almost all cases. Or the use of EEG networks as a way in which now more advanced technologies, specifically AI, can sometimes out surpass even current human experts, allowing ever more convenience and accessible use for both patients and others alike. In short, we have seen how technology has gradually allowed us to better the situation of those with limited mobility by communicating their smaller gestures to us in bigger ways that let us truly see them for what they are; individuals that are no better or worse at certain things than ourselves, who possess a simple anatomical difference that we do not.

Endnotes

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xi Vrbancic, G., & Podgorelec, V. (2018). Automatic classification of motor impairment neural disorders from EEG signals using deep convolutional neural networks. Elektronika ir Elektrotechnika, 24(4), 3-7.

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