



Intelligence in the internet age: The emergence and evolution of Open Source Intelligence (OSINT)

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ABSTRACT

This paper introduces the concept of Open Source Intelligence (OSINT) as an important component for understanding human problem solving in the 21st century. OSINT is in many ways the result of changing human–information relationships resulting from the emergence and growing dominance of the Internet and the World Wide Web in everyday life. This paper suggests that the Internet/Web changes the dynamic relationship between what Cattell and Horn have identified as the two general factors of human intelligence: crystallized intelligence and fluid intelligence. The Internet/Web open up new possibilities for accessing information and transcending over-determined cultural intelligence in problem solving. This offers fluid intelligence, which often trails off in adulthood, a new vitality across the lifespan. But the diminishment of crystallized intelligence, and especially cultural intelligence, also presents a number of important problems in maintenance of cohesive, social cooperatives. The development of OSINT (using tools and ethos created by the Open Source movement of the last few decades) offers both a framework for reaching beyond the boundaries of traditional cultural intelligence and ways to create cooperative, open, problem solving communities. The Internet/Web will continue to create confusion and fear as we move deeper into this new age, but also presents extraordinary possibilities for augmenting human intellect if we can understand it and learn to harness its potential.

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1. Introduction

Thirty years ago J.L. Horn wrote, “One fairly recent trend of change in our culture seems bound to have an important influence on intelligence testing, the trend in the way that information is transmitted and received.” (1979, p. 232) In one sense Horn was ahead of his time, predicting future relationships between information (delivery) and intelligence; but in another sense his words display the distance between 1979 and today. Horn’s focus (in the article) was on the expanding role of film and television in the measurement of intelligence, and the subsequent dissemination and discussion of findings.² The Internet, as we know it, was in its infancy, still very much on the margins of even the most advanced thinking: a vision of the future watched over by small groups of academics and technological innovators (Waldrop, 2001). Even these early Internet pioneers barely understood the implications of the burgeoning technology and how it would change humans’ relation-

ships to information. While the advances in information delivery and processing systems Horn refers to have abilities to recreate intelligence across different mediums and social landscapes, the Internet represents possibilities for fundamentally changing the general of human problem solving through the lifespan. The Internet, and its most powerful tool to date the World Wide Web, have the potential to alter the trajectory of human intelligence and extend controlled, goal oriented activities of the human mind deep into the information universe.

1.1. Crystallized intelligence, fluid intelligence, and Open Source Intelligence

The differentiation between crystallized intelligence (Gc) and fluid intelligence (Gf) developed by Cattell and Horn has emerged as a dominant conception in the understanding of human thinking and problem solving (Carroll, 1983). Humans are born with a natural, dynamic, ability to interconnect different pieces of information into cohesive wholes.³ These patterns on initially fluid, diffuse and experience dependent. The most advantageous of these patterns eventually solidify into permanent habits of thought that

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² Horn was especially impressed with investments universities were making in film media.

³ This is an idea that stretches back to Gestalt psychology and even all the way back to Aristotle.

can be used over and over again and passed down through generations. Cattell (1943) compared the process to coral forming out of dynamic, free floating organisms. Through the 20th century cognitive/ intelligence researchers have suggested humans use this intellectual coral to create schemes about the way the world works (e.g. Neisser, 1979; Piaget, 1954).

Cattell (1943) outlining two general factors in human intelligence, made the point that both individuals and communities use these crystallized habits of thinking as efficient and reliable ongoing problem solving vehicles. Younger humans (generally through mid-adolescence) for the most part use a fluid intelligence (Gf) to solve problems and navigate their local ecologies, but as they grow older the crystallized habits of thought (Gc) become more important in thinking processes. Gf (for a number of organic and social reasons) slowly trails off (Horn & Cattell, 1967). There have been some extensions of and changes to the theory of fluid and crystallized intelligence but it has remained relatively stable in both idea and measurement for the better part of a century (Carroll, 1983). The Internet has the potential to (radically) change the ways in which Gf and Gc develop and interact for both individual and community purposes. This is not because the Internet will prove Gf–Gc wrong, or even lacking, but because the long term ramifications of the new technology may engender fundamental changes in the abilities of especially older individuals to use Gf in their everyday problem solving.

1.2. Evolving human–computer symbiosis

There has been an evolving relationship between the human and the computer over the last half century (what Licklider (1960), referred to as human computer symbiosis). Initially computers served as addendums to or helpers in human problem solving. The more recent developments of the Internet/Web have created new roles for human–computer symbiosis in information relationships, actually augmenting human intelligence in dynamic problem solving. The invention of the Web and the extraordinary speed with which it has come to influence even the most mundane human tasks has been both dramatic and confusing. The Web as an extension of the human mind is creating new interactions between two general factors of intelligence (Gf and Gc). The Internet/Web engenders possibilities for a new intellectual vitality for Gf through the lifespan, but one that must navigate shoals and eddies created by the needs and demands of cohesive community/society life (a role often embedded in Gc); a combination that opens a new arena of human problem solving – Open Source Intelligence (OSINT).

We suggest that OSINT is not a completely new type of human intelligence, but in general it has emerged in human problem solving only during specific/provocative types of goal driven activities (e.g. the local community feels a high enough level of risk to suspend its control of information and encourage new types of information searches and linkages, or an individual makes extraordinary efforts to question accepted knowledge systems). And that these goal driven activities are limited in time (as soon as the crisis has passed the local community reasserts control over available information). Openly available information that transcends local control does not really create OSINT as much as it opens up the possibilities for making new types of searches and links and democratizes the process. In much the same way the possibilities of the universe fuel Gf, and the needs and knowledge systems of the social group fuel Gc, it is the new possibilities offered by the Internet/Web to search without boundaries and consider multiple alternative solutions simultaneously that fuels OSINT.

It is critical to understand how the fast moving technologies of the Internet/Web are changing the nature, scope and trajectory of the human–information relationship. OSINT provides a framework and an approach for understanding human intelligence in the

Internet age. Earlier exploration into this changing informational landscape has led to a growing literature outlining some of the human costs and fears arising in conjunction with these new technologies (e.g. Carr, 2010). This paper explores the consequences of Internet driven human computer symbiosis from a more positive perspective. A perspective necessitated by two inescapable facts: (1) the Internet is not only here to stay, but will certainly grow in influence (sometimes exponentially) over the coming years and (2) we are far better off understanding an omnipresent force such as the Internet in terms of its meaning and potential in our thinking and our lives rather than as a threat.

1.3. Structure of the paper

This paper is divided into two parts; the first longer (and more Gc dependent) and the second shorter (and more Gf inspired). The first section of the paper examines the evolution of OSINT over the last half century. The first rumblings of OSINT actually predate the computer age and is more closely related to intelligence gathering from open sources of information (e.g. newspapers, public speeches), primarily by the military but also other agenda driven institutions (Burke, 2007).

The idea of an active, Open Source Intelligence took on greater urgency as the Internet opened up and made available a seemingly unending and unrestricted of information sources (nodes). One of the earliest and most important initiatives in framing the Internet as a problem solving tool was the Open Source movement (Raymond, 2001). As Open Source communities developed into productive working groups Gc became secondary (less necessary and less valued) to maintaining a continuous, free flowing stream of innovative ideas and creative initiatives. Open Source communities primarily promoted Gf with minimal energy put towards recreation of the community (coral) itself (any necessary cultural history was automatically archived online and easily retrievable). Seeming to recognize the social dangers inherent in relying primarily on Gf many of these communities developed external maintenance tools to keep from flying off their social axis.

The practices, culture and ethos of the original Open Source movement migrated (sometimes successfully and sometimes unsuccessfully) to different types of collective projects – social, academic, political (Stalder & Hirsch, 2002). New technologies provided opportunities to extend individual capabilities and community efficiency in using Gf in combined problem solving, but also created problems by losing some of the safeguards provided by Gc (e.g. task focus, predetermined standards for contribution). At the same time, through the Web and Web 2.0, the tools of the Internet were becoming more democratized, both open to and critical for a far wider population (well beyond the hackers and programmers of the Open Source movement). A growing number of users and user initiated online ventures have become capable of using new connectivity proficiency to journey deep into the information universe in ways that transcend culture/context dominated intelligence (e.g. Sternberg, 1985). At the same time nascent, problem solving (virtual) communities have been experimenting with social proxies for cultural intelligence that keep the intellectual activity from becoming too diffuse and/or confrontational. The key to these new capabilities, and the core of OSINT, is being able to navigate an extraordinarily rich, complex information landscape, where individual processing skills are expansive, integrated with and responsive to general, community centered problem solving systems.

The second section of this paper addresses how recognition and cultivation of Open Source Intelligence might change our relationships to technology, our relationships to information, and our relationships to the world around us. Globalization, technological development and environmental imperatives are all having a

major impact on the way humans live their lives and think about the world. The changes can be challenging, confusing, and at times opaque, leading to a growing sense of ecological crisis (Stokols, Shalini, Runnerstrom, & Hipp, 2009). OSINT suggests a different approach to fast paced technological innovation; an approach that allows us to augment and possibly gain a greater understanding of human intelligence attempting to grasp and decipher a growing set of unknowns. There are of course difficulties and dangers in OSINT itself because of its dependence of what Rheingold (1993) has labeled “virtual communities” and their susceptibility to manipulation. But if we can accept and embrace the new possibilities and trajectories for information processing emerging out of the information revolution through active application of OSINT, the possibilities for the human mind, individual and collective, are boundless.

2. The evolution of OSINT

The earliest forms of Open Source Intelligence involved the search for and creative combination of freely available information and synthesizing findings into actionable form. This early incarnation of OSINT dates back to the Second World War (Burke, 2007; Schaurer & Jorger, 2010). The emphasis of this type of problem solving is not necessarily the availability of information itself, but the ability of the information gatherer to locate relevant information (encode) and mold it into a sense making whole (combinatorial) in a completely transparent fashion that treats information as a resource rather than a commodity. The information gatherer is consciously using Gf to continuously redefine and solve problems based on best available information. For example, during the war, intelligence gatherers recognized an important connection between railway efficiency in France and the price of oranges in Paris – and could use the combination to determine the success of an overnight railway bombing raid. There was little in stored knowledge of trained analysts that could have predicted this combination. Intelligence gatherers must always be aware that pre-determinations about importance of information, as well as culturally accepted aids and concepts that help to organize information can be counter-productive in unique circumstances. In a mechanized war all situations are novel and reliance on assumptions and habits can be disastrous (there is an old adage about generals “always fighting the last war”).⁴

OSINT that developed during WWII has at least two highly applicable components relevant to current discussions of Open Source approaches (Burke, 2007). (1) A well referenced, *transparent* report for the end user. References must be linked to openly available sources, obvious and accessible to anybody reading the final analysis. Transparency enables any user to base their judgments of conclusions on their own examination of information rather than expertise and/or trust in some restricted data source. This would later emerge as a central tenet of the Open Source movement; you cannot really trust an application or program unless you have complete and open access to all underlying source code and code history. Transparency also enhances the interested community's ability to easily and quickly disseminate important conclusions among all relevant parties so that they can be flexibly used for different scenarios/problems. (2) Link tables in which information nodes are weighted by importance to content area and targeted problem(s). An end user should be able to locate de-

sired information based on their own immediate problem, but also see how and why other information in close or related fields might link back to the target nodes. This allows any information based system to remain dynamic, with judgments about relevance based on outcomes rather than preservation of some in place system. Thus if a user is looking for current water resources in a particular area the information can be found quickly. The user can also see and understand links back to weather patterns, who is in charge of local resource management, crop production, food prices and price fixing, level of discontent based on available food supply, and rise in recruitment by extremist groups.

OSINT serves a dual purpose – it creatively gathers, selectively encodes, and combines transparent information to develop solutions to novel problems, and as part of its natural process brings higher levels of trust among interested users – especially that the solutions are focused on the targeted problem and *not* maintenance of some interested community organization. OSINT attempts to over ride adult Gc based in cultural intelligence and replace it with Gf based opportunities, by presenting information in ways that engender inductive (Sternberg, 1985) and abductive (author citation) reasoning approaches. The purpose of this early OSINT is to invite end users to draw their own inferences about meaning and relevance, and map them onto higher order rules systems, developing their own solutions to unique problems.

OSINT is at once cognitive and social in nature (although the social aspects can be ambiguous beyond common problem solving activity). It can be used to right information imbalances, address the lack of trust members of the community may have in third party problems solvers (or even each other), for community verification of conclusions, and to promote extended information sharing within the community (Burke, 2007). Information in an OSINT framework is more open and horizontal in nature, spread out across the entire community (which promotes a more Gf/inductive response to information) instead of maintained by specific sets of individuals and groups within the community (which promotes a more Gc approach as individuals attempt to maintain their place in the system by claiming ownership of information). So if for example there is recognition of a relationship between water table level and increase in extremism the information is distributed across possible end users who might have interest in or be able to add a new link to the situation; whether the end user is a military advisor or a Community Based Organization administrator.

2.1. OSINT and the Open Source movement

Early OSINT was driven by technological advancement (e.g. mechanized war) but not a product of the computer/information revolution. It was based primarily in novel ways of gathering and interconnecting information, and helping to create an atmosphere, where users (dealing with complex problems that demand immediate response) can escape patterns/habits of thinking embedded in (often outmoded) context/cultural intelligence. Users are able to bypass preformed concepts and expectations and approach a problem from a more creative stance. This early OSINT was also one of the first movements in the idea that technological innovation was occurring too quickly for communities to rely primarily on Gc. But the promotion of fluid/inductive approaches in adult intelligence remained relatively narrow and problem specific. It was the Internet and the Open Source movement that put human intelligence in general on a new trajectory.

There has been a long relationship between the computer and human intelligence, but we would argue before the Internet this relationship was primarily concerned with (reproduction of) Gc (the computer during this period had a major impact on the ways we understand human intelligence but not a revolutionary one). Horn (1968) describes crystallized intelligence as simple anlage

⁴ What is interesting about the emergence of OSINT during WWII is that a number of inter-related ideas emerged at the same time (for similar historical reasons), including the idea of thinking as a “web of trails” (Bush 1945) and the differentiation between crystallized and fluid intelligence. The invention and new available information sources that emerged in this short period presaged a period in which intellectual work would become more dynamic.

functions supplemented by culturally/societal developed aids (strategies that help us remember important information like chunking) and concepts.

The anlage capacities of individuals are thus harnessed as it were, by the dominant culture for the for the purpose of **maintaining and extending the intelligence of the culture**. This process is architectonic, building from a base of prerequisite concepts and aids to a superstructure of concepts and aids... This is the factor representing crystallized intelligence. (Horn, 1968, p. 246–247, emphasis ours)

Initially computers served as helpers or even junior partners by enhancing human activity through externalization and stabilization of the Gc that Horn describes above (aids and concepts could be programmed into computers greatly enhancing human anlage functions).⁵ The great hope – and fear – was that computers could reach a high enough level of anlage functioning on their own they could generate their own aids and concepts in problem solving.⁶ It was not until the Internet that computers began to seriously extend possibilities of Gf problem solving into adulthood.

It was the Open Source movement that first grabbed hold of the online possibilities of Gf (or intelligence with the exploratory qualities of Gf) as a focused problem solving intelligence. The Open Source movement comes from emergent hacker communities (Raymond, 2001) that made source code public, available, and open to improvement from any interested party (the individuals could in-link to examine and use the code for their own needs and/or out-link in an attempt to modify the code). A unique and encompassing approach to information has emerged from the Open Source phenomenon (see author citation for extended discussion). There is some disagreement over the relationship between early forms of OSINT as information gathering and the Open Source movement (e.g. Wikipedia, 2010). But Burke (2007) in a comprehensive review of OSINT suggests that the Open Source movement has made some important additions to the practice of OSINT and we see the two as contiguous. Robb (2004) points to a number of important implications that the Open Source movement has for OSINT as intelligence gathering and recombination, some of which help illustrate the connective relationship between OSINT, the Open Source movement, and Gc and Gf.

1. Put information online (openly available) as early and as often as possible (there is no reason to hold information, no proprietary claims to information, an idea that has been taken to the next level by Berners-Lee (2006) with his idea of linked data). Information gathering, generating and synthesizing nodes should put raw data into linkable hypertext format as soon as possible so that collaborative forums can naturally and easily emerge around common problems. The idea that information should bypass any socio-cultural or expert driven filter is critical to OSINT. Horn, Donaldson, and Engstrom (1981) suggests one of the reasons that adults have progressively diminishing Gf is because they have difficulty “getting up” for a difficult problem. Part of the reason for this might be that cultural intelligence does a great deal of the work in adult problem solving (Horn, 1968; Sternberg, 1985) with the ratio of Gc–Gf increasing over the lifespan. Putting raw information up on the Web removes this culturally woven safety net for both information

gatherer and end user. Individuals are offered the freedom, and left with the possibility, to determine relevance of information for encoding and combination.

2. Put no limitations on the pool of possible collaborators in attempts to find a solution. Any collaborator has the potential to offer a solution that can be replicated and become part of the core data base. Constraints on participation based on rank, group membership, and or education are self-defeating. This is an idea that reaches as far back as Dewey (1916)⁷ and his conception of a problem solving democratic community. Gc can be safe and efficient for the user but it can also be relatively static and narrowed in scope by acceptable contributors. Those who most “closely resemble(s) the proto-type of an intelligent person” (Sternberg, 1985, p. 63) are accepted as experts by particular cultures in particular fields (this can be accomplished as easily as putting on a white laboratory coat).
3. Treat all interested parties as potential co-developers within an expanding network. These potential co-developers are the most important “assets” in problem solving and they should be recognized and cultivated based exclusively on input. The human mind’s greatest resource is other human minds, and the most productive posture for problem solving is connecting out rather than turning in. This is especially important for novelty and what Cattell (1963) and Sternberg (1985) refer to as insight. The word “insight” though may be a misnomer, especially in the context of OSINT. Individuals often develop new patterns of thinking and understanding by discovering new information beyond learned/stored knowledge (e.g. information provided by other individuals or communities who have a different perspective of an object/subject) and linking this new information back into their problem solving process. It might be more accurate to refer to this phenomenon as a new “in-link.”⁸

Being open to the idea that information can be used in unexpected ways. This is possibly the most important aspect of OSINT, the idea it is possible and productive to look for and make connections that are not immediately apparent or are even (initially) counter-intuitive. For example one might not recognize that the emergent activities of a group of disparate, anti-establishment hackers would offer a unique road map to centralized, military and military like agencies in fighting extremist terrorism. The ability to recognize and be open to unexpected value in new information is extremely important in OSINT – and Gf in general. Integration of new information (that falls outside cultural intelligence boundaries) is probably a conscious (and many times difficult) choice on the part of adults and may be one of the reasons Gf diminishes as we grow into adulthood. As individuals develop into vital members of the community it becomes important that their thinking become less diffuse and more “organized” in socially accepted ways. At an action level this means individuals must focus on a more limited corpus of information in problem solving to be successful in the larger community (limiting both problems that can be posed and possible solutions). The Internet provides a relatively safe forum for making new in-links and out-links. OSINT opens the thinker up to a wider scope of information while at the same time promoting differentiation between relevant and

⁵ We recognize it is possible to make the opposite argument that computers are independent of acculturation processes and are therefore more representative of Gf. In our view though computer programs are over-determined – “dependent on mutually supportive skills linked together through positive transfer” (Horn, 1968, p. 248) – which is one of the defining qualities of Gc.

⁶ This would make computers functionally equivalent to humans on that factor of intelligence – e.g. HAL of 2001 *A Space Odyssey* or the recent computer Watson that competed on *Jeopardy*.

⁷ We believe there are strong links between the Cattell-Horn conception of Gf and Dewey’s ideas on problem solving in democratic communities. One of the reasons they are not more commonly linked together is because the Gc of the academic culture does not really encourage it.

⁸ Sternberg was most of the way to this conception of “out-link” in his description of concept of novelty in task understanding (1985). The second and third processes, and we believe most important, is “accessing a novel conceptual system,” and then “finding an appropriate concept” in that new conceptual system.” (p. 83) On the Web that would mean searching for a new site or file and then linking to an idea within that node.

irrelevant information (selective encoding). And it stresses openness to creative linking between nodes (selective combination) while at the same time optimizing efficiency of both search and experimental linking. *OSINT and the Open Source Movement-Emergent communities based in Gf.*

Open Source Intelligence suggests a very different approach to adult use and management of information at the individual and community level. In many cases adult problem solving is viewed primarily as a “management” issue using Gc (often stored in long term memory)⁹ to quickly and efficiently develop sanctioned solutions to pre-defined problems (e.g. Sternberg’s discussion of the move from self-termination approaches to problem solving to exhaustive approaches). OSINT offers the possibility of maintaining high levels of the exploratory qualities of Gf well into adulthood, focusing on the types of encoding of under-determined attributes that are more common in childhood.

2.2. The Socio-cultural based interrelationships between Gf, Gc and OSINT – an evolution of qualities

The relationships between Gf, Gc and OSINT and socio-cultural influences are complex and difficult to untangle at this point. What we believe is true is that OSINT combines the natural tendency of the human mind to reach out and explore the universe that drives much of Gf with the emphasis on focused and efficient problem solving that plays an important role in the emergence of Gc. Gf is the more organic type of intelligence, the natural inclination of humans to reach out and explore their world in an effort to better comprehend it. But this exploration is often diffuse and unstructured, putting logical/efficient problem solving at risk. *Gf is exploration based, users are willing the sacrifice efficiency and focus to discovery and creativity in response to developing a response to an immediate problem. There is little interest in building or participating in replicable knowledge systems.*

Gc usually develops later than Gf, often times in conjunction with some type of schooling or formal learning activities (e.g. apprenticeships). Children are slowly acculturated to local knowledge systems and expectations. At the individual level Gc probably emerges from the way the mind interacts with and organizes social experiences (see Vygotsky (1987) for a plausible discussion of this process). Successful intellectual activity is measured by the way individuals use socially sanctioned knowledge systems to solve community posed problems (whether it is weaving a carpet or taking a standardized test). Information availability for problem solving is delimited (or closed) by social boundaries. It is not so much that individuals do not search for new sources of information beyond socially determined boundaries – it is that problem solvers are not really aware of their existence. *Gc is solution focused, often addressing problems already determined as important by the social community. Information search is socially controlled and bounded with greater emphasis on information processing/mastery of the process.*

OSINT combines efficient problem solving with open, but focused search for new information, making unique links between information sources, enabling development alternative possible solutions, and even new types of problems (Glassman & Kang, 2011). This type of linking has occurred prior to the Internet and the Web, but generally only when the social community itself feels at risk and demands alternative possibilities (e.g. World War II, Burke, 2007; Bush, 1945), and often among well educated adults who eventually return to socially sanctioned knowledge systems. The Internet opens up new and open information sources that transcend the local social group to any person at any time. There

are few if any social gatekeepers (Lewin, 1947) for definition of problems and development of solutions. At the same time individuals are learning to reign in and focus their intellectual activity on relevant problems through socially directed education systems, they are given the abilities to move beyond socially sanctioned information. It is the combination of available, easily accessible information, the ability to do a direct search that links disparate sources together, and the willingness to consider unique, unfamiliar alternatives as viable solutions (and even problems) that is at the core of OSINT, and differentiates it from both Gf and Gc. *OSINT is controlled exploration that is open to new and different connections and possibilities combined with focused problem solving. OSINT promotes goal directed activity that is capable of transcending social and cultural boundaries.*

2.3. Minds finding each other on the Internet

Stalder and Hirsch (2002) were among the first to take some of the organizational tools developed organically through the Open Source movement to the next logical step; applying this new approach to sharing and using varied information and perspective to any type of creative, cooperative community project. The Open Source movement initially emerged in reaction to universities/companies claiming direct ownership of the source code of computer programs as protected commodities (as soon as programs were well developed enough for global use the source code was closed to even the original programming group and possibilities of progress through code alterations became impossible). Many of the programmers involved in code development became upset at having their work embargoed from them and started a movement to make source codes of computer programs open access (freely available to anybody)¹⁰ and open to changes at the source code level (hence the origin of the term “Open Source”). Programmers who wanted to work on freely available projects collaboratively, without restriction of hierarchical based oversight, used the Internet in developing virtual communities/cooperatives to develop their own open and free computer programs such as Linux (Raymond, 2001). These programmers were the first to explore this new, extended Gf that had the potential to combine the natural curiosity, innovation and daring of early problem solving with much of the control and efficiency found in stable communities.

Stalder and Hirsch suggested that potential Open Source communities do not have to be working on a defined software program but can be part of any shared community. Individuals can form online groups that bypass local cultural intelligence and expert based hierarchies and become co-developers of a shared project/idea, openly and transparently sharing and vetting information. But they also suggest that these types of communities are representative of a different type of adult problem solving, as rife with inherent dangers as it is with possibilities. We argue that the Internet/Web opens up a context for adult based, Open Source problem solving using advanced, adult fluid intelligence to almost anybody with a modem. OSINT puts greater demand on individuals for maintain stability within their nascent communities, without safeguards usually provided by culturally determined intelligence.

2.4. Creating Gc proxies for Gf Web based communities

The shared information model used by Open Source communities can often run counter to linear knowledge building and contextual boundaries established by social/cultural communities (i.e. groups driven and maintained by context/cultural intelligence). The uniqueness of the Open Source model has created a

⁹ While some have suggested Gf is highly dependent on working memory (Conway et.al 2002), Gc seems to be more dependent on ability to access information from long term memory to working memory.

¹⁰ Open access is one, and perhaps the simplest, aspect of an Open Source approach.

number of difficulties in maintaining stable, online problem solving activities over time. Questions quickly emerge such as; How do you determine recompense for intellectual property? How do you keep communities active and organized when there are no experts, and administrators are on an equal footing with participants? How do you keep communities from devolving into a cacophony of competitive voices all claiming to provide the most valuable information? These are just some of the organizational difficulties Gc helps to alleviate for ongoing social cooperatives.

2.5. Emergence of the “trusted user”

There has been a sometimes painful evolution of participant derived methods designed to maintain a balance between an open, democratic community and an influx of potentially indiscriminate/destructive information (e.g. unsubstantiated claims, ad hominem attacks). In initial attempts to keep Open Source initiatives expanding, lists (such as Nettime) established sets of moderators – individuals chosen to make judgments about the appropriateness (though not the quality) of all in-links to the community project. In this model conscious, immediate moderation takes the place of cultural mediation (e.g. Vygotsky, 1987) as the primary filter for information. The moderators are not representative of an ongoing social/cultural group and are not working towards any goals beyond the needs of the immediate project.

OSINT communities externalize (and in the process make transparent) social maintenance tasks usually embedded in cultural intelligence. Information is vetted at the point of entry into the community, but only in terms of general appropriateness (the actual value is left to the judgment of the community as a whole). Theoretically there are no hidden agendas and all decisions are archived and easily accessed. The moderators’ sole task is to keep the project and problem solving on a productive course; there is no social/cultural gatekeeper function. Every project remains a work in progress and every piece of new information represents a potential breakthrough.

A difficulty with the moderator approach is that it creates a hierarchy, where the moderator’s own context/cultural intelligence can easily be translated into externalized habits of the community. The larger population that has the potential to offer and/or recognize novel avenues of thought is potentially controlled by much smaller sub-population of moderators who may be relying on their own historically developed Gc. Moderators may, without realizing it, take “too much” responsibility for the flow of information entering into the project conversation (Gc may be far more difficult to transcend as an individual than as a community) and become self-determinative about what is even allowed to be encoded by problem solvers. Protests concerning the dangers of appointed moderators led to modifications in general information processing within Open Source communities.

Moderation moved from being individual focused to community developed. Open Source working groups began to cultivate methods for identifying a coterie of “trusted users,” – a form of fluid, open co-ownership of the project. Trusted user status is earned rather than given and must be maintained over time. Generally this is accomplished through active and positive participation in the project. New trusted users are continuously being added in while others drop away, and the population of trusted users changes along with the trajectory of the project on which the community is working. Trusted users are given the opportunity to judge a piece of information up or down based on their own perceptions of adherence to community standards.

The trusted user system began with the site NoLogo (Stalder & Hirsch, 2002) but has been used by a number of sites dedicated to an OSINT model. In its simplest form each potential contribution to the community is judged: 1 for value, 0 or no vote or neutral, and a

–1 for being detrimental to the project as a whole (sometimes referred to as a troll rating). Posts are removed in only the most extreme conditions, but participants know that if a contribution has a neutral rating it probably has already been judged to be of limited value to the community, and if it has a negative rating that it should be avoided or read with extreme care. Once a user has reached a critical level of positive judgments for their contributions (e.g. a cumulative score of +20) they are given “trusted user” status and the ability to judge information.¹¹ Moderation of information becomes a self-generating process within the community, but it is dependent on members developing at least a partial population of users with critical skills in selective encoding that meet the needs of the collective community project.

2.6. OSINT: search, organize, differentiate (SOD)

In outlining the differences between Gf, Gc and OSINT it is, we believe, beneficial to return Raymond Cattell’s original metaphor of living organisms of the oceans and the way they crystallize over time into solid reefs (Cattell, 1943). Cattell compared Gf to the small ocean organisms being washed into shore and then back out. Ideas are free floating and transient, offering possibilities without a focused structure, making exploration exciting but having limited productive value. Gc can be understood in terms of the way some of these organisms coalesce over time into a barrier reef. The metaphor for OSINT is the ability to stand on the solidified reef and cast a net in a focused attempt to pull in some of the surrounding ocean organisms in an effort to solve problems. A child engaged in Gf problem solving is playing in the ocean while OSINT provides the tools of a fisherperson attempting to pull new, relevant ideas from the waves. There is a qualitative difference between the two. The fisherperson has a base on the solidified reef but the focus of the activity is out towards the ocean and the continued dynamic activity of the floating organisms. The availability and the quality of the nets tossed out into the ocean of information, including the how fine the mesh, are critical to the search process.

A critical recent innovation enhancing the possibilities of OSINT problem solving is the emergence of advanced search engines. While trusted user systems help establish community stability and keep in-links of irrelevant and/or destructive information from overwhelming a community, search engines do much of the baseline organizational work that is usually part of Gc – creating on the spot categories that in many ways mimic aids and concepts in process but not in kind. The organization provided through Internet search is malleable and the user does not have to store even successful information attributes to access for future problem solving (information can be accessed at any time through the Web – the only thing that needs to be stored is the prompt).

Sternberg (1985) suggests individuals have at least two approaches to problem solving. There is self-termination (Sternberg, 1977) which seems closer to fluid intelligence: the problem solver chooses the minimal number of attributes of a given stimulus to achieve a solution to a problem. If successful in finding the solution the individual terminates the process. If not successful the individual looks for another attribute and continues until a successful solution is discovered (or it is assumed the problem solver gives up). This process of self-termination is close to the concept of “web of trails” that Vannevar Bush (1945) suggested is at the heart of scientific innovation. But reflecting the same type of developmental progression of intellect suggested by Horn and Cattell (1967) Development lead individuals away from self-termination

¹¹ Stalder and Hirsch suggest the trust user system is based at least partially on the academic peer review system. But because the trusted user system is community oriented, transparent (all ratings are tagged and archived) and immediate it has less chance of being manipulated by cultural intelligence.

information processing and in the direction of exhaustion processes (Sternberg & Rifkin, 1979). With exhaustion processes, which seem more closely tied to Gc, individuals store the information they need for problem solving in long term memory (which will necessarily be limited) and access what is needed into working memory when solving a problem. Exhaustion promotes the idea of the carefully trained expert as quintessential problem solver. The expert learns and stores the most important information in a given field and then accesses it in varied combinations when needed.

The switch from self-termination strategies to exhaustive strategies probably occurs for some of the same reasons Horn and Cattell suggested for the evolution from Gf to Gc over the lifespan. Self-termination processes are discovery/innovation oriented by they are also chaotic, unsystematic and inefficient: the individual may move from one attribute to the other without any strategy or organization for choosing attributes. There are also the difficulties involved in continuously having to search the local ecology for new information every time one attribute fails and another is needed. It is both safer and more efficient to maintain an accessible store of information (in long term memory) that can be accessed when needed; but this necessarily limits the field of inquiry for both individual and community (a group can be trapped by its own cultural intelligence). The search engines of the Web offer possibilities of altering this equation by making search for and the selective encoding of information far more ‘user friendly.’ But even this user friendly atmosphere demands greater emphasis, greater abilities, and greater confidence in skills such as search, organization and differentiation of information (SOD).

2.7. More active searching

OSINT combined with advanced search engines, provides a much lower threshold for recognizing novelty (including new types of relevant information and new combinations) in a problem situation. The Internet/Web affords easily accessible and retrievable new information based on simple input of identified attributes. This lessens dependence on anlage thinking enhanced by socially determined (or at least taught) aids and concepts. The balance of information processing moves from taking in reusable information and then using “insight” for productive recombination, to reaching out and developing “in links” through active search. Individuals continuously develop links and webs of thought in response to stimuli (Barsalou, 2008; Bush, 1945). The constant and seemingly exponential expansion of the information universe allows individuals to freely link to an extraordinary array of possible sources, including those that are not sanctioned, or are even outlawed, by the immediate teaching community (e.g. the tension between government/culture and Internet use in highly controlled societies such as China and Iran. The fact that many individuals continue to successfully search for new information in spite of social condemnation and technological firewalls speaks to the highly intuitive nature of this skill). Access to new and different types of information opens up the possibilities for unique solutions but also for recognition of new problem sets (Bardini, 2000).

2.8. Increasing differentiation

The problems we face in life become more complex and more challenging with age, as well as understood in the context of larger social groups (e.g. Kohlberg, 1969; Selman, 1980). Active searching can push the mind beyond its comfort zone in processing accessible but unfamiliar information. With Gc based in cultural intelligence differentiation is in many ways already built into the process, with aids and concepts naturally narrowing the types of information considered. Fluid approaches, especially in adulthood, and especially when using the reach of the Web, opens problem

solving up to almost unlimited information possibilities.¹² Without advanced *differentiation* capabilities information can become overwhelming and create confusion and possible shut down. Search engines play an important role in differentiation by generating immediate, responsive categories to input. As we move deeper into this new information era and augmentation of thinking becomes less about simple connectivity and more about community oriented problem solving strategies, abilities to quickly and effectively differentiate relevant from irrelevant information will become crucial and highly valued. Users will need to rely more on their own tools sets and be less dependent on automatically generated responses to search prompts.

2.9. Organizing the world

The key to differentiation is efficiency in the *organization* of information. Generally the organization of information has not really been a first order task for individuals in high functioning societies. Information is often times organized for the user through social/cultural–historical based mediators (e.g. Horn’s aids and concepts, Vygotsky’s culturally developed mediating artifacts 1987). Prior to the Web it was difficult and sometimes unproductive for an individual to try and reach beyond an individual’s extended, or even immediate ecological milieu to find new information. The Web opens users up to new “trails” of information not vetted and/or mediated by any local, social or cultural traditions. Organization of information is based to a higher degree on external, rather than internal connectedness (Mayer & Greeno, 1972). In OSINT individuals integrate new information into their general thinking systems in order to develop cohesive patterns of thought.

2.10. The Web as an extension of mind

Growing demands in differentiation and organization of new information, especially when combined with the diminishing impact of cultural intelligence, can be anxiety producing (Stokols et al., 2009). The Internet/Web places new demands on especially adults’ information processing capabilities that can (only) be partially mitigated by tools such as search engines. But over reliance on moderating/mediating proxies provided by search engines and trusted user systems in Open Source communities can also be dangerous. Individuals have to realize that using the Internet in problem solving is not simply a transfer to more efficient information delivery systems. *There is a qualitative shift in the types of information available for processing.*

One of the elements limiting the early impact of the Internet was lack of dependable, non-traditional organizational structures for the constant flow of information (Stross, 2009). The Web has already gone through a number of evolutionary steps in the ways in which information is organized based on usage and recognition, including the development of search engine technology and blog and wiki rating systems. At this point some of the most advanced organizational structures have been developed by Google.¹³ Categories of information are created at the moment of the information search, usually by typing an attribute in the form of key word, series of words, or phrase into the Google search box. The search engine sends out “crawlers” into the document universe for responses and using complex algorithms generates on the spot categorical lists. Success in the search for relevant information is dependent on the applicability of the chosen attribute (much like any other intellectual activity). The search can continue with the user refining the development of categories with

¹² In some ways the change is akin to moving from a social mating system based on arranged marriages to one based on speed dating.

¹³ Google’s mission is statement is actually written, “Organize the world’s information and make it universally accessible and useful.”

each attempt at finding a relevant source until the satisfied and then terminates the process (which is the reason we compare this method of problem solving to self-termination processes). The more applicable the category the more focused the relationship between retrieved information and target problem.

2.11. Google

Searches are imperfect and function very differently from culturally developed concepts. Using a system Google refers to as Page rankings (based on an algorithm developed by company co-founder Larry Page) the retrieved information is ranked based on in-links from other users in the Google universe to the target page (Stross, 2009). The user can then use generated rankings to help define the quality of retrieved information. Users often adopt the rankings as part of their differentiation strategy by concentrating on the first page of the impromptu category or even the top line retrievals. But users are in danger of making a mistake if they consider the rankings as being in any way similar to Gc based in cultural intelligence – that is believe the responses at the top of the list are based some exhaustive understanding of the attribute entered in the search box. The rankings in practice are very fluid. By clicking on and linking to the URL of one of the retrieved pages the individual is helping organize the information and recreating the differentiation/organization tool for the next user. One of the difficulties with this type of community organizing system is a “rich get richer” dynamic (Barabasi, 2003). Once a node establishes a reputation as a “reliable source” it will get more clicks/in-links creating a stronger reputation, which in turn will naturally lead to more clicks and higher position on retrieved category lists.¹⁴

Page rankings can be manipulated by other external activities in ways context/culturally developed knowledge is not. Techniques such as “Google Bombs” (Calore & Scott, 2001), the “confidence game” of the information age can easily influence categorization by artificially building up link counts. These manipulations can lead to differentiation of information that is more restrictive, and potentially more dangerous, than socially/culturally developed aids and concepts.¹⁵ The individual’s responsibility and role in organization of information will only increase, become more complex, and demand greater social obligations as human–Internet relationships evolve. As the Web moves toward a mature Semantic Web, groups of individuals will be developing dynamic categories for information that will need to be more difficult for individuals to manipulate and/or treat as crystallized intelligence. Rather than searching for words within the documents users will be typing in words that match the ways in which other users have described the information in the document. The ability to selectively encode relevant information will be dependent on the natural byplay, almost an emerging language, between the user as searcher and the user as categorizer. This represents advanced, complex, but highly specialized communication skills.

2.12. Some core principles of OSINT

OSINT is still developing, and probably in its early stages, but we believe it is possible to lay out some core principles as outlined in this paper.

1. The most critical skills in OSINT are search for, organization of, and differentiation of information.
2. OSINT relies far more on processes reminiscent of fluid intelligence than processes involving crystal intelligence. This continues and even increases into adulthood.
3. OSINT makes self-termination processes of problem solving much more ‘user friendly’ and exhaustive processes less necessary. Again this continues and even increases into adulthood.
4. Information is always transparent, always open access, always readily available, and treated more as a community resource than an individual commodity.
5. Ability to develop a reliable community to moderate/vet new information is critical. The value of information processes are correlated with the level of user(s) trust.
6. There are no set hierarchies in problem solving and little predetermined (context/cultural intelligence). This frees users to explore new avenues of thinking but also puts much more responsibility on them in terms of encoding and combination.

3. Psychology in an age of information driven opportunity

The possible changes brought about by the Internet/Web in information processing holds the promise of greater innovation in response to the problems of an increasingly complex world; but it can also lead to higher levels of fear, anxiety and alienation that so often accompanies the loss of habits and traditions that add stability to our lives. In their article *Psychology in an Age of Ecological Crisis* (2009) Stokols, Runnerstrom, Gould & Hipp focus on the latter, suggesting the turmoil created by some of the technological innovations of the information age is creating new types of anxieties and problem sets. There is a fear of cognitive, social and emotional overload resulting from the continuous and sometimes omnipresent flow of new information. To this we add what may become the most pervasive fear in the new information age: fear that we cannot contain and control information, within the self or within the community. To use a scientific metaphor information has moved from solid state (always something we can see and touch such as words written on paper or calculations done by hand), to a liquid state (information that can be poured into a computer to be manipulated and rearranged), to a gaseous state (the Internet, where information is part of the atmosphere. No matter how hard you try to contain it some will leak out).

Some of the issues Stokols et al. discuss include problems that can be endemic to unconstrained Gf such as cognitive (over) load (e.g. DesStefano & Lefevre, 2000) and increased difficulties in focusing on a task; the ability to escape the constant influx of new information and find relief and comfort in the habits of thought; and the alienation and confusion that emerges when individuals begin to rely on virtual communities for their social relationships (Stokols et al., 2009), where friendships can take on far different meanings. Are we in danger of becoming disembodied voices screaming empty information at each other as we float in a chaotic virtual universe? Will this information become impossible to hold and contain, constantly seeping out to be used by people we do not know in ways we do not anticipate?

These fears have a saliency and a poignancy that should not and cannot be avoided – a clear signal easily picked out from the background noise of the technological revolution. We suggest OSINT has the possibility to not only ameliorate many of these concerns but to push some of the information based issues into a different perspective. A perspective that stresses the positive nature of the changes we are experiencing and focuses us more on, where we are going than what we might be losing. It is becoming more important for individuals and societies as a whole take this psychological step over the new, technological chasm. The genie is out of the bottle and there is no way to get it back in. Cultural intelligence

¹⁴ Google recently refined their algorithm so that original content pushes an information node higher up the retrieved category listings. Because position in the list is dependent on user in-links, and in-links are highly dependent on placement in retrieved links, unoriginal data can quickly descend in importance. The new algorithm has the possibility of functioning in the same way as copyright but within a more dynamic information universe. This is just one example of how the safeguards embedded in Gc might be translated into Gf/OSINT.

¹⁵ It will be interesting to see if users can overcome this hurdle of treating search results as a form of cultural intelligence in practice which may say a good deal about whether individual Gf→Gc abilities are more organic or more culturally oriented.

humans have relied upon may no longer have the same cache and power, while gate keeping functions built up over centuries become irrelevant.

Herbert Simon was warning about information overload caused by the computer revolution close to a half century ago (1969).¹⁶ But the trails of unlimited information and the ability to easily form communities around the use of this information offers, if not a completely new type of intelligence, a new trajectory for the ways we think and solve problems in our lives; a trajectory that might be a better fit for human needs in an age of ecological crisis. A recent example of how OSINT fits crises of a technologically driven world might be found in the online reaction to the nuclear crisis at Fukushima Dai-ichi.

3.1. OSINT in response to a nuclear crisis: A short case study

The disaster of the nuclear reactors at Fukushima Dai-ichi offers glimpses of the possibilities in creating open communities that transcend cultural/crystallized intelligence using the new capabilities of the Web. Advances in technology has created new and terrifying crises with which we have little or no experience – and Fukushima Dai-ichi may be one of the worst of the new age. But the burgeoning technology of the Web is also providing new ways of dealing with these problems, where disparate groups of individuals are able to impact the flow and quality of information, alleviating concerns, informing an anxious public, and eventually offering new types of solutions.

The Fukushima Dai-ichi disaster quickly turned the blogosphere into a universal learning experience as explanations, descriptions and scenarios became interlinked across the Web. Interested parties, and possible problem solvers, were not restricted to a unilateral flow of information reported by culturally sanctioned sources (e.g. newspapers, wire services) or even expert nuclear information outlets (Japanese and international). Instead users, anxious and confused about events and repercussions, could log onto the Web and *actively search* for information from a variety of nodes. Linking and commentary, where possible served as immediate peer review for quality of information (sometimes information was linked and then the in-link node provided space of further discussion) – many of the more reliable and explanatory sites achieved notoriety through high levels of in and out links from central hubs (author citation 2010). Savvy users, experienced on the Web, could use sites with strong trusted user systems to help *differentiate* good information from bad. A poorly sourced analysis of the disaster that had gone viral but contained questionable conclusions was debunked by well respected “hubs” within 48 h and has since dropped from the developing networks of interlinked data (Elliot, March 15, 2007). These reliable Open Source communities emerged within days using OSINT to develop and *organize* specific, reliable information that demanded Gf and self-termination type approaches (and indeed did not even offer the possibility of exhaustive approaches). For example measuring updated radiation levels in and around Fukushima (Schenkman, March 25, 2011). People establishing sites actively traded information and searched for co-owners, including individuals in nearby areas with handheld Geiger counters.

3.2. OSINT as a model for thinking and research

The relationship of research, cognition and learning with the Internet has thus far been mixed. There have been forays into this new information world but we argue they have been relatively tentative, with levels of wariness based in Simon's (1969) warning

about maintaining a balance between input and output. If we are overwhelmed by a constant influx of information, have no way of reclaiming Gf in adulthood in a productive way, we begin to suffer diminishing returns, where increased information actually hurts problem solving abilities (DesStefano & Lefevre, 2000). We suggest that many of the core concerns revolve around fears about how knowledge and knowing, thinking and learning will change as a result of new technology. Wikipedia (Lih, 2009) offers a case in point. The evolution of the online encyclopedia was an accident, based on a miscalculation about how people interact with information (author citation) – and yet it continues to grow into perhaps the premier information source in the world today. In spite of Wikipedia's growth and increasing usage many have a hard time accepting and trusting the fluid character of Wikipedia (how can an encyclopedia be reliable if it is not exhaustive?). The mistrust persists even though rigorous scientific study has shown it to have error rates similar to traditionally respected information sources (Giles, 2005). The credibility of Open Source based information seems too new and too different to have the same credibility of well vetted Gc.

There are two important interrelated issues in OSINT that we believe will gain in importance as researchers recognize the inevitability of technological change and the growing influence of the Internet/Web in people's lives: the idea of individual differences in OSINT, and the issue of measurement (how do we actually know if people are incorporating OSINT into their problem solving?). The first, the idea of individual differences, will help connect OSINT more firmly with the field of Intelligence. It is difficult to know at this point whether OSINT will be defined as an augmentation of Gf capabilities, or as a completely new and unique frame of intelligence similar to those proposed by Gardner (1999). At this moment in history we suggest OSINT needs to be more about learning than natural abilities. As has been suggested in this paper OSINT is representative in a dramatic shift in traditional expectations about the trajectory of intelligence from childhood to adulthood. The shift moves from Gf–Gc to Gf–Gc/Gf. This shift means readjustments to human–information relationships at different ages, and at a more systems level within community, society, and between societies. As for individual differences in response to these changes there is already some evidence that they exist on some level. For example children with Asperger's have been shown to have stronger abilities in Gf (Hayashi, Kato, Igarashi, & Haruo, 2007)¹⁷ while there is also a good deal of anecdotal evidence that individuals with Asperger's tend to be more comfortable and more successful on the Internet (Silberman, 2001).¹⁸

The ability to recognize differentiation is going to be based, at least to some extent on measurement. It will be a challenge to come up with reliable, valid measurements for OSINT. Cattell, by his own account (1963) did not come up with a satisfactory measure for fluid intelligence until two decades after he first established the theory of Gc and Gf (1941, 1943). We of course believe that OSINT itself may speed this process considerably.

The Open Source movement is the first large scale merging of the potential of the Internet and the Web with the human mind, and we believe the harbinger of what is to come. Open Source is both representative and demanding of a different type of intelligence – not a new way of knowing (author citation 2010) but one that has been mired in the background of societal and even global view of what intelligence means and how it should be

¹⁶ Arguments about how much information individuals can handle in their everyday lives pre-date the computer (author citation).

¹⁷ Temple Grandin's descriptions of her thought processes leading to innovation (1995) are both Web like and based in self-termination approaches to problem solving.

¹⁸ We first came across the acronym OSINT in a series of diaries and comment threads on the Web where some participants also discussed their own struggles with Asperger's Syndrome.

cultivated. It is impossible to know what the future of human–information relationships will be only that they will almost certainly change in ways we cannot imagine.

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