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Global Brain That Makes You Think Twice

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Abstract

In this position paper we introduce our approach to positive computing by developing and integrating methods for future assistant and companion agents which could help us a) avoid making mistakes due to biases caused by insufficient knowledge, b) be more empathic and righteous, c) be more sensitive and thoughtful. We present text processing techniques for automatic discovery of possible reasoning errors and provide hints to make users doubt their beliefs when there is a possibility of harm. We present existing sources and methods, discuss on how natural language processing technologies could contribute to various aspects of well-being by giving examples of systems we develop, and describe the strengths and weaknesses of our approach.

Introduction

Human – The Biased Creature

Since (Kahneman 2003) has been awarded the Nobel Prize in Economics in 2002, more and more lay people without any background in psychology of decisions have realized how dubious reasoners they are. But do we change our behaviors even after being told we might be biased? Mostly not, because we believe that even if the bias phenomena are now widely studied and confirmed, they don't really apply to us (which is yet another bias). We quickly forget what we learned and our mental walls close quickly as they exist in subconsciousness and controlling them requires some effort. What if we had a micro-scale wearable advisor monitoring our linguistic or physical behaviors and warn us when we fell or are going to fall in a bias trap? We already have wearable devices which monitor our movements, physiology or dieting habits and they warn us when we do things that are not suitable for our health. Our vision is to go a step further and prepare technologies to keep us healthier also in psychological, social or even moral aspects. We often copy our parents bad habits, we share gossip and beliefs that are not true, and harm ourselves or others without realizing it. Intuitions might be wrong but also they might be confirmed by the latest studies or investigations. On the other hand, every year we can read contradicting research results about coffee or red wine being healthy or not healthy at all. In the era of information flood we have access to various sources but we don't have time for deeper inquiries. If we do, we tend to search for results we *would like to* be true. As Kahneman often underlines "what you see is all there is" (Kahneman 2011) – we read our favorite portals, we follow people who think like us or have similar opinions and the filter bubble (Pariser 2011) help us imprison ourselves even more deeply. If we believe in conspiracy theories, we tend to avoid main-stream media and vice-versa, we rarely navigate to the conspiracists sites. We trust our *guts* and don't trust people who question our beliefs and challenge our opinions. But what if a cold, analytical machinery could always whisper a comment to our ears and make us doubt what we are so very sure about? At the first glance such idea seems to have more issues than Google Glass project which was supposed to be our extension providing more natural interaction with both real and cyber worlds. However, after a second thought about motivations behind using health-related devices and growing number of people who share their private data, the idea, at least in the authors' opinion, seems more plausible and worth discussing.

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Learning to Avoid Techno-traps

The era of fast networks, powerful but cheap computers and Big Data brings us lots of changes in our lifestyle, work or entertainment. The scientific / technological progress has always been simplifying most of lives, even if it kept displacing workers, but this time it also gives us more pleasures and distractions waiting within the reach of our hands every single second. It gives us permanent connectivity with others and instant access to knowledge, and the saved time we can spend in various ways. But for example the US statistics show that even if Americans have 45 minutes of free time more than 40 years earlier, they would rather spend it in front of TV-sets (Aguiar and Hurst 2006). Probably it is our nature to choose less mind-engaging activities whenever it is possible, and we tend to become children making easiest choices – from eating fast food to watching funny videos online. We feel happier but isn't it an illusion? Instead of allowing science and technology progress to lead us up an "easy" alley, we can use the very same progress to support humanity with preserving its deepness, its aesthetics, human's touch and inborn will to learn and seek for higher truths. Because it is not easy to win with commercial products which usually

avoid annoying users, our approach is to add the proposed "personal development" themes to applications for learning or entertainment. Later in this paper we describe examples of implementations and the underlying technologies, in the next section we discuss technology from the well-being perspective.

Well-being and Technology

New Oxford Dictionary defines *well-being* as "the state of being comfortable, healthy, or happy" but this definition would be discussable for many thinkers, especially the relation between happiness and comfort often given us by the technological outcomes, both manufactured and datified. Philosophers like Kierkeegard, who underlined that technology doesn't give us meaning, or Heidegger for whom technological calculative side was in opposition to human's mediative one, sent us a warning that we should not lose ourselves in comforting conveniences of industrial advancements. Baudrillard talked about dangers of media which gradually blurs boundaries between reality and copies of reality making us indifferent to many aspects of life like suffering. Nietzsche warned us we can't be servants of knowledge, that the knowledge must serve us, but are we doomed to become more and more robotic buoys floating along streams of Big Data oceans? It would be very hard to pull people away from devices and gadgets which are obviously useful, so if books are losing with TV[1], we believe we should produce even more advanced devices or upgrade existing ones to be able to infuse users with deeper thoughts, higher needs, and suggest swimming against the flow. For example automatic watchdogs for our online and offline behaviors, discussion-capable bots, automatic decision-support advisors and art generators could help us become better people and decrease Internet hate. Sartre defined *Facticity* (Heideggerian *Geworfenheit*, a term denoting "being thrown in the world", having no influence on when or where we are born, on our wealth or capabilities), as an obstacle to our freedom but also suggested we can overcome this obstacle by making right choices or by changing ourselves. Hegel introduced a *world spirit* concept (collective consciousness of culture) in which freedom can be broaden by acquiring more skills and more choices more free until we reach ultimate freedom. The current era of sharing knowledge spreading with mobile devices to even very rural and poor areas of the globe becomes capable of giving us more of those skills and choices. Knowing other ways of thinking, living or communicating broaden our horizons beyond actual borders, both physical and abstract. Remote health-care applications shorten distances and make physicians' advices available to poorer societies. Popularity of services like AirBnB or Uber suggest we want to trust others, to be free and not limited by existing structures. People themselves create networks which can be explored further and with the fruits of technology we can actively support their expansion. Below we describe these still messy sources and how they can be utilized for boosting our empathy, tolerance, morality, etc.

[1]http://www.bls.gov/news.release/pdf/atus.pdf, retrieved on 17 Jan 2016

Global Brain and Its Utilization

Although we work mostly with WWW resources and are influenced by earlier works of (Heylighen and Bollen 1996), here we define *Global Brain* exponentially growing, whole data heritage – from simple tweets, Internet of Things records, images and weather maps to scientific papers, encyclopedias and movie masterpieces. Nowadays online reviews are used for opinion mining, image processing helps finding adequate images and voice recognition simplifies interactions with devices. Almost every time we use some technology – we leave a trace, piece of information or knowledge, which can seem to be more or less valuable depending on further usage. But in our opinion the real, mostly still undiscovered, globalization of knowledge lies in further integrating (often unrelated at the first sight) realms of knowledge. Artificial Intelligence researchers tend to specialize in particular fields and work on algorithms for refining, gathering or utilizing knowledge for a very specific goal. However, it is still difficult to build e.g. companion agents (personal assistant applications, elderly-care robots, etc.) which could combine more than two-three realms, for instance our smartphones still don't confront our knowledge with popular views, scientific discoveries, can't advise us on what we should do in complicated situations (though they are very quick with advising us what to buy). One of the reasons is obviously lack of data as we are (still) not willing to share everything, another one is the diversity of data types and even if they are similar, correlations are not discovered yet. We believe that in order to create algorithms seeking sense among all realms, we need to automatically "translate" the 01 strings data to a natural language which is very noisy and difficult to process by machines but gives us possibility to analyze errors and to control the "thinking" process of a machine (differently from "black box" methods). As many investigations have suggested, not the algorithm sophistication, but the amount of data is often the key to better results (Banko and Brill 2001; Brants et al. 2007; Halevy, Norvig, and Pereira 2009). On the other hand, as the Wisdom of Crowds phenomenon shows (Surowiecki 2004), we need to be careful to provide as much diversity and decentralization as possible to assure high standards of collective intelligence.

Mining Knowledge

Currently the main source of acquiring knowledge, both for humans and for machines, is text and we also concentrate on textual data. The field of knowledge acquisition via text mining is vast and except market-oriented goals as sentiment analysis (Liu and Zhang 2012) or question answering (Gupta and Gupta 2012), there is also a wide range of natural language processing methods to be applied by researchers from various fields, e.g. analyzing historical texts (Piotrowski 2012), gene genealogies (Clement, Posada, and Crandall 2000) or aspects of cultures (Michel et al. 2011). The plethora of scientific papers being published daily brought a need for automatic processing of research results, although currently most work is done in medicine related fields, where the amount of publications is highest

(Alamri and Stevenson 2015) but there are also more wholistic attempts to support all scholars (Dunne et al. 2012). Although there are applications aiming directly at users' well-being, e.g. by providing stories (Honkela, Izzatdust, and Lagus 2012), most of them have well-being in mind indirectly. In this paper we want to describe several methods which could lead to applications for users who intentionally choose self-development and to applications which hide betterment trials. Both types have similar goals – to allow users to reconsider their opinions, decisions and behavior by detecting their cognitive biases, to rethink their behavior and attitudes, to make them think twice by exposing them to things or thoughts they would not be seeking otherwise. In our opinion this goal is achievable only if we go outside the narrow specializations and integrate current and future technologies (see Figure 1). The basic idea is to automatize the laborious and time-consuming process of searching for the trustful data, a task which many of us would be willing to perform but a) have not enough time, b) prefer to trust his or her own guts and risk the overconfidence effect.

Methods to expose users to different points of view were introduced in many papers (Paul, Zhai, and Girju 2010; Fang et al. 2012; Qazvinian and Radev 2011) and can be used as a starting point for the integration mentioned above. However, near future is going to provide us with much more data that can be used for further enrichment of knowledge needed for processing. As shown in Figure 1, one of the essential sources of subjective data are *opinions* and its *perspective changer* module is supposed to gather personal behaviors and habits for generalizations. Besides automatic retrieval from open data like blogs done by specialized web-crawlers (Rzepka, Komuda, and Araki 2009), it allows user (one who permits to share his or her private data) to see anonymous crowd trends automatically analyzed by the system together with pros and cons output. For example one of our systems analyzes blogs of ill people in order to find unnatural patterns which could lead to yet undiscovered drug effects (Kitajima, Rzepka, and Araki 2014). There are already some commercial applications which integrate various methods and data sources. An example of such marriage is given below.

Preferences, Health and Activity Data Integration

Currently mobile devices like smartphones gather data in separate channels for our preferences (music, movies, books, restaurants, places, etc.) to recommend similar items. The main goal is to boost sell and the application developers often apply myriads of tricks to increase earnings of the application provider (and the sellers who pays the provider for every purchase). Applications and devices gathering health and food intake data are a step further into integrating process. For example they can monitor weight from our scales, exercising activities and direct calories input (including detailed information from barcode readings accessed by a smartphone camera) as MyFitnessPal portal[2]. The service collects data from the users, and in return give them data visualisation, simple advices or healthy food recipes which may be chosen according to preferences discovered in existing data. We predict that such integration will keep widening to create sophisticated user models and provide recommendations based not only on tastes or health condition (including heartbeat or galvanic skin response, GSR), but also by combining them with linguistic and behavioral patterns, social activities and life rhythm. This will probably bring an outburst of applications that can monitor your lifestyle and advice what you should do to feel better – except of suggesting food it would recommend restaurants, menus, activities according not only to your preferences and GPS data (known from many geolocation-based services), but also specific needs and conditions of the user's body, cultural background, age, etc. This is the trend we predict, are interested in and plan to employ our ideas to.

[2]http://www.myfitnesspal.com

Applications Targeted at Specific Users

When Internet-of-Things devices in home appliances, cars, cameras bring even more data, we may see further data integration which at first will be widely avoided due to the privacy issues and worries about security. However, users tend to lower their acceptance bars when it comes to anxiety about their children or elderly parents. Our moral issues of surveillance are often being redefined when we want to assure security to our beloved ones who are more vulnerable. We worry if our children's insufficient experiences cause problems in online interactions or if our elderly parents start behaving strangely or forget about their medicine. Most of us don't like spying on anyone, especially on their relatives, but the instant anxiety can cause a gradual shift to purchasing systems where machines themselves would suggest (or try to persuade) the target user not to repeat mistakes and try to make them realize the dangers of their behaviors. There are already systems created for detecting harmful expressions in a relatively young field aiming at automatic discovery and prevention of cyberbullying (Ptaszynski et al. 2010; Dinakar et al. 2012); also trials with a robot using ethicists' knowledge to handle appropriately pills reminders for elderly was introduced (Anderson, Anderson, and Armen 2006). Utilized methods, after shifting target from the third to the first person, could become useful part of integration.

Holistic Approaches

If the new generations start caring less about sharing their lives with artificial intelligence applications[3], the integration might step up to a whole new level which uses access to above mentioned linguistic (e-mails, chatlogs, social networks, etc.) and image-related (photos, videos) personal data. With the progress in machine reading and image understanding fields, the user modeling will be easier and deeper which should allow to broaden the physical health monitoring to mental health monitoring and advisory systems could also provide suggestions based on latest scientific findings.

[3]This can be caused by various factors as advances in security technologies and shifting processing from data centers to more and more powerful personal devices – for instances anonymization and generalization of information could be done before sending it to a cloud.

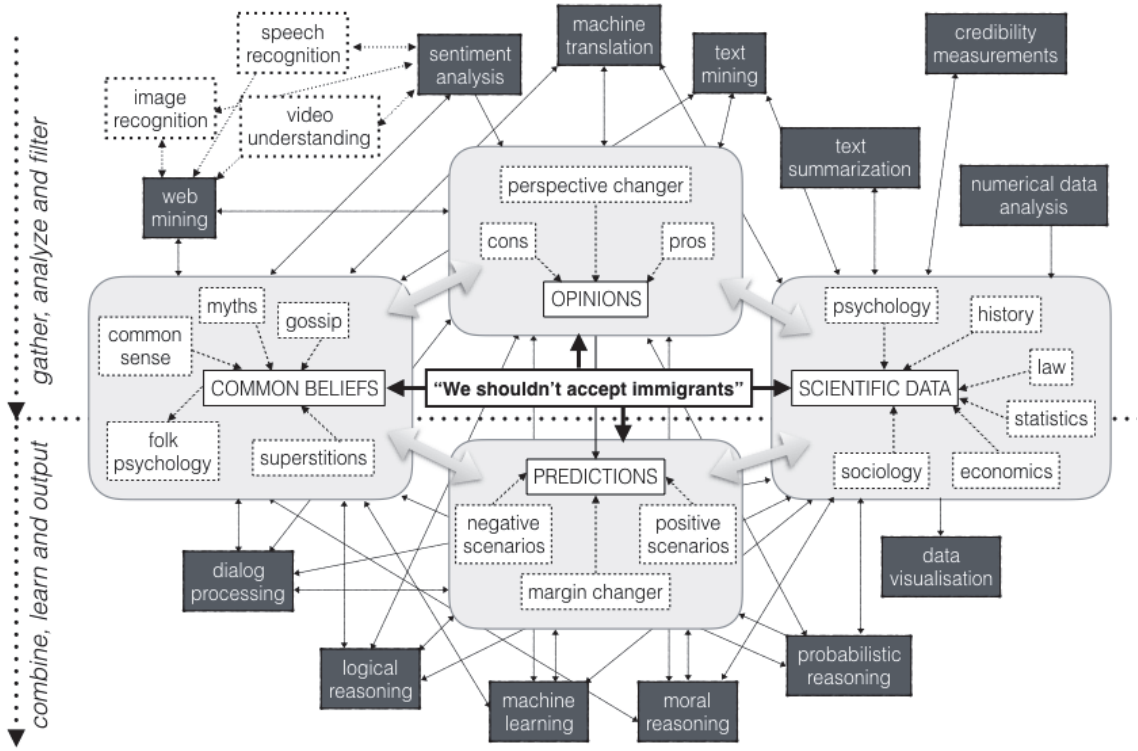

Figure 1: An example of automatic methods integration for providing user with knowledge for broadening his knowledge (in this example triggered by a specific statement). There are many more possible connections from non-linguistic realms represented by three media-understanding related technologies in upper left, which are still in the early stages of research but after addition will contribute to the global wisdom network efficiency.

As the dense net of interdependencies shown in Figure 1 and symbolized by all two headed arrows, we also believe that progressing integration will allow an practical and inspiring interaction between groups of methods and datasets. Scientific findings, at least in the first period of integration, will play a role of a counterpart to common beliefs which are often wrong and cause reasoning errors – both by humans and machines, for which the common sense is usually most difficult to understand and apply. Researchers for decades try collect common sense for machines (Lenat and Guha 1989; Singh et al. 2002; Suchanek, Kasneci, and Weikum 2007; Van Durme and Schubert 2008; Rzepka, Muramoto, and Araki 2012), but what is "common" very often depends on many factors of context and none of the approaches can be recognized as fully succesful. However, if integration achieves higher levels of sophistication and the Big Data grows in the same pace, we believe that an integrating system will be able to perform its own investigations and confirm or disconfirm both commonsensical and specialized knowledge and examine scientific results by finding contradicting data. It could be a better method for automatic assessing text credibility than current ones, used mostly for non-scientific resources (Rubin and Liddy 2006; Castillo, Mendoza, and Poblete 2011). Reexamining and improving quality of research output would clearly contribute to the overall well-being but the automatic process of confirming it would also provide a powerful support for other integrated methods and their applications. In the next section we introduce a few of our projects and their roles in the holistic vision of methods/data integration for utilizing Global Brain.

Our Systems for Well-being

Ethical Support Systems

Until now we concentrated on developing methods for commonsense (*General Beliefs* group in Figure 1) and emotional (*Opinions* group in Figure 1) knowledge acquisition. An example of combining both groups is automatic consequence retrieval for moral assessment of human acts (Rzepka and Araki 2005; 2015c). Currently we are working on adding reasons, not only consequences of analyzed behaviors in order to give the system a wider spectrum of ethical evaluation. We utilize Japanese blogs to gather richer contextual information, because e.g. stealing something or hitting somebody, in spite of having harmful outcomes, should be evaluated differently when there is a reasons like helping someone or self-defence. Another example of applying similar techniques is cyberbullying detection (Ptaszynski et al. 2010), which application allows to display a warning before sending e.g. a damaging comment to a social media. Algorithms discovering unusual patterns in language by combin-

ing natural language processing with clues from psychology and ethics are the first step toward ability to recognize harmful or untrue statements. Currently we work on methods for automatic confirmation of the utterance credibility, as often common sense knowledge is simply wrong. In case of "exotic" countries like Japan we often read or hear "facts" which are pure stereotypes – outdated or lacking any empirical evidence whatsoever. However, automatic analysis of official statistic data is difficult and probably machine reading of scientific publications or automated statistical investigations may bring better results. We also use judicial data to assess potential punishment of acts (Rzepka et al. 2008; Tanaka, Rzepka, and Araki 2015), as we believe that law-related data could also be beneficial in "common sense" confirmation process and evaluating personal judgements. Well-being could also be improved if for example judges were equipped with bias-detectors. Millions of cases are impossible to remember and, as Kahneman showed, judges are prone to human errors and significantly change their verdicts depending on their hunger level (Kahneman 2011).

Dialog Systems as Integrators

Acquired knowledge can be used in various applications, but conversation is one of the most natural ways to persuade someone, to make a suggestion or to make somebody feel better (or worse, which is often needed to make somebody think or react). We believe that combining question answering (Yatsu, Rzepka, and Araki 2012) and dialog processing methods (Rzepka et al. 2010) will become the core of our above mentioned holistic approach for artificial companions, assistants or tutors with the goal of making us think twice. Choosing a proper sub-module for a given utterance depends on context understanding which is one of the most difficult, yet unsolved problems of artificial intelligence. However, as we see in mobile assistants, the more data the agent possesses (calendars, contacts, family info, access to knowledge base, etc.), the conversation, even without remembering and processing previous utterances, becomes more useful and natural. Affective control of a conversation flow allows not only know when a system should or should not praise a user (Matsumoto, Rzepka, and Araki 2015) but also crack a joke to make the user smile in sad moments (Dybala et al. 2012) or soften the criticism.

Toward Automatic Cognitive Therapists

Various methods of cognitive therapy has proved to be a useful tool for tackling a growing problem[4] of depression (Hofmann et al. 2012) and computers can help human therapists (Wright et al. 2014). We also proposed a system (Rzepka and Araki 2015a), which could be used in various scenarios when cognitive restructuring is hidden into daily conversation in order to correct user's distorted cognition and underlying dysfunctional beliefs. Having access to a wider spectrum of user's data, a machine could gain a deeper insight into the patient's life and generate analysis helpful for human therapists who usually don't have enough time to devote oneself to a particular case. When millions of automatic therapists could share their findings (results of long-term efficacy experiments involving users detailed data), human specialist might start learning from their automatic counterparts.

[4]http://www.who.int/mediacentre/factsheets/fs369/en/, retrieved on 20 Jan 2016

Teaching Foreign Languages

Benefits of learning foreign languages influence not only individuals but also societies and economies, in many places of the globe speaking more than one language is a key for better life. However, Japan being a good example, often learning from textbooks is not sufficient to acquire sufficient conversational skills. There are places where dialog partners are not available and video-conferencing is often limited by the time of both sides, and many people are just too shy or are ashamed of their inadequate vocabulary. To support such cases we created a system utilizing phenomenon of code-switching (replacing more difficult words with words native to the learner) which long-term goal is to become artificial language tutor (Mazur, Rzepka, and Araki 2012b). As miscellaneous studies show, emotions influence learning and memorizing processes (Craig et al. 2004; Bower 1992) therefore we added affective analysis and proved that emotions are useful also in second language acquisition systems (Mazur, Rzepka, and Araki 2012a). Another idea is to trigger user's attachment not only by using emotions but also by generating interesting conversational topics with vocabulary automatically match learners skills. Adding challenging subjects to the dialog may improve not only the linguistic skills but also provoke deeper thoughts and promote critical thinking.

Aesthetics from Big Data

As mentioned in *Learning to Avoid Techno-traps* section, the era of Big Data tends to yield profits and make our life easier, there is a natural worry that datification of our lives will not only threaten our privacy but also, by commercialization, will decrease number of exposures to artistic values. Our approach is not to go against inescapable technological progress but to utilize its fruits to keep us sensitive. One of the examples is a haiku poems generator (Rzepka and Araki 2015b) that can be added to a blog and illustrates every new entry with a haiku, an associated sound and an image. The novelty of our approach is the integration of automatic analysis of similar blog entries with preset multimedia and image search results. Using descriptions borrowed from outside the input text and loosely associated images make users think and appreciate poetry more than in case of baseline that only chooses representative words from the input. Similar approach we took in our metaphors generating system (Rzepka et al. 2013), which tries to use simili and by figurative speech expose users to less machine-like utterances. We believe that naturalness of machine-generated language will be crucial for decreasing the level of stress which often accompanies us while using dialog systems in mobile phones or car navigation systems. One example of employing latest technical advancements with a need of natural

language is RadioBots project (Kimura, Rzepka, and Takamaru 2015) in which we are actively involved. Three artificial "radio celebrities" host an automatically generated radio programs choosing interesting topic. The system broadcasts through Japanese video sharing website Niconico which allows listeners to comment programs in realtime. The system observes the trends and comments and can alternate the broadcast to answer or spark a further discussion by techniques described in *Mining Knowledge* section. The software is supposed to choose challenging topics, expose users to art and make them feel and think which integrates our other methods into one system.

Future of Pros and Cons Trade-off

Our proposal is to use the Global Brain to regain what we are slowly being stripped off by becoming addicts to the ease. However, there are several possible problems. As mentioned earlier, anyone who decides to implement our methods might not care about assuring credibility of sources and could add extra features to any system being developed – language tutor may trick us to buy a product, cognitive therapist correct our walking paths to reach a given store and haiku poem can expose us to images of products which we may be interested in. The method showed in the last example is already widely used to show users advertisements in which he or she could be interested in. Although giving us an impression of Big Brother watching every our move, we tend to to silently agree to the lesser evil. But how far we are willing to go, when it comes to the trade-off between having a free solution and the need of giving private information in return? We like free services but only 33% of US survey respondents identify the social media trade-off scenario as acceptable and 51% saying it is not [5]. But from the same survey we can see a considerable difference in responses between younger (<50 years old) and older users (>50 years old). Forty per cent of former replied that the compromise is acceptable, while only 24 per cent of the latter agree to the deal. Notable change may happen when Big Data is able to discover diseases or predict epidemics. When higher stakes of well-being like "longer life" will be on the table, probably many of us will play their own genetic code card without hesitation. Another problem of the Global Brain could be erroneous conclusions if we allow systems to draw causations from correlations too freely. Automatic findings can also be altered by malicious hackers, radicals, or the software providers as mentioned earlier. If someone induces a delicate, hidden influence on users, mischievous manipulations can be difficult to spot. We believe that the shared data / methods integrators themselves should prevent users from potential risk of being subconsciously maneuvered into unwanted behaviors. Integration of data sets and methods should help to develop mechanisms automatically discovering anomalies in other methods and data sets. As we need exposure to different people to find errors in others and ourselves, our automatic helpers might need to watch each other taking different security measures. Similar safety valve exists also in social networks. By using our real names on Facebook, we are forced to behave because such system defends us from suspicious individuals without "friends", we pay for peacefulness with our privacy. On the other hand, our social media usage can become artificial as insurance companies or even countries[6] closely watch our activities and employers browse our online life to see if someone is a "good person". Time will show how much we are going to give away and if gained profits will benefit both personal and overall well-being.

[5] http://www.pewinternet.org/2016/01/14/privacy-and-information-sharing/

Conclusions

In this paper we introduced our thoughts on integrating various methods and data into systems which are not only consumption-centered and by making us think, learn or feel – improve our rationality and welfare. We presented a variety of existing methods which could be used to achieve this goal, as well as systems we currently develop. We underlined a need of integration not only for expanding the global wisdom but also for defending itself by its diversity. Socrates advised his fellow Greeks that false beliefs ruin their lives (Vlastos 1994) and most of us know that, but our busy lives keep us away from arduous investigations. Everyone likes to be right and righteous but cognitive biases often misguide us. Humanity, from the time it started to create groups and hunt together, grew against our basic emotions and needs and technological inventions and artistic creations always have helped us to become more moral and thoughtful. Current era of connectivity and Big Data gives us a chance to do in on a unprecedented scale. Our idea is to integrate existing technologies ans growing resources to confront our evolutionary shortcomings by utilizing aspects of both our crowd reflexes and the latest globalization trends for supporting our progress toward more peaceful and understanding civilisation. Obviously the more we know, the more we have to adjust our thinking but combining methods and resources now becomes easier than ever. With Big Data we are being forced to change many of our often sentiment-based methods – from how we choose baseball players to how we discover new fields of research and areas of business. We help building the Global Brain and protect ourselves from malicious machines at he same time, for instance every time we input words to Re-Captcha[7]. The message of this paper is that we could extend such ideas to grow our common knowledge and simultaneously protect ourselves from our biases. We already use hardware and software to fight our physical laziness and gluttonous habits, why wouldn't we develop ones for our intelectual weaknesses? Like companies smuggle their algorithms into useful applications for commercial goals, maybe the academic researchers should do the same for achieving higher goals.

[6] China plans to made obedience to the state a game where a citizen collect points in order to have better loan conditions, http://www.bbc.com/news/world-asia-china-34592186 retrieved on 23 Jan 2016.

[7] https://www.google.com/recaptcha/

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