What Web Collaboration Research Can Learn from Social Sciences Regarding Impairments of Collective Intelligence and Influence of Social Platforms

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ABSTRACT

This paper gives a short overview about issues relevant for online collaboration platforms that could be better understood by applying social science research formerly conducted mostly in offline settings. Additionally, we are pointing out which theories, mostly from media sociology, could merit to be tested in settings supposed to exhibit collective intelligence traits. The content we present is not intended to be a complete literature review but rather tries to provide ideas and approaches to make use of existing knowledge in the social sciences for the research of online group collaboration.

THE TWO SIDES OF ONLINE COLLABORATION COLLECTIVES

The ability of social collectives to produce meaningful content through the online software systems they populate is one of the biggest promises of the human-machine apparatus we call the World Wide Web. They gather and structure knowledge (Wikipedia), propel trends and discuss current topics (Twitter, reddit[1], discussion boards), and add meaningful meta-data to content (Tagging-Systems), sometimes by incorporating a variety of opinions and viewpoints (comment sections on media sites, Facebook).

In the remainder, we refer to such online platforms on which (i) users collectively produce vast amounts of meaningful content that can be in some way aggregated and used and (ii) content that is made available to and consumed by a large number of users on the open Web.[2] Thus, this phenomenon has two aspects of significance that will be discussed in the following with regard to the lessons that can be learned from traditional social sciences and the "scientific toolbox" they provide in terms of methodologies, theories and empirical evidence.

The first facet alludes to the collective production of content and the trust that is placed in it. Because of the vast numbers of contributing users, the content generated by collaborative platforms is plenty; while additionally, due to the "wisdom of the crowd" that is assumed to guide and control meaningful output of these systems, it is also trusted to be of high quality and importance, as can be well seen by the high consumption and usage of knowledge extracted from Wikipedia, the importance assigned to current trends on Twitter and the use of systems like reddit or Facebook as the main gatekeepers for the daily consumption of news by many users.

The collective intelligence that is the basis for the trust placed in the output of these systems is, however, a fragile thing that hinges greatly on the social dynamics the userbase exhibits, shaped not only by the composition of the userbase itself, but also by the environment the software system provides. Certain behavior patterns can lead to unwelcome results of the collective process, just like it is the case for offline scenarios, covered by decades of research on the emergence of harmful social interaction patterns in certain populations, leading to a vast body of scientific work aiming to understand, predict, and prevent the occurrence of such phenomena. These include mass hysteria and panics, stock market bubbles and disease spread; the mechanisms at work have been tried to explain with the help of organizational theory, social imitation theories and psychological approaches, to name only a few. In the remainder of this paper we will discuss a selected sample of these theories and research approaches that we see fit to aide in studying current online phenomena related to collective intelligence.

Secondly, one should, apart from perceiving these extremely popular platforms as digital agoras and online production places, see them in the role of the mass media they have become, similar to TV, radio and traditional press. This perspective merits being taken into account on the sole fact that generally, around 50% - 90% of users of these platforms are mere

[1] `http://www.reddit.com` might not be known to every reader. It is a social news website where users submit content in the form of text, links or images (ranked 124th most visited website by alexa.com). Other users vote the submission "up" or "down", which is used to determine its position on the site's ranking.

[2] By this, we mean output that is in some form an aggegregate product of the contributions of single users, such as an Wikipedia arcticle, the ranking of "relevant" or "hot" items on a social news site (*not* the news themselves) or the folksonomy produced by an open tagging platform.

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"lurkers" [27], only consuming and not contributing actively to the content, with platforms like Wikipedia and Reddit receiving millions of unique visitors per day.[3] At the same time, online media consumption gradually replaces offline media consumption. Once this view is taken, very similar questions arise in respect to online media that have formerly been asked towards the traditional mass media. Long standing theoretical frameworks in the field of media sociology and media impact studies, like Agenda Setting Theory, the Cultivation Hypothesis or Selective Reception can help to better understand the effect of these online mass media on their recipients. Although of course, on the Web2.0, the users are not merely passive recipients, but active contributors themselves, making it necessary to modify the overcome theoretical approaches and their segregation into the clearly distinct roles of journalists, media producers and audience. Here, the above discussed aspect of collaborative production plays a crucial role, as the collective mostly takes over the roles of audience, journalist, newsroom editor and gatekeeper at the same time.

Hence, as online collective creation and online mass media aspects are two sides of the same coin for these platforms we will point out certain research areas in this regard in the following that could profit from the application of social science theory that was traditionally applied mostly in the offline realm or at least not extensively used to explain collective collaboration phenomena.

C.I. RESEARCH ISSUES AND APPLICABILITY OF SOCIAL SCIENCE THEORY

In this section we list either issues that have (i) become salient as problematic for the outcome of collective intelligence in the aforementioned platforms and could benefit from the application of traditional social theories to study them or (ii) theories and methods of social sciences (mainly media sociology) that we think would merit a closer look and more extensive application to online scenarios such as the ones described by us.

Representativeness

Whom does the userbase of a particular online collaboration system represent? Who is effectively responsible for the content produced, and which portion of the general population are these users a sample of? This pertains to questions about the experience, knowledge and political and ethical views of the responsible authors, among other aspects. A Wikipedia article about "Terrorism" written by mostly western, male editors may for instance not be an optimal, unbiased document on that topic.[4] In the same vein, predicting a general political vote merely by the utterances of the particular 1-3% of the overall population that actively use Twitter may lead to false results.[5] On top of the fact that the typical users (readers and contributors) of a system might not be representative of the general online (or offline) population, for a range of online collaboration systems the phenomenon of a small minority of contributors providing most of the edits and content [26, 16] has been observed. For Wikipedia, for instance, Priedhorsky et al. [20] show that a vast majority of the content is actually provided by a minuscule fraction of all editors.

The specific reasons for the low representativeness that might occur in some systems are, however, not exactly clear. Gender Studies can help to explain why still, a relatively small amount of women [10] is contributing to collaborative platforms, but have not yet delivered sufficient clarification on the issue regarding crowd collaboration. The theory of the Digital Divide and associated works [2, 8] try to explain the differences in media and online usage between different demographics and social layers and have a long tradition under related terms such as the "Knowledge Gap" and "Knowledge Divide". However, this research often focusses on the economic variables determining the type of internet access and could be employed more thoroughly in order to research and explain why certain populations do not take part in the online discourse and creation (sometimes called "second-level digital divide" [22]) and if this is truly hurting the ability of collaborative online platforms to achieve optimal results. Questions not yet satisfactorily answered in these two field are, e.g.: Do male users habitually dominate the shaping of the collective result in a collaborative, interactive environment? Do more technology-savvy users or users with specific socio-economic premises (e.g., more spare time) have a vantage point in online discourse that leads to their eventual prevalence in discussions and negotiations about content?

Information cascades and conformity

One aspect that has been shown to impair the independent decisions of the members of the crowd (a pillar of collective intelligence [24]) is certainly imitation. By abandoning their individual decision-making capabilities, single members of the swarm don't tap into their cognitive resources which in turn are lost to the collective, possibly resulting in herd-like decisions based on the choices of a few early opinion leaders. Especially the work on the concept of *social proof* [3] and *information cascades* [1] merits a closer look upon from web scientists. An information cascade can occur where all participants place their decisions on the preceding users' decision instead of their own knowledge. If a critical mass of users has (implicitly) assessed a content to be right, wrong, shareworthy or else, it is likely that this assessment will be adopted by more users. All in all, this is a valid social heuristic in many cases but may also hamper the detection of incorrect or harmful content or the revision of biased content towards more balanced opinion expressions. The mechanism of an

[3]Wikipedia: About 15 mio unique visitors/day, reddit: About 1.5 mio/day, see `http://en.wikipedia.org/wiki/Wikipedia:About` and `http://blog.reddit.com/2012/11/now-is-time-to-invest-in-gold.html`

[4]Findings [10] suggest that active editors cover a narrow section of the offline-population's socio-demographic scope, a problem the community has identified as the "systemic bias" of Wikipedia. `http://en.wikipedia.org/w/index.php?title=Wikipedia:Systemic_bias`

[5]Overall, ca. 170 Mio. Twitter users are active (`https://t.co/RAMwR5qD`), while only around 60% of those do actually tweet (`https://t.co/XlREnRj`). This means 2.4% (active) and 1.4% (tweeting) in relation to the world population, with numbers varying considerably in the Top20-Twitter countries (E.g., USA: 13% of total population active, 7.8% tweeting, France: 2.7% active, 1.6% tweeting (`https://t.co/RAMwR5qD`)).

information cascade was first used to explain stock market trends and bubbles and has since been shown to be applicable to many domains. The topic of information cascades is related to studies on information contagion and diffusion, for example regarding the spread of news via Twitter and social bookmarking [17], with the crucial difference that the decision of the crowd can only be "wrong" insofar that information is spread which is not vetted for its factual correctness. Other works have covered information cascades and their potential to actually produce incorrect descriptions in open tagging systems [7]. Still, the research conducted on how a collective online system can fail (or succeed) through imitation is disproportionally covered compared to research on offline imitation behavior.

Apart from getting over-popular through imitation, it is also interesting to ask if topics or viewpoints relevant to a substantial amount of users will not get addressed at all on large social platforms, as these users might feel that their opinion is just a marginal perspective and that, e.g., voicing it might ridicule them, alas there could be a strong support for it by other users that do not speak up either. An example could be the popular self-image of many online communities, like reddit.com, as very liberal and rather atheist, which might deter more conservative users from voicing their views actively.[6] Noelle-Neumann's thesis on the "Spiral of Silence" [19] focusses on exactly this kind of self-censoring effect regarding mass media and might prove applicable to why certain views in the crowd might not be voiced, eventually impairing collective intelligence. Still, there is little research work known to the author that tries to test this theory in an online collaboration setting.

Territoriality and ownership behavior

When collective products are claimed as property by single users or users assert that they posses special rights to alter and maintain content, this might lead to unwelcome consequences for the collaborative work process. In the instance of Wikipedia, certain editors tend to become over-protective about article content against changes from other editors. Although explicitly discouraged by Wikipedia,[7] strong feelings of ownership towards an article and protective behavior are not uncommon and "[...] run the risk of deterring new community member participation." [25]. Some authors infer that "[...] editors appear to inappropriately defend their own contributions." [12]. Articles guarded in such a way naturally run the risk of being biased as new contributions tend to get accepted only if conforming to the "owner's" taste. The same rule holds for all systems where direct collaboration is required and the contributions of the authors compete in some way for space in the end product. This might happen in discussions, were one or a few users want to control the discussion arena and draw the attention to their viewpoints or in open source software development, where code has to be revised or extended. One explanation might be that the more time and resources someone invested in creating an artefact, the more likely she will defend it from being altered. In the online collaborative context, however, this has not been sufficiently proven. More research about collaborative work and perceived possession of information items in the organizational and general online context [21, 5], adapted and tailored to the specific case of open online collaboration platforms could provide a much deeper level of understanding of how this phenomenon comes to be and what damage it can do to the dynamics of collective intelligence. Another area insufficiently explored in this regard is research on how humans in general defend their territories and possessions and what strategies they apply [6], and if this could yield interesting new approaches to explain the behavior of large groups and sub-groups collaborating online.

Maturing, conventions, bureaucracy

Suh et al. [23] suggest that the declining growth of the English Wikipedia indicates a state of matureness where many articles are close to complete on a factual level. Correlating with this development, a consolidated text has emerged for many articles, which now is relatively fixed insofar that it is hard for new and occasional editors to change content. As [23] point out, the ratio of reverted edits to the total number of edits has increased with occasional editors experiencing greater resistance compared to regular ones.

This example shows how collaborative systems grow and mature, in respect to their userbase that stays with them, in respect to the content they produce and maintain and regarding the explicit and implicit rules they institute, be it those regarding "hard" instructions how to use the system features or rather "soft" ones, defining what users might or might not do in interaction with others and with the content. In Wikipedia's case, there is on the one side the high completeness of articles that makes it hard to change or extend them and on the other side a system of written and unwritten rules that is extremely complex to understand for editing newcomers. On reddit, in comparison, the key to success and many "upvotes" for a post is the knowledge of what the userbase likes. There is, so to say, an almost secure recipe for creating trends on this and similar social bookmarking websites, once a users follows its implicit rules and the taste of its old-established users. Any other system where users are dependent on the approval of others is likely to encounter the same dynamics, which can, but don't have to be, harmful for the collective work result as their original purpose of peer-to-peer review and control is vital to these systems.

[23] compare the slowing growth of Wikipedia to a confined biological system where nutrients run out and hence the replication rate of its inhabitants is decreasing (e.g., an island population with a limited food supply). It is further shown that the article growth rate exhibits the same development curve. This is a prime example of learning from research from external research domains, in this case to explain the decrease of easy contribution opportunities to a collaborative system. Similarly, research into organizational structures and emerg-

[6] Conservapedia, the ultra-conservative "sister" of Wikipedia, founded by ex-Wikipedians (`http://www.conservapedia.com`), reveals that some users might leave the platform altogether, possibly leading to a bias of the remaining users and content.

[7] `http://en.wikipedia.org/wiki/Wikipedia:Ownership_of_articles`

ing, self-governing communities, from economics and sociology likewise, should be utilized to a greater extend to assess what effects this "emergence of structure and stability" in an online community has on its ability to be collectively intelligent as it develops into a more organized form.

Agenda Setting and Opinion Leadership

Agenda Setting theory, made popular by the works of McCombs and Shaw [18], postulates that the media controls what topics and issues its audience deems important through frequent coverage of these subject matters. According to the theory, media cannot influence *how* the audience thinks, but *what* topics and issues it thinks about. Hence, the same questions asked regarding traditional mass media can be raised towards online media [15] and, more importantly in our argumentation, towards collective decision-making: Although no central, top-down control is exerted, is there an agenda to the content being produced or posted by the collective, which is it and who is promoting it? While in traditional agenda setting research, this question was aimed mainly at journalists, media makers and the powers that might influence them, on today's Web2.0 the constellation has become more intricate as these roles are united in each content-producing user, each representing their own points of view. An equally important question: Are the prominent topics of an online collective set by unconscious agreement of the crowd or some kind of deliberate control, or a mixture thereof? Is "Agenda" then still a proper term, as it implies some kind of conscious, goal-oriented planning? These issues are strongly related to the aspects of representativeness and imitation, as well as to who might take the role of an opinion leader in these collectively controlled systems. First introduced by Lazarsfeld and Katz [14], the research on typical opinion leaders has advanced steadily over the years [11], but needs to be transferred more accurately to the described context to analyze its impact on online collective intelligence. If strong opinion leaders can be systematically identified in the online crowd, and if they even typically share particular attributes – be it demographically, in terms of their world view or else – this could severely harm the collective intelligence process taking into account, e.g., the harmful effects imitation can have, as discussed above.

Cultivation Theory, Parasocial Interaction

According to the Cultivation Theory, originally developed by Gerbner and Gross [9], mass media, mainly television, coins the perception of social reality by their recipients. This effect is supposed to intensify with growing use of the medium, where as an extreme, a televison viewer only perceives social reality through the medium. It is closely related to the concepts of Agenda Setting and the Spiral of Silence as discussed above, but points out *how* media actually coins the perceptions of reality by the audience. The theory of parasocial interaction [13] goes one step further by assuming that perceiving certain social contexts and persons in the media can give the perception of real social contact and thus supersede it. While this has been mostly researched on the non-interactive space of TV [4], it would merit to be investigated extensively in the context of users of platforms like reddit or Wikipedia, which effectively do not form any social bonds in the traditional sense, but merely let non-contributors watch the social interaction of others.[8] Will this lead to a cultivation of these users and even to a imaginative social bond with certain crowd members, especially active content providers? And will this in turn affect the way in which content is produced, rated and curated, effectively changing the output of the crowd?

CONCLUSION

In this paper we presented a brief overview of possibly problematic issues of collective intelligence that could profit from the application of social sciences research that has predominantly been conducted offline. On top we proposed to transfer some methods and theories from media sociology to online collaboration collectives to test if their findings hold in these settings. The propositions and literature presented thereby provided a spotlight on possible interesting research foci in the field of collective intelligence.

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[8]This research area is not to be confused with research on environments like multiplayer online games or chat rooms, where interaction with real social partners takes place.

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