On the status of intellectual values in TOC

Oded Goldreich
Department of Computer Science and Applied Mathematics
Weizmann Institute of Science, Rehovot, Israel.

November 17, 2011

Abstract

Using the sociological methodology of interpretative text analysis, I study the status of intellectual values in the TOC community during the last three decades. Specifically, analyzing the motivational parts of papers that appeared in several *STOC* proceedings, I found evidence to my feeling that the importance attributed to intellectual values has declined in the last decade (or so). I consider three reasons that might have caused this change, and speculate that the change is due to the combined effect of two of them, which correspond to well-known sociological theories.

Clarification: The term *values* is adopted from Sociology, where it is defined as the set of beliefs of a society (regarding what is correct, good, and/or desirable). By *intellectual values* I mean a specific type of values; that is, those that advocate curiosity, study, and understanding. In particular, I believe that the TOC community holds (and should hold) both intellectual values and non-intellectual values. The issue at hand is the balance among them.

The mind-set. I am talking about intellectual values, not about intellectual activities; that is, I'm talking about what exists in the background. I am talking about the TOC community as a social group, not about individuals who are members in that group; that is, I'm talking about the sociology of TOC. I intention is to call for corrective actions, not to complain on the current state of affairs.

Contents

1 Introduction

Each science has two "faces": An *intellectual* face, which represents a desire to understand a specific type of phenomena (and is captured by a specific type of questions), and an *instrumental* face, which represents the hope to use the understanding gained in order to predict and/or effect (or manipulate) the environment.[1] (Note that throughout the essay the term "intellectual" refers to the *motives* (or motivation) for research, not to the actual research *activity*, which is highly intellectual regardless if its motives are intellectual or instrumental.)

These two "faces of science" are intimately related. It is well know that a test of good understanding is its predictive power (which refers to predicting the normal course of the evolution of the environment or its evolution under planned intervention). The other direction is even more obvious: Non-trivial prediction depends on some understanding of the situation.

One may wonder whether or not the desire to understand the world is independent from the desire to predict and/or effect it. But even if the quest for understanding is merely an artifact of the wish for power (of prediction and/or manipulation), the quest for understanding acquires an autonomous status; in fact, no scientific discipline can exist without it. In particular, as hinted at the very beginning, each scientific field is defined by the questions that it seeks to address (i.e., study and understand).

The two faces of science are reflected in two corresponding value-clusters; the intellectual cluster, pivoted at values such as curiosity, study, and understanding, and the instrumental cluster, pivoted at values such as applicability, technical progress, and measurable achievements. Indeed, the intellectual and instrumental value-clusters are closely related, and both clusters are pivotal to Science. Still, the corresponding values are not identical, and an overemphasis on one cluster at the expense of the other cluster is bound to harm the development of a discipline. In particular, the decline of the intellectual cluster endangers the driving force of Science; its very soul.

1.1 What is happening in TOC?

For a few years, it has been my feeling that the value system of the Theory of Computation (TOC) community is changing. Specifically, my feeling is that intellectual values (such as understanding and curiosity) are in decline, whereas the instrumental values (such as operational progress, practical applicability, and coping with technical difficulty[2]) are dominating the scene (i.e., the communal atmosphere in TOC). Before proceeding any further, let me stress that I see no fault with the instrumental values per se; my concern is that the non-instrumental (i.e., intellectual) values are in decline.

---

[1] The same hold with respect to mythological thinking, which is actually more intellectual since it insists on "final" (or absolute) answers and views all phenomena as being of one type (to be explained uniformly by a single theory). Indeed, Science gives up on achieving final answers, and is content with partial answers that "work" (i.e., produce the desired effects and/or predictions). This comment is influenced by the works of Levi-Strauss. I wish to stress that this comment, as well as the entire text, is not concerned with the consequences of the (intellectually driven) inquiry, which may be instrumental; I am rather concerned with the importance attached to *the inquiry as a goal by itself*. In other words, I am concerned with the (social) status of the quest for understanding, unconditioned on the instrumental benefits of this quest; that is, I am concerned with the status of the intellectual values.

[2] Since I was misunderstood regarding this issue in the past, let me stress that here I refer to *coping with technical difficulty* as a value (by itself) rather than as means to achieving some goal. The distinguishing question is whether overcoming technical difficulties is appreciated because of what it has achieved (i.e., some other goal) or as an instrumental value by itself (i.e., possessing technical skills). A related misunderstanding refers to a narrow interpretation of intellectual values; let me thus stress that, in my opinion, developing new techniques (or extending existing ones) fulfills an intellectual value whenever these techniques are candidly aimed at coping with interesting problems of the field.

To test my feelings, I decided to go over a few STOC proceedings and to assess the values that underly the motivations that various papers offer to the study that they undertake. A rather detailed discussion of this methodology – why it was chosen, how exactly it was executed, and what are its underlying assumptions – is provided in Section 2. (Indeed, a violation of any of these assumptions may deems my empirical conclusions incorrect.)

My main finding is that there is evidence supporting my hypothesis regarding the decline of intellectual values in TOC. Specifically, the motivational text in papers that appeared in the *STOC'83* proceedings made significant more reference to intellectual values than the corresponding papers in the *STOC'07* proceedings. Checking also the proceedings of *STOC'91* and *STOC'98*, it seems that the change occurred after *STOC'98*. For details, see Section 3.1. (In the rest of the introduction, I will assume the validity of my findings, and thus talk of the decline of intellectual values in TOC as a fact.)

Needless to say, I think that it important to reverse the process of decline of intellectual values in TOC, and that this goal is achievable. For further discussion of this agenda see Section 5. However, an attempt for change must be based on an understanding of the causes for the current state of affairs, which is attempted next.

1.2 Three theories

Let me briefly discuss three theories that may be used to explain the decline of intellectual values in TOC (or rather three phenomena that may cause this decline). Further discussion of these theories can be found in Section 4. (This discussion may be of interest also to readers that are unconvinced by my thesis and/or my empirical study, because it indicate potential dangers that loom over TOC.)

The most intrinsically oriented theory asserts that intellectual values play a bigger role in the early stages of the development of a field, a stage which is marked by many works of explorative nature. Putting aside the question of whether this theory is valid at all, I checked the motivational profile of explorative works (which were indeed more common in *STOC'83*) and found that the evidence for the decline of intellectual values in *STOC'07* is even more striking in explorative works (see Section 3.2). Furthermore, although the percentage of explorative works in *STOC'91* and *STOC'98* seem to be at the same level as in *STOC'07*, the motivational profile of works in *STOC'91* and *STOC'98* is more intellectual than in *STOC'83*.

In view of the above, I suggest to reject the theory that attributes the decline of intellectual values (within TOC) to the characteristics of the research at varying times.[3] Instead, I suggest to seek the causes elsewhere, specifically, in sociology. Two sociological theories seem most applicable here: The first refers to the dynamics of the field (i.e., TOC) itself, while the second refers to the effect of society at large.

The dynamic of the evolution of (academic) fields. This theory asserts that as a field become more successful (or, actually, is considered so from the outside), the competition within the field intensifies, and this creates pressures towards "objective" measures of accomplishment that can be reviewed from the outside. Such measures are typically oblivious of intellectual contents, whereas they are easier to implement with respect to instrumental contributions. Thus, under the reign of (externally monitored) competition, intellectual values decline.[4]

---

[3]Needless to say, this change of values is likely to affect the character of the research conducted, but the issue here is of identifying the causes for this change of values, not its possible consequences.

[4]Indeed, here I merely apply a general theory of Bourdieu regarding the evolution of fields. This theory talks explicitly both of the rise of competition and of its connection to the neglect of intellectual values and the pressures

The effect of society at large.   The second theory refers to the effect of the Zeitgeist on any activity that takes place in society (including scientific research). Specifically, the claim here is that intellectual values are in decline in the Western society for more than one hundred years, and that the decline has become more and more drastic with time.[5]

For further discussion of both theories, see Section 4. Let me finish the introduction by mentioning one natural question, which is not discussed in Section 4: *Why did the processes analyzed in these two sociological theories affect TOC in the 2000's rather than, say, a decade before?* I do not have a theory so refined as to be able to address such a question, but I do note that (1) these processes are greatly intensifying in the last couple of decades, and (2) in general, a "cultural lag" is a well known social phenomenon.

2   Methodology

As stated in the introduction, I decided to study the evolution of values in TOC within the last three decades by analyzing papers that appeared in several STOC proceedings. In this section, I will explain why this method was chosen, how exactly it was executed, and what assumptions underly the validity of my empirical findings and conclusions. It is crucial to read this section in order to decide how much weight to assign my findings (presented in Section 3).

I think it is evident that the question of change in values in TOC is sociological in nature. It refers to the culture (i.e., values) of a specific social group (i.e., the TOC community). Thus, the relevant research methodology is that of sociology.

The method that I chose is known in sociology as text analysis (or "secondary document analysis"), and I think that I had no alternative choice towards studying the question posed in the introduction (i.e., the change in values in the TOC community in the course of time). Other sociological methods such as experiments, surveys, case studies, participant observation, and unobtrusive measures are all infeasible (especially, when referring to the past). Thus, I chose text analysis.

2.1   Interpretative text analysis

Within the method of text analysis, there are two classical approaches. The more "objective" approach[6] calls for mechanical procedures that refer to the text on the verbal level. While mechanical verbal analysis may be useful in many cases, it cannot possibly address the question I was interested in. Specifically, putting aside the question of implementation, I think one cannot assess the values underlying the text by simply counting words such as "understanding" or "practice" (since the meaning of each occurrence depends on its context).

Thus, in my opinion, I had no choice but to take the more controversial approach of interpreting the texts that I read. This *interpretative approach*, which is well rooted in the Sociological tradition (starting with Weber), emphasizes the importance of *understanding the social context of the text and the meaning that it carries.* Needless to say, I believe that I am well qualified to offer such an understanding; I have been a member of the social group that I am analyzing throughout the

---

on "objective" measures.

[5]This decline was observed already by Weber (in the beginning of the 20th century), who predicted its intensification, and was of major concern to thinkers such as Habermas (in the second part of the 20th century).

[6]The objectivity of this approach is also controversial, since at the end of the day one should give a meaning to the numerical data ("Mere statistics is not Sociology" [Berger]). So one cannot avoid the subjective action of interpretation; one can only decouple it from the data gathering process.

entire period being analyzed, and I know its sub-culture quite well.[7]

Of course, the danger in applying this method is that its reliability depends in a crucial manner on the personality of the researchers; specifically, on their ability to try to be unbiased (as much as possible) in their interpretations. All I can say here is that I tried my best, and that in case of doubt I went against the thesis that I was trying to confirm.

2.2   How exactly was this method implemented

Given the choice of the method of interpretative text analysis, there is still room for many additional choices. One major choice is where and how to look for the values that underly the texts (and, in particular, in which texts)? Here I made the following choices:

The texts.   I decided to look at papers that appeared in a few *STOC* proceedings. This choice is informed by the fact that STOC and FOCS are, by far, the most influential publication venues in TOC. This is true nowadays, and was also true three decades ago. Thus, I believe that a proceedings of a certain year gives a very good picture of the culture of TOC at that year. Indeed, I also assume that culture changes slowly, and that the rate of change (i.e., second derivative) is even milder.

Given my limited resources and since I was most interested in the difference between the early 1980's and the late 2000's, I initially thought of only using one proceedings from each of these periods. Due to some circumstances (out of my control) I got hold of the proceedings of *STOC'83*, *STOC'91*, *STOC'98*, and *STOC'07*. After observing a significant difference between the profiles of the proceedings of *STOC'83* and *STOC'07*, I decided to also study the other two proceedings in order to see how this difference evolved. I believe that these four proceedings can be treated as representative samples of STOC and FOCS papers of the corresponding periods.

The values reflected in motivational parts of the text.   I decided to infer values from the part of the paper in which the studied problem is introduced and motivated (i.e., usually in the paper's introduction). I asked myself *what values underly the assertions and/or opinions expressed* (regardless of whether or not I agree with these assertions and/or opinions).[8]

Typically, this amounted to asking whether the motivation presented to the reader is *dominantly intellectual* (i.e., seeking understanding or being curious) or *dominantly instrumental* (e.g., seeking to improve performance and/or address practical concerns). In case of a dominant motivation, I also asked whether this motivation is expressed (almost) *explicitly* or is just *implicit* in the text. See further discussion of these (italicized) terms below.

As is argued next, in my opinion, the question of whether the valued-motivation is expressed explicitly or just implicitly is at least as important as the question of what motivation is deduced by reading the text.

The values understood rather than those meant.   I decided not to try to speculate on the real motivations of the authors, but rather to evaluate what a typical (contemporary) TOC reader would have understood the motivation to be. In addition to my belief that the former speculations

---

[7]Indeed, such a level of familiarity with the sub-culture being studied is quite rare (but not unknown) in sociological studies.

[8]In particular, if the text explicitly states a motivation of a specific type (i.e., intellectual or instrumental), then I took it as expressing such values regardless of whether I would have motivated this specific paper using this type of motivation or a different one. Indeed, in some cases, I disagree with the text's choice of the motivational type. (In all these cases an instrumental motivation was dominant, whereas I would have highlighted an intellectual motivation.)

are less reliable than the latter evaluations, I think that the latter evaluations are more relevant to the question of what values were held by the community at that time. This is because of two reasons: (1) papers published in this influential venue reinforce the values that are promoted (implicitly or explicitly) in them, and (2) the publication of a work in this venue is positively correlated with the popularity (i.e., social acceptability) of the values promoted in it.[9]

Note that the two aforementioned effects are much stronger when the motivation is expressed explicitly; that is, (1) the values are reinforced more when expressed more explicitly, and (2) the acceptability of a work for publication is more correlated with the popularity of the values that are expressed more explicitly in it.

In light of the above, my study boiled down to reading the introductory parts of the papers in the said proceedings (typically this meant reading the abstract and introduction), evaluating what a typical (contemporary) TOC reader would have understood the motivation to be, and determining whether or not this motivation is stated (almost) explicitly in the text.

The terms: explicit or implicit intellectual motivation. As stated above, for each paper that I read, I asked myself whether the motivation presented to the reader is dominantly *intellectual* (i.e., seeking understanding or being curious) or dominantly *instrumental* (e.g., seeking to improve performance and/or address practical concerns). Indeed, in some cases, I viewed the motivation as both intellectual and instrumental (i.e., no type dominated the other), and I marked these cases as *mixed*. In case of a dominant motivation, I also asked myself whether this motivation is expressed (almost) *explicitly* or is just *implicit* in the text.

Needless to say, the aforementioned terms are not well-defined, nor do I think that I can provide such a definition.[10] Thus, I suggest to view me as a classifier that is unable to formulate the classification rule that it is using. Furthermore, the classification rule (whether explicit or implicit) is quite subjective (although far, I believe, from being arbitrary). A good defense to raise here is

---

[9]I expect that my last two assertions may face some opposition within the TOC community, which is not used to pay attention to the social aspects of its activity. The underlying claim here is that the TOC community should not be viewed as a collection of individuals and/or of abstract ideas, but rather as a social group. As a social group, it is subject to group dynamics, which includes socialization and conformity. In particular, values and norms expressed in a main selective forum of this group are viewed by most of the group's members as correct (i.e., representing the group's values and norms, that is, the group's expectations from its members). This accounts for Effect (1). Regarding Effect (2), I think that the conference's PC and reviewers are to be conceptualized as its selected officials, and as such they are likely to react (typically unconsciously (!)) to conformity or deviation from the group's values and norms (i.e., apply positive sanctions towards conformity and negative sanctions towards deviation). Note that I do not claim that the activity of the PC and the reviewers reduces to such sanctions, but I do claim that social sanctioning (w.r.t the relevant behavior) is a factor in accepting works for publication. (The relevant behavior here is choosing research topics that are widely considered interesting and providing motivational statements that are considered adequate. Also, let me stress that unconscious (rather than conscious) sanctioning is a well-known social phenomenon.)

[10]But, of course, I can provide examples for clear cut cases. For example, if the text says "We study X in order to shed light on Y", where X is a specific problem and Y is a general phenomenon of well-established (theoretical and/or practical) interest, then I took it as providing an *explicit intellectual motivation*. (Indeed, there were a few works that were explicitly motivated by the desire to *understand* a phenomenon that occurs in practice; there were taken as providing an *explicit intellectual motivation*.) On the other hand, if the paper claims that its goal is to devise algorithms that would have *direct* impact on practice (e.g., yield implementations of improved performance in practice), then I took it as providing an *explicit instrumental motivation*. (Such papers were quite rare in all proceedings.) Likewise, if the *main* reason a paper offers for studying a problem is that it is technically difficult, then I took it as providing an *instrumental motivation*. (Such papers were rare too, and did not appear in the papers that I sampled from the 1980's and 1990's.) Lastly, if the text states no motivation, but addresses a problem that has been widely perceived (at the time) as being mainly of theoretical interest, then I took it as providing an *implicit intellectual motivation*.

that the classification of all papers was produced by the same person in about the same time. But the down side is that this person was aware of the source of each paper,[11] and so one may suspect a bias, which may gear all results to the direction of confirming that person's hypothesis. This is a possibility that I was constantly aware of, and tried my best to counter-act.

On the evolution of my study. I estimate that I spent 20–30 minutes on a typical paper. My initial objective was to see if there is a difference between the proceedings of *STOC'83* and *STOC'07*, and so I first read and analyzed these two proceedings. Having detected such a difference, I was curious as to when it occurred, and thus also studied the proceedings of *STOC'91* and *STOC'98*. Since I found that the profile of *STOC'91* was more intellectual than that of *STOC'83*, and since I got tired of this study, I allowed myself to sample twenty papers out of the seventy five papers of *STOC'98*. I believe that my choice to "cut corners" w.r.t *STOC'98* does not affect the reliability of my study, because the results of that sample were very conclusive (see discussion in Section 3.1).

2.3   Listing my assumptions

Let me end the current section by compiling a list of the assumptions that I used for relating my actual study (as discussed in Section 2.2) to the question raised in the introduction (i.e., the change in the status of intellectual values in TOC).

1. The value structure of TOC at a certain time is reflected in the motivation that typical papers in STOC/FOCS proceedings (of that time) offer for the research reported in these papers. That is, while individual authors and/or specific papers may present motivations that may not reflect the value structure of TOC, the aggregated profile of the motivations presented in all papers appearing in central TOC venue in a certain period does reflect the value structure of TOC at this period.

   The value structure of TOC is reflected not only in the type of motivation used (i.e., intellectual, instrumental, or mixed), but also in whether or not an intellectual motivation is explicit. Specifically, the percentage of papers (in STOC/FOCS proceedings) that provide an explicit intellectual motivation reflects the status of intellectual values at the time.

2. Typically, the variability (w.r.t value profile) among STOC proceedings of consecutive years is relatively low. Ditto regarding the variability between STOC and FOCS proceedings of the same year.[12]

3. My classification of motivations into types and sub-types is sound, and in particular was not biased by my knowing the identity of the proceedings in which these motivations appear.

These assumptions will be further discussed in Section 6.

---

[11]This was an artifact of the fact that I read all papers from the corresponding proceedings itself. But, of course, I could have dated almost all of the papers also if they were to be presented to me at random.

[12]The only exception occurs when a PC takes a public initiative that is directed to encourage submissions of a certain type, where this type is related to the values that I studied. This has occurred only once in the period that I studied – in *STOC'08*.

3   Results

The results are presented while referring to the two parameters discussed in Section 2.2 (i.e., intellectual-vs-instrumental and explicit-vs-implicit). These parameters were evaluated using interpretative text analysis as discussed in Section 2.1. Indeed, reading Section 2 is essential for evaluating the following results.

3.1   Main analysis

I considered the reader's impression of the paper's motivation, which may be taken as intellectual, instrumental or mixed. In the former case, I distinguished between a motivation that is (almost) explicitly stated and one that is only implicit.[13] The results of my analysis are tabulated next, where the columns show the number of papers of each type as well as their percentage (in each conference).

	STOC'83	STOC'91	STOC'98	STOC'07
expl. intellectual	23 [42.6%]	22 [37.9%]	[50%]	16 [20.8%]
impl. intellectual	9 [16.7%]	22 [37.9%]	[35%]	29 [37.6%]
total intellectual	32 [59.3%]	44 [75.8%]	[85%]	45 [58.4%]
mixed (int+ins)	17 [31.5%]	10 [17.2%]	[10%]	27 [35%]
instrumental	5 [9.2%]	4 [6.9%]	[5%]	5 [6.5%]
total	54 [100%]	58 [100%]	[100%]	77 [100%]

Table 1: motivations as taken by a reader

Recall that for *STOC'98* I only sampled twenty papers out of the total of seventy five papers, which is the reason that the corresponding column shows only percentages (rather than also actual number of papers).

I was most interested in comparing the motivational profiles of *STOC'83* and *STOC'07*, shown on the most extreme columns of Table 1. My reading of these columns is that, while the fractional figures for the intellectual, mixed, and instrumental motivations are essentially similar in the two proceedings, there is a significant difference is in the percentage of works that provide an (almost) *explicit intellectual motivation*: Specifically, a difference between 42% and 21% is significant.

The other two columns, showing the figures for *STOC'91* and *STOC'98*, indicate that these two proceedings have a motivational profile that is at least as "intellectually oriented" as the one of *STOC'83*. Actually, *STOC'91* shows a noticeable increase in the fraction of papers that have an implicit intellectual motivation (at the expense of those with a mixed motivation). Note that the figures of *STOC'98*, which are based on a random sample, are more "intellectually oriented" than those of *STOC'91*. (Since the margin is large enough to account for a sampling error, I concluded that *STOC'98* was at least as "intellectually oriented" as *STOC'91*.) Indeed, it seems that *STOC'91* and *STOC'98* were more "intellectually oriented" than *STOC'83*, whereas the "decline" came after *STOC'98*.

---

[13]This was not done for the other cases (or classes), since the numbers of papers of the other types seemed too small to serve as basis for statistics. This concern applied also to the "mixed" class, especially since for this class one should ask which of the motivations is explicit. In fact, the "mixed" class is an aggregate of three sub-classes referring to the relative emphasis (placed by the text) on the two different types of motivation (i.e., intellectual versus instrumental).

My conclusion from the above is that between *STOC'98* and *STOC'07* a significant decline occurred in the fraction of papers that state an (almost) explicit intellectual motivation. I view this conclusion as evidence to the thesis that the last few years saw a decline in the importance attributed in TOC to intellectual values.

3.2   Additional analysis

I speculated that the most popular reaction within the TOC community to the results presented in Section 3.1 would be that the decline in intellectual values is due to the dominance of works of explorative nature in the early stages of the development of a field. So the first question that I tried to answer is whether the volume of explorative works has indeed declined.

Towards this end, I partitioned the works in each proceedings into sets that are supposed to reflect the nature of these works. Specifically, I identified works of an explorative, follow-up, and mixed (i.e., between explorative and follow-up) nature. The "mixed" type emerged in attempt to accommodate clear borderline cases (i.e., where using any single term would have been highly inappropriate). Needless to say, these terms are not well-defined, nor do I think that I can provide such a definition. Still I believe that I followed the common interpretation of these terms, but, again, my identification of works as having a specific nature is clearly subjective. Also, within the non-explorative works, I set aside works that address an open problem (but eventually did not use this partition in my analysis).[14] Let me stress that for each work I chose the type that best reflects the *focus* of the work, bearing in mind that many works exhibit a few characteristics. The results of this typing are presented in Table 2.

	STOC'83	STOC'91	STOC'98	STOC'07
explorative	38 [70%]	21 [36.2%]	[30%]	23 [30%]
follow-up	8 [15%]	19 [33.8%]	[20%]	21 [27%]
mixed (exp+follow)	4 [7.4%]	8 [13.8%]	[10%]	8 [10%]
address open	4 [7.4%]	10 [17.2%]	[40%]	25 [32%]
total	54 [100%]	58 [100%]	[100%]	77 [100%]

Table 2: paper type

As can be seen in Table 2, a significant decline in the fraction of paper of an *explorative profile* did occur between *STOC'83* and *STOC'91*, but there was no significant decline afterwards. In particular, the decline in exploration between *STOC'91* and *STOC'07* is far too small to account for change in the motivational profile during that period (as recorded in Table 1). Furthermore, as can be seen in Table 3 (below), also within the set of papers of explorative profile, the "intellectual profile" declined between *STOC'83* and *STOC'07*.

	STOC'83	STOC'07
expl. intellectual	21 [55.2%]	5 [22%]
impl. intellectual	7 [18.4%]	6 [26%]
mixed (int+ins)	9 [23.7%]	10 [43.5%]
instrumental	1	2
total	38 [100%]	23 [100%]

Table 3: motivations in explorative works

---

[14]I maintained the data regarding this partition because I felt that it may be of independent interest.

The results in Table 3 also refute the claim that the decline in explicit intellectual motivations is due solely to the fact that authors of follow-up works (and/or of works that address an open problem) feel that they need not repeat the known motivations (which were presented in the initiating works on this topic).

4   Three Theories (or Possible Causes)

In this section, I wish to further discuss the three theories that were presented in the introduction in attempt to explain the results of Section 3. But before doing so, I wish to address the gap between the results presented in Section 3 and the thesis of decline of intellectual values in TOC.

Indeed, even without disputing the results presented in Section 3, one may comment that they only reflect a decline in the tendency to explicitly state intellectual motivation for the research reported in TOC papers. My view, as expressed already in Section 2.2, is that the question of what motivation is explicitly stated is intimately related to the culture of the community (i.e., to its value structure). Indeed, individuals may follow individual tendencies in deciding whether to take one action or another, but *if there is a significant change in the aggregate actions within a social group* (i.e., the TOC community), *then the cause must be of a social nature.*[15] Specifically, results such as presented in Section 3 require a social explanation that spells out what they mean as well as what are their causes.

Thus, one should ask what can be the (social!) cause of a decline in the explicit reference to some values (in some context). It is almost tautological to say that the (social) cause is that it became less (socially) acceptable and/or expected to make such explicit references. There could be two reasons for such a phenomenon. The first reason is that the said values became less popular (i.e., declined in the relevant culture). The second reason is that it became less acceptable and/or expected to make explicit references to any value (in that context).[16] However, the second reason describes a phenomenon that I also view as indicating a decline in intellectual values. Specifically, in my opinion, the social acceptability of papers that do not really motivate their study (by reference to some values) represent a low level of interest in intellectual values.[17]

In light of the above, I propose that *the fraction of papers that contain explicit statements of intellectual motivation is related to the standing of intellectual values in the TOC community.* Hence, a decline in the said fraction reflects a decline in the said standing.

The rest of this section will deal with three theories that attempt to explain the decline of intellectual values in TOC (or three possible phenomena that may account for the decline). Indeed, these three theories were already briefly discussed in the introduction. (This discussion may be of interest also to readers that are unconvinced by my claim regarding the said decline.)

---

[15]The last assertion is perhaps the most basic thesis of Sociology; it first appeared prominently in Durkheim's pioneering works.

[16]In particular, some readers may wish to explain my results by arguing that authors of follow-up works (and/or of works that address an open problem) feel that they need not repeat the known motivations (which were presented in the initiating works on this topic), and that the fraction of such works increases as the field matures. However, as shown in Table 3, the fraction of papers that contain explicitly statements of intellectual motivation decreased also when restricting attention to papers of explorative nature.

[17]Let me stress that I refer to the research community as a social group, not to its individual members. An individual may avoid providing a real motivation for a variety of reasons, but the issue here is how does such a behavior become socially acceptable. I claim that the social acceptability of such a behavior indicates that the community attaches little important to this behavior's most likely consequences, which include (non-expert) readers lacking an understanding of the rationale underlying specific research, and novices not being socialized into a culture in which the question of motivation (i.e., why is a research done) is important.

4.1 The effect of the decline in exploration

The first theory asserts that the decline of intellectual values is related to the decline in the fraction of works of explorative nature, which play a bigger role in the early stages of the development of a field. Although the results reported in Section 3.2 conflict with this theory (when applied to TOC in the last three decades), I wish to raise a couple of questions regarding this theory.

Why is exploration more dominant at early age? The first question is why is exploration more dominant at the early stages of the development a field. The cynical answer is that exploration offers greater opportunities and less effort (cf., the claim of "picking low hanging fruits"). Not being a cynic, I strongly reject this answer, while also noting that performing a good exploration is not easier than solving problems posed by others. In any case, I believe that exploration is preferred (whenever it is possible), because it *directly* reflects a candid interest in the field and a true curiosity about it. Thus, intellectual values cause exploration, rather than the other way around.

When exploration is no longer possible (or less of a begging option), the intellectual drives must find satisfaction in coping with problems that were uncovered during earlier explorations. Such problems are uncovered in abundance by a good exploration, and it may take generations of researchers to cope with them (and with their derivatives). The question of whether the intellectual drives can find satisfaction in coping with these problems is related to the next question.

Does exploration reflect a deeper intellectual interest? The second question is whether exploration is actually more correlated with intellectual values than solving problems uncovered during earlier exploration (and left open by it). As admitted above, there is something more direct and more charming in exploring new terrains. But does it necessarily reflect a *deeper* interest in the field than coping with the field's problems? I do not think so. I think that searching for ways of coping with fundamental problems (uncovered by good exploration) satisfies the quest for understanding no less than exploring new terrains and discovering new problems.[18]

Thus, if the intellectual drives decline this is not because they can not be satisfied (or that the community perceives this to be the case), but rather because the intellectual values are not being socialized (i.e., they are not being reinforced by the relevant research community).

4.2 The dynamic of the evolution of (academic) fields

According to this theory[19], an academic field emerges when a group of thinkers (typically academics) develop an interest in a new type of questions, which are not addressed by any other (academic) field. The field is relatively autonomous (with respect to the society at large as well as towards other fields). It is defined by its specific activities and/or interests, has its own internal

---

[18]Indeed, a parallel to childhood versus maturity is begging. There is something charming in a child's exploration of the world, but this does not reflect a deeper intellectual interest than the adult's attempt to understand the world. Thus, finding intellectual satisfaction in coping with problems parallels the process of maturing.

[19]As stated in Note 4, the theory of the evolution of fields was developed by Bourdieu (in a sequence of works in the 1970's and 1980's).

structure and its own symbolic capital, which is subject to conflict and struggle.[20] [21] This symbolic capital (typically represented by prestige and hierarchy) is not reducible to economic capital and its translation (or transformation) to economical capital is far from immediate.

When a field manages to attract the attention of many people outside it, it is considered successful and the value of its symbolic capital increases (in the perception of society at large). At such a time, the internal struggle on command of the field's symbolic capital *intensifies*: The initial interests are forgotten (or become less important), and the focus moves to a (vulgar) competition on symbolic capital. Indeed, competition is a vulgar form of culture, which degenerates any field of science (or art) in which it becomes dominant. The essence of competition is shifting the focus from the primary and intrinsic interests of the field (i.e., its questions) to secondary and external artifacts used in the competition. The latter artifacts should be easy to compare, and the focus on this comparison is instrumental by nature.

The competition in a successful field intensifies because of the interest of external people (i.e., outsiders) in its outcome (i.e., the distribution of symbolic capital, which becomes translatable to externally bestowed benefits).[22] The outsiders' interest in the result of the competition causes their interest in administering (or just observing) the competition. In order for the competition to be administered (or just observed) by such outsiders, it must take a form that these outsiders can understand. Thus, the competition must refer to things that outsiders can compare. Various publication statistics are indeed a good example, and no wonder that they appeal to outsiders (e.g., deans) much more than to real experts. In general, outsiders seek "objective-looking" measures, and are not concerned with how these measures are related to real understanding of the field (which they definitely lack). Clearly, in such an atmosphere, intellectual values decline. The health and vitality of the field require opposing these outside pressures, but this is far from being easy.

To summarize, competition develops when a field succeeds in generating enough interest so as to attract much external attention (i.e., attention from outside the field) as well as a large number of new participants. Thus, competition cannot be avoided in a successful field (regardless of whether or not it would have been good to avoid competition). Yet, competition can be tamed and/or moderated by the field's adherence to its intrinsic values and norms. The decline of intellectual values in TOC is thus a consequence of the scientific success of this field and its social failure to oppose the social forces unleashed by this scientific success.

4.3 The effect of society at large

This theory is rooted in the realization that what happens inside scientific disciplines is not independent from what is happening in society at large. Scientists are members of society at large,

---

[20]This struggle reflects the dynamics of the field; that is, the emergence of new ideas and the progress in coping with the field's problems. Thus, this struggle (over symbolic capital) is aligned with the field's intrinsic interests in its own problems. Concretely, the more one contributes to a better understanding of these problems, the more symbolic capital (e.g., prestige) one accumulates. In contrast, in the competition mode (reviewed below), symbolic (and non-symbolic) capital is assigned according to goals that do not necessarily promote the field's intrinsic interest. That is, not all forms of struggle are equivalent.

[21]Indeed, this essay may be conceptualized as part of a struggle over symbolic capital, and it can be said that I try to defend intellectual values because I believe that their decline depreciates my own symbolic capital. However, Bourdieu (unlike other contemporaries) believed in the existence of an ultimate truth, and rejected the view that all positions in the struggle are equivalent. Thus, from his point of view, I may claim for truth while being aware that truth may serve my interests.

[22]The true outsiders are joined by complying insiders, who gradually forsake their intellectual interest in the field, which eventually makes them effective outsiders. Thus, the term "outsiders" may apply to them too; that is, these complying insiders also promote competitions and are subject to their logic (of focus on things that are easy to compare).

and they internalize its culture, which in turn affects their thinking and behavior. This effect is not restricted to their private life, it applies just as well to their research: People's most basic ways of thinking and communicating are a social product (or construct), ditto their behavior. Of course, people develop beyond the basics, and their development may be influenced by individual circumstances and/or traits, but one should never underestimate the fundamental role of the basics.

The fundamental impact of society on the scientists' ways of thinking and behaving means that these may change when society changes (especially, when it changes in a fundamental manner). Thus, if intellectual values decline in society at large, then they are likely to decline also in all scientific disciplines. Hence, the thesis that intellectual values have declined throughout the 20th century (and more so towards its end) is relevant.

The thesis that the Western society is shifting from intellectual values to instrumental ones can be traced to the end of the 19th century (if not much earlier).[23] Furthermore, it is often argued that this shift has intensified in the last couple of decades.[24]

5   Conclusions

> The philosophers have only interpreted the world, in various ways; the point is to change it.
>
> Karl Marx, Theses on Feuerbach

The evidence given for my feeling that intellectual values have declined in TOC is of little relevant to what I really want to do, which is to advocate a restoration of the intellectual values in TOC. Still, I was curious about the validity of my feelings, and was pleased to find some support for them. Furthermore, the claim that things were different in the past provides some evidence that they may be possible in the future. Indeed, one may object to the last proposition saying that the current (or future) circumstances are different than those of the past, but then this would be a circumstantial claim not an absolute one. The above raises two questions: (1) why is it important to increase the impact of intellectual values on TOC, and (2) whether this is possible.

As hinted in previous sections, I believe that intellectual values are the soul and driving force of every scientific discipline. Without them the discipline lacks a commitment to a set of common goals (i.e., its founding questions), and the research community lacks a sense of solidarity. In particular, bare competition can provide neither. Thus, I believe that it is crucial to increase the impact of intellectual values on TOC.

---

[23]It should be stressed that nobody objects instrumental values per se; the concern refers to their dominance (or their monopoly) in current Western society. For example, Weber who viewed instrumental rationality as the core of modern society (and its many benefits), was greatly concerned of the decline of intellectual values. This decline became a key concern of many thinkers in the 20th century; one notable example is Habermas (and, in general, the entire "Frankfurt school"). It should be noted that many social thinkers (but not all!) view Science itself as being totally instrumental, and thus view the rise of Science as a demonstration of the reign of instrumentalism. I think this is due to their looking at Science from outside and not seeing its intellectual face, which indeed is not the face that is typically shown in public.

[24]This can be demonstrated by recalling a famous example from the end of the 19th century. At that time it was noted that, while members of traditional societies have a fairly good understanding of the tools that they use, members of Modern societies use tools (e.g., the tram) without any understanding of their operations. They only have clear expectations as to what will be the result of applying these tools (e.g., they expect the tram to take them to the designated location according to a posted time schedule). In contrast, it seems that at the current age we use tools without even having a sound expectation as to the result of applying them; we rather try them out. E.g., consider the use of search engines. In general, current social trends advocate not trying to understand reality, which is viewed as a game, but rather focusing on playing this game.

Turning to the second question, I admit that opposing the social forces that cause the decline of intellectual values is far from being easy. But I think that such an opposition is possible, especially since the TOC community is relatively small (which facilitates the creation of solidarity and the effecting of change). If the TOC community is determined to change its culture, then no outsider can prevent this. The outsiders will have to adapt to what the TOC community values; they have no choice (i.e., there is no alternative TOC community). It is only up to us!

What is to Be Done? Here are some concrete suggestions for the defense and promotion of intellectual values in TOC. These suggestion refer to actions that individuals can take, but they will be effective only if these individual actions will become sufficiently common.

- Let the intellectual values guide you in your own research and in your interaction with other researchers. That is, ask yourself why are you pursuing a specific study and/or interaction, and how does it relate to the goals of TOC at large.[25]

- When presenting a scientific work (either of your own or of others, either in writing or orally), provide an explicit account of the ideal motivation for this work.[26] That is, tell the readers or listeners why they should be interested in this work.

- When serving on either a PC or a hiring/promotion committee, try to steer the committee towards taking decisions on the basis of a real *understanding* the contents of the work being considered rather than on the basis of some superficial "objective-looking" measures.

- Object to the dominance of vulgar competition wherever it emerges. For example, object to any argument that is based solely on reference to such competitions (i.e., awards, various forms of paper counts, various forms of citation statistics, etc).

Indeed, individual actions may be much more effective if they are socially coordinated. Thus, it may be useful to make these actions a topic of social discussion, to form groups that are committed to promote them, to create forums that promote them, etc.

6 Postscript: Subsequent Discussions

In this section, I briefly discuss a few issues that were raised by some friends who read an earlier version of this essay.

On grouping together technical difficulty and practical applications. Although I view both "coping with technical difficulty" and "being motivated by practical applications" as instrumental values, I am well aware that these values are different (and that researchers who cherish them may object to be put in the same category). One may object to the analysis that views both these values as instrumental values, but still see that these values are not of the intellectual type. Again, this does not contradict the fact that pursuing these values is an intellectual activity,

---

[25]On the other hand, bear in mind that typical research is but a tiny step in an attempt to address problems that arise from the definition of the TOC. That is, one should not confuse the ideal guidance provided by the field's founding questions with unrealistic attempts to instantly resolve these questions. (Such attempts are the core of mythological thinking, not of Science.)

[26]I used the word 'ideal' in order to indicate that I mean the motivation as it should be, which may be different from the actual motivation that drove the research historically. The latter, incidental motivation, may make an entertaining story, but is not valuable as a source of inspiration or as a basis for education.

nor that this activity may lead to better understanding. The question here is what is being advocated as a value: achieving a better understanding or something else (i.e., impact on practice of demonstration of technical skills).

On the core-TOC versus application-oriented dispute of 1996. The *intellectual versus instrumental dichotomy* (which is the focus of this essay) is somewhat related to the *core-TOC versus application-oriented dichotomy* (which was the subject of much debate in TOC in 1996).[27] In my opinion, core-TOC research is a proper superset of research governed by the desire to understand TOC (i.e., intellectual values of TOC). In particular, core-TOC research may be instrumental (e.g., aimed at technical progress and/or at measurable achievements).

The reason I did not think of this relation before being confronted with it (by others) is that what I opposed most in 1996 was the advocacy of *directing research in accordance to perceived external pressures.* That is, application-oriented research was not advocated as a value, but rather suggested as an opportunistic possibility (or even a necessity).[28] What I see as the issue today is a shift in values within the TOC community, which I conjecture to be indirectly caused by outside pressures. This shift seems to be taking place without any discussion and/or advocacy.

Still, it makes sense to ask whether the dispute of 1996 has had an effect on the historical evolution of the value structure of TOC. In particular, did it strengthen or weaken the status of intellectual values in the short term (e.g., in STOC'97 or maybe also in STOC'98) or in the longer term? Needless to say, this is a very interesting question.

The variability of STOC/FOCS conferences. The concern is that STOC conferences of consecutive years do not necessarily maintain the same motivational profile of papers in the program, and that in some cases the change in profile is quite significant. This phenomenon is typically attributed to the variability in the PCs, and it stands in clear contradiction to one of my assumptions (see Section 2.3).

Concretely, the concern is that a specific PC of a specific year could have been non-representative of the community w.r.t the very issues that I studied (i.e., their values). In such a case, the values expressed in the papers in the corresponding proceedings would reflect the values appreciated by the PC and not those appreciated by the community at large.[29]

I speculate that the effect of such a (possible) bias (in selecting a program out of the submitted works) is too small to account for the gap that I observed. Furthermore, unless the PC has explicitly encouraged submissions of a specific type (which happened only once in the relevant period [*STOC'08*]), the motivations provided by the *submissions* are unlikely to be correlated with the specific PC. Thus, the PC must be extremely biased in order to form a highly non-representative (w.r.t values) program out of a rather representative set of submissions, and I do not think that the worst PC we ever had could have reached such levels.[30]

Indeed, I believe that values are reinforced by a feed-back cycle that goes through the character of the submissions, the composition of the PC, and the profile of the final program. Yet I believe that the effect of each specific year is relatively small, whereas a significant difference may appear

---

[27] A position paper by Avi Wigderson and myself regarding this matter (and defending core-TOC research) is available from the web-page http://www.wisdom.weizmann.ac.il/~oded/toc-sp.html

[28] The opportunistic nature of the suggestion to redirect research towards application was not explicitly stated, but it was implicit in the suggestion and evident to all.

[29] Recall that in Note 9 (in Section 2.2) I argued that the publication of a work in a venue is positively correlated with the PC's attitude towards of the values promoted in this work.

[30] I am making the last assertion as a person that was very critical of several past PCs.

only when the same direction is reinforced several years in a row. Needless to say, it is worthwhile to try to verify these beliefs.

Other venues. The question here is whether an analysis of different venues (e.g., different conferences) would have yielded similar results (i.e., a decline in explicit intellectual motivation). My guess is that the answer is positive, provided that the alternative venue also serves the TOC community (or that the sub-community that it serves does not view itself as being in opposition to the TOC community at large). That is, the profiles in such an alternative venue may be different than in STOC/FOCS, but I believe that the same decline (relative to the corresponding profile) would have been observed in it too.

As indicated in in Section 2.2, I believe that the STOC/FOCS conferences provide a more direct picture of what happens in the TOC community, because of their dominant role in the community. This is the reason that I focused on analyzing them, but it is indeed interesting to see what happens in other venues.

Verifiability by independent data and/or research. The fact that I did not provide clear definitions of the parameters that I studied (e.g., what counts as an explicitly stated intellectual motivation) is a fundamental drawback of my study.[31] In particular, it does not allow to verify my own statistics nor to gather analogous information regarding other venues. However, this does not prevent others from studying the questions addressed in this essay, by using their own intuitions regarding these parameters (and collecting data accordingly). I would welcome any candid attempt to do so!

Acknowledgments

---

[31]Let me stress that this is the case because I did not see a way of coming up with a clear definition. This does not mean that I don't have my own intuitions about these notions. These intuitions suffice for classifying various works according to these implicit notions, but I am unable to formulate the classification rule. The TOC reader should be well aware of such situations, which are a central topic of research in COLT/ML.