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The Explanatory Value of Cognitive Asymmetries in Policy Controversies

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ABSTRACT: Citing an epistemic or cognitive asymmetry between experts and the public, it is easy to view the relation between scientists and citizens as primarily based on trust, rather than on the content of expert argumentation. In criticism of this claim, four theses are defended: (1) Empirical studies suggest that content matters, while trust(worthiness) boasts persuasiveness. (2) In social policy controversies, genuine expert-solutions are normally not available; if trust is important here, then a clear role for cognitive asymmetry is wanting. (3) Social policy controversies pivot on values, so that biases and ideologies may explain participant behavior. (4) Few experts communicate perfectly; rather than cognitive ones, one might cite social differences.

Keywords: *ad hominem*, *ad verecundiam*, deficit model, *ethos*, expert, lay audience, *logos*, trust, values

1. INTRODUCTION

It is standard to claim that laypersons, policy makers included, are often deficient in the sense of being unable to fully understand expert argumentation, and must therefore—on the grounds of an epistemic or cognitive asymmetry—base policy decision exclusively or to a large extent on trust. This claim features at least implicitly in explanations why some audiences receive an expert’s reason-claim complex as a mere appeal to authority (catchphrase: only the conclusion travels, but the reasons receive no uptake).

Furthermore, the cognitive asymmetry claim serves to explain the observation that expert argumentation may change upon “traveling” across contexts (Rehg, 2010), for instance “from a technical argument to an appeal to authority” (Goodwin & Honeycutt, 2010, p. 22). The above claim may also feature in explanations why the public context regularly witnesses attempts at lowering the expert’s trustworthiness (*ad hominem* argumentation) rather than counter-argumentation engaging critically with the cognitive content of the expert’s reasons.

As it were, participants to public context discussions are unable to engage at the level required for an expert context. Yet, these participants regularly align their discourse to, and therefore presumably understand, the role of (implicit) trust.¹ As Weingart (1999) contends, when it comes to policy making, some evaluative verdicts are inevitable:

¹ For Hardwig (1991) “[i]f A trusts B implicitly, she will often not have or even feel the need to have good reasons to believe what B says” (p. 699, italics mine). The importance of trust is recognized in science communication and elsewhere. “Key to the relationship between science and the public is trust” (Gregory & Miller, 1998), cited after Borchelt (2008, p. 153) who treats trust as an amalgam comprising competence, integrity, and dependability of scientists.

If scientific knowledge is linked in any way to ‘interests’ (in policy-making), it is evaluated as supportive, contradictory, or even dangerous. Knowledge inevitably comes under these evaluative verdicts once it enters the public arena and is considered politically relevant. This is, again, an aspect of the politicisation of science inseparable from the scientification of politics. (Weingart, 1999, p. 56)

Our purpose is to critically examine the explanatory value of the cognitive asymmetry claim. In particular, we question its usefulness in explaining (what appears to us as) a regular pattern in expert-layperson communication: cognitive message-contents originating with an expert meet with a primarily non-cognitive (or affective) response by non-expert audiences. Our thesis is that an appeal to epistemic or cognitive audience-deficits explains too much, and potentially hides alternative explanations from analysts’ views.

Section 2 provides a sketch of the explanation which grounds the public uptake of expert argumentation as a mere authority argument, such that audiences are more aligned to considerations of ethos rather than logos (see below). To express this in a more precise manner, Bayesian terms prove helpful and—paired with empirical results—lead to a rival explanation that is open to empirical testing (Sect. 3). We then present four challenges with respect to the cognitive asymmetry claim (Sect. 4), and close with a brief summary (Sect. 5).

2. EXPLANATION SKETCH ON A DEFICIT MODEL

The explanation sketch is as follows: Complete understanding of an expert’s reason-claim-complex is not possible, unless message recipients possess domain-specific information and/or skills comparable to that of the expert-sender. Non-experts are assumed to lack as much. In this respect, they may be considered deficient—hence the term *deficit model*.² As it were, lay folk cannot evaluate the expert’s reason-claim-complex *on a cognitive basis*. Here, cognition contrasts and indeed competes with emotions or affects, widely understood, and crucially with (dis)trust.

To illustrate, assume that an expert, EXP, forwards reasons R_1, \dots, R_n to support a policy P, and to undermine a range of alternative policies, P^* (which to support would entail that P is a suboptimal choice vis-à-vis P^*). Assume further that a non-expert hearer, H, understands at least P (and possibly also P^*), while the same does not hold for each R_n presented by EXP, or for the manner in which EXP construes the support between R_1, \dots, R_n and P (and, respectively, construes undermining P^*). Finally, assume that H desires to

² The deficit model has been criticized and is sometimes rejected as inadequate for science communication. Alternatives include the *dialogue* and the *participation* model, both of which recognize citizens’ active role as discourse partners and providers of local knowledge, respectively. See Bucchi (2008) for an overview. As Jones and Salter’s (2003) discourse analytical study demonstrates, the deficit model nevertheless “retains a foothold in the discourse arena” (p. 30). More than that:

It can be argued that the transparency and openness frame [which, for instance, includes scientist-citizen consensus meetings] is in fact a revised version of the deficit model. ... [T]he assumption that a deficit of information suggests a deficit in ability has been discarded, but the assumption that, if the public had the appropriate information, they would support the new technology has been retained. This is where transparency reinvents the deficit model. (Jones & Slater, 2003, p. 34)

personally evaluate P vis-à-vis EXP's reason-claim-complex, rather than withhold judgment (*epoché*).³

On the deficit model, it now sounds natural that H will seek recourse to other cues as the basis for an evaluation of EXP's argument.⁴ Social psychological experiments can demonstrate that, under controlled conditions, evaluations may exclusively build on "atmospheric" factors, i.e., cognition may be replaced by affect (see the empirical study by Witte & Boy, 2007, reported in Zenker, submitted).⁵ To say that, in such cases, a hearer's evaluation is comparatively more attuned to the speaker's *ethos* than *logos* (and using these terms in a wide sense) renders the phenomenon in traditional terms.

By finding it remarkable that evaluations of argumentative messages may be attuned also to a speaker's *ethos*, one implicitly suggests that—as far as the evaluation of expert argumentation is concerned—considerations of *ethos* and *logos* need not always cohere. Particularly, two cases are of interest: *ethos* overrides/replaces *logos*; *ethos* influences *logos*. In both cases, H's evaluation of the expert's argument (or justification) for a policy P may be negatively affected vis-à-vis one not coming about under conditions of a cognitive deficit.

The above sketch can be used to suggest a reason why *ad hominem* argumentation is with some frequency reconstructable in public discussions of social policies: personal characteristics of the message source, i.e., the expert, become more important than the cognitive contents of the message. Irrespective of whether our currently best measures of the public understanding of science in fact support the deficit model (see Sturgis & Allum, 2004 for a criticism), our ability to account for the occurrence of *ad hominem* argumentation lets the deficit model appear attractive. It suggests *why* empirically validated verbal participant behavior comes about.⁶

3. BAYESIAN EXPRESSIONS

To make the above more precise, one may use standard terms from the Bayesian approach to argumentation (Hahn & Oaksford, 2006). One would like expressions for the comparative contributions of cognitive and affective factors to the evaluative result of a reasoning claim complex. Let E (for evidence), particularly E_{logos} and E_{ethos} abbreviate the cognitive and the

³ This last condition may easily go unnoticed. *Pace* those with high hopes for participatory democracy, it is not a given that a lay person desires to form an opinion on a policy option, unless personal reasons motivate. Moreover, the issue would be precluded negatively, unless one assumes audiences to be unbiased in the sense of not already *fully* endorsing a policy *alternative* to that being argued for. I return to this in Sect. 5.

⁴ Goldman (2001) explicitly recognizes the reasonability of evaluating experts *also* on the basis of how they handle dialectical obligations in debate settings:

The idea of indirect argumentative justification arises from the idea that one speaker in a debate may demonstrate dialectical superiority over the other, and this dialectical superiority might be a *plausible indicator* for [the non-expert or novice] N of greater expertise, even if it doesn't render N directly justified in believing the superior speaker's conclusion. (p. 95, italics mine)

⁵ Zenker (submitted) contends that the cognition/affect distinction, although "rough and ready," deserves to be developed (rather than rejected), and should come out as a limiting case of any distinction replacing it.

⁶ Compare how Pragma-dialecticians explain the occurrence of fallacies, namely in a *functional* way as a conflict in balancing a rhetorical and a dialectical goal (van Eemeren, 2010). In contrast, the deficit model suggests what in Durkeim's terms is a *real explanation*, purporting to name the efficient cause of a social phenomenon.

affective components of a message. Further, let H (for hypothesis) abbreviate the policy in question, and $P(H)$ the subjective degree of belief in this hypothesis (P for probability).

Then the ratio $P(H|E_{logos})$ over $P(H|E_{ethos})$ equals 1 *if and only if* (iff) considerations of *ethos* and *logos* contribute equally; it is <1 *iff* *ethos* considerations outweigh *logos* considerations; and it is >1 in the reverse case. Furthermore, it may seem natural to assume that the sum of *logos* and *ethos* considerations yields a measure for the overall evaluation of a policy (or, in our terms, a hypothesis). This would yield (1):

$$(1) \quad P(H|E_{logos}, E_{ethos}) = P(H|E_{logos}) + P(H|E_{ethos})$$

However, the overall evaluation may well be a more complex function (abbreviated f) than mere summation, yielding (2)—to which we return below:

$$(2) \quad P(H|E_{logos}, E_{ethos}) = f [P(H|E_{logos}), P(H|E_{ethos})]$$

Another standard assumption is that messages received from experts are more reliable than messages received from non-experts. This is normally expressed by demanding that, for experts, the probability of (receiving) the evidence(-report) is greater if the hypothesis is true than if it is false, as in (3).

$$(3) \quad P(E|H) > P(E|not H) \quad [\text{likelihoods of receiving evidence from reliable sources}]$$

Adjusting (3) to the distinction between evidence based on the expert's *logos* and evidence based on considerations of the expert's *ethos* yields:

$$(4) \quad P(E_{logos}, E_{ethos}|H) > P(E_{logos}, E_{ethos}|not H)$$

4. SOME EMPIRICAL RESULTS

Empirical studies suggest that, when asked to compare messages, participants tend to rate the following, in this order, as increasingly *less persuasive* evidence types: statistical evidence, expert report, causal evidence, anecdotal evidence (aka non-expert report) (Hornikx, 2008). Pornpitakpan (2004, p. 243) finds “[t]he main effect studies of source credibility on persuasion seem to indicate the superiority of a high-credibility source over a low-credibility one.”

Moreover, when comparing participants' degree of belief in a conclusion vis-à-vis evidence received from a comparatively more reliable source (read: expert) and from a comparatively less reliable source (read: non-expert), Hahn, Harris, & Corner (2009) and Hahn, Oaksford, & Harris (2012) report the earlier to boost the posterior belief. Put more succinctly:

$$(5) \quad P(H|E_{EXP}) > P(H|E_{nonEXP}) \geq P(H) \quad [\text{comparison of prior and posterior belief in a hypothesis, given evidence from an expert or a non-expert source}]$$

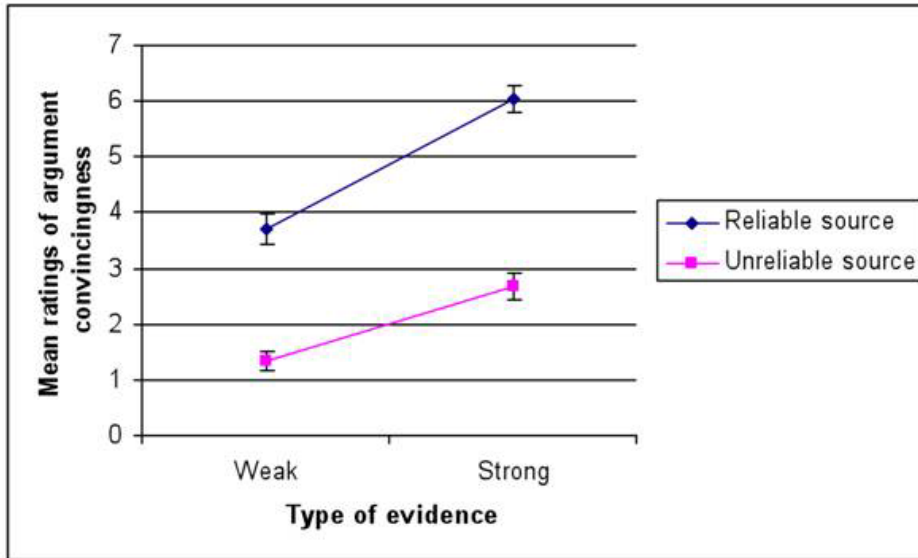


Fig. 1. Crossing weak and strong evidence types with reliable and unreliable sources (Hahn et al., 2012)

Hahn et al. (2012) further report that, when crossing weak and strong evidence types with reliable and unreliable sources, $P(H|E)$ turns out to be sensitive to both the persuasive strength of the evidence and the reliability of the message source (see Fig. 1). A reliable source communicating a strong (or persuasive) type of evidence correlates with a comparatively greater increase in the posterior degree of belief than a reliable source communicating a weak type of evidence.

These and similar studies being externally valid would suggest that some audiences can and do distinguish types of evidential strength. Such results create difficulties for the view that, provided only the conclusion travels across contexts, *then for cognitive reasons* (see below). Moreover, for the overall evaluation of the message, audiences seem to treat the *reliability* of a message source literally as a contributing *factor*, and not as a summand.

Provided one identifies the intended effect of an *ad hominem* (which aims at discrediting the expert's ethos) as the lowering of the perceived reliability of the message source, it is natural to ask: as low as what? Obviously, it is not clear to what degree of belief audiences change if a presumably reliable source is attacked on the basis of *ethos* considerations. One might think that attacking the expert's *ethos* lowers an audience's degree of belief *at most* to that applicable if a non-expert (i.e., a comparatively less reliable source) presents an identical argument (or: the same evidence). In this case, the degree of belief would be that which is effected when only content merits are tracked, i.e., $P(H|E_{logos})$.

However, it is at least possible that an *ad hominem* affects a degree of belief at values below that assigned to a comparatively less reliable source communicating the same evidence. Thus, just as source reliability *boosts* the posterior degree of belief (in ways modeled by a factor rather than a summand; see Fig. 1), an *ad hominem* could influence audiences' degrees of belief in a similar factorial way—but in the negative direction.

If so, then *ad hominem* argumentation may be frequently reconstructable not (so much) because audiences are unable to engage with the argument content (in a cognitive

manner), but because the attack on the source's ethos may be the more powerful suatory strategy⁷—more powerful, because it leads to a comparatively greater reduction in the audience's degree of belief than engaging cognitively *as a non-expert* with an expert-claim might. It is another matter altogether whether this is how things *should* be.

Vis-à-vis this hypothesis, consider the (ethno-methodologically valid) observation that a necessary condition for identifying an expert-context is—not the absence, but—the presumed irrelevance of objections geared solely towards the *ethos* of the arguer (or expert). This stance is defended in Zenker (2011). If implicit trust is enjoyed, an *ad hominem* move would hardly arise. Else, expert contexts assume that evaluations are (largely) brought about and (largely) remain independent of evaluations of the expert's *ethos*. Thus, depending on the context in which the argument arises or to which it may travel (here: an expert vs. a non-expert context), the function f in $P(H|E_{logos}, E_{ethos}) = f [P(H|E_{logos}), P(H|E_{ethos})]$ may differ markedly.

5. FOUR PROBLEMS FOR THE DEFICIT MODEL

The above yields a straightforward empirical question: In a public context, does an *ad hominem* attack lead to comparatively greater reductions of an audience's degree of belief in the expert's claim than engaging with that claim cognitively as a non-expert? The question is presumably not so much in need of discussion, but demands empirical investigation.

What may need discussion is the claim that an empirical investigation is at all worth pursuing. To support this latter claim, we now present four problems for the deficit model. Above, we had taken this model to suggest why the public context is “ripe” with *ad hominem* attacks against expert argumentation, namely: non-expert participants to the public context cannot engage cognitively with the expert's argumentation. We would like to suggest that this may be true (or relevant) in far fewer cases than readily assumed.

Although participants may be able to engage cognitively, they may chose not to do so whenever cognitive reasons do not significantly favor one policy option over others (Sect. 5.1), or for strategic reasons, i.e., when arguing *ad hominem* is the more persuasive strategy (Sect. 5.2), or for moral reasons, i.e., when policy controversies pivot on moral differences (Sect. 5.3). Finally, we suggest that some cases allegedly indicative of cognitive differences between expert and lay audience might be viewed as cases of communicative incompetence (Sect. 5.4).

5.1 When Content Matters but Trust Counts

The literature harbors case studies of so-called controversies, including scientific ones (e.g., on the “nature” of light), and those at the boundary between science and society (e.g., nuclear energy, stem cell research, global warming). Here, it is characteristic that *unique* expert

⁷ Martin (2000, p. 203) observes for the case of *science debating*:

It is extremely difficult, though not impossible, for audience members to seriously challenge or expose a speaker. Experienced speakers have heard nearly every question many times before and rehearsed their responses. Furthermore, they have the authority of being the speaker, with a presumption of more time to speak and having the last word. Occasionally, though, a speaker may lose a joust with an audience member, usually by being caught off guard or ill prepared by someone who is extremely knowledgeable and well prepared.

solutions are not known at the time one may legitimately speak of a controversy.⁸ With the “[q]uasi-experimental implementation of new technologies” (Weingartner, 1999, p. 158) being the current normal case, analysts may therefore expect various mutually exclusive policy options to be available also because the technological alternatives may not yet be worked out such that *exactly one* alternative may be deemed to be objectively best.

[A] multitude of scientific–technical issues has captured public attention: the safety of recombinant DNA, the ethics of reproductive technologies, the application of biotechnology in agriculture, the ethical, political and economic implications of sequencing the human genome, the depletion of the ozone layer, the implications of CO₂ emissions for anthropogenic climate change, the transferability of mad cow disease (BSE) to humans, and other less visible ones. In all these controversies, it has become commonplace that the adversarial parties, be they governmental or non-governmental groups, engage scientific experts to present evidence which supports their respective views. (Weingartner, 1999, p. 156)

Thus, without adopting some material assumptions that expert-discussants disagree over, (discourse-)analysts face difficulties in justifiably claiming that a policy option is *de facto* favorable over another. In such cases, it may *not* be unreasonable for public context audiences to align themselves to the expert’s *ethos* in order to decide for or against one or the other policy, rather than come to no evaluation.

Therefore, in the absence of (what are normally called) *decisive reasons*, it can be legitimate to personally endorse the opinion of experts found to be (more) trustworthy, and attack those not deemed worthy of one’s trust.⁹ Perceptions of trust may thus be legitimate reasons for favoring one policy over another. Hence, provided with a choice among equally (un)supported policy options—in the sense of a tie between the respective argument-contents—otherwise identical verbal behavior becomes explainable independently of cognitive deficits or asymmetries.

Conversely, one way of adjusting the explanation on the deficit model consists in the demand that the policy in question (for or against which an expert has raised an argument claim complex) is not part of a controversy featuring equally unsupported policy options. Other than for cases already “shelved” (according to our best historical accounts), it may prove difficult to ascertain as much.¹⁰

⁸ However, unique solutions may become available later. Presently, for instance, inoculation is widely (though not universally) accepted as the best policy. When introduced in 18th century England to fight smallpox, at first, the procedure proved controversial throughout modern Europe.

⁹ Relatedly, one may also explain *ad hominem* attacks when this condition is flouted. Thus, assume that EXP supports policy P with reasons R₁, . . . , R_n, while citizen C rejects P for reasons unrelated to R₁, . . . , R_n—say, because P will literally change C’s backyard, which C perceives to threaten her entrenched ways of life. Then E will not appear trustworthy, because C is already “sold” on P being a false policy. See the next subsection.

¹⁰ In specific cases (e.g., risk estimates or the distribution of funds to competing projects), analysts may find it reasonable to side with the results of elicitation techniques which make use of performance weighed solutions to aggregating (or “pooling”) expert opinion such as the Cooke Method, which “generally produces uncertainty spreads that are narrower than the ‘democratic’ pooling approaches [e.g., the equal weight view], but wider than those provided by single experts” (Aspinal, 2010, p. 294).

5.2 *Controversies Pivoting on Moral Values*

It is characteristic of some long-standing disagreements that participants diverge over a (set of) moral value(s). Jackson's (2006) study of the "science of race" may be read as a case in point. Values may provide the perhaps most decisive reason for or against some policy. Thus, moral values and the biases (Gigerenzer & Brighton, 2009) or ideologies (see Rehg, 2010, pp. 57–80) sustaining them may explain behavior otherwise accounted for on a deficit model.

Provided that the moral values endorsed differ between expert and audience, audiences may consider some value-differences to support a legitimate personal attack—namely on the grounds of the expert not endorsing a particular value subset. To give extreme examples, think of those who do not endorse the free speech principle in political debates or do endorse an unconditional free-rider strategy in economic games. Perhaps less extreme, think of those who reject human embryonic stem cell research on religious grounds, or not (see Zenker 2010).

Such value divergences between experts and their non-expert audiences leave hardly any explanatory role for cognitive asymmetries, unless some values are considered morally true, yet cognitively comparatively more costly to recognize *as true* than others. In fact, in the case of a controversy at the scientist-citizen interface, such value differences may preclude (some, perhaps all) cognitive grounds from having relevance. As an example, consider that freedom of research constitutes a value that, presumably, is strongly endorsed by many scientists, and is presumably not strongly endorsed by many citizens.

Conversely, one way of adjusting the explanation on the deficit model consists in the additional demand that the policy in question is not part of a controversy pivoting on moral values. It may prove difficult to find too much in the remainder set. Would the discussion on the potential harm of electromagnetic radiation (mobile phones, microwaves, etc.) qualify as a controversy or a scientific debate?

5.3 *Ad hominem as a Strategic Move*

To postulate a cognitive deficit on the part of the non-expert audience is strictly insufficient to yield the desired *explanandum*: the occurrence, at a high frequency, of *ad hominem* attacks. A complete explanation based on this postulate would include at least two additional factors: the desire or preference (ascribable to the non-expert) to somehow evaluate the expert, her argument, or both. Moreover, a complete explanation would also include a desire or preference to engage in argumentative verbal behavior. After all, why not rest silent, content with judgment suspended?

Generally, an *ad hominem* attack implies a cognitive deficit only if participant behavior maps strictly into one side of the presumed cognitive asymmetry, namely into a "lack of understanding." However, strategic attempts at deception ("misleading signals") provide a counterexample. Put differently, when exploiting a cognitive asymmetry to explain public-context data, one supposes that public-context audiences do not play strategies.

It is not clear if this constitutes a sound assumption, especially as the media impress upon the public context various forms of "spin doctoring." As outlined above, a personal attack may be the "better" strategy even if a non-expert fully understands the expert's reasoning-claim complex, and could perhaps also engage with that complex on the basis of its content-

(de)merits. At any rate, participant behavior to-be-explained is not without further assumptions indicative of a cognitive deficit or asymmetry.

Conversely, one way of adjusting the explanation on the deficit model consists in the demand that these conditions are met. Yet, it is not clear when we can safely say they are.

5.4 What Did You Say?

Without special training, few communicate in readily understandable terms, even to experts in other fields.¹¹ At times, the overt message-content may be so rudimentary that a correct uptake requires having understood it previously. Very short talks at very large conferences make for a “good” example. Politeness standards, a long standing tradition of disregarding (“playing over”) communicative infelicities, and—perhaps more widespread among academics than other professions—fear of appearing ignorant by asking for clarification sustain this condition.

Apart from the above, experts regularly draw from a specialized lexicon normally not shared outside of their domain. They also tend to endorse ways of construing support relations between reasons the domain-relative validity of which precludes them from being shared widely. Think of *inference to the best explanation*, or a logical calculus rule such as *negation as failure*. Empirical studies suggest that, without special training, lay arguers may normally not be assumed to correctly understand classical argumentation figures such as *reductio ad absurdum* (van Eemeren, Garssen, & Meuffels, 2009, p. 80) which are frequent in academic settings.

Finally, when speakers intentionally favor “code” (aka esoteric expressions) over more “pedestrian” ways of putting matters, then the relevant asymmetry may not so much implicate a cognitive, but a social level—that at which status is perpetuated.

[C]ognitive boundaries between technical and lay knowledge are, at least to a significant degree, rhetorically constructed, and are crucial to the maintenance of social and political boundaries. Thus, interrogating the cognitive distinction challenges the social distinction, and the power produced by that distinction, as well. (Kinsella, 2002, p. 199)

One need not restrict this view to expert-citizen interaction, but may apply it also to discourse across scientific fields. Even the unavoidable division of labor typical of large scale research projects—which is said to incur a constant reliance on others’ expertise—might be interpreted as evidence in favor of unsuccessful communication between scientists.¹²

¹¹ Hardwig (1991) points out that (implicit) trust rules most ways of coming to know *even between scientists*. After all, experiments are mostly not repeated in identical setup; the review process does normally assume that data are not faked; in large scale research, scientists can at best reliably evaluate the competences of a few of their collaborators.

¹² For the medical domain, Fallowfield and Jenkins (1999) trace such communication deficits to both institutional and educational shortcomings (e.g., too little time; disciplinary training vis-à-vis interdisciplinary work-life), and report these to negatively affect communication between medical researchers, practitioners, and patients, measured, for example, by information recall. Perhaps one reason in support of this general view is the almost complete absence, on most of our campuses, of “old fashioned” ideas such as a *studium generale* which could, in principle, enable scientists—*before* they acquire and further develop specialized knowledge—to learn to communicate “with one voice,” rather than be socialized into the disparate jargons of various fields.

6. SUMMARY

We have tried to undermine the claim that citing cognitive deficits between experts and audiences provides a good explanation for the observation that the public context regularly witnesses attempts at lowering an expert's trustworthiness, rather than engaging with the content of an expert's argument. While such audiences may be able to engage cognitively, we have suggested that they may choose not to do so provided that cognitive reasons do not significantly favor one policy option over others, or when arguing *ad hominem* is the more persuasive strategy, or when policy controversies pivot on differences in moral values. Moreover, we have suggested that cases which allegedly indicate cognitive differences may also be viewed as cases of communicative incompetence on the part of experts or instances of perpetuating social differences. In particular, the claim that arguing *ad hominem* may be the more persuasive strategy compared to engaging cognitively as a non-expert is open to potential falsification.

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