The Jubilatory *YES!* On the Instant Appraisal of an Experimental Finding

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Introduction

"We would not, after all, want to make too much of a tape recording of the word 'Eureka'" (Collins, 1983:110, n. 31).

This paper is based on a video recording of the situated achievement of an unprecedented experiment in current physics, the local spectroscopy of a particularly complex superconductor, and its instant appraisal by the involved experimentalist: his jubilatory *YES!* The paper analyzes that first appraisal, as well as the experimentalist's pursuit of a similarly positive one by me, the attending cameraman and participant observer[1].

The instant appraisal and subsequent promptings of a similar appreciation are described as the local expression of the twofold disciplinary relevance of the experimental finding. On the one hand, the displayed finding is celebrated by Pete, the involved experimentalist, as completing his thesis. On the other, it is manifestly acknowledged by him as the experimental answer to a hitherto open question of physics:

Is lead molybdenum sulfate ($PbMo_6S_8$), the probed compound, a multi-band superconductor, exhibiting its "double gap" spectrum as expected, "yes" or "no"?

In examining how the experimentalist's instant appraisal and its successive elaborations formulate the temporary closure of his disciplinary inquiry, the delivered paper questions speculative skepticism in social studies of science, whilst reminding readers of the embodied and instrumentally equipped, yet disciplinarily directed character of physical inquiry.

The paper, in particular, affords us with a "perspicuous setting" (Garfinkel, 2002:181-182) to reflect upon a central, long-standing assumption in social studies of science: the so-called "underdetermination thesis", holding that theory choice cannot be settled by experimental evidence, and the related skepticism with respect to crucial experiments. A few preliminary remarks introduce that thesis, regarding its prevalent role in and for sociological argumentation. I will take up the reflection hinted at in conclusion, after having outlined the suite of microscopic experiments that the filmed one proved part of and analyzed its instant appraisal as the local expression of its disciplinary relevance[2].

[1]As such, I am indebted to the physicists who, eventually, allowed me to observe their lab work on a day-and-night basis. In particular, I would like to thank Pete, one of my privileged informants (by pseudonym), for allowing me to attend, film and analyze the experimental situation as it unfolded. Acknowledgements are also due to Christian Greiffenhagen and Andrew Carlin for their remarks and observations on a prior draft. Without the criticism by Sara Keel and Martina Merz, and funding by the Swiss National Science Foundation, this paper couldn't have been written up. Any remaining error or incongruity is mine.

[2] The examined case, as we shall see, contrasts starkly with controversial episodes of historical and sociological interest (e.g., Chen, 1994; Collins,

Neither "too much", nor "too little", is thus to be made of the experimentalist's jubilatory *YES!* The outlined paper, in other words, may be read as a late rejoinder to H.M. Collins' ironic suggestion, quoted in the epigraph.

No crucial experiments? Preliminary remarks on a central assumption

In his recent review of the social studies of science, J.R. Zammito (2004) locates a single assumption as their common ground. The assumption is philosophical in character, repeatedly invoked and, in a nutshell, states that theory choice in scientific practice is necessarily *underdetermined* by experimental evidence (ibid., e.g., p. 10). The "crucial experiments" whose empirical results would allow one to opt for one conjecture, theory or model rather than another, upon reflection, lose that decisive quality and determining character, if only for the unwarranted conclusion that the rejection of one model entails the acceptance of a single alternative. More fundamentally, the so-called "theory-ladenness of data" has been taken to render impossible any ultimate refutation (or confirmation) of physical theories (ibid., pp. 18-20).

This "underdetermination of theory by experiment" thesis, in its multiple versions and variations, as well as the associated criticism(s) of the *experimentum crucis* principle, have occupied philosophers, invited debate and filled dictionaries (e.g., Franklin, 2009; Hacking, 1983, chap. 15; Laugier 2006; Zammito, 2004, chap. 2). As M. Friedman (1998) has pointed out, the very possibility of a sociological approach to scientific knowledge has been suggested to hinge upon the acceptance of the involved thesis. Why? The basic line of argument seems to be this: *if* scientific theories were determined by "reality, experience and reason" *per se*, this would leave the sociologist unemployed - s/he would simply have no motive to explain how their determined character had been brought about *ad hoc*, as a practical matter and historical contingency (Friedman, 1998:244-245, quoting Shapin, 1982:159, n. 2).

The underdetermination thesis, in turn, provides a key motive for the project of sociological explanation: since (say) any physical theory cannot but be underdetermined by experimental evidence, theory choice could and should be explained otherwise, by political interests, social causes or credibility assumptions, the list being virtually open-ended (Hacking, 1992; Shapin, 2010:401, n. 20). Historical circumstance or "chance" should thus prove all the more important to explain the particular course of this or that disciplinary development (Bloor, 1991:171-172)[3].

The point of this paper, to be sure, is not to review or rehearse trivia of philosophical and/or social studies of science. Also, if the briefly presented thesis may be considered "trivial", then this seems to express its central and assumed character for most of science studies, indeed – at least if one accepts their critical review by Friedman and Zammito, or grants some plausibility to Hacking's discussion of the "instability myth" (1992:38-41). Be that as it may, the key point of this paper *is* to reflect upon an empirical case that, at first sight, doesn't fit the central assumption of theory underdetermination by experimental evidence. The case was hinted at in introduction: the filmed achievement of a (manifestly) successful experiment – that is, the first local spectroscopy of $PbMo_6S_8$, when discovered to exhibit multi-band

2010; Shapin, Schaffer, 1985). See also Lynch (this issue).

[3] The outlined thesis is basic to the sociology of scientific knowledge (SSK; e.g., Bloor, 2004:927-928; Shapin, 1996:296-297) and it remains central to "post-positivist" studies of science at large – from Quine to Latour, as argued by Zammito (2004).

superconductivity and instantly appraised by a jubilatory *YES!*, prior to being progressively explicated in its disciplinarily relevant specifics[4].

The ensuing video analysis describes the case at hand. To anticipate the final discussion, an ethnographic irony may be pointed out, namely: the sustained pursuit of descriptive inquiry "back stage" (where various kinds of tinkering, politicking and other "scientists' sins", Sacks 1992:394-395, might have been expected) made the experimental situation appear all the more like an innocuous "front stage" presentation (the observed physicist proceeding "hypothetico-deductively", by testing a single hypothesis via a crucial experiment)[5].

Physical inquiry via microscopic experimentation

13	**E**	**YES|.**
14	E	|((claps his hands right before
15		spectrum is completed))
16		***#3***
17	E	((lifts his arms in jubilation))

(Excerpt 1, lines 13-17)

The above excerpt documents the instantly occurring jubilation of our experimentalist (E), as he spots the expected spectrum of the probed $PbMo_6S_8$ sample[6]. His jubilation appears as a particular "action in the course of an action" (Widmer, 2010:64). It may thus be examined in two ways at least. First, we may focus on the latter, the "matrix activity within which language usage takes place" (Levinson, 1992:67) – at present, the experimentalist's analyzable course of physical inquiry. Second, that language usage – his jubilatory "YES" – may be examined on a turn-by-turn basis, in its interactional context, and yet as a constitutive part of its matrix activity. The key question for our video analysis may thus be stated as follows:

Just how can the matrix activity be seen to be achieved in, through and as the interactional context?

This question will be taken up shortly. For the moment, I follow one of H. Garfinkel's later advisories to *use* a "documentary method of interpretation" (DMI, Garfinkel, 1996:16-17) to present the matrix activity: the suite of experiments to which "YES", eventually, would constitute the appropriate answer. The narrative outline expresses an initial "member's understanding" of the analyzable course of physical inquiry via microscopic experimentation[7].

In his initial characterization of the DMI, Garfinkel highlighted the mutual elaboration between "actual appearance" and "underlying pattern" in any interpretive process of sociological reasoning, lay or professional (Garfinkel, 1967:78). This ubiquitous, circular feature may be used to expose, in its experimental progression, the physical inquiry as the

[4] The unprecedented character of the experiment consisted in the successful local *step* spectroscopy. That is, the experimentalist probed the examined $PbMo_6S_8$ sample on one of its "atomic steps", the inclined juncture between two surface areas (comparable to an oblique "fault line"), and that under unprecedentedly stringent conditions (see below).

[5] This "ethnographic irony" was brought to my attention by a recent paper on the practice and presentation of mathematics (Greiffenhagen and Sharrock, 2011).

[6] Transcription conventions are to be found in appendix. For the purposes of this paper, the transcript has been translated to English, except for the experimentalist's jubilatory "YES" (already proffered in English). The Francophone original can be requested from the author.

[7] The "task of the analyst in analyzing naturally occurring scenes", as R. Turner put it and we shall take for granted, "is not to deny his [member's] competence in making sense of activities, but to *explicate* it" (Turner, 1970:187). For related approaches to DMI in practice, see Slack et al. (2007:180-182) and Leudar et al. (2008).

matrix activity of present interest. Consider figure 1 to begin with.

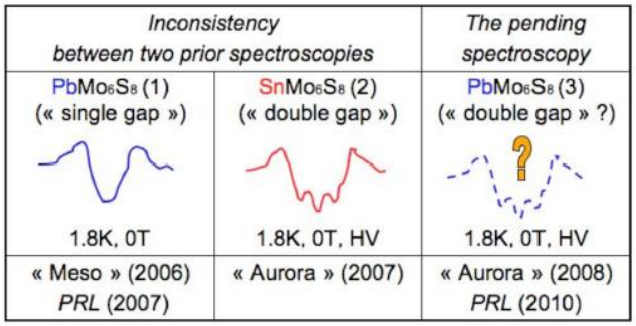

Fig. 1 Initiated series of microscopic experiments on two related compounds, $PbMo_6S_8$ and $SnMo_6S_8$

With a few cues, colors and keywords, the figure above exhibits the experimental progression of the physical inquiry that led up to a pending spectroscopy, our crucial experiment and its open question: *is lead molybdenum sulfate* ($PbMo_6S_8$) *a multi-band superconductor?* The figure, in other words, can be interpreted in terms of the matrix activity that it documents: the physical inquiry that it summarizes, experiment by experiment (1, 2), up to the decisive, yet pending spectroscopy (3). This documentary interpretation, although it leaves open what (say) a "spectroscopy" and "multi-band superconductor" might be, is consistent with E. Livingston's general observation on physics experiments: "experiments do not occur in isolation; they are part of mutually elaborating suites" (Livingston, 1995:10). The documented suite of microscopic experiments, in turn, may be further exposed and interpreted with narrative means, as the following paragraphs suggests.

In August 2006, Don, a lab colleague of Pete (both experimentalists by pseudonym), conducted an initial microscopic experiment on $PbMo_6S_8$ by subjecting the probed compound to a controlled range of bias voltages (i.e., a spectroscopy). As a result, Don obtained a first "single gap" spectrum (1) which, at the chosen temperature (at 1.8 K / - 271.2° C) and magnetic field (at 0 Tesla), taught him that the selected compound became superconducting at *one* single, specific energy level (i.e., transporting electric current without resistance at that level or "band" only). This experimental finding, obtained with "Meso", his low-temperature scanning tunneling microscope (STM), proved sufficiently interesting to be submitted, by Don, and accepted for publication, by *Physical Review Letters* (*PRL*), one year later. The main interest of the experimental finding lay in its *anomalous* character with respect to the prevalent model of superconductivity (the so-called "BCS-model", see Blundell, 2009:48-65).

In 2007, Pete started out experimenting with his low-temperature STM "Aurora". Contrary to Don's initial results on the lead compound, *Pb*Mo_6S_8, Pete obtained a "double gap" spectrum (2) on a *related* tin compound, *Sn*Mo_6S_8, a spectrum which identified it as a *two* energy level superconductor (i.e., a "multi-band superconductor", not a "single-band" one, as the prior spectroscopy would suggest). This inconsistency motivated Pete to project another experiment on the lead compound, this time devoted to having the compound probed with his STM facility "Aurora" (3). The experiment, conducted in November 2008, was devised to settle the open question. Due to the improved conditions of measurement (e.g., high vacuum, HV), Pete expected the lead compound, $PbMo_6S_8$, to also disclose a "double gap" spectrum, confirming the hypothesis of "multi-band superconductivity". This finding would and did prove *novel*, as nobody else had conducted or succeeded the experiment before (to the best of Pete's knowledge at least). Yet the finding would *not* be anomalous with respect to the conventional model of superconductivity. Eventually, Pete submitted a paper for publication to

PRL in 2010 on the basis of the obtained finding[8].

The preceding narrative, of course, offers a simplified account. It does not retrace all the way-stations, all the delivery delays, and other ups and downs of STM and participant observation in the considered domain of physics, from a microscope explosion to the presently considered experiment (see Sormani, 2010). Neither does the narrative delve into physics *qua* physics, data normalization, collaborative writing and the like, as the initial figure, tracking down of *PRL* references and further ethnographic detail may allow us to.

Yet the offered narrative should be of particular interest to the ensuing video analysis. For one, it outlines the matrix activity whose experimental closure appears to have been marked by the experimentalist's jubilatory "YES". For another, it begs the question of *just how*, if at all, the involved experimentalist's actual experiment and its instant appraisal display his practical orientation to the outlined background, via a similar DMI or not[9].

Disciplinary relevance and interactional context

> "Research by conversation analysts focusing on the verbal modality has shown that lexical selection is shaped by features of the interactional context […]" (Stivers and Sidnell, 2005:2-3).

Taken out of context, the jubilatory "YES" by an isolated experimentalist can be joked about, but hardly understood. The prior section outlined the unfolding inquiry of experimental physics to which the observed exclamation would count as the positive answer. This section, more specifically, examines the interactional context in (and as part of) which that positive answer was delivered as a first appraisal: the experimentalist's instant appraisal of the intended spectrum upon its manifest production. The interactional context, at present, concerns thus *not* the "verbal modality" *per se*, but how the experimentalist's talk, initiated by his "response cry" (Goffman, 1978), is geared to the visual display of the launched experiment and its manifest result: the "double gap" spectrum of $PbMo_6S_8$, the probed compound. Not only does the instant appraisal of the experimental finding manifest and relate to its disciplinary relevance in observable detail. That relevance, moreover, is formulated by the experimentalist, with respect to his matrix activity and its local achievement. The experimentalist's talk and conduct thus exhibit his situated use of a DMI[10].

The first spectrum and its instant appraisal: disciplinary relevance in actu

The video record of the manifestly successful experiment affords us with a special opportunity for descriptive analysis via its detailed transcription. Part of that

[8] The submitted paper was accepted and published earlier this year and, on the basis of its experimental evidence, refutes the principal conclusion of the prior paper – that is, the observed feature (two distinctive "double gaps") of the related compounds (PbM_6S_8 and $SnMo_6S_8$) witnesses "multi-band superconductivity", rather than "single-band superconductivity" being exhibited via a "single gap" spectrum, as initially conjectured and observed. On the distinction between "novel" and "anomalous" findings, see Brannigan (1980:560-561).

[9] The latter question appears all the more pertinent given H. Garfinkel's final reservations against using (and imputing) the documentary method of interpretation as a hermeneutic scheme which glosses the specifics of any practical action *in situ* (Garfinkel, 2002:113, 203-204, 279). See also Watson (2001).

[10] The successful experiment could be filmed as I happened to be co-present to its witnessable production on Sunday morning, 9 November 2008, with a video camera in hand.

"special opportunity" consists in the peculiar character of the recorded situation: the experimentalist attempts an unprecedented experiment, the local spectroscopy of $PbMo_6S_8$, in the presence of a cameraman largely unacquainted with the physical question at stake. Yet my lack of understanding, rather than preceding microscopic experimentation, appears as an emergent feature of its filmed course. Similarly, the experimentalist's orientation towards the disciplinary relevance of the launched experiment appears as an observable feature of his conduct, both embodied and instrumental[11].

The first excerpt, when expanded, may assist our video analysis (see appendix, p. 75, excerpt 1).

The expanded excerpt documents the first local spectroscopy of $PbMo_6S_8$, as achieved by the filmed experimentalist, and his immediate appraisal of its successful result, the "double gap" spectrum as displayed on the computer screen, instantly greeted with his jubilatory "YES". The excerpt makes apparent the contingent character of the on-the-spot appraisal, as well as the contrasting expression of its delayed response, the experimentalist's instant jubilation (lines 13-17) being followed by my muted laughter a second later ("mhu, mhu, mhu", 23). Let us consider, turn in turn, that contingency and this contrast.

The instant appraisal of the first spectrum, to begin with, appears to be contingent upon the experimentalist's silent, yet successful routine. First, he launches the local spectroscopy, at a newly selected position (01-02). He does so by pressing the appropriate "spectro" button (02). Second, he monitors the launched experiment, by attending to its local conditions on the oscilloscope (04-06, ***#1***) and its progressively displayed result on the computer screen (9-11, ***#2***). Third, he gives his positive appraisal, upon noticing the relevant feature of the obtained spectrum: its "double gap" shape, as displayed from the left to right (13-16, ***#3***)[12].

The experimentalist's appraisal is given upon the visible production of the intended spectrum, but prior to the actual completion of the spectroscopic procedure (18-19, ***#4***). It may thus be qualified as an "instant" or "on-the-spot" appraisal, indeed. The examined excerpt, by consequence, makes evident not solely that the "assessable [phenomenon] first has to be established, brought to the foreground and within the focus of attention of the participants, *before* it can be assessed" (Lindström and Mondada, 2009:307). More specifically, the excerpt documents how a distinctive, practical "focus of attention" (i.e., an experimental one) is established, thus *anticipating* the particular type of phenomenon to be monitored, and possibly discovered (i.e., a novel spectrum), although that focused, practical anticipation may not be accessible or intelligible to all co-present parties at once (and may thus escape the subsequent analyst, too)[13].

As the attending cameraman, at any rate, I do only start to focus upon the produced spectrum (18-19, ***#4***) *after* its audible and embodied appraisal (13-17, ***#3***). My focus, however, remains somewhat tentative and indeterminate, insofar as I zoom in on the computer screen (18), rather than on the relevant spectrum in particular (as shown in picture excerpt ***#4***). This manifest lack of detailed understanding finds a further

[11] For a related description of "exhibiting (mis-) understanding" in interaction, see Hindmarsh et al. (2011).

[12] A companion paper is in preparation to specify the described routine in and as its oriented achievement (cf. Sormani et al., forthcoming).

[13] If only for the fact that the experimentalist, at present, wouldn't teach his "praxeology of perception" (Coulter and Parsons, 1990) in the course of its enactment, via or even as his DMI.

expression in my subsequent, but delayed response: "mhu, mhu, mhu" (23). This response, characterized as "muted laughter", contrasts with the instant delivery of the experimentalist's first appraisal (13-17). The response, indeed, occurs only well after the first and upon the initiation of the second spectroscopy (21-22).

The ambivalent features of the delayed response, more specifically, mark a *partial* understanding. On the one hand, my short series of laughter particles, albeit delayed, displays my continued orientation towards a conversational preference: a first appraisal, as in the case of an assessment, yielding a similar second, if not upgraded and contiguous one (Pomerantz, 1984a). One the other hand, the apparent withholding of a similarly positive response manifests, again, my seeming lack of understanding regarding the phenomenon to be appraised (as my initial, yet tentative zoom had, 18). Accordingly, the muted character of laughter, each of its particles ("mhu") beginning with "m" (23), provides for their hearing as continuers, too (at least in French, where continuers usually start with "m") – inviting thus the experimentalist to explain the assessable phenomenon, as and when (re-)produced on the computer screen (21-22). Does the sequel to the examined excerpt warrant that additional hearing?[14]

***Prompting and pursuing a similar appraisal: disciplinary relevance* in verbo**

The focused anticipation, by the experimentalist, of the intended spectrum, the "double gap" spectrum of $PbMo_6S_8$, was suggested to be enacted via documentary interpretation (see above, note 13). Readers may have noticed that the experimentalist, indeed, seems to assess the produced spectrum by recourse to a DMI. Its practical enactment finds a characteristic expression in his visual monitoring of the displayed spectrum and its emerging shape, or "pattern" (11-12, ***#2***). The latter, however, is positively appraised only upon the recognizable production of its key feature, once "apparent" (the "double gap" shape, when coming into plain view, 13-16, ***#3***). The experimentalist's first appraisal, his jubilatory "YES", enacts and embodies, in that sense, a particular DMI.

This documentary method allows him to identify the intended figure (the "double gap" spectrum) against its "noisy" background (the horizontal zigzag line, to the left and right of the identified figure, see ***#4***). Yet, as pointed out, the experimentalist doesn't teach his heuristic method in the course of its enactment (hence also the lacking zoom on the relevant phenomenon, 18). Conversely, we may ask if he would make it explicit to the cameraman in pursuing a similarly positive appraisal by him and, thereby, perhaps upgrading his understanding. Consider excerpt 2 (see appendix, p. 76)[15].

The possibility that the assessable phenomenon, as the manifest cause for instant jubilation, may have remained unintelligible to me doesn't seem to have escaped the experimentalist. Excerpt 2, indeed, does not only document how he

[14] If assessments and continuers are differently oriented-to phenomena in "ordinary conversation", exhibiting mundane understandings in their collaborative production (Goodwin, 1987), the presently observed ambivalence seems to express the *temporary* lack of such collaboratively produced understanding (set aside, possibly, participants' manifest understanding of lacking understanding). Incidentally, I may also be heard to disaffiliate with prior self-praise (as S. Keel pointed out to me, following Pomerantz, 1978).

[15] Incidentally, the experimentalist's tacit recourse to a DMI may contribute to specify a suggestive analogy, that of "extracting an animal from the foliage" (see Garfinkel et al., 1981:132).

pursues a positive appraisal to be echoed by me, by variously prompting me to join jubilation (finishing by tapping me on my right leg, 47-53). Furthermore, the excerpt makes apparent how the experimentalist, thereby, elaborates the grounds for such jubilation: first in curricular terms ("that's the thesis", 27-29, ***#5***), then only in the visually apparent ones ("big gap, small gap", 37-41, ***#6***, ***#7***). That is, the experimentalist's pursuit of an appropriately aligned response manifests, at first, how he himself identifies the displayed spectrum in terms of a matrix activity of disciplinary relevance, albeit expressed in curricular terms to begin with. This initial expression, in turn, begs the question of how the apparent aspect (the displayed spectrum) may relate to the inferred one (the thesis completion)[16].

The first prompting of a positive (co-) appraisal can be heard to be achieved through the experimentalist's formulation: "in PRINT SCREEN, VOILA. That's the thesis" (26-27, ***#5***). Note its jubilatory tone (26), similar to that of the initial on-the-spot appraisal (13). The sustained tone of voice, followed by the instant expression of a positive implication ("that's the thesis", 27), makes relevant an appraisal aligned with the initial one. The positive implication is spelled out at the very moment of the spectrum's reproduction, as displayed on the computer screen in the upper middle window (28-29, ***#5***), and that in terms of a (presumably) familiar object ("the thesis", 27). The experimentalist, in short, offers me a second opportunity to proffer a positive response, regardless of my presumed understanding of physics or manifest lack thereof. An unspecific congratulation, for instance, may thus be expected. However, I do not (manage to) offer the pursued type of response, but stick to muted laughter (33-34)[17].

Yet, as I continue to refrain from a more openly positive response, the experimentalist continues to pursue it. His pursuit of such a response appears in and through his subsequent question: "you see?" (35). For one, the question's production in overlap with the continuously muted laughter (33-34) suggests that such laughter wouldn't count as an appropriate response, at least not for the experimentalist (where the latter category may warrant the possibly interruptive question). For another, the experimentalist doesn't wait for my answer. Instead, he points to the upper right window on the computer screen (36), possibly to instruct me on visual grounds and, thereby, to afford me with further clues for a positive response (as I now seem explicitly assumed to be lacking them)[18].

The delivered instruction is of analytic interest in several respects. First, note its minimal character: the experimentalist indicates and names the "double m-shaped" curve on the computer screen, "m" by "m" (38-39, ***#6***, 40-41, ***#7***), as the relevant phenomenon: "big gap, small gap" (37). Second, he does so in the very course of its automated reproduction in the upper *middle* window, replicating a further "double gap" spectrum (31-32, ***#6***, ***#7***). Third, in giving his instruction in the upper right window of the screen (where spectra are progressively recorded), he affords me with the possibility to monitor any upcoming spectrum, as and when it is reproduced in the upper middle window (ibid.). Finally, he assesses the

[16] The question will be taken up below, as it seems to have been oriented to and taken up by the involved participants, too. For related analysis on "pursuing a response", see Jefferson (1980); Pomerantz (1984b) and, more recently, Keel (2011).

[17] The experimentalist, on the other hand, seems to have treated my prior, muted laughter (23) as an effective continuer - to the effect, at least, that it leads him to spell out a first reason (27) for his initial jubilation (13).

[18] The sketched description may be usefully compared with D. Macbeth's (1994) and, again, A. Pomerantz' (1984b) analysis.

reproducible and reproduced phenomenon (***#8***) by repeating and emphasizing one of its instructed terms: "BIG" (42). The pacing and placing of the delivered instruction, followed by the phrasing of the assessed phenomenon, allow the experimentalist to give me, as the attending cameraman, a further opportunity to deliver a timely and suitably valued response. This doesn't seem to have escaped my attention. Indeed, I start releasing my laughter, delivering it more quickly, right upon the completion of the replicated and reassessed spectrum (43-45, ***#8***).

The experimentalist, through the examined sequence, appears to have taught me not only *which* phenomenon to appreciate – the "double gap" spectrum – but also, and primordially, *how* to monitor its progressive production, as visibly replicated, from left to right ("m" by "m", as it were). The experimentalist, in other words, has made explicit his "praxeology of perception" in and as its DMI, as presently formulated and initially enacted (see excerpt 1, 11-12, **#2**, **#3**).

My eventual release of laughter appears to have been heard by him too, as it is supported by his touch: he starts tapping me on my right leg (47-48), prior to repeating his initial, jubilatory "YES" (50). This tapping and that repeat can be seen as they could be experienced, namely: as a last attempt at prompting me, as cameraman and witness, to deliver a positively aligned response. The experimentalist's attempt, however, proves to be of limited success. After hearing the repeated appraisal (50), I fall back into muted laughter (51), and offer solely two or three non-mitigated laughter particles, as my final response (54), and that only after sustained prompting via further tapping by the experimentalist (52-53)[19].

To sum up, the three observed promptings led to no joint jubilation: I didn't offer a positive appraisal of the first produced, instantly greeted and, then, reproduced spectrum of $PbMo_8S_6$. In vain, the recorded spectrum was praised to have the experimentalist's thesis completed. In vain, its key feature was pointed out: its reproducible "double gap" shape. In the course of pursuing a positive response, the experimentalist elaborated various grounds for its requested delivery. That successive elaboration, however, left open how those grounds would relate to each other, as aspects of the same picture or, more to the point, as parts of the same discipline.

Why would the displayed spectrum be identified, in particular, as bringing the experimentalist's thesis to a happy ending? The epistemic aspect of its disciplinary relevance, in addition to its curricular implication, was not spelled out in the course of the examined episode. The experimentalist himself seems to have oriented to that possible lack of explanation, as he sums up and emphasizes the lived episode as an extreme case: "that's the thesis *in one single strike*" (59-60). His summary, indeed, begs the question of which knowledge claim may justify the episode's emphasis. Put otherwise, the "extreme case" summary may stand in need of an account or justification (for a contrasting analysis, see Pomerantz, 1986).

Formulating the experimental confirmation: **in verbo veritas?**

Documentary means of interpretation were described as methodically deployed, by the involved experimentalist, to have

[19] The muted character of laughter, as manifestly sustained, may be heard as consistent with the category "cameraman" (expected to film, or film quietly, rather to comment on the scene). Technically put, the mutual relevance of object articulation and progressive co-assessment appears as mediated by participation framework (Fasulo and Monzoni, 2009) as well as possible disaffiliation with self-praise, as pointed out before.

established, elaborated and demonstrated the grounds for the instant appraisal of his experimental achievement: the *first* local spectroscopy of $PbMo_8S_6$ of a *particular* kind (see above, note 4). A documentary method of interpretation (DMI) was described to be variously involved in that unprecedented achievement and its running commentary. One possible criticism, then, would be to fault the descriptive analysis for glossing its distinctive phenomena through the invoked notion (as ventured from the outset, note 9).

An alternative line, the one taken here, is to describe participants' own "glossing practices" (Garfinkel and Sacks, 1970), through their recognizable and consequential use of documentary methods of interpretation. At present, such interpretive glossing, for the lack of a better term, appears particularly evident in the experimentalist's formulations designed to put the reproduced spectrum into disciplinary perspective. How? Excerpt 3 bears the answer (see appendix, p. 77).

As mentioned before, the experimentalist formulated his local spectroscopy, once achieved and appraised, as an extreme case: "that's the thesis in one single strike" (59-60) – that is, as an exceptional case of luck, whichever experimental preparations may have facilitated it. Excerpt 3, in turn, documents in terms of an experimental confirmation the knowledge claim that needed (or still needs) to be met for that case to be made and such luck to be expressed. A closer look at the experimentalist's successive formulations may prove instructive as regards his interpretive glossing.

Consider how and when he starts formulating his confirmation: "now. I know that i- it's |true." (93-99, ***#9***). The placement of "now", in the course of experimentation, may be commented upon first. It marks the moment when the experimentalist resumes his commentary of the experiment. The preceding five spectra (not shown here) were attended to by him in silent satisfaction, marked by his smile of relief, a nod of confirmation, and a sip of water. His confirmation, then, gets progressively spelled out. "Progressively", at present, means manifestly attuned to the automated reproduction of spectra displayed on the computer screen (i.e., in the upper middle window). Note, in that respect, how the experimentalist holds off his knowledge claim ("i- it's true […]", 95-96). This allows him to have that claim spelled out at the same time as the next spectrum is reproduced, the adjective ("[…] true", 96) being stated at the very moment the spectrum is completed (98-99, ***#9***).

Yet, as attentive readers may have noticed, the traced out spectrum *fails* to exhibit a "double gap" shape (***#9***), and that although the experimentalist seems to have "waited out" the visible reproduction of just that shape. The experimentalist's knowledge claim, then, comes to stand as an interesting case of interpretive glossing. Indeed, the stated claim glosses over a potentially critical imperfection (lack of "double gap" shape, if repeated, may challenge the intended experimental result)[20].

The experimentalist, however, does not revise his formulation. Instead, he elaborates it in more general and, at first, too general terms of physics (101-102). The generality of those terms can be recognized, insofar as they relate to the intended model ("inside", 102), rather than any particular spectrum of the launched experiment ("on screen", as it were). The

[20] This is not to say that prior experimentation was devoid of interpretive glossing. Indeed, the instant appraisal of the first spectrum (excerpt 1, 13, ***#3***) already glossed over or, at least, left unmentioned the "noisy" background against which it was identified (i.e., the zigzag line to the left and right of the traced spectrum, ***#4***). For a related discussion of *Gestaltsehen*, see Fleck (1979:84-92).

knowledge claim, indeed, is elaborated *prior* to the assessable completion of the (re-)initiated spectroscopy (100-103, 109-110). The observed elaboration offers thus a second expression of interpretive glossing.

As the spectrum, however, is traced out on the computer screen, from left to right (103), the experimentalist orients to the possible discrepancy between the intended physics model and the manifest experimental result(s). That is, he downplays the critical potential of the previously observed, now reproduced imperfection (***#10***). He both understates the difficulty of the required repair ("it's just a question of searching for […]", 104) and emphasizes the minor target of that repair ("[…] the small gap in more detail", 105). Yet again, the experimentalist's formulation is offered in the manifest absence of a probative result, given the sustained lack of "double gap" shape (***#10***). His formulation constitutes thus a further instance of interpretive glossing[21].

Three cases of interpretive glossing have been examined where, each time, the experimentalist would gloss (or gloss over) the discrepancies between his running commentary and the results displayed on the computer screen. Such glossing, of course, can be inspected more closely, to even further specify the work it does, for his knowledge claim to be upheld.

Conversely, the section title question may be addressed: *in verbo veritas?* This question seems to have been the experimentalist's, too (set aside, presumably, its Latin phrasing). In the analyzed excerpt, at least, he finishes by offering a technical account which responds to the critical type of doubt expressed by the stated question. In alluding to the problematic conditions of the initiated experiment (113-114), the experimentalist postpones further discussion of its key finding, instant appraisal and interpretive glossing. So do I assisting him in his word search (116). Together, we "gloss glossing", as part and parcel of its tacit pursuit, instead of explicating the means and methods of documentary interpretation that it relies upon, as presently attempted.

Deflating underdetermination: Some concluding remarks in critical perspective

Delivered as a jubilatory "YES", the instant appraisal of the local spectroscopy marked its disciplinary relevance in terms of a matrix activity: the physical inquiry, conducted via microscopic experimentation, that this first spectroscopy was intended to bring to a close. The manifest achievement of the unprecedented experiment, in turn, was described to be contingent upon a silent routine, yet giving rise to both lively jubilation and interpretive glossing.

The experimental finding, at first, was unequivocally greeted as the intended answer to the open question of experimental physics. The visual display of that answer, furthermore, was praised to have a positive implication: a thesis completion, based upon an experimental confirmation. Yet, as the experimentalist set out to formulate the latter claim, its very basis appeared to be called into question, given the multiplication of inconclusive spectra. The experimentalist's initial "suspension of disbelief" (Holton, 1988) proved thus at risk and prone to doubt. This emerging ambivalence, then, turns the described situation into a "perspicuous setting" indeed. It allows us

[21] The experimentalist doesn't say *which* model of physics that he claims to have been confirmed. He would do so in his thesis, however. In its acknowledgment section, the following passage is to be found: "the moment when we discovered multi-band superconductivity in $PbMo_6S_8$ was truly special". The author, in that passage, appears thus to be identified as a colleague or witness, rather than the cameraman or participant observer.

to reflect upon obvious underdetermination by experimental evidence, as theoretically supposed, with respect to disciplinary relevance, as practically required[22].

The speculative gist of the underdetermination thesis has been summed up as follows:

> "For any given base of empirical data, logically distinct alternative theories can always be developed" (Zammito, 2004:20).

At present, we examined this thesis and assumption as an "epistopic" – that is, as an instructive matter of practical concern (Lynch, 1993). The resulting re-specification, as it seems, leads to a *double deflation*.

On the one hand, far from capturing the sociological quintessence of Science Writ Large, the thesis may be seen as characterizing, at best, a particular phase of a single experiment, as explicated to a novice observer. The speculative gist of the underdetermination thesis comes closer, indeed, to the "undirected vision" (Fleck, 1979:92) of a novice observer or beginning researcher, where "things can [possibly] be seen almost arbitrarily in this light or that" (ibid.), than to the direct, yet directed perception of the expert (e.g., Pete, our experimental physicist). Accordingly, the typically intended "'why' questions", be they raised by SSK or related approaches, "[do] not [appear as] theorist's questions but [as] those of e.g. beginners, learners, and strangers" (Hutchinson et al., 2008:97). During the examined experiment, I wouldn't join jubilation. The resulting silence, then, could be heard as the mute(d) expression of a patent incapacity: the incapacity to take for granted the disciplinary relevance of the experimental finding. Conversely, its "why" was taken for granted, as graphically displayed and manifestly celebrated, by the competent experimentalist. He didn't suffer any "problem of induction", as might have been imagined (e.g., Shapin, 2010:23)[23].

On the other hand, the descriptive analysis of the examined case, the local spectroscopy of $PbMo_6S_8$ and its instant appraisal, calls into question the dualist framework in terms of which the underdetermination thesis is often cast: the "back stage" / "front stage" contrast of (e.g.) "doing" *versus* "presenting" science, be it verbally or in written form (Schickore, 2008). The presently examined situation faults this dualist picture, where untidy, indeterminate practice stands in need of retrospectively determining rationalization. The $PbMo_6S_8$ experiment was indeed devised as a *demonstratively determining* one from its very outset - a "crucial experiment" having "two theories in question" (Hacking, 1992:44). To reduce its demonstrative potential to a retrospective gloss, at least for the case at hand, is to neglect productive practice and idealize discursive form (e.g., in and as convincing presentation, communal agreement or expert interpretation). Indeed, "technical activities are not asocial acts awaiting their social determination" (Lynch, 1992:253). Similarly, they do not appear as dull moves awaiting their epistemic warrant.

However, this double deflation of the underdetermination thesis, at least in its speculative expression, should not be

[22] The theoretician's puzzle, in other words, shall be re-examined in the light of (if not as) a practitioner's concern – in line with Turner's stance (see note 7, above), rather than Collins' irony (see initial epigraph).

[23] As L. Fleck emphasized, "[once] tradition, education, and familiarity have produced *a readiness for stylized (that is, directed and restricted) perception and action* [,] [then] an answer becomes largely pre-formed in the question, and a decision is confined merely to 'yes' or 'no', or perhaps to a numerical determination [or single spectrum]" (Fleck, 1979:84; example added).

misunderstood as the detailed promotion of an alternative or traditional picture of "Science". Instead, readers are invited to treat the highlighted aspects as facets of a single, ethno-methodological argument: the central task of descriptive analysis is less to interpret a possible indeterminacy that (seemingly) anyone could imagine but almost never experience than to understand the manifestly effective determinateness of (say) "mature laboratory science"[24].

At any rate, the examined episode of a demonstrative experiment and its instant appraisal should have offered us an apt reminder of the involved practitioner's unique concern to have his local manipulations and incidental formulations (their "interactional context") match *and* manifest the physical inquiry that they were to serve (its "matrix activity"). To doubt this concern on the grounds of (video-)analytic acumen or to derive it from a philosophical thesis, presumably, would not only be to engage in an activity different from the one described but, furthermore, to put oneself in a position to miss its distinctive disciplinary relevance. The point of this paper, then, was to avoid that risk, as well as to criticize its uncritical acceptance, at least with respect to one experimentalist's jubilatory *YES!*

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[24] The argument has been lifted from Hacking (1992:55) and adapted to suit the present conclusion.

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Appendix:

Transcription conventions

[ ]	onset and end of overlap
=	latching, no discernible interval between adjacent utterances, or activities
(1s), (.)	pause, micro-pause
he-	cut-off
so	emphasized stretch of talk
>so<	faster stretch of talk
°so°	quieter stretch of talk
SO	louder stretch of talk
?	rising intonation
.	falling intonation
,	"continuing" intonation
( ), (go ahead)	incomprehensible passage, uncertain hearing
((does))	description, comment
' |	comment on non-verbal activity, one sign per participant, if there is a verbal line, marked on the verbal line and again on the comment line

Ex.: **here |I let you have a look.**
|((hands the magnifier to the student))

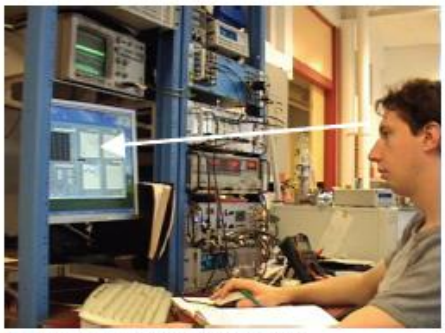
#1	indication of film still placement in the transcribed activity
tic tac	computer mouse noise
toc toc	spectroscopy regulation noise
tap tap	leg tapping noise

Excerpt 1

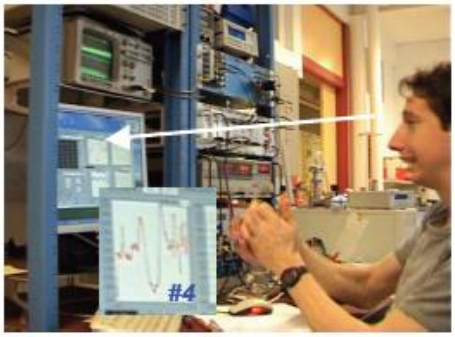
E: experimentalist, C: cameraman
((seated in front of the STM facility))

01 E ((launches a ***1st spectroscopy*** at new
02 position, |by pressing the "spectro" button))
03 >|*tic tac*<|
04 E |((monitors the oscilloscope))
05 |*toc toc*|
06 |((signal detection))
07 ***#1***
08 *toc*|
09 |((1st spectrum is traced in "spectro"
10 window, from left to right))
11 E ((monitors spectrum, as it is traced))
12 ***#2***
13 **E** **YES|.**
14 E |((claps his hands right before
15 spectrum is completed))
16 ***#3***
17 E ((lifts his arms in jubilation))
18 C ((zooms in on the computer screen))
19 ***#4***
20 *toc toc*|'
21 |'((a ***2nd spectroscopy*** is
22 initiated at the same position))
23 **C** **'mhu, mhu, mhu.**

#1 *((signal detection on oscilloscope))*



#2 *((E monitors spectrum))*

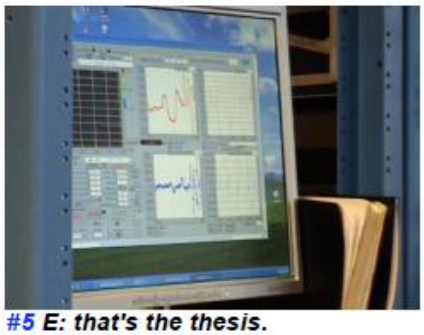


#3 ***E: YES!*** *((clapping his hands))*

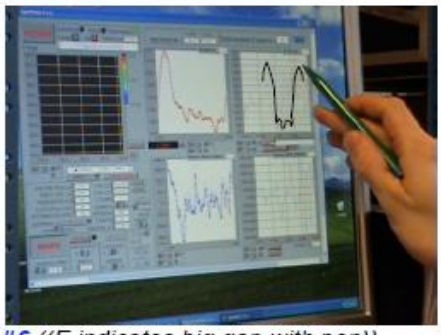
Excerpt 2

E: experimentalist, C: cameraman
((seated in front of the STM facility))

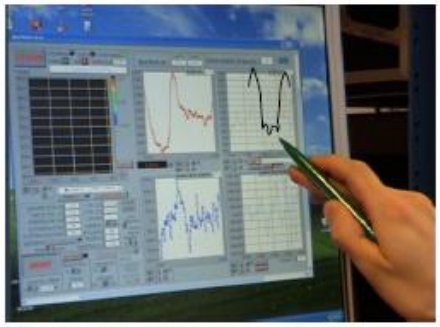
24 E |((presses "print screen" button))
25 |*toc*
26 **E** **in PRINT SCREEN|, VOILA.**
27 **E** **>|that's the thesis|.<**
28 |((the 2nd trace is completed))
29 ***#5***
30 |*toc toc|'*
31 |'((a ***3rd spectro-***
32 ***scopy*** is initiated))
33 **C** **'mhu,**
34 **[m h u.]**
35 **E** **[you see?]**
36 E ((points at the right window with a pen))
37 **E** **b|ig gap, sm|all gap.**
38 E |((indicates big gap with pen))
39 ***#6***
40 E |((indicates small gap with pen))
41 ***#7***
42 **E** **BIG.**
43 **C** **mhu, >'hu, hu.<=**
44 '((the 3rd spectroscopy is completed))
45 ***#8***
46 *toc| toc|*
47 E =|((taps C on his right leg))
48 *|tap, tap, tap=*
49 |((a ***4th spectroscopy*** is initiated))
50 **E** **=YE:S.**
51 **C** **mhu, hu, hu:=**
52 *=|tap, tap=*
53 E |((continues tapping))
54 **C** **=he, he, (he).**
55 (4s)
56 ((the 4th spectroscopy is completed))
57 *toc |toc|*
58 |((a ***5th spectroscopy*** is initiated))
59 **E** **|that's the thesis in one single**
60 **strike.**



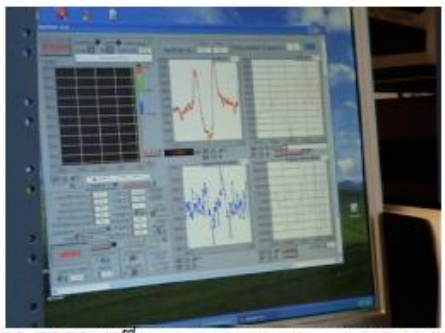
***#5* E: that's the thesis.**



#6 ((E indicates big gap with pen))



#7 ((E indicates small gap with pen))



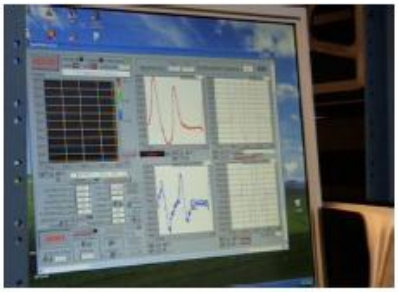
***#8* BIG!** *((3rd spectroscopy is completed))*

Excerpt 3

E: experimentalist, C: cameraman
((seated in front of the STM facility))

93 *toc|*
94 |((an ***11th spectroscopy*** is initiated))
95 **E now. I know that i-**
96 **it's |true.**
97 *toc |toc|*
98 |((the 11th spectroscopy is completed))
99 ***#9***
100 |((a ***12th spectroscopy*** is initiated))
101 **E |the physics- >the physical model<**
102 **inside is good.**
103 |((the 12th spectroscopy is traced out))
104 **E >|it's just a question of searching for**
105 **the small gap< in more detail.**
106 ***#10***
107 **E because, |you see, HERE=**
108 |*toc |toc|*
109 |((the 12th spectroscopy is
110 completed))
111 |((a ***13th spectroscopy*** is
112 initiated))
113 **E =>|we really don't have tunneling**
114 **conditions< uh-**
115 |((the 13th spectroscopy is traced out))
116 **C optimal?**
117 **E optimal.**
118 |((the 13th spectroscopy is completed))
119 *|toc*
120 ***#11***

#9 *((11th spectroscopy completed))*



#10 E: small gap in more detail

#11 *((13th spectroscopy completed))*