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AUTHORITY AND AUTHORITY RELATIONS IN MATHEMATICS EDUCATION: A VIEW FROM AN 8TH GRADE CLASSROOM[1]

Compared to studies in general education, authority has received little attention in mathematics education, despite an increasing interest in sociological perspectives in mathematics classroom research. The subject of authority is particularly important in mathematics education, on the one hand, because of the immense authority mathematics itself seems to possess and pass on to its practitioners, but also, on the other hand, because of the anti-authoritarianism present, to some degree, in many trends in mathematics education such as cooperative learning approaches and constructivist pedagogies. Such an anti-authoritarian stance appears justified by data from an 8th grade mathematics classroom (supplemented with data from a second 8th grade classroom) which suggest that teachers possess immense authority in the eyes of the students and that this and other authority relations are strongly evident in the students' non-reflective ways of interacting not only with their teachers but also among themselves. However, theoretical considerations on authority show that the problem may not be authority *per se* but the way one conceives the notion of authority, that there exist kinds of authority, such as Benne's 'anthropogogical' authority, which can encourage reflective and also fruitful collaborative work.

KEY WORDS: 'anthropogogical' authority, mathematical classroom authority, Learners' perspective study (LPS), reflective mathematical interaction, sociological perspectives

1. INTRODUCTION

In the study of general education the notion of authority has not been neglected. It could hardly be otherwise. A teacher at the head of a classroom is one of the commonest images conjured up by the word 'authority'. That the authority of teachers in real classrooms is often challenged or mocked by students is no contradiction of this image, but, on the contrary, further evidence for it. Of course teachers' authority is not the only manifestation of authority in the classroom even if it is the most obvious one; student life also takes in, among other things, the authority of administrators, of textbooks and textbook writers, of parents, of 'successful' peers – an entire web of authorities. And if this web of authorities is evident in the general classroom, it is all the more so in the mathematics classroom, not the least because of the immense authority mathematics itself seems to possess and pass on to its practitioners. On the other hand, many of the important trends in mathematics education, for example, those towards cooperative learning, towards independent and individual thinking, towards student participation in the construction of mathematical ideas, appear to have an anti-authoritarian component, or, at least, to require the diminution of teachers' authority. For these reasons, the study of authority in mathematics learning promises to be particularly interesting and important.

The study of authority in mathematics education is clearly pertinent to investigations from sociocultural perspectives, which in recent years have received no small amount of attention within the mathematics education community (e.g. Clarke, 2001; Lerman, 2000; Cobb and Bauersfeld, 1995, Edwards and Mercer, 1987). Nevertheless, although literature exists touching on the question of authority (e.g., Mellin-Olson, 1987; Boaler, 2003) explicit attention to the question has, on the whole, been rare in the research literature.[2] In partial response to this, our principal goal for the present paper is to describe qualitatively authority relations as they were observed in an 8th grade mathematics classroom. But in doing so we hope also to raise some general issues related to authority. Specifically, we wish to:

1. Describe the variety and pervasiveness of authority relations at work in mathematics classrooms.
2. Consider how authority relations may influence students' ability to reflect for themselves on the one hand, and work cooperatively, on the other.
3. Suggest ways of thinking about learning and teaching that are not anti-authoritarian as such but which aim towards *kinds* of authority having the potential to engender thoughtful students who can also work with others.

The mere statement of these issues, especially the implication that there are different kinds of authority, hints that 'authority' is not a simple and univocal concept. Thus, the first part of this paper will build a theoretical framework by taking a look at the notion of authority in general and then as it relates specifically to education. The general development here will rely heavily on the thought of Max Weber, which, while it is not completely current, is also not completely dated and is still behind many treatments of authority. The second part of the paper will present the research context for our study of authority, namely, the Learners' perspective study, which is an international video study of mathematics classroom practice (Clarke, 2001). Next, some of the empirical data will be presented and discussed. Finally, a refinement of the idea of authority relevant to the goals of mathematics education will be taken up in the conclusion. The idea of anthropogogical authority coined by the educational theorist Kenneth Benne will figure strongly in that discussion.

2. Authority in General and Authority in Education

2.1. *Classical authority*

Perhaps the greatest difficulty in speaking about authority is speaking about it briefly. From the many and varied treatments of authority relations by sociologists, philosophers, and historians (see Krieger, 1973 for a thorough discussion), we may take the following as a working definition, at least to start: *A relation of authority exists when one person (or group of people) tends to obey, act on, or accept without question the statements or commands of another person (or group of people or any other entity capable of producing statements or commands).* Except for our emphasis on the acceptance of statements, this definition is essentially that of Max Weber, whose discussion of authority in *The Theory of Social and Economic Organization* (Weber, 1947) is really the *locus classicus* for the subject. Weber states that authority or, rather, imperative control (*Herrschaft* which means, literally, 'dominion', 'mastery', or 'control') is "... the probability that a command with a given specific content will be obeyed by a given group of persons" (Weber, 1947, p. 139).

Weber's definition stresses, as does ours, that where there is true authority, or 'imperative control', there is not merely power of one person or body over another, not merely coercion, but "a certain minimum of voluntary submission" on the part of the controlled and an interest in obedience on the part of the authority (Weber, 1947, p. 247). In this way, authority, unlike power plain and simple,[3] has as much to do with those who obey it as it does with those who command it; a relationship of authority is a quasi-reciprocal one. Hence, although there are many ways authorities achieve obedience, Weber insists that central among them is a claim to *legitimacy*; people obey authority to the degree they recognize its legitimacy.

If follows from this that different kinds of authority and mechanisms by which they exercise power will be determined by the kinds of legitimacy they claim for themselves. Weber identifies, accordingly, three grounds of legitimacy – rational, traditional, and charismatic grounds – and three concomitant 'ideal types'[4] of authority – legal, traditional, and charismatic authority. The basic characteristics of these types of authority are summarized in Table 1.

2.2. *Authority in education – expert authority and shared authority*

In educational settings, which were not Weber's main concern, the Weberian categories of authority are, nevertheless, relevant; indeed, in the classrooms considered in this paper each of these forms of authority, including the charismatic variety, could be discerned at one time or another.

TABLE I
Weber's three basic types of authority

Authority type	Authority base	Response	Examples
Legal authority	Legal or bureaucratic system – an order characterized by established rules or laws ("an established impersonal order")	Rational obedience to law, rules, etc.	Lifeguard, Police Officer, Legal Judge
Traditional authority	An order characterized by sanctity or ancient foundations	Loyalty	Parent, Village Elder
Charismatic authority	An order characterized by its unavailability to ordinary human beings	Devotion	Shaman, Sage, 'Genius'

However, in the classroom – and particularly in the mathematics classroom – another obvious kind of authority also comes into play, *expert authority* (Levin and Shanken-Kaye, 1996; see also French and Raven, 1959, who speak of expert *power*); this is the authority of those who 'know their subject'. Expert authority in Weber's scheme is a part of legal authority, for one's position in a bureaucracy typically requires a certain competence, a certain 'specialized training' (Weber, 1947, p. 304). But this means that one's being an expert authority, being an authority on, say, mathematics, is contingent on having a place within a bureaucratic system; this is clearly problematic and has been given, accordingly, due attention in the sociological literature (e.g. Waters, 1989). Of course, this Weberian position is not *completely* wrong in the context of mathematics education: mathematics teachers do have authority because of their university degree or teaching license and their acceptance as 'teachers' within a school system; however, surely, they also have authority because of the belief among their students that they possess knowledge – powerful knowledge in the case of mathematics – that the students themselves lack. An expert authority is a *source* of information and guidance; one turns to an expert authority for instructions, not, by contrast, for a discussion. It is worth pointing out, in this connection, that the Greek word for 'source', *arché*, also means 'sovereignty', and in the plural, *hai archai*, 'the authorities'. The necessity of speaking about expert authority highlights the fact that as we turn to authority in educational contexts we must take into view a slightly different set of circumstances from those belonging to the traditional sociological setting.

One such set of circumstances is, naturally, that connected with the problem of classroom discipline. Thus, in Willard Waller's classic study on the sociology of education (Waller, 1932), the principal contexts for authority are understood to be, with little subtlety, the control of classrooms, the enforcement of school rules and regulations, and the maintenance of order in the school system itself. Waller describes authority in uncompromising terms as 'despotic' and 'autocratic' and sees the classroom as a kind of battleground in which the teacher is always struggling for complete control. Current treatments such as Levin and Shanken-Kaye (1996), by contrast, tend to view discipline as a matter of changing or managing students' behavior (so that ultimately students manage their own behavior) rather than repressing it. To this end, they assume that being flexible and responsive to students' needs is generally preferable to being rigid and despotic. But this, to some degree, also requires that teachers bend to the will of the student without themselves losing authority. Levin and Shanken-Kaye's development, in this way, shows that solving the problem of discipline involves allowing the students to have a part in the authority structure of the classroom, to share authority.[5]

The idea of sharing authority is not restricted to classroom discipline. Indeed, authority in the enforcement of discipline and authority in actual learning cannot be easily compartmentalized. In this connection, Oyler (1996) makes a distinction between the 'content dimension' and the 'process dimension' of teacher authority. Within the 'content dimension', the teacher controls the domain of knowledge, that is, the teacher provides what students are to know and is the final arbitrator in determining what is true, legitimate, and relevant. Within the 'process domain', the teacher controls the domain of discourse, controls, as Oyler puts it, the "flow of traffic and of talk in the classroom" (Oyler, 1996, p. 21). However, since controlling the flow of talk in the classroom means controlling the flow of ideas, giving weight to some questions and dismissing others, the separation between these two domains is hardly absolute; the teacher's control of the classroom is thus also the control of knowledge. But Oyler equally stresses that where students are invited to share authority they will not only determine the level of noise, so to speak, but will also initiate and take control of questioning and discussion. Presumably, by doing this, the students are no less controlling what knowledge comes out of the classroom session, thus, the sharing of 'process' authority again leads to 'content' authority.

The emphasis on sharing authority is emblematic of a general tendency in the thinking about authority in educational settings, namely, the tendency to see a sharp boundary between those commanding authority and those subject to it as neither necessary nor productive in the educational process. This is certainly true in thinking about cooperative learning, discovery learning (Oyler, 1996, pp. 25–27), and other constructivist pedagogies (see Dowling, 1998). However, some caution is necessary here. Thus, Boaler (2003, p. 8) points out:

> There is a common perception that the authority in reform mathematics classrooms shifts from the teacher to the students. This is partly true, the students in Ms Conceptual's class did have more authority than those in the traditional classes we followed. But another important source of authority in her classroom was the domain of mathematics itself. Ms Conceptual employed an important teaching practice – that of *deflecting* her authority *to* the discipline.

In other words, although the authority of the teacher is attenuated in the classroom, the classroom does not, therefore, become less authoritative; rather, in Boaler's view, the weakened authority of the teacher, ideally, becomes replaced by the strengthened authority of mathematics itself.

2.3. *Authority of mathematics or of the mathematical community?*

But can mathematics itself truly be an authority? This is a crucial and subtle question. At the outset, we accepted a notion of authority which requires the notion of obedience. When one reacts to mathematics as if it were an abstract power, there is a certain sense that one can be obedient to mathematics. This occurs when, for example, an argument is stopped in its tracks by the claim that one position or another has been 'demonstrated mathematically.' In such situations, because the purported mathematical demonstration is rarely presented in fact, it is possible truly to say mathematics has commanded unquestioning obedience. But when one accepts a position or feels compelled to follow a course of action having followed a mathematical demonstration, it should not be said, except perhaps metaphorically, that one is being obedient to the authority of mathematics; one is only persuaded by a demonstration whose every step, in the best circumstances, has been weighed, criticized, and, only afterwards, accepted. On the other hand, one can be obedient to the norms and practices of mathematics – for instance, that a mathematical claim demands a mathematical proof. For this reason, it may be important that Boaler refers to the mathematical *discipline*, and not mathematics *per se*. For the word 'discipline' points not only to the logic and content of mathematics, but also to the whole set of procedural and regulatory practices accepted by mathematicians and people who use mathematics.[6]

So, to be obedient to the discipline of mathematics, in its fullest sense, is to be obedient to the community of practitioners of mathematics – but not in the sheepish way that might be expected from one facing a powerful board of directors. The kind of obedience intended here is of one who is fully part of the community. In a way, this is the final and highest expression of shared authority. Benne (1970) has called this 'anthropogogical' authority. Unlike other forms of authority, Benne's 'anthropogogical' variety does not aim to preserve any social structure or the rules of any system but to cause a community to grow and be renewed.

Although we shall discuss Benne's ideas in more detail in the conclusion – for they represent more an ideal to which education might aim than a description of the way things are – it should be evident to the reader that there is a clear path from the notion of authority presented at the start of this section to these ideas of Benne. Yet, the vision of authority at the one extreme is, admittedly, quite different from that at the other. For this reason, as a terminological convention, we shall use the phrase 'revised authority' when we mean notions of authority close to those of Benne, while for notions of authority captured by the initial definition, including the basic notion of expert authority, we shall simply write 'authority'.

To conclude the theoretical discussion of authority, we must stress that, as we have just observed in connection with Benne, the reality of authority hardly exhausts its possibilities. Naturally, our data focus on the former; from the data, we present a case study of how authority relations *actually* appear in an 8th grade mathematics classroom. The principal forms of authority which we discern are, indeed, those traditional forms akin to the Weberian types and expert authority. But such empirical findings cannot be properly understood without viewing them against the possibilities of authority. For this reason we have given more attention to these wider aspects of authority than some readers might, at first, deem necessary, and we shall further develop them in the concluding discussion. But for now, the main theoretical points made so far can be seen in the Figure 1.

3. THE RESEARCH SETTING AND METHODOLOGY

3.1. *The learners' perspective study*

The observations and thoughts on authority presented in this paper are only part of a more extensive study of student practices called the *Learners' perspective study* (LPS) (Clarke, 1998, 2000). The LPS is an ongoing international effort involving nine countries, which arose out of the Third International Mathematics and Science Study's (TIMSS) video project. The TIMSS project sought to identify and analyze national norms for teaching practice; its results, however, were widely debated and not universally accepted (e.g. Keitel and Kilpatrick, 1999; Stigler and Hiebert, 1997, 1998, 1999). Among the major objections were that it focused exclusively

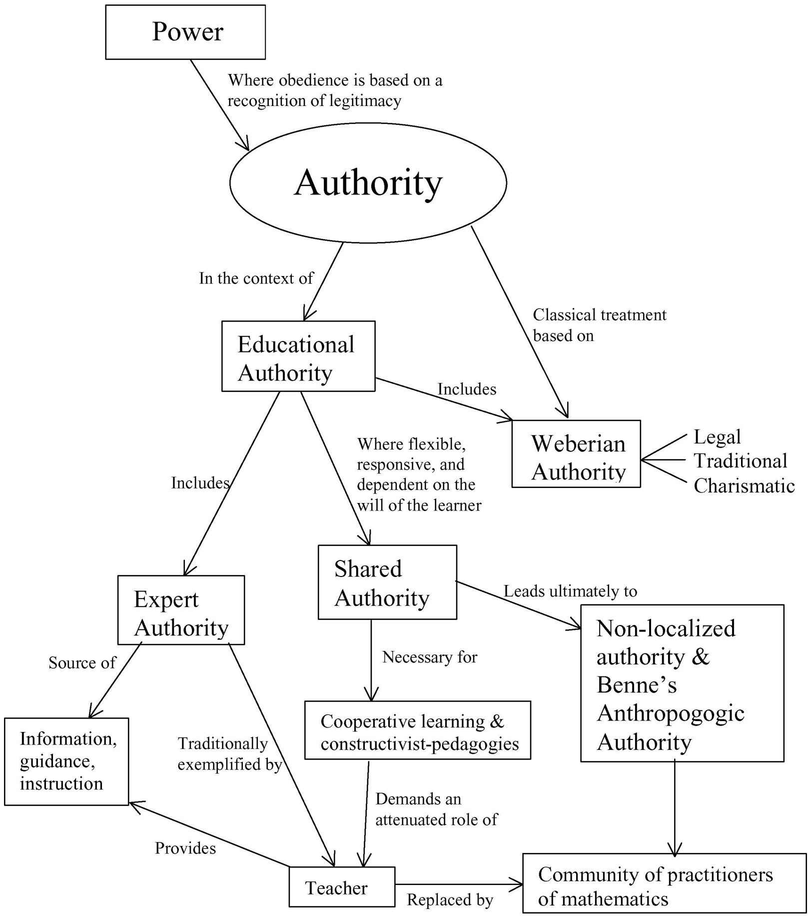

Figure 1. Authority: Summary of main ideas.

on the teacher while ignoring the important role students have in the learning process, and that only one lesson per teacher was recorded. The LPS, by contrast, focuses on *student actions* within the context of whole-class mathematics practice and adopts a methodology whereby student reconstructions and reflections are considered in a substantial number of videotaped mathematics lessons. Its aim, ultimately, is to identify and explore the ways students conceive mathematics classroom practice and mathematics learning.

3.2. *Methodology*

As specified by Clark (2000), classroom sessions were videotaped using an integrated system of three video cameras: one viewing the class as a whole, one on the teacher, and one on a “focus group” of two or three students. Following each lesson, the students in the focus group were interviewed. The researchers were present in every lesson, took field notes, collected relevant class material, and conducted all the interviews.

Ten to fifteen consecutive lessons in each class were videotaped. This meant that almost every student, at one point or another, was a member of a focus group and, therefore, interviewed as well. Once a week, moreover, the teachers themselves were interviewed. A notable aspect of all the interviews was that the interviewees could view and react to the videotape of the lesson preceding the interview. Needless to say, the interviews themselves were also videotaped. Following each filming session, we, our administrative assistant and technical crew engaged in a period of group reflection in which we compared notes, discussed issues, and raised questions concerning that day’s lesson.

For both the student and teacher interviews, a basic set of questions was constructed, but only to provide a general guideline for the interview; in practice, we allowed the interview protocol to remain quite flexible so that we could freely pursue particular classroom events. In this respect, our interview methodology was along the lines of Ginsburg (1997). This particular methodology was chosen because the overall goal of the study was, from the start, not so much to test hypothesized student practices as it was to discover them in the first place. Because of this, too, our research – and this paper – tends to have a non-traditional ethnographic flavor akin to that in Fried and Amit (2003) (see also Eisenhart, 1988).

The fruitfulness of this open-ended research approach has been deomonstrated by this very study of authority. Among the general research questions for the study originally set out by Clarke (2000) was the question of whether teacher and learner practices are conflicting or mutually sustaining. This led us to ask the students during the interviews about the circumstances in which they request help from their teacher, and, from there, whether they request help from other people as well. We put the question this way because we observed in the classroom sessions (and this can be clearly seen in the video tapes) that although the students sat in pairs and were meant to work together, they rarely worked cooperatively; rather, they seemed to ignore their co-workers and turn to the teacher, or sometimes to a ‘knowing’ member of the class. From these observations and our interviews a new set of questions arose for us concerning students and authority, questions such as, Who is an authority for students? What is the extent of the authority of various people? How pervasive is the influence of authority in students’ mathematical lives? What effect does students’ relationship with authority have on their mathematical practice? The open-ended approach of the LPS thus allowed these questions, which were *not* among the initial research questions, *to become* research questions for us.

The specific case which formed the basis for this paper was a sequence of 15 lessons on systems of linear equations taught by a dedicated and experienced teacher, whom we shall call Danit. Danit teaches in a comprehensive high school. Her 8th grade class is heterogeneous and comprises 38 students, mostly native born Israelis, but also new immigrants from the former Soviet Union and one new immigrant from Ethiopia. The data from Danit's class were supplemented by further data from a second classroom in a different school, which was also studied within the LPS framework. Four lessons in this second classroom were observed and eight students were interviewed. The lessons were on geometry and were taught by a teacher, whom we shall call Sasha. Sasha is a new immigrant from the former Soviet Union with several years' experience teaching in Israeli schools and much experience teaching in Russian schools. His 8th grade class is a high-level class and comprises 30 students.

4. FINDINGS AND INTERPRETATIONS

4.1. *Students seeking authority*

When students were asked to whom they turn for help when they run into difficulties, they provided always the following sources of help: their teacher, their friends, their parents, or their siblings. Of these, the students' teacher and friends were the dominant sources of help spoken about in the interviews. When asked to whom they turn first, some students said the teacher and some their friends. The reason given for turning to friends first was almost always that the "teacher is too busy and can't get to everyone." Often, however, it seemed to us from our observations of the class that students turned to their friends first simply because their friends were near, for usually they were students sitting at the same desk.

Teachers, friends, parents and siblings form a web of sources of guidance; when one source is unavailable or unable to help, one turns to another. For example, if Yara in Sasha's class cannot get help from Sasha, for one reason or another, she turns to one of her friends:

Interviewer: And if your friend doesn't know?
Yara: If my friend doesn't know, I ask someone else – or my father.

Again, when we asked two students, Maor and Coby, in Danit's class how they would check to see if their teacher has made a mistake (a possibility they had trouble accepting), Coby answered as follows:

Interviewer: . . . So what conclusion do you draw?

Coby: That you have to check with a few people, a few answers, like, if is correct. I, say, I ask the teacher, I have to ask a few more people and see if it's the same thing.

Interviewer: Who else would you ask?
Coby: My mother, friends.
Interviewer: Ah, your mother?
Coby: Yes.
Interviewer: Friends from the class?
Coby: Yes

This web, moreover, appears to have a hierarchical structure. Of course physical proximity is a trivial principle of hierarchy: friends, since they sit at the same table, come first, then the teacher, then parents and siblings. But beyond such trivialities, the web seems to forms a hierarchy according to the degree of authority possessed by the sources, by which we mean the degree to which a person's statements are to be taken unchallenged. Often this appeared to be, rather prosaically, the degree only of expertise, as in this exchange with two of Danit's students:

Interviewer: When do you go to the teacher [for help] and when do you go to your friends?
Gila: When there is, say, some subject I don't understand, then I go to the teacher, because she explains better than the other kids. But if its just, say, where to put the minus and where the plus, or something like that, those are little things.
Sarah: // Little things friends can help you with.
Gila: That's it, I just go and ask [friends].
Sarah: If you don't understand at all, then you go to the teacher, and she explains to you really everything. But, again, if it's something little, friends can help you.

As sources of guidance and instruction, it is clear we are speaking here about *expert authority*, as explained in the general discussion above. And yet it is important to stress we are also dealing with authority in a wider sense: the reason a person's statements are not to be challenged, as we shall soon see, is not always dependent on the degree of the person's knowledge, though it may be perceived that way. Thus Yara's father, who is not a mathematics teacher, becomes an option for help and guidance when Yara's friends in the class cannot help her. Indeed, parents and older siblings are typical examples of *traditional authorities*, not expert authorities. Now, in this hierarchy of authorities, there is no question, the teacher comes first.

4.2. *The teacher's authority*

The teacher's tremendous authority, in every sense of the word, was evident in all of the student interviews in both Danit's and Sasha's class. First of all, whatever else happens in the classroom, students place the teacher at the center. This could be seen plainly in the responses to a task we gave in every interview in which the students were asked to describe the lesson as if they were describing a movie scene. A typical response was this one from Danit's class:

Sylvia: Ok, she [Danit] came in, we got organized, and then she said that today we were going to put aside the material we learned yesterday and start something new; and then she showed us exercises on the board; and then she asked what material we were going to learn today, and we said equations in two unknowns. She explained a little on the board, gave some examples; and then she said to us to practice from the book and we did exercises from the lesson she gave; and then she went around among the kids – whoever needed help; and then we finished the lesson, that's it.

What is particularly striking about this is that Danit emphasizes independent work and rarely gives more than an abbreviated frontal lesson. Nevertheless, in Sylvia's description the camera seems always focused on Danit; for Sylvia, it seems, no presence in the class is as obvious as that of Danit – so much so, that Sylvia never once says 'Danit' or 'the teacher', only 'she', as if there is no need to explain who 'she' is.

But the teacher's authority means more than merely an indisputable presence. For example, at one point in our interview with two students in Danit's class, Michael and Saul, we asked whether a graphical method or algebraic method of finding the solution to a system of equations was more reliable. Here is the exchange:

Michael: If I get a answer for one and a different answer for the other, then you've got to check. If I get the same answer, then I'll believe it's correct. But if there's, maybe, still some doubt in my mind, I ask Danit.

Interviewer: What does Danit have that other people don't?

Michael: [Dramatically] She's a teacher, she can help; if you make a mistake, she corrects it!

Interviewer: And if she errs?

Michael: She doesn't err.

Saul: She studies everything at home before she comes to class.

Michael: Otherwise she couldn't correct – she's a teacher!

Interviewer: But she did make a mistake at the board.

Saul: She got mixed up because she substituted wrong.

Michael: Those are nonsense things she gets mixed up about, but real things [gestures to show the weightiness of the things he has in mind] – if two exercises are supposed to get the same answer or not, it doesn't seem to me she'd get mixed up about that.

In this exchange, one is impressed by the extent to which Michael and Saul are willing to see Danit as nearly infallible, and the extent to which they are willing to defend her authority, even when she is seen to make a mistake. The students view her, apparently, not only as one who knows more than they do and as one who, because of her position in society, deserves their respect, but also as a strong figure with powers they lack. When Michael says, "She's a teacher, she can help; if you make a mistake, she corrects it!" he sounds as if he is speaking of a healer, a miracle worker, rather than of his 8th grade math teacher. One sees here a clear example of how the teacher's authority is not only expert authority or traditional authority, but also even *charismatic authority*, to use Weber's categorization.

Similarly, when we asked Sylvia and Shari, also Danit's students, what exactly do they expect from the teacher when they ask her for help, the exchange was as follows:

Interviewer: What do you expect when you ask the teacher for help? What do you expect from her?

Sylvia: That she will explain to us better

Shari: [confidently and without pause] When she comes over to me, when she explains to me, *suddenly I understand better* [emphasis added].

Interviewer: How do you explain that you suddenly understand better? Why is this?

Shari: Because she explains to me on the worksheet and shows me the way.

Shari did not really seem to know how to answer the question, how to explain her sudden understanding, but she was convinced that, under Danit's influence, she did indeed *suddenly* understand better. Consistent with this image of Danit, was the importance the students seemed to place on the mere fact of Danit's coming over to help them when they worked on exercises. When we asked what the climax of the lesson was, Elana, in the same interview in which Sylvia and Shari participated, answered, "When I was having trouble with the book and I called [Danit]." In a different interview, another girl in Danit's class, Gila, answered the same question in precisely the same way. Conversely, on two different occasions we came across a student in Danit's class who also appeared to be having trouble with the exercises, but who did not ask Danit for help. When we asked them why not, we received the same response both times: "The teacher doesn't want to help me." Such a statement presents a picture in which the attention the students receive from the teacher is dependent on the teacher's whim. The teacher becomes, in this interpretation, a dictator, though, surely, for most students, a beneficent one who willingly helps them when they need help. Nevertheless, conceiving the teacher as a creature of whim is to conceive the teacher as a creature with terrific power. Again, we wish to emphasize that this kind of authority that the teacher possesses thus goes beyond expert authority, and certainly beyond the other 'rational' type of authority, legal or bureaucratic authority, the authority gained just by having a certain position in the school.

We should also point out that it is of no small importance that these teachers are mathematics teachers. Thus, in the same exchange with Coby and Maor, referred to above, Maor says:

Maor: I wanted to say that if I want to ask something and the teacher tells me the answer, I don't check if the what the teacher says is correct, I take it as obvious that it's correct, *especially if it has to do with mathematics* [emphasis added].

Moreover, both Coby and Maor, throughout our interview with them, frequently asked us to qualify whether we were speaking about mathematics in particular, hinting that mathematics was atypical among school subjects. Mathematics is viewed as different from other subjects; it is categorical and unambiguous. So it came as no surprise that, in our interview with her, Chanita from Danit's class, said:

Chanita: Its like, in math [*cheshbon*, lit. 'arithmetic'] there's one answer; *its not like literature where someone can say this way, and someone can say that way* [emphasis added].

The mathematics teacher, accordingly, must be taken to be an authority in a subject where authorities cannot be easily challenged.

4.3. *The authority of peers – authority ad-hoc*

That the teacher should be given this degree of authority by the students is perhaps not very surprising. However, we were surprised to see how easily students are willing to see *other* people as authorities to a degree similar to that to which they see their teacher as an authority. For example, we were interested in seeing how students understood the significance of "showing their work," whether this was only a requirement of students or of mathematics itself. So, we asked whether a salesman who explained to customers how much they should pay given such and such a discount had to show his/her work. To this, Ben, again from Danit's class, replied as follows:

Ben: No, I can rely on him . . . I can rely on him – for sure lots of people come to him – there must be those who know percentages and things, and they rely on him, so I can rely on him too.

It is worth noting here that the Hebrew word Ben uses for 'rely' is *somech* which is closely related to the word *somchute* meaning, literally, 'authority' (Maor when asked whether "Danit knows" similarly replied that he can "rely (*somech*) on her").

Students tend to see authorities at every turn. Their web of sources of guidance becomes, in this light, a true web of authorities. What is particularly striking, though, is that this extends also to the students' friends. As mentioned above, friends in the class are a dominant source of help. But when the students turn to their friends they tend to turn to them only for answers. And, as we saw with Sasha's student Yara, when one friend does not know, she turns to another. In one interview in Danit's class, we asked a student, Ari, why he did not ask his friend for help at a certain point during the lesson. He replied, "I knew Yuri wouldn't know the answer . . .," and that was consistent with Ari's general disparaging attitude towards Yuri as a fellow student, even though they claimed to be friends outside of school. On the other hand, Yuri often looked to Ari for help, and Ari looked to the teacher as a source of help.

Thus, when students are perceived by their fellow students as knowing the answer to some question they are treated for that instant as an authority, that is, the answer is accepted and not discussed. When students are not perceived as knowing the answer, they are usually not asked. In fact, in the classroom videos it can be seen quite often (though less so in the geometry classes) that students sit together, occasionally speak together, but do not really work together, even though they are not necessarily encouraged to work individually, where Maor does not ask anything of Coby because Coby "is working," even though they were supposed to work together! When Yuri, for example, looked at Ari's work, it was never with any discussion; Ari is only a source of information that can be relied upon, just as the salesman's information could be relied upon by Ben.

To understand the significance of this tendency of students to treat one another as authorities *ad hoc*, one needs first of all to see what alternative stands opposed to it. This need not be considered hypothetically, for in Sasha's class we found an exception to the tendency. During his lesson, Sasha gave a geometry problem to the class; we watched as two girls, Yana and Ronit, solved the problem in a truly collaborative spirit. Ronit showed her diagram to Yana; Yana commented and pointed to her own diagram; they discussed the problem together, and, finally, came to a solution. Yana and Ronit happened to be our focus group for that lesson, and throughout the interview we saw how different their behavior was from other students we observed: they consulted with one another, raised possibilities on their own, revised opinions, and seemed to arrive at common conclusions. In other words, rather than treating one another as possible authorities, that is, only as possible sources of answers, Yana and Ronit treated one another as intelligent interlocutors who could work together to make progress on the question at hand. We should stress that this was, indeed, behavior different not only from that of students in Danit's class, but also from that of other students in Sasha's class. For instance, at one point in our interview with Yara, we asked if she could draw a triangle having two acute exterior angles; she said she could, and she proceeded to draw a diagram, which, obviously, could not be correct. When we asked Panina, the second girl in the focus group, whether Yara's diagram was ok, she assented immediately and with no further remark.

5. Discussion

5.1. *Authority and students' ability to think and interact meaningfully*

Speaking about argumentation, Simon (2000) claims that, because students treat teachers as authorities who can give a stamp of approval on the students' mathematical arguments, it does not follow that students lack the ability and willingness to engage in the validation process themselves. This is a reasonable claim, and, certainly, our interview with Michael, quoted above, gives some confirmation of it. Simon compares the students' relationship to the teacher, in her/his capacity as an authority, to the situation of a mathematician who is working in a field not her/his own and who seeks the evaluation of an expert in that field (Simon, 2000, p. 166). But the evidence presented above shows that the way the teacher is an authority for the student is much stronger than this. In this connection, we tend to agree with Lewis-Shaw when she writes "[The students'] perspective consists in relating to the world with less awareness of the nature and extent of their personal authority or control. Consequently, they strive for a sense of belonging, count on the teacher for some level of security and authority and regard him as the holder of knowledge and expertise" (Lewis-Shaw, 2001, p. 182).

This strong authority relationship is bound to affect the way students engage in mathematical thinking. An indication of this is given in Helme and Clarke (2001). They report that when a teacher approached a small group of students working on a problem there was a different pattern of interaction in which the teacher's questions became the central focus. Moreover, "With the teacher asking virtually all the questions, there was little opportunity for students to initiate ideas or spontaneously express and resolve uncertainty" (Helme & Clarke, 2001, p. 146). Such a situation cannot be conducive to reflective thought about mathematical ideas.

In Danit's class, we observed how the teacher's authority can truly create conditions in which it becomes very easy for students to use concepts unreflectively. Danit asked at a certain stage what allows us to go from the system,

$$\begin{cases} 2x + 3y = 18 \\ x = 3 \end{cases}$$

to the equation, $2{\cdot}3 + 3y = 18$, that is, what allows us to substitute 3 in place of x? She prompted the class, saying, "It begins with 'A' . . . ". Eventually, Oren, whom we interviewed afterwards, said "axiom" (roughly the same time as another student). But which "axiom"? Danit gave the answer the "axiom of substitution." We asked Oren about what went on in that instance. Oren told us how he remembered the word "axiom" when Danit said that the word began with "A". We discussed the meaning of axiom, which he seemed to grasp in a very rudimentary way. However, when we asked Oren if he had any idea why such an axiom might be needed, he had difficulty grasping what we were asking him. It became clear that Oren recognized an axiom here mainly because Danit said there was one. In other words, the need for an axiom was accepted on Danit's authority only. This was striking because more than once during the lesson Danit tried to emphasize that things in mathematics were not true because she said so, or the because the book said so, or because anyone else simply said so.

5.2. *Implications for collaborative learning*

That the pattern of authority existing between teacher and student can also come to characterize the relationship between students, even in a small measure, clearly has important implications for collaborative learning. For as Johnson and Johnson (1989) suggested, "Simply placing students in groups and telling them to work together does not promote greater understanding of mathematical principles or the ability to communicate mathematical reasoning to others. Group efforts can go wrong in many ways" (p. 237). Where students are accustomed to treating one another as authorities one student will simply listen and assent to the other, or, alternatively, will turn to a different authority, just as Yara turns to another friend when the first "doesn't know." The point is, where students are accustomed to treating one another as authorities no true dialogue takes place between them, and where there is no true dialogue there can be no true collaborative learning. Thus, the establishment of an authority relationship between students becomes one of the most potent ways in which "Group efforts can go wrong"! The point would be merely an academic one if it were not that collaborative learning seems to be one of the more effective means of encouraging reflective thinking (e.g. Johnson and Johnson, 1989, p. 236). In this way, by helping to develop a relationship between students not based on authority, but on intellectual partnership, we go far towards encouraging also the kind of thoughtful approach to learning mathematics that most of us strive for.

5.3. *Non-localized authority*

But is intellectual partnership as truly opposed to authority as we have made it appear? Is authority something to be shunned, removed from the classroom? To answer these questions we must backtrack and recall our initial discussion of authority. At the start of that discussion we said that by a relation of 'authority' we mean a relationship in which one person (or group of people) tends to obey, act on, or accept without question the statements or commands of another person (or group of people or any other entity capable of producing statements or commands). Expert authority, which was the variety we most often intended when we used the word authority in the foregoing, is certainly an authority relation in this sense. However, we showed how a deeper look at authority, especially in educational settings, leads to the possibility of 'shared authority' and, ultimately, a kind of authority which is non-localized, that is, in which there is no immovable division between the subject and agent of authority (a possibility that may be compared, by the way, to Foucault's views on power, specifically, that it "must be analyzed as something which circulates" (Foucault, 1980, p. 98)). This view of authority, because it is so different from that of the Weberian mold, we call 'revised authority'. As representative of 'revised authority', we take the work of the educational theorist, Kenneth Benne.

5.4. *Benne's idea of anthropogogical authority*

Benne's basic thesis is that, understood correctly, authority can be approached as a force for liberation and social change; it need not be the mere emblem of the despot. Thus, from the start, Benne situates authority not in a context characterized primarily by power and struggle but by dependence and interdependence; an authority relationship arises, in Benne's view, where one person has a need or purpose that another has the power to satisfy (this is the one restricted sense in which power is connected to authority – power that is not coercion):

> Authority is always a function of concrete human situations however large or complex the situation may be. It operates in situations in which a person or group, fulfilling some purpose, project, or need, requires guidance or direction from a source outside himself or itself. The need demarcates a field of conduct or belief in which help is required. The individual or group grants obedience to another person or group (or to a rule, a set of rules, a way of coping, or a method) which

claims effectiveness in mediating the field of conduct or belief as a condition of receiving assistance. Any such operating social relationship – a triadic relation between subject(s), bearer(s), and field(s) – is an authority relationship (Benne, 1970, pp. 392–393)

Within this framework, Benne discusses three different kinds of authority: expert authority, rules authority, and 'anthropogogical' authority.

Authority of expertise is epitomized by the relationship between a doctor and a patient. One of the crucial characteristics of this authority relationship is that it is "grounded in a persistent differentiation of function and specialized ability between bearer and subject" (Benne, 1970, p. 395). In other words, as long as the relationship exists, the doctor remains the doctor and the patient the patient.

In the second type of authority relation, authority of rules, the subjects are like players of a game. They need the rules of the game to make the game work and, therefore, they consent to obey the rules. The authority of rules brings out the supreme importance of consent and agreement in authority as opposed to obedience only. Thus, Benne says, "... the authoritative character of rules and codes does not rest upon the 'original' legislation of founders or remote legislative bodies, but upon re-legislation of the rules and codes through the decision by particular groups of people to act and interact in and through them" (Benne, 1970, p. 398). Only if this is kept in mind, he says, can it really be said that the rules themselves are the bearers of authority in this relationship.

It is tempting to see mathematics itself as this kind of authority of rules. But as we argued above, mathematics itself as an authority is a problematic notion, as is the notion that mathematics is merely a fixed body of rules. Nevertheless, conceiving the exercise of authority (rather than mere power) as negotiation and the bringing of a group into accord turns out to be the key to the last form of authority, anthropogogical authority – and *this* kind of authority is the kind that best describes that of the *discipline* of mathematics.

'Anthropogogy' is a word coined by Benne, which, as an alternative to 'pedagogy', reminds us "... of the need of human beings at all chronological ages to be reeducated ..." (Benne, 1970, pp. 391, note); it is directed towards the continuous formation and renewal of the entire community. For anthropogogical authority, Benne again turns to the doctor for his paradigm example, but, in this case, the doctor and medical student rather than the doctor and patient. The relationship between a doctor and a medical student may, at the beginning, appear similar to an authority relationship based on expertise, but, in fact, it differs from that in two crucial ways. First, as the relationship persists, the distinction between the doctor and medical student fades, until finally, when the medical student's studies have been completed, the distinction has vanished completely, and the two become colleagues. This is why Benne says, "All anthropogogy is at once a mothering and a weaning, a rooting into ongoing authority relations and a pulling up of roots" (Benne, 1970, p. 401). But what does he mean by "ongoing authority relations"? This has to do with the identity of the bearer of authority, in which lies the second crucial difference. In the relationship of expertise, the doctor is the clear bearer of authority; here, it is the entire medical community – not only the people who make it up, but also the norms by which it functions and the collective knowledge and skill it contains – into which the medical student is inculcated. There is some resemblance in this way to the authority of rules, but where rules are, for the most part, fixed, the community is fluid and ever developing. As Benne puts it:

> The ultimate bearer of educational authority is a community life in which its subjects are seeking fuller and more valid membership. Actual bearers and subjects of this authority must together build a proximate set of mutual relationships in which the aim is the development of skills, knowledges, values, and commitments which will enable the subjects to function more fully and adequately as participants in a wider community life which lies beyond the proximate educational associations (p. 401).

5.5. *Some implications and final thoughts*

Anthropogogical authority addresses the problems which we raised at the start of this concluding discussion, namely, that relationships of authority interfere with students' ability to reflect for themselves and participate in the construction of mathematical ideas and, at the other extreme, with their ability to work collaboratively to solve problems and obtain mathematical insights. Authority interferes in this way, however, *only* when it is imposed from the outside, as it is in the case of simple expert authority; when the student is engaged in that kind of relationship, authority gives no practice in negotiation and independence, *only* in domination and obedience. But as we have seen, anthropogogic authority does precisely the opposite by blurring the division between agent and subject, by shifting the emphasis from domination and obedience to negotiation and consent, and by conceiving the relationship of authority as dynamic and fluid. Thought of in this way, such 'revised authority' fits very well the model of mathematical work that we do want to instill in students. It conceives students as participants in a community of mathematical thinkers (which is far wider than the community of professional mathematicians) – and this means, in its turn, not mere blind obedience to a fixed and fully known body of rules, but the continual attempt to discover rules and define their scope, *as well as* working within and finding the grounds of existing rules and knowledge.[7]

Seen in this light, it is clear what is wrong with the web of authority that was evident in Danit's and Sasha's classes: by turning always from one figure to another, and never to themselves, the students not only fail to develop their own mathematical thinking but they also perpetuate this failure by always defining themselves as *outsiders* with respect to mathematical discourse.

'Revised authority' as we have been discussing it, we might add, also sheds light on the public-private dichotomy in mathematics education described in Fried and Amit (2003). Fried & Amit use this dichotomy, well known in political and social thought, to categorize different kinds of mathematical activity. Thus, for example, reflections, deliberations, false starts belong to the private domain while precise use of standard notations and representations belongs to the public domain. Their basic claim, made in the course of investigating students' use of mathematics classroom notebooks, is that overemphasis on the public domain stifles very important activities in the private domain. The connection to what we have been saying in this paper is clear once one sees that authority, in the unrefined traditional sense, belongs in the public domain and is pitted against the free, uninhibited, and reflective work characteristic of the private domain. 'Revised authority' links these two domains by inculcating students with the sense that their future lies in being participants in shaping the public domain, that is, that their private reflections and deliberations matter in building and developing the community of mathematical thinkers.

Finally, we want to express our conviction that 'revised authority' is relevant not only for the philosophically-minded educational researcher, but also for teachers in the field. Our data showed that teachers have tremendous authority, in the non-revised sense, and that this authority may have an impact on how students interact with the teacher and, ultimately, how they approach mathematics. Teachers must be made to realize this possibility, but also shown that the alternative need not be relinquishing authority; they must learn to see themselves, like Benne's teaching doctor, working to make their students into colleagues who finally will completely share authority with them.

NOTES

1. This paper is a much expanded version of a talk (Amit & Fried, 2002) given at the PME26 Conference, held in Norwich, England, July 2002.
2. Vithal (1999) is a possible exception, though her emphasis on the complex relationships between *democracy* and authority makes her work somewhat different than ours. Still, we find the idea of 'complementarity' in this context a fruitful idea and one in line with our own thoughts on authority.

3. In Weber's words, power (*Macht*), by contrast to authority, is only "the probability that one actor within a social relationship will be in a position to carry out his own will despite resistance, *regardless of the basis on which this probability rests* [emphasis added]" (Weber, 1947, p. 139; see also Wolfe, 1959, pp. 99 – 102). Authority is, thus, a form of power but not identical with it. So, although many things which can be said about power can be said about authority as well, still, the distinction between power and authority is quite fundamental (which explains why we omit what might be for some an obvious source, namely, Michel Foucault (e.g. Foucault, 1980)) and, needless to say, more ancient than Weber. Thus, for example, in section 34 of Augustus' *Res Gestae* (a section which Leonard Krieger describes as "the most revealing pronouncement in the whole history of the idea of authority" (Krieger, 1973, p. 144)), Augustus tells how he relinquished power (*potestas*), by which he meant specifically legislative power, yet, because of his deeds, fame, and virtue, possessed greater authority (*auctoritas*) than anyone else in Rome; he possessed authority, which, of course, made him also a possessor of power, because those over whom he had authority recognized that he *deserved it by right*.
4. By 'ideal types' of authority, Weber means formal categories of authority into which actual historical examples can be analyzed, without necessarily identifying a given authority with any single one of them.
5. Wolfe (1959) uses the term 'shared authority' in a slightly different sense in speaking about the way authority is shared in a household.
6. This view of mathematics, in which the activity of real human mathematicians has a central role in defining what mathematics is, has been a constant theme in the philosophy of mathematics at least since Lakatos. Thus, for example, Hersh (1998) calls mathematics a social-historical phenomenon and Ernest (1991) calls mathematics a social construction. However far one wants to take this point of view, it is hard to deny that there *is* this social side of mathematics that, at the very least, disciplines the discipline of mathematics.
7. This can be related to Lave and Wenger's (1991) idea of 'communities of practice' and the theory of learning connected with it, namely, 'legitimate peripheral participation'. According to Lave and Wenger, learners are always engaged in the practices of a community, and, by participation in these practices, eventually become active and productive members of the center of the community; it is a view which conceives learning, thus, as "an evolving, continuously renewed set of relations" (p. 50). (We are grateful to Norma Presmeg for pointing out this connection between our work and these ideas of Lave and Wenger.)

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