

## Discipline-specific Socialization: A Comparative Study

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**Abstract:** Do different disciplines cultivate different epistemologies? We draw on the epistemological framework of D. Kuhn et al. that delineates three perspectives: absolutist, maintaining that knowledge is objective and immutable; multiplist, maintaining a radical relativism; and evaluativist, maintaining a qualified relativism. We conjectured that typical instruction in the humanities would tend to foster evaluativist views more than typical instruction in the sciences. Twenty biology majors and twenty history majors evaluated competing accounts in biology, history and judicial contexts. Structured interviews concerning these accounts were used to assign each participant an epistemological view in each discipline. These results were considered in conjunction with learners' reports of their educational experiences. We were disappointed to find that there was an overall tendency toward absolutism. Our main finding is that students are distinguished by major and epistemological view, and that typical history instruction more than typical science instruction seems to foster evaluativist views in history.

### Introduction

Learners' epistemologies are of increasing concern to learning scientists. What learners believe about the certainty and simplicity of knowledge, and about the source and justification of knowledge influences how they approach knowledge construction and learning (Hofer, 2004; Schauble, Glaser, Duschl, Shulze, & John, 1995; Songer & Linn, 1991). Schooling and level of education appear to be a strong factor in the development of these beliefs (Kuhn, Cheney, & Weinstock, 2000; Schommer, Calvert, Gariglietti, & Bajaj, 1997). Although developmental patterns have been associated with grade level, it seems that educational experiences rather than age explain most differences in epistemological views. Unique educational experiences are associated with epistemological perspectives that depart from that grade level's norm (Smith, Maclin, Houghton, & Hennessey, 2000), and classrooms with different curricular foci at the same grade level can be characterized by different epistemological belief patterns (Tabak & Weinstock, 2005).

Moreover, there is increasing evidence that epistemological views are discipline specific, that is, the same individual may hold different beliefs about science than about art or psychology (Hofer, 2006). Despite differences between disciplines, there seems to be some measure of regularity concerning beliefs within and about particular disciplines. This suggests that learning experiences are key in shaping epistemological views, and that different disciplines cultivate different beliefs about the nature of knowledge. In this paper, we report on a study that examined whether different disciplines, college-level biology and college-level history, fostered different approaches to knowledge. Specifically, we compared the ways in which biology majors and history majors evaluated competing-claim scenarios in biology, history and judicial domains. In addition we explored whether students' approaches to these tasks and any differences among them seem related to students' accounts of their college learning experiences.

### Background

#### The Absolutist, Multiplist, Evaluativist Framework

We approach this exploration of biology and history majors' epistemological views from the framework advanced by Kuhn and her colleagues (e.g., Kuhn & Weinstock, 2002). This framework is consistent with a number of approaches in developmental psychology's investigation of personal epistemology (Hofer & Pintrich, 1997). The framework distinguishes between three approaches to knowledge: (1) "absolutist"—the conception of knowledge and knowing as objective and absolute, (2) "multiplist"—regarding all knowledge as subjective and relative and, therefore, indeterminate because of multiple points of view and (3) "evaluativist"—a qualified subjectivity that integrates subjective and objective aspects of knowledge permitting a degree of evaluation and judgment of knowledge claims. Table 1 elaborates some of the beliefs about the certainty of knowledge, the source of knowledge and the justification of knowledge that are associated with each of these perspectives.

Table 1: Characteristics of epistemological views along central dimensions of the nature of knowledge

	Absolutist	Multiplist	Evaluativist
Certainty	Knowledge is certain. Any uncertainty results from error or insufficient information.	There is no certainty.	There is no certainty. But, one account may be more trustworthy if there is more evidence to support it.
Simplicity	There is one single correct account based on self-evident facts.	There are multiple accounts.	There are multiple accounts each containing different types of information, arguments, and interpretations.
Source	Knowledge comes from experts or authority that are able to discern the objective reality.	Knowledge derives from opinions.	Knowledge is constructed.
Justification	Facts either prove or disprove knowledge claims.	Knowledge claims can never be truly defended, because all opinions are equally valid.	Preponderance of valued sources of evidence.

### Why Adopt this Developmental Framework in the Learning Sciences

This framework has been employed mostly in the area of developmental psychology. In the learning sciences, research on epistemology has focused more closely on particular disciplines, predominantly science, and has focused on the distinction between absolute and dynamic or constructivist views of science/knowledge (e.g., Hogan, 2000; Songer & Lim, 1991). We have found that the Kuhn et al. framework has refined our understanding of epistemological perspectives within particular disciplines, and especially in science. In particular, this conceptualization reveals nuanced distinctions that might exist in students' specific conceptions of the nature of science, by pointing to two perspectives that can fall under a constructivist or dynamic view of science. For example, learners who note that two scientists can look at the same data and arrive at two different but correct explanations may be attributed with a dynamic view of science. Yet, when viewed from the Kuhn et al. framework, there are two possible epistemological views that might underlie this position: a multiplist or an evaluativist perspective. This distinction has important implications for learning in the disciplines, and most notably in inquiry-based science, because of its impact on an individual's inclination to critique and refine explanations.

Being inclined to judge the value of a claim or explanation rests on a consideration of knowledge as a product of construction. If knowledge is considered immutable, then it makes more sense to simply assimilate the new information, than to question the strength of its warrants or explanatory power (Songer & Linn, 1991). This depicts an absolutist perspective, and this depiction is a point of convergence between the prevalent approaches in the learning sciences and in developmental psychology. Yet, even if knowledge is considered constructed, there may not be much motivation to critique it if radical relativity/multiplicity, is espoused. That is, if people believe that all claims are equally valid then critique may seem like a pointless exercise. This is in contrast to scientific practice, where explanations are continually critiqued and refined in order to arrive at the most parsimonious explanation that explains the widest range of data or phenomena. This type of practice is motivated by seeing knowledge as constructed but subject to adjudication. Or, in other words, on adopting an evaluativist perspective. In sum, an evaluativist, but not a multiplist perspective would be commensurate with science learning goals, but this distinction would not be perceptible in the absence of the Kuhn et al. lens.

### The Present Study

We conducted the present study as a follow up to earlier surprising findings. In an earlier study we compared epistemological perspectives between a "regular" school and a science-centered school that has an extended project and inquiry oriented science curriculum. We had expected students in the science-centered school to tend more toward evaluativism, especially in science. However, these students actually tended toward absolutist

views in science (citations omitted for blind review). This led us to consider why an emphasis on science might lead to absolutist views. We conjectured that the emphasis on science made broader societal beliefs such as the belief in the superiority and certainty of science more salient, and that these broader scripts shaped learners' views about science. In response to our surprising findings, we also began to explore learning in other disciplines, and further conjectured that instructions it is typically carried out in the humanities, and especially in art, would foster evaluativist views to a greater extent than typical science education. There is a measure of irony in this line of conjecture— in the sense that the disciplines that are less privileged in society, such as art in comparison to science cultivate the epistemological views that are more valued (at least from a Western social science perspective).

Therefore, we set out to compare the epistemological views of students in a scientific discipline and in a humanities discipline. We focused on biology and history as a function of access to participants, and of our prior research experience. We expected history majors to tend more toward evaluativism than science majors. We expected students to have differentiated views concerning their own and other disciplines. As we noted in the introduction, prior research has documented discipline-specific and differentiated epistemological views (Hofer, 2006). Many of these studies employed questionnaires that ask participants about how knowledge claims are handled in different disciplines. We were interested in examining how learners' epistemological views come into play and guide their decisions in contextualized reasoning tasks. Questions about a discipline might trigger stereotypes and societal scripts, but performance on a task, we thought was less susceptible to these threats. So, we decided to compare students' views by comparing their reactions through structured interviews to competing accounts in their major discipline, in the other group's major discipline, and in an everyday context.

## Methods

### Participants

We interviewed ten university biology majors and ten university history majors in a university in Israel. The students were in their second or third years of study. Undergraduate studies in Israel in the humanities, social sciences and natural sciences are three years long, so third year students in particular were at the final stages of their undergraduate disciplinary education. Importantly, undergraduate studies in Israeli universities are very discipline-focused, that is, almost all of the coursework is completed within the department of their major. This often includes various "service courses," for example, students majoring in education, psychology and sociology may each take a statistics course, but they will not take the course in the statistics department, rather they will take the course in their respective departments. This lends more support to attributing any differences found between biology and history majors to their disciplinary socialization. It also suggests that any disciplinary socialization that we may find may be stronger than in more interdisciplinary contexts (such as the emphasis on a rounded education in liberal arts that is found in many colleges in the United States).

### Task

Our task draws on earlier work by Kuhn and Weinstock (2002), who presented participants with competing accounts of historical cases. Our task included three scenarios from three different disciplines: biology, judicial, history. The biology case was adapted from learning environment design work by Linn and colleagues (Linn, Clark, & Slotta, 2003). The judicial case was loosely adapted from a case used in earlier studies (Kuhn, Weinstock, & Flaton, 1994) to assess argument skill (the original cases were abridged and selective versions of actual cases). The history scenario was adapted from the Kuhn & Weinstock study. The three disciplines were chosen so that each participant will engage with a scenario from their discipline of study, a scenario from the other group's discipline of study, and a scenario from an everyday domain. Each of the three scenarios depicts competing accounts of the same events. Figure 1 shows an English translation of the biology scenario. Each scenario was followed by a post-task epistemology interview that targeted the participants' views of the dimensions of personal epistemology, mainly the dimensions of certainty, source and justification of knowledge. Figure 2 shows the post-task epistemology interview guide for the biology task. There were only slight variations in the post-task epistemology interviews to accommodate the different disciplines, for example, whether historians or scientists were named in the questions. We also questioned participants about their learning experiences, and in particular, whether they had encountered discrepant accounts as part of their major area studies. Figure 3 shows this post-task learning experiences interview guide.

¶  
¶  
¶ Across North America frogs are being found that have major physical deformities. Some frogs have deformed eyes. Others have misshapen or multiple legs... or they are missing their legs altogether! The following are two brief accounts of why the frogs are being deformed. ¶  
¶  
¶  
¶  
¶ A brief account of why the frogs are being deformed ¶  
¶ By G. Agnon ¶  
¶ Scientist investigating the frogs ¶  
¶  
¶ North American frogs have been found with deformed legs. The deformed frogs have cysts in the area from which their legs develop. These cysts are caused by parasites. The parasites enter the tadpole early in its development and burrow into the area from which their legs develop. As the tadpole develops into an adult frog, the cysts caused by the parasites interfere with normal development, and the frog develops with leg deformities such as multiple legs or no legs. ¶  
¶ In order to test whether the parasites cause the deformities in the frogs, small plastic beads were surgically implanted into tadpoles in the location where cysts were observed in adult frogs—in the area of the body from which legs develop. Many of the frogs that developed from these tadpoles had multiple legs and feet coming out of the area in which the plastic bead was implanted. Parasites in the water are causing these deformities in the frogs. ¶  
¶  
¶  
¶ A brief account of why the frogs are being deformed ¶  
¶ by M. Moyal ¶  
¶ Scientist investigating the frogs ¶  
¶  
¶ In recent years, North American frogs have been found with deformed legs and eyes. Chemicals in the water are causing deformities in the North American frogs. The chemicals in the water come in contact with the tadpoles while they are developing, and this contact causes a reaction that interferes with normal development. As a result, the adult frogs that develop from these tadpoles have deformed body parts. ¶  
¶ In order to test whether the suspected chemical was in the water, a sample of water from the area where the frogs live was taken. The water was treated with a substance that is known to cause a reaction with the suspected chemical, and the expected reaction did indeed occur. In order to test whether this chemical can cause the observed deformities, the chemical was applied to normal tadpoles, and the frogs that developed had deformities similar to those observed in the North American frogs. ¶  
¶  
¶

Figure 1: Biology scenario adapted from Linn et al.

¶  
¶ Explain in your own words what is going on with the frogs? ¶  
¶ - Can you elaborate? ¶  
¶ Are the two scientists' explanations significantly different? ¶  
¶ - What are the differences between them? ¶  
¶ Is it possible that both explanations are correct? ¶  
¶ - If not, why? ¶  
¶ - If so, how is it possible? ¶  
¶ - Is one of the scientists' explanations more correct? ¶  
¶ Can someone be certain about what is causing the deformities in these frogs? ¶  
¶ - If so, how? ¶  
¶ - If not, why not? ¶  
¶ Would a third scientist's explanation concerning the frog's deformity be different from the two explanations that you just read? ¶  
¶ - If so, why? ¶  
¶

Figure 2: Post-task epistemology interview for the biology scenario

¶  
¶ When you think about your studies here in college thus far, what seems important to you? ¶  
¶ What stands out? ¶  
¶ Have you changed in the way you approach knowledge, thinking or problem solving, not just in your studies? What do you think brought about these changes? ¶  
¶ [Probe for types of educational experiences, and for educational contexts—college, high school, etc....] ¶  
¶ In your studies, have you ever encountered a situation similar to the task you just did where there are two similar, but somewhat conflicting, accounts or explanations for the same event? ¶  
¶ Can you describe that situation? → ¶  
¶ What did you think about it at the time? ¶  
¶ [didn't think much of it, seemed natural, found it confusing] ¶  
¶ Do you think differently about it now than you did then? How so? Why? ¶  
¶

Figure 3: Post-task learning experiences interview

## Procedure

A number of research assistants interviewed the participants. Each scenario followed the same sequence: The research assistant gave the participant a sheet of paper with the scenario and gave the participant a few minutes to read through the scenario. When the participant felt that they had read the scenario carefully, the research assistant interviewed them following the posttask epistemology protocol for that task, in a structured interview style (see Figure 1 for an example of the biology interview). The order of the scenarios varied across participants. After all three scenario interviews, the research assistant continued with the interview following the post-task learning experiences interview (see Figure 2). The sessions were audio recorded.

## Analysis

The interviews were transcribed and coded. Transcripts, devoid of identifying information, such as the subject's major, were segmented into statements. Each statement was coded as exhibiting an absolutist, multiplist or evaluativist perspective, based on the characterizations summarized in Table 1. For example, attributing differences between the discrepant accounts to error or lack of skill would be coded as absolutist, attributing differences to equally valid opinions would be coded as multiplist, and emphasizing interpretation over opinion would be coded as evaluativist. These response level codes were used to assign an overall epistemological perspective per scenario to each interviewed participant. About 20% of the interviews were coded by a second coder with a high degree of agreement between the coders.

The learning experiences interview was not coded. Rather, after each participant was assigned an overall epistemological view, we grouped the learning interviews by major and epistemological view. We examined the interviews to see whether there were similarities in the learning experiences reports and whether these similarities corresponded to epistemological assignment, and or major.

## Findings and Discussion

The results of the epistemological view assignments are presented in Table 2, a capital letter "X" under the corresponding column denotes the epistemological assignment: A—absolutist, M—multiplist, E—Evaluativist. For some participants it was difficult to make a firm decision about their epistemological assignment, therefore, they were coded as being midway between two views. This is indicated in the table by two lower case letters "x" positioned midway between two columns.

We found that both biology and history majors tended to be absolutists in all disciplines, most pronouncedly in the judicial discipline, which was outside both group's area of study. This is surprising, because prior research suggests that the majority of people maintain multiplist positions (Hofer & Pintrich, 1997; Kuhn et al., 2000). History majors were markedly absolutists in the biology scenario, tended markedly toward evaluativism in the history scenario, and tended markedly toward absolutism in the judicial scenario. Biology majors showed a clear pattern only in the judicial scenario where they were markedly absolutists. They also tended toward absolutism in both the biology and the history scenarios. We speak of these patterns cautiously, because our sample is small so assertions concerning patterns are prohibitive, especially in the absence of statistical tests.

The main finding is that history majors but not biology majors exhibit within their discipline of study an epistemological perspective that is distinguished from their views in the other disciplines. Moreover, the history majors' view in the history scenario, their discipline of study, tended toward an evaluativist perspective, which is considered to be a more productive view in academic contexts. The difference between history and biology majors in the overall patterns of epistemological assignment, and the difference within the history majors' assignments in their discipline of study versus other disciplines, suggest that history and biology students have different learning experiences and that these experiences give rise to different epistemological views when contending with disciplinespecific content. It also suggests that epistemological views, and evaluativist views specifically, can be cultivated through instruction.

We do not have baseline data for these participants documenting their perspectives prior to their college education, so there remains some question about whether these patterns can be attributed to their college experiences. In addition, one could argue that there is a form of selfselection at play here that conflates the results. That is, it may be that people who maintain certain views tend to pursue certain majors. However, if this were the case we would not expect to see the type of within-major outside-of-major trends that we seem to be seeing for the history majors. Of course, these questions need to be probed more rigorously with a broader study that includes this type of baseline data. Nonetheless, we believe that the findings from the learning experiences interview lends support to our findings and claims, despite these methodological limitations.

Table 2: Epistemological view assignment per scenario per participant

Major	Biology Scenario			History Scenario			Everyday Scenario		
	A	M	E	A	M	E	A	M	E
History			X		x	x <sub>a</sub>	X		
History	X				X			X	
History	X				x	x	X		
History	X				x	x	x	x	
History	X				x	x	*	*	*
History	X				x	x	x	x	
History	*	*	*		x	x	X		
History			X					x	x
History	*	*	*	*	*	*	x	x	
History	X			X			x	x	
Biology			X	X			X		
Biology	X					X	X		
Biology	X			X			X		
Biology		X		x	x		X		
Biology			X	X	x	x			X
Biology	*	*	*	X			X		
Biology	X						X		
Biology	X						X		
Biology	*	*	*	*	*	*	*	*	*
Biology	X					X		X	

The participants' responses to questions concerning their educational experiences at the university also show distinctions between history and biology majors. All of the history majors noted that they had encountered situations similar to those presented in the scenarios, where the same phenomenon or event is explained through competing accounts. Only four biology majors reported encountering competing accounts in their classes.

The History majors responded immediately, assuredly and fluently that they had encountered competing accounts in their studies and easily provided specific examples. They seemed to associate this idea of competing or multiple accounts with "what History is." For example:

"Ah, actually yes. There are a lot of cases like that that show you some event and then ((two undecipherable words)) another direction and then you need uh to decide uh which interpreter you go for more. I usually just combine the two interpretations. Present uh there are some that say this and there are some that say that and I try uh not not to say anything conclusive. Which explanation is more acceptable. Because some think this and some think that. History is not an exact science. That is you can't uh say what is right and what is wrong. Anyone can come with his interpretation." [History major translated from Hebrew]

"(Laughing) of course I did. That's what you do in history. (Interviewer: Can you describe the situation). Yes, if I need to hand in a paper on two different sources that I need to compare and check who wrote from what perspective did he write, from what era did he write, and who paid him to write...so like I need to think about these things." [History major, translated from Hebrew]

The Biology majors hesitated, and were hard pressed to provide examples. Some biology majors referred to a different concept, such as being presented with different accounts on an exam and having to identify the correct one (i.e., multiple choice questions) or noted that there are proteins that have two different functions.

Despite their familiarity with the notion of competing accounts, the history majors did not express ideas concerning principled ways of critiquing competing accounts and for favoring one account over the other. Most of the history students noted that individuals simply have to choose for themselves what seems to suit

them most. For example (sic, translated quotes): "...if one book strengthens your view and another thaweakens your view, then you will obviously go with the one that strengthens your view..." or "I hold on to what works for me, what I believe in and that's that. I know that both are uncertain." In this respect, thhistory majors reflected more of a multiplist than evaluativist perspective.

Our findings are commensurate with our expectations that instruction can play an important role in cultivating epistemological views, and that typical instruction in the arts and humanities is more focused on multiplist and evaluativist views than typical science instruction. This is ironic, because as we have noted in the background section, it is the evaluativist perspective that is most commensurate with science learning goal. The overall tendency toward absolutist perspectives is rather disappointing. It is also somewhat disappointing that the history majors seem to lack a disposition to critique, which we posit would be part and parcel of a full and complex evaluativist perspective.

## Conclusion

This study was exploratory. It served mostly to point to profitable research directions, than to provide firm ground for conclusions. We studied a small number of participants, and employed only a single measure. In addition, our knowledge of the instruction underlying the views we explored is limited to narrow self-reports. Our goal is to follow this initial study with a broader investigation. We intend to combine written instruments administered at a large scale with smaller scale interviews, and to complement student self-reports with instructor self-reports and classroom observations. We expect that such a study would enable us to make stronger claims about disciplinary differences in the cultivation and adoption of epistemological views, as well as point to the particular instructional strategies that seem to foster these views. Our hope is that these endeavors will help us understand how instruction and learning environments can advance the refined development of evaluativist perspectives.

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