Learning
A Momentary Stay Against Confusion

Abigail Lipson

IN THE COLLEGE YEARS

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It assumes direction with the first line laid down, runs a course of lucky events, and ends in a clarification of life — not a great clarification, ... but a momentary stay against confusion.

— Robert Frost

When Robert Frost wrote these words in a preface to his Collected Poems, he was referring to “the figure a poem makes” (Frost, 1939). He suggests that poetry emerges from the interplay between intentionality and serendipity. Through a combination of orderly progress and wild chance, we manage to produce out of chaos “a clarification of life.” Most importantly, though, Frost recognizes that the clarity is impermanent, while the confusion is ubiquitous.

When I first read this passage as a college student, I felt immediately that it described not only the path of poetry, but the experience of learning. Often when we learn something, our understanding emerges as a clear and stationary “figure” against a background of buzzing motion. A mess of unconnected details coheres into a pattern: a lead we follow on a hunch takes us to new insights; a brain abrim with jumbled words finally cranks out a readable sentence. The clouds clear and we see a world that is crisply defined.

Our clarity, however, doesn’t last. Inevitably, we identify new details that don’t fit the pattern; or we find that our leads lead only to more leads; or we realize that we have more to say if only we can find a way to say it. We are confused again, striving for clarity again, and seeking new understandings. And each new understanding we achieve is only a “momentary stay against confusion.”

So. Does learning, then, involve slogging through endless confusions with occasional brief respite of clarity? How depressing! This doesn’t seem to do justice to the excitement and joy that are so much a

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part of learning. Or is learning a progression from one clarity to the next, with refreshing interstices of confusion in between? Well, this is a
clearer thought, certainly, but it doesn’t seem to acknowledge how
stressful the learning process can sometimes be. So what roles do clarity
and confusion play in learning? Examining a specific example will bring
this question into focus and ground our discussion of the learning pro-
cess in something concrete.

The following conversation between a college student (S) and
teacher (T) is a composite of several similar conversations I have had
over the past few months. The student is presented with a statistics
problem and solves it confidently, but quite incorrectly. In the ensuing
exchange, the student’s clarity gives way to confusion, and from this
emerges a new — and better — clarity.

(II)

The Heads-Tails Problem

Which of the following is the most likely sequence to result
from five consecutive flips of a fair coin?

(a) H H H T T
(b) T H H T H
(c) T H T T T
(d) H T H T H
(e) All four sequences are equally likely

S1: The answer is (b). Definitely.

T1: Can you say why?

S2: Well, getting heads or tails is random, and (b) is the most random
sequence.

T2: What about (c)? Why do you figure that (c) is less likely to come up?

S3: Well, it’s got four Tails out of five, and three of them are all in a
row. That doesn’t seem too likely. You’d figure to get about half
and half, since it’s random whether you get Heads or Tails. Unless
the coin’s loaded or something.

T3: Let’s assume that we’re dealing with a fair coin. What about (d)?
That’s got about half Heads and half Tails.

S4: No. It’s just too regular. If you flip a coin, it comes out to about
half and half, but it doesn’t just alternate like that — H T H T.
You can’t ever tell what the next throw is going to be.

T4: So you’re pretty sure of (b).

S5: Yeah.

T5: Let me check something out with you. If you flip a coin once, it
could come up either Heads or Tails, like you said before. There
are a total of two ways it can come up, and you are equally
likely to get either one of them. So the chances of the coin com-
ing up Heads, say, are one-in-two. And the chances of it coming
up Tails are the same, one-in-two. Does that make sense?

S6: Sure.

T6: Okay. Now let me ask you something. If you flip a coin three
times, which sequence is more likely to come up in your three
throws: Heads-Heads-Heads or Heads-Tails-Tails?

S7: Heads-Tails-Tails, I would think.

T7: Why is that?

S8: Well, you’re more likely to get a mix than all Heads. I would think
the chances of throwing Heads-Heads-Heads aren’t very great.

T8: Can you give me the exact odds? I mean, out of all the possible
ways the coin could come up on three throws, what are the
chances that you’ll throw a Heads-Heads-Heads?
S9: Oh gosh, let’s see. I’m sure there’s a formula for that, but I don’t know it. I guess I have to list out all the possibilities. Can I write this down?

T9: Sure.

S10: Okay. H H H; T T T. Okay. H H T; H T H; T H H. Hmm. Is that all the ones with two Heads. Yeah. T T H; T H T; H T T. So that’s not too many. There are eight ways the flips could come out. So getting H H H is only a one-in-eight likelihood.

T10: Great. And what are the chances that you’ll throw Heads-Tails-Tails?

S11: Well, there are a lot of chances for two Tails, so they’d be greater, the chances. Oh, no. You mean exactly, getting exactly Heads-Tails-Tails, in that order? So wait a minute, wait a minute. I guess I’ll still have to say the chances of Heads-Tails-Tails are greater than the chances of all Heads.

T11: You’re right that we’re talking about sequences here, about exact orders. So what are the actual chances that you’ll throw the exact sequence of Heads-Tails-Tails?

S12: (Pause.) Oh, now I’m totally confused. Damn. This is more complicated than it looks!

T12: What are you thinking?

S13: First I was thinking that Heads-Heads-Heads was less likely, then I was thinking that Heads-Tails-Tails has a one-in-eight chance, but that’s the same chance of getting Heads-Heads-Heads. So that doesn’t make sense, and now I’m not sure.

T13: What doesn’t make sense?

S14: Well, that Heads-Heads-Heads is just as likely. I would think it was less likely than getting a mix. I don’t get it.

T14: Well, look at your list and answer this: Which is more likely, that you’d get H H H or a mix of Heads and Tails?

S15: Definitely a mix, like I said. Oh! Wait a minute! You were asking about exact sequences here, right? So it’s more likely to get a mix, but maybe it isn’t more likely to get exactly a particular mix, a particular order? I mean, they’re all one-in-eight, the chances of any particular sequence, no matter what it is. I guess that makes sense, doesn’t it?

T15: So getting Heads-Heads-Heads is just as likely as getting Heads-Tails-Tails? One-in-eight?

S16: Well, it doesn’t sound right, but I think that’s right. And you know what it makes me wonder is if maybe before, I was thinking about all the mixes of Heads and Tails together instead of particular sequences.

T16: Can you say more?

S17: Okay. It is pretty likely to get some kind of mix, and it isn’t very likely to get all Heads, but then again it’s not too likely that you’ll throw any particular exact order that you name. Any exact order of anything of any Heads and Tails, is just as unlikely, and that makes it just as likely. That actually makes sense.

T17: Yes it does. You want to take a look at the original question again?

S18: Oh, yeah! Can I change my answer? Can I say (e)? Definitely (e)! Boy, I’m glad I didn’t bet on this!

(III)

The first solution offered by the student is a common error. In fact, a great deal of formal research has been conducted expressly to understand how people think about stochastic problems like this one (e.g.,
Kahneman and Tversky, 1982; Konold, 1988). But our interest here is not so much in why the student got this particular problem wrong, as it is in the path he followed to his different and corrected conclusion.

Initially, the student was certain of his answer and clear in his formulation of the problem. In his comments S1 through S5, he sounds confident and unperturbed, patiently explaining to the teacher what he sees as patently obvious reasoning. Then between T5 and T10, the student encounters some challenges to the integrity of his initial understanding. Responses to his teacher’s questions can’t be easily generated given his conceptualization of the problem. But he is reluctant to abandon his initial understanding, since it is all he has. In S11 he reaffirms his initial position, although with less confidence than he had before.

As the conversation continues, our student encounters more new information and puzzling questions and, between S12 and S14, he becomes “totally confused.” He clearly sees the inadequacy of his old way of construing the problem, but has only the vaguest of hunches as to what a more adequate construal might be. He has left the solid ground of his initial clarity and finds himself buffeted by a confusion of incomplete and incompatible ideas. He appears to be quite uncomfortable.

Then between S15 and S17, the student’s confusion begins to give way to a new clarity, a different understanding than the one with which he began. He is no longer clinging to his initial answer, as he was at first; and he is no longer simply lost and confused, as he became next. He seems, instead, energized and motivated to explore this strange new way of understanding the problem and to consolidate his speculations into a coherent structure. In S18 he offers his revised solution with revived certainty.

(IV)

The basic pattern of this student’s experience — the figure his learning makes, to use Frost’s words — is one we can find reiterated in many other contexts. For example, the pattern generated here in a short ten minutes of the student’s time matches an ontogenetic pattern well recognized by developmental psychologists. Structural theories of intellectual development, in particular, describe development over an organism’s lifetime as “a process of equilibration ... in which inadequacies of earlier forms of reasoning are encountered and overcome by the construction of more adequate forms” (Basseches, 1989, p. 23). One might say that the inadequacies of our particular student’s reasoning on this particular problem were similarly encountered and overcome by his construction of a more complex construal of the laws of chance.

Piaget’s central concepts of assimilation and accommodation, the constituents of the process of adaptation, are relevant to our student’s experience with the Heads-Tails problem as well. (See Piaget, 1978). Roughly, Piaget defines assimilation as the incorporation of information or experience into already-existing cognitive structures (which corresponds to our student’s behavior in S3 and S4 as he accepts some gentle challenges to his initial answer and responds to them from within the framework of his original solution). Accommodation, in contrast, takes place when an organism’s cognitive structures themselves change in response to environmental demands, becoming more inclusive, complex, or sophisticated (which corresponds to our student’s eventual abandonment in S15 of his initial problem-model in favor of a new one, after the original had proved inadequate to addressing the questions posed by his teacher). All cognitive activity, according to Piaget, involves aspects of both assimilation and accommodation.

Cognitive-developmental theories describe a bigger picture, of course — the individual’s growth through life stages — than the one we have painted of our student’s momentary experience. But despite the difference in scale, the two pictures trace a common pattern. Indeed, this same pattern can be seen on an even larger scale than the ontogenetic. Thomas Kuhn’s work on the structure of scientific revolutions, for example, describes on a sociohistorical scale the tendency for scientific thought to operate within the bounds of its current “paradigm” unless and until it encounters significant anomalous data for which the paradigm simply cannot account. Only then does a scientific revolution occur involving the generation of a new and more accommodating paradigm (Kuhn, 1962).
(V)

But let’s return to the smaller scale and our examination of real-time on-line learning. Perhaps we can define more clearly the path our students take through clarity and confusion in the learning process. Table 1 offers a five-step map of such a path (see p. 10). Each step is described in terms of (a) its stability and the relative status of the student’s “old” and “new” understandings; (b) the most immediate challenge which the student faces; (c) the student’s prevailing behavioral tendencies, and (d) the teacher’s perceptions of the student.

The first step illustrated in the table, the INITIAL STATE, refers simply to the student’s starting point: his existing understanding of a problem, his existing competence at a skill; his existing store of accumulated knowledge. I have labeled this state a stable one, in recognition of the human tendency to “stick with what we know.” In fact, it makes good adaptive sense, when we have some workable way of understanding things, to keep right on using it. We tend to interpret new information in ways that maintain or confirm our existing understandings and we tend not to recognize contradictory information even when we encounter it (see, for example, Chapman and Chapman, 1982). In this state of clarity we experience little stress and high confidence. We feel we know what we’re doing.

Problems only arise when we encounter insurmountable challenges to our familiar way of understanding things. The second phase illustrated in Table 1 describes our usual response to such challenges, RESISTANCE. Amos Tversky and Daniel Kahneman, two researchers known for their work on the heuristics and biases that arise when people encounter situations of uncertainty, have noted the general “reluctance to revise a rich and coherent model, however uncertain, and the ease with which such a model can be used to explain new facts, however unexpected” (Tversky and Kahneman, 1982, p. 128).

Other researchers point out that, as we encounter new information which simply cannot be understood within our existing conceptual frameworks, we find ourselves facing a cognitive dilemma (Metalsky and Abrahmson, 1981). We have two choices. We can either dispose somehow of the new information by denying or distorting it, and thus maintain our original beliefs, or we can discard our beliefs in light of the new information. Whenever they possibly can, people will tend to resolve this dilemma in favor of their prior beliefs. (See Alloy and Tabachnik, 1984). As Jacques Barzun has commented, a student’s mind can be like a strong rubber band, which a teacher “can stretch a little by pulling hard, but which snaps back into shape the moment you let go” (Barzun, 1982, p. 1).

If the world continues to present us with information that repeatedly and powerfully challenges our existing conceptions, we will eventually find it impossible to hang on to them. At this point we are likely to become uncomfortably confused or uncertain. The third box in Table 1 describes this phase as one of DISRUPTION. Several developmental psychologists have suggested that, however uncomfortable such disruption may be, it is both inevitable and necessary in order for growth to occur (e.g., Perry, 1970; Kegan, 1982). We are motivated to resolve the disruption, and in doing so we develop a more sophisticated understanding of the world.

The fourth box in the table describes a phase of REORGANIZATION. At this point in a student’s problem-solving effort, the motivations of the student are forward looking, rather than backward-looking as they were in the RESISTANCE phase. The student is trying to consolidate a new and effective understanding rather than trying to hold on to an old and ineffective one. The result is the FINAL STATE; a new stability, a state of confidence and certainty much like the INITIAL STATE but at a new level of complexity or adaptation.

(VI)

The circle, or rather spiral, illustrated in Table 1 is an abstraction. It doesn’t describe every learning experience. It may not even describe any learning experience. When a student learns some discrete fact or engages some specific problem, this activity takes place within a much richer and larger context. The five-step model described here is an artificial isolation of factors that can’t be so cleanly extricated from the
complexity of human existence. Furthermore, a brief replay of your own learning experiences will undoubtedly reveal many whose paths followed quite a different route than the one mapped here. Perhaps you approached a problem, not from an initial state of clarity, but from an initial state of uncertainty; perhaps you by-passed resistance; perhaps you dwelled in disruption.

Still, despite the abstraction and artificiality of the five-step model presented above, it does seem to capture two fundamental realities about the role of clarity and confusion in learning, these can be summarized as follows:

Clarity, as a rule, feels better than confusion. We are motivated to keep clarity if we have it and to seek it if we don’t.

Confusion arises inevitably as we encounter in the world information or experiences that challenge our current ways of understanding.

What do these observations tell us about how we might best go about the process of teaching and learning? First, we should probably examine any intuitive assumptions we may have to the effect that “Clarity is Good” and “Confusion is Bad.” Clarity is good in many ways, but our efforts to cling to it sometimes lead us to resist or avoid opportunities for learning and growth. And confusion is bad in many ways, but it is also a source of joy in life and a necessary prerequisite for certain kinds of development.

Second, we might derive from the model some ways of motivating ourselves in moments of complacency and comforting ourselves in moments of frustration. Precisely when we feel most solidly settled in our ways of thinking, we could try to open our eyes to new challenges. And precisely when we feel most confused and ungrounded, we can remind ourselves that continued efforts will bring us around, eventually, to new clarities.

Learning, at its best, as Frost says about a poem, “begins in delight and ends in wisdom.” We needn’t resist as much as we sometimes do. We needn’t despair as much, either. Instead, we need to recognize that

Table 1: FROM CLARITY TO CONFUSION AND BACK AGAIN
clarity and confusion are both, in their turn, the stuff that learning is made of. Both should be welcomed and even pursued.

References


