

Student-built Theory, or You Only Really Learn What You Figure Out For Yourself

Anya Hogoboom
William & Mary

1 Introduction

To the extent possible, I structure my courses so that students make the observations and proposals that move the class forward. It is not uncommon in linguistics courses to have students work on data, in class or in a homework assignment, that is more complicated than what has been presented thus far in the course. Students use the skills they have gained from the course to puzzle out the pattern in the new data and how to capture it. A class centered around student-built theory expands this approach to be the vehicle by which new theory is introduced. As such, students not only analyze a new dataset but articulate whether it is predicted by the class' current theory, and, if it is not, they propose and argue for a new component that will allow us to satisfactorily capture the pattern. The trajectory of the class is thus building and revising that student-built theory.

This approach has (to my knowledge) more commonly been used in syntax courses, where it is possible to revise and expand, say, phrase structure rules and transformations incrementally ever further in the light of that much more data. This was the method employed with undergraduate courses when I was a graduate student at the University of California, Santa Cruz, and I my approach to teaching phonology is directly inspired by the faculty there, especially Jorge Hankamer and Judith Assien for whom I was a teaching assistant. I have worked to map this kind of approach onto phonology content, such as the evolution of the rule formalism—from classic rule notation (i.e. SPE-style (Chomsky and Halle 1968)), to alpha-notation, to feature geometry, and this progression is re-created by students confronted with a series of data.

It is possible to use this approach to a greater or lesser extent. While I attempt to deploy as much content as possible using this method, it can be done for a single in-class exercise, or anything in-between. When deciding what to exclude from this method, I consider whether I could reasonably expect to guide students to the target solution. While I use the method for evolutions of rule formalism, I do not use it for the initial, classic rule formalism. Perhaps it would be possible to do so, but I find it is useful to teach the classic rule formalism as a component of capturing the relationship between the underlying representation and the surface representation since this can be a tricky concept for students. Once this is in place, however, students are in a position to modify and expand the formalism. I also do not use the method for introducing the set of phonological features. While it would be possible to have them deduce at least a subset of them, I again consider the features a foundation that helps with understanding the enterprise.

I start by discussing the goals and benefits of student-built theory in §2. I then move through a series of examples in §3. In §4 I discuss logistic components of engaging in student-built theory, including the challenges it presents to both the students and the instructor, and §5 concludes.

2 Rationale

Teaching a new concept by giving students relevant data and asking them to engage with it such that they discover the concept, and wrestle with what it means for our current class theory, has multiple potential advantages over directly teaching a new concept.

* Many thanks are owed to Jorge Hankamer for the subtitle, both the words themselves and the guiding principle. Thank you to my graduate school professors who modeled student-built theory, colleagues who have discussed it, and students who have collaborated with me over many years to craft each class out of freshly built theory. Thank you to the organizers of AMP 2021 for inviting me and thank you to the audience for their helpful comments.

First, it gives students ownership of the theory and its evolution. One of the challenges of teaching theory is getting students to appreciate why the next iteration represents an advance. In order to appreciate the improvement, students need to understand what it can do for us that the previous version could not. And in order to understand the improvement, students need to pay attention to the details of the data and the argument. If all of these components are made to be the students' job directly then they naturally become invested in the theory and its details. Students develop a deeper understanding of the theory both because they need to in order to know what it predicts and because they were a part of literally creating the theory. Students (like humans generally!) are resistant to change and student-built theory highlights the reason the formalism needs to change. When students themselves amend and expand the theory, the changes occur as a natural evolution and students are clear about their motivation.

Second, giving students ownership over the theory empowers them. Students find it extremely satisfying to propose advancements that are adopted into the official class theory. (By "class theory" or "class's current theory" I mean the state of the current collective understanding and associated formalism. This is created by discussing the students' work at the class level and deciding what will be adopted into our class theory.) Having the experience of successfully seeing and solving issues for the current class theory teaches students that they can do meaningful work. They themselves can advance the theory. This of course also feeds into the first point, of student engagement with the theory.

Third, having students confront problems of theory and hypothesize their own solutions gives them practice with skills they can use in any field. The work gives students practice with weighing evidence, thinking through effects of a proposal, and articulating a line of reasoning. It also, as referenced in the first point above, necessitates students changing their minds about what we want our theory to look like. I explain to my students that these skills are really the most important part of the course, since they are the ones they will use over and over again in the world, unlike proposing new grouping nodes for our feature geometry model, which (sadly) has limited direct applicability.

Finally, teaching a class centered on student-built theory makes every iteration of the course feel fresh, because it is being created anew each time. As the instructor, you get to watch students grapple with a problem, for example, during in-class group work, and try out different approaches before finding that "ah ha" solution. It is extremely satisfying as the instructor to see students go from productively frustrated to pleased and proud. This progression generally takes place during a single instance but can also occur over time. I have had students over the years who were frustrated with the work and therefore not able to enjoy finding solutions even when they did so successfully. In almost all such cases, by the end of the semester, the students were won over, however, and have often let me know that while they found it frustrating at the time, they now feel incredibly accomplished and appreciate the experience.

3 Examples

The examples discussed come from my undergraduate course "Phonetics and Phonology." It is a required course for linguistics majors and our introductory course is the only prerequisite. The class size is generally about 35. There is a further, optional phonology course which has this course as its prerequisite, but for most students Phonetics and Phonology is their only phonology beyond what is introduced in the general introduction to linguistics course.

The majority of the course is phonology and the major of that is rule-based phonology. I have students work as long as we do in older theory for several reasons. One is that it picks up directly from where they left off in the general introduction course. Another is that older theory forms the working assumptions (e.g. feature sharing) of later theory, and so it is valuable for students to have a firm foundation in older theory. While it should be possible to deploy student-built theory with any era of formalism, the relative simplicity of older theory allows fuller understanding and control, and the key skills of understanding, assessing, and improving theory transfer to any theory.

3.1 Examples: Theory leaps While student-built theory can be used for any level of theory advancement, the most challenging is the high bar of significantly evolving the theory. Here I talk through the basics of how I elicit the moves from classic rule notation to alpha notation to feature geometry. The thread of being able to satisfactorily capture the process of nasal place assimilation runs through this progression. Early on we look at nasal place assimilation data, like that in (1) and after stating the generalization and linking it to

phonetic motivations, I ask why we are not able to write a rule to capture the process.

- (1) Diola Fogy (a Niger-Congo language spoken in Senegal; Sapir 1965, cited in Ito 1986)

/ni-gam-gam/	→	nigaŋgam	‘I judge’
/na-ti:ŋ-ti:ŋ/		nati:nti:ŋ	‘he cut (it) through’
/na-mi:n-mi:n/		nami:m̩mi:n	‘he cut (with a knife)’

It is not immediately obvious to most students that the rule cannot be written, and it is a helpful exercise to ask them to clearly state the problem. Students are typically asked less about where theory falls short (as compared to how it works to capture new data) and so this is something that they have less experience with. Students of course cannot propose (or appreciate) a theoretical advance if they do not see the previous short-coming.

Given some time to consider, students realize that our phonological rules do not allow for dependent, or linked, changes. I prompt students to explain that while we have an elegant statement of the process (“nasals assimilate to the place of the following consonant”) we would have to write a series of rules to get the right effect. And while we could write a series of rules (nasal → bilabial / _bilabial C, nasal → velar / _velar consonant, etc.) this would not satisfactorily capture the process, as it makes it appear that there is a series of unrelated processes. This successfully sets the stage for a problem to solve in the future.

In time we gain phonological features and learn to capture natural classes and write rules employing them. When we start, we consider the place features to be binary (rather than privative). After the class has become comfortable with employing the features, I introduce data like that in (2) which shows voicing assimilation.

- (2) Hungarian (a Uralic language spoken in Hungary; Barkai and Horvath 1978)

re:z	‘copper’	rezben	‘in copper’
re:s	‘part’	rezben	‘in part’
fok	‘degree’	fokto:l	‘from a degree’
fog	‘tooth’	fokto:l	‘from a tooth’

I ask students to state the process as simply as possible (“obstruents assimilate to the voicing of a following obstruent”), show how our rule system would handle it ([-sonorant] → [+voice] / _[-sonorant, +voice]; [-sonorant] → [-voice] / _[-sonorant, -voice]), and critique that solution. We discuss what kind of advance is needed; namely one that allows for the change made to be dependent on the environment. Then I ask for ideas of how our formalism could be modified to allow this. Students often want to write something like “same voicing as the following consonant” to the right of the arrow in the rule notation (in the ‘change’ spot) and we discuss how we want something that a computer could be programmed to follow. At some point, a student (or students) will come up with the idea of a variable, which of course is the key insight. While it would be possible to have the students create their own variable system, I share that linguists typically use Greek letters here and we produce: [-sonorant] → [α voice] / _[-sonorant, α voice].

Once we are clear on and comfortable with this change, I bring the Diola Fogy data back and ask if we now have a solution the problem of capturing nasal place assimilation. Students see that (because we have binary place features), we need a rule that variable-links each of the place features between the change and the environment. I have students point out the advantage of this rule (it captures the process with only one rule) and then consider if there is still anything that we are not totally satisfied with. Some students see that the rule is rather cumbersome; if we fully capture all places of articulation including different coronals, we need quite a few variable-linked features. We agree to rest on our laurels (of having captured the process with the single rule) for the time being, however.

In time we see that most rules make one change, and I ask what problems we would have if we went so far as to require rules to only make one change. We see that cases we had previously analyzed as requiring two changes could be understood to only use one. For example, early on we look at Tamil data as in (3).

- (3) Tamil (a Dravidian language spoken in the south of India and in Sri Lanka; Asher 1982, dataset compiled by Carr 1993)

taŋi	‘water’	taŋgai	‘younger’
pandu	‘ball’	ʃandɾɐ	‘moon’
kayam	‘crow’	mayɛ	‘son’

We saw at that time that we can analyze voiced stops and voiced fricatives as being allophonic variants of voiceless stops. The originally-deduced rules are as follows.

- (4) Original rules for capturing the Tamil pattern
- voiceless stops become voiced after a nasal: [-son, -cont] → [+voice] / N_
 - voiceless stops become voiced fricatives after a vowel: [-son, -cont] → [+voice, +cont] / V_.

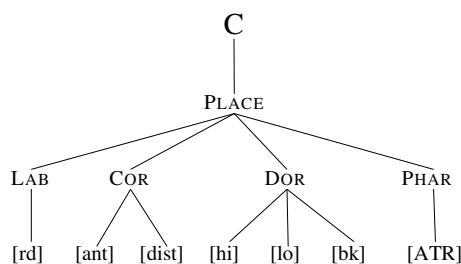
Now that we want to consider whether it is feasible to require rules to only make one change, we turn back to the Tamil and consider whether we have another option. Students work to reconcile the Tamil analysis with the one-change-per-rule hypothesis, and at some point a student or students will propose “stacking” changes. That is to say, we can use the following rules instead, with the assumption that two different rules can apply to the same word in the course of its derivation.

- (5) Revised rules for capturing the Tamil pattern
- stops become voiced after a sonorant: [-son, -cont] → [+voice] / [+son]_
 - stops become fricatives after a vowel: [-son, -cont] → [+cont] / V_.

Having met with success in our initial work to force rules to make one change, we turn again to nasal place assimilation. I ask students again about what still bothers us about our way of capturing this process, and now besides the rule being cumbersome, it clearly runs afoul of our one-change-per-rule hypothesis. In this case, however, we cannot fix it by breaking up the change differently, because we very specifically want a single rule to capture the process. Here I introduce some scaffolding to allow students to propose feature geometry rules of assimilation.

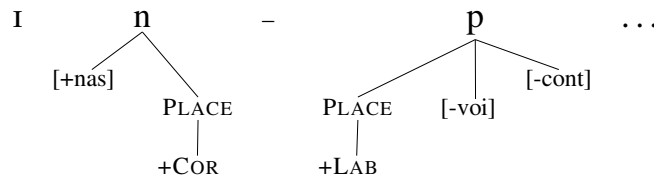
At this point, I point out that we have been thinking of our features as being in a bundle, but suggest organizing them into a hierarchical structure. I say that if we organized our place features, we would be in a position to reimagine what assimilation looks like. I write up a diagram like that in (6). We already know about place-dependent features and so it would be natural to visualize them as hanging off of the relevant place. We do not have a feature “place” so the PLACE node is something new, an idea to try as we attempt hierarchical feature organization.

- (6) Feature organization (first steps)



I then show how we would assume every segment has this kind of structure hanging off of it (along with other, as-yet-unorganized features, which we take to be hanging off of the slot), and write up an example of a word which undergoes nasal place assimilation, such as English /ɪn-pʌsəbəl/ ‘impossible’, as in (7). (As a reminder, the class has binary, rather than privative, place features at this point.)

(7)



Having set us up in this way, I then ask students to reimagine assimilation. Given this new model, how could we envision nasal place assimilation? This is probably the biggest leap I ask them to make, because feature geometry rules are very different from classic rule notation. I generally have students work on this in small groups in class, but I have also done it as a whole-class discussion or as a “thinking question” assignment outside of class (see §4.1 for discussion of different presentation modes). When done as an in-class assignment I find it helpful to be able to go around to the groups and give feedback on their ideas and also see when several groups have found the target solution so I know when we have a path forward as a class.

However the question was deployed, I bring us back to a full-class discussion and ask for proposals. Someone will (eventually) propose connecting the nasal with the PLACE node of the second sound. We clarify, if needed, that the line would be from the slot of the nasal to the PLACE node of the following sound, and that we need to assume that the change causes the nasal to lose its original PLACE node, since it cannot have two. We admire the simplicity of the change, while noting what a departure it is from our previous model. I ask students to consider what this kind of rule does as opposed to the old, feature-copying type of rule. Someone will see that it models a single place articulation, rather than a series of two identical ones, and we decide that this, too, is an improvement. I then flesh out how feature geometry rules are written and what maps onto the components (target, change, environment) of the classic rule notation.

Thus over the course of perhaps four weeks students have evolved our rule formalism, with each step necessitated by patterns in the data, and with using nasal place assimilation as a reoccurring theme. Revisiting the same phenomenon has the advantage of not needing much “soaking in” time for students to understand the patterns involved. Having a multi-step evolution process demonstrates that we are always trying to make our theory better, and we are never really done. I now turn to examples of students expanding our model within a theory.

3.2 Examples: Expanding theory Given the success of getting even nasal place assimilation to be captured with one change per rule, I tell the class that we are going to assume that in fact all rules only have one change, and that having only one change is therefore a criterion of licit rules going forward.

When we start feature trees, I give them the structure shown above in (6), where the place features are organized under a new PLACE grouping node, and the features that are already known to be dependent on those place features are organized under them. Everything that is as-yet unorganized hangs directly off the slot (as shown for [nasal], [voice], and [cont] in (7)). I tell students we might wonder whether there are grouping nodes other than PLACE, but we are going to set the bar high for deciding that there are. Not only do grouped features need to have something in common, but we have to see them acting as a unit in some process of assimilation.

With this background, they get data from Classical Greek, as exemplified in (8).

(8) Classical Greek (spoken in Greece around 500-300 BCE, Buck 1933, dataset from Kenstowicz 1994)

tri b -o:	‘to rub’	tetri p -tai	‘has been rubbed’
		etri p^h -t ^h e:n	‘I was rubbed’
grap ^h -o:	‘to write’	gegrap t -tai	‘has been written’
		grab d -e:n	‘writing’

Students see that Classical Greek exhibits stops assimilating to both the voicing and the aspiration of a following stop. As our feature tree currently stands, [voice] and [aspiration] hang directly off the slot. It is

therefore impossible to write a rule that captures the process with a single change. Students must therefore propose a new grouping node. They can name it anything they would like, although most name it “Laryngeal” since [voice] and [asp] are listed as “laryngeal features” on our feature reference sheet. (A memorable class, in the whole-group discussion, however, decided to name it “Larry.”)

It can be difficult for students to explicitly propose new structure. It is not uncommon for students to show an appropriate grouping node but seem to take it for granted. I emphasize that something new must be proposed and motivated before it can be used.

Another way I have students propose a refinement to our feature tree model is by examining the behavior of the definite prefix in Arabic, as exemplified in (9).

(9) Arabic (lingua franca of the Arab world, dataset from Kenstowicz 1994)

ʔal-qamr	‘the moon’	ʔaf-ʃams	‘the sun’
ʔal-faras	‘the mare’	ʔan-nahr	‘the river’

Working with this data, they see that the [l] of the definite completely assimilates to a following coronal. The question is then how we can amend the structure of our feature tree to allow this kind of process to be captured with just one change. I find that this is a really great problem for students to wrestle with. It does not require a theory leap, but it does require understanding the enterprise and following a need (here, to capture complete assimilation with one change) to its logical conclusion. The logical conclusion, of course, is a grouping node just under the slot. (Students tend to call this the ALL or EVERYTHING node, although I will refer to it as the ROOT node in what follows.)

Giving students data that prompts them to expand/refine the current theory has several benefits. It still entails proposing new things, but on a smaller scale than shifting theories requires. I find that students have a better understanding of why we have the nodes we do (ROOT, PLACE, LARYNGEAL) and do not have others (i.e. a manner node) because they in fact had to propose two of the three grouping nodes. While there is a concern of confusion arising from ever-changing theory ([voice] attaches to the slot! No, it’s under a LARYNGEAL node! Actually, it’s under LARYNGEAL which is under a ROOT node that hangs off of the slot!) I find dealing with pieces of the feature tree’s organization in turn makes the whole structure clearer than if it were given out all at once. The last type of example I discuss is where there is no new formalism per se, but students are led to make connections that enhance the theory.

3.3 Examples: Putting pieces together The last type of example I discuss is one where students realize that we can correctly predict a pattern with the formalism we already have, as long as we make certain assumptions. One example of this type of problem is how the Tamil pattern (discussed above in §3.1) can be captured even if we only allow a rule to make one change. The solution there, to have stops become voiced after any sonorant, rather than specifically after nasals, requires building up changes in a way we have not seen before. An example derivation is shown in (10), employing the revised rules shown in (5) (which are pre-feature geometry).

(10) Derivation using the revised Tamil rules from (5)

	/makɛ/
[-son, -cont] → [+voice] / [+son]_	g
[-son, -cont] → [+cont] / V_	ɣ
	[maɣɛ]

This is a good example of an instance where students do not need to propose something new, but it is not trivial to see how to solve the problem.¹

Another instance of a case where we realize that our theory can do more than we were previously making use of is where rule ordering makes a meaningful difference. Up until this point, however, we have never

¹ Technically the two rules used to capture the Tamil pattern could occur in either order. Occasionally a student notices or asks about this and then we look at it with the other ordering and notice that it would also work, albeit have the somewhat odd consequence that the intermediate stage would give rise to sounds (like [x]) that the language does not have on the surface.

had rules interact. I have students look at the patterns of vowel insertion and vowel shortening in Yawelmani, exemplified in (11).

- (11) Yawelmani (a native American language that was spoken in California; Newman 1944, Kuroda 1967, Kenstowicz and Kisseberth 1979)
- a. paʔit-hin paʔt-al 'fight'
 A $\emptyset \rightarrow i / C_CC$ "insert [i] after the first of three consonants"
- b. ʃap-hin ʃa:p-al 'burn'
 B $V \rightarrow \emptyset / V_CC$ "shorten a long vowel before two consonants"

I then show words like [ʔa:mil-hin] and have the students tell me the underlying representation must be /ʔa:ml-hin/. I focus their attention on this UR and draw their attention to the fact that there is a long vowel before two consonants, which is the environment for vowel shortening, and yet, the vowel does not shorten. I emphasize that we are confident in our proposed rules, and ask them to propose an explanation that uses the pieces we already have.

Students definitely wrestle with cases like this as well as ones where they need to propose a new piece of theory. Of course, the target solution is to assume crucially ordered rules. If vowel insertion applies before vowel shortening, the environment for vowel shortening is no longer present. By giving students the pieces of the puzzle and having them try out different solutions, I find they understand and remember why we need rule ordering better than if the concept had been directly explained to them. In this, as in all cases, once we have an accepted class solution, I do explain it directly and walk through how and why it works.

3.4 Summary of examples Regardless of the level of the problem, in order to be successful, students need to understand what we have done up until that point and be familiar and comfortable with the overall enterprise of checking data and theory against each other. I provide a large amount of scaffolding, in order to point students down a productive path (or at least onto a productive field) and because I want as many students as possible to be successful in solving the problem. It is important to give students the space and time to try out different approaches. One drawback to whole-class discussions of a problem is that if one student sees the solution relatively soon, many other students have not had sufficient time to think through what might be needed. This is where in-class group work or homework assignments can provide a fuller experience for more students. Finally, it is necessary for students to understand that they have the power to propose new things, which is not something they have likely been asked to do before.

4 Logistical considerations

Asking students to build the theory comes with multiple challenges, most of which I have developed mitigation strategies for. There are many decisions to be made along the way, including what to have them deduce, how much scaffolding to give them, and what type of deployment method to use. I first discuss the benefits and drawbacks of the different types of assignments.

4.1 Deployment methods There are four ways I have students think about what new advance a dataset necessitates. The first is as a whole-class discussion. In this case we look at the data together, I call on volunteers to explain the problem, propose solutions, and to discuss pros and cons of proposed approaches. This has the benefit of keeping everyone together (at least in theory) since everyone hears all the answers given. It is generally also possible to reach the target solution in less time than in-class group work would need. The disadvantage is that not everyone will have had sufficient time to think through the problem and each proposed answer. Further, some students may not attempt their own thought process because they know others will figure it out and volunteer. (While I encourage class participation I do not require it since some people are less comfortable putting their observations and ideas forward.) Thus, if I want to make sure that all students have more time (and incentive) to actively engage with thinking through the problem at hand, I use a different method.

I typically have one problem per class that I give out as in-class group work. Groups may have two, three, or perhaps four students; ideally enough that someone is in a position to support students who do not see how to tackle the problem but small enough that everyone feels obliged to participate. In-class group work also has the advantage of being able to be overheard such that the instructor has a sense of how far the

groups have progressed with the problem. I frequently pause the groups to ask someone to explain what we are seeing with the data at hand, and for someone else to explain why it is a problem for our current theory, and then have everyone return to working in their groups. I have added this step over the years in order to not have groups that are still struggling to understand the problem when others are well into formulating their solution.

Finally, I have used two kinds of assignments for completion outside of class. The first is a classic homework assignment. The second is a low-stakes “thinking question” that I have more recently started giving weekly, where I set up the background at the end of the previous class (for example, the vowel insertion and vowel shortening rules of Yawelmani) and then give them the puzzle, which they only need to answer in a few sentences, rather than the fully fleshed out answers required by homework assignments. I have mostly moved whole-class discussions to being thinking questions, prompted by pandemic considerations of lower in-class engagement. I have been pleased overall with the result, since it requires everyone to try out posing a solution, but not one their classmates will hear, or that will count for a serious portion of their grade. (I give half the credit on thinking questions for clearly restating the problem, which we see together in the end-of-class scaffolding and I reiterate in the prompt.) It has been very exciting to see how many students are able to come up with the idea of something like a variable in order to capture a process like voicing assimilation. I also created some new questions, that I had never asked in any form before, to serve as thinking questions, such as the example in (12). I give this question after the class in which we discover neutralization.

(12) Example thinking question:

In class we saw examples of sounds that a language normally contrasted neutralizing in a particular environment. Neutralization here means “fails to contrast.” In all the class examples, sounds failed to contrast because one of the two turned into the other one (like [d] and [t] in German normally contrast but word-finally they are both [t]).

There are two other ways that sounds that were different underlyingly can no longer be told apart.

In your answer (i) State what it means for sounds to neutralize (ii) List the first way, that we’ve seen (iii) Explain another kind of change that also counts as neutralization (iv) Explain a third type of change that would also result in neutralization (hint: this one is a more extreme change).

I have found that the question in (12) is a good way to get students to engage further in a way that helps prepare them for when they later see cases where neutralization results from two sounds changing to a third sound (answer to (iii)) and cases where sounds neutralize because they delete (answer to (iv)).

I now turn to discussing challenges of this teaching method and strategies for mitigating them.

4.2 Hurdles and strategies on the student side The student-driven method of teaching is new to almost all students and the tasks can feel daunting to many. Because students are generally unpracticed at proposing theory they often do not realize the scope of power that they have. A common complaint I get, after the class has arrived at the target solution, is “I didn’t know we could do that!” (When students are considering what seems to them a radical solution and ask me if they are allowed to do that, I tell them that they are allowed to do anything that they can argue for and justify by showing how we would be better off for adopting it.) Especially once the class talks through possible solutions to a homework problem and arrives at a class-level solution, it can be depressing for students who have worked hard on a problem only to realize that they came up with a solution that did not, in fact, actually work. Finally, there is not a book to fall back on, which can disadvantage students who feel they learn best by reading (and re-reading).

I have a variety of mitigation strategies and am continuously looking to develop more. Regarding student morale, it helps to make sure students have a variety of chances for success. Especially when asking a low(er)-hanging fruit question in class, I look for (and often pause for) a volunteer who is less likely to come up with a feasible new piece of theory. Working with an-class group also allows more students to be part of a successful analysis. I encourage students to work together on the homework assignments as well, but do not force anyone to. I suggest exchanging contact information with in-class group members at several times early in the semester (after telling them to find someone to work with on the in-class problem whom they have not previously worked with). While the homework requires that students must write up the presentation of their analyses independently, any idea that was generated within their working group is available for everyone in the group to use as their own. I explain that this is because everyone in the group helped make observations and suggestions— including and especially suggestions that did not end up working— that allowed the target

solution to be reached by the group member who did so. Thus students who feel that this kind of work is not their strong suit can still be successful by contributing to a small group.

I explicitly talk about how important it is to work on a homework assignment early and often, explaining that they cannot start writing until they have an analysis, and formulating an analysis takes time, and they cannot even try to formulate an analysis until they understand what the problem is, and understanding what the problem is can take time. I acknowledge that because the assignments can feel daunting, it is very easy to put off working on them, or even looking at them. I suggest that they look at the assignment the day they get it and try to understand the problem, and tell them that even if it feels confusing at that point, if they then pick it up again the next day, it is very likely that they will realize something that will cause it to make more sense. I explain that working on it with time in-between so that it can simmer in one's brain is a happier, better use of time than working on it for the same amount of time all at once.

I want students to feel supported in the endeavor. Sometimes students do not realize the tools they have, from class discussion and previous work, and therefore feel that they are underprepared. Besides encouraging group work, I try to have one-on-one conversations with students who are struggling, by encouraging them (via homework feedback, after-class conversation, or by email) to set up an appointment with me. I find that when students are able to express what they are unhappy about and I am able to acknowledge that while also highlighting resources and suggesting strategies that they end up feeling much better. When students come to office hours because they are stuck on a homework assignment, I can often un-stick them by asking them a series of questions that require them to explain what they have done thus far, the problem they have run into, what it would take to solve it, etc.

More recently I have continued to use components that were consequences of remote learning and am finding they are also extremely useful for classes that are meeting in person. One of the problems previously was that there was no record of the class other than the notes that students who were present took. Switching from writing on the board to writing on a projected iPad means that I can then post that record of the class trajectory. When I had to post recorded classes for asynchronous students, I was surprised to hear from strong students who had been present for the recorded class that they would go back and watch those classes, in order to solidify their understanding. This made me realize how helpful a record of the course could be for all students, not just those who were not physically present. I have therefore started to record and post all classes. (I do this by opening a Zoom session on my laptop and starting recording, joining from my iPad, and screen sharing from the iPad. I chose non-mirrored displays on the computer and then move the Zoom window from my computer screen to the classroom screen. Thus students in the class (and any zoomers) see the iPad screen.) The concern, of course, is that students will try to do the work asynchronously if they feel like they have the option to, when it is meant to be a support for students unable to come to a particular class and for anyone to revisit a class' content. I am cautiously optimistic, however, that by making expectations clear, the benefits will outweigh the drawbacks. When I assign homework that requires significant problem solving I try to give students a couple of options beyond regular office hours for getting help. I will sometimes add an extra office hour, which can make students feel supported whether or not they make use of it. I also tell students to email me if they are stuck. In the past, I would email back and forth with such students, but it was often not satisfactory. Now I just ask them if they have a minute to hop on a quick Zoom and I am generally able to clarify what is behind their question or support them in thinking through the piece of the assignment they could not get to fit and the experience is both significantly faster and more satisfying for all parties. Of course being available in the evenings is not always possible (or desirable). (I do not advertise that I will make an immediate appointment; just that they should reach out.) Also, because many students do work in groups, I find that answering one person's questions is really answering four people's questions as the conduit passes the information along to other group members.

Student assignments are graded for both content and presentation, where they are expected to essentially write a mini-paper that lays out the problem and leads the reader through their proposed solution in a professional tone. My homework prompts have typically been fairly minimal, but more recently I have included a series of subquestions that help guide the student through tackling the problems. (I did this when some/all students were remote and I was concerned about my ability to sufficiently support them in the writing/presentation aspect of the assignments.) In my more advanced class I did this but told students that after working through the assignment they should then delete the questions and edit their answers together such that they formed a coherent explanation of the problem presented by the data and their proposed solution. I was generally pleased with the results of this second strategy and so am now implementing it in my mid-level

course.

Posting the record of the class notes (and the recording of the class itself) helps to mitigate the lack of a textbook. Sometimes I post a reading about a particular concept that was introduced. I have used a book in the past that did not discuss theory in depth, such that students could use it as a resource for the fundamental units and ideas. (It did not seem to provide enough benefit to continue to recommend it.) I am in the process of developing my own reference materials that I post after major advances so that students have a clean explanation of it, with examples. This is what they ideally would have gotten from the class discussion, but of course it is difficult to both get everything important into one's notes at the same time as processing what is being discussed. I would not want to have written material for every class, since the idea is not to replace students' notes.

4.3 Hurdles and strategies on the faculty side There are also significant challenges on the side of the instructor. When leading in-class discussions that are meant to lead to new pieces of theory it can be difficult to encourage students to venture suggestions. Alternatively, students may propose something you were not expecting and do not immediately know how to respond to. It is notably slower to grade homework assignments in which students propose something new, both because as the instructor you have to be able to follow their (possibly flawed) presentation and figure out how much they understand, and because they might be presenting an analysis you have not previously thought of and need to spend time determining whether there is a flaw in it, given what the class currently knows. Finally, having students advance the theory does slow down the deployment of material, as one can lecture more quickly than support students through puzzling through what is needed.

I very much enjoy that student-built theory leads to unexpected observations and analyses. This makes the class feel new every time I teach it, because the students must build the theory anew each time. It can be really interesting to see what students notice and propose. Sometimes a student will see something that is a ways ahead of where we are as a class and I tell that student to hold that thought for a few weeks and then we will be in a position to look at exactly that idea. Sometimes a student will come up with an analysis that has merits and which I have never considered, which is always a “wow” moment. As I have taught more classes with student-built theory I have become much more comfortable with thinking through student ideas on the fly. One strategy I use is to write up the proposal and talk through how it would work, outwardly to make sure everyone is following but also to give myself time to think it through.

Changing my homework assignments to have more explicit structure (i.e. a series of subquestions) is speeding up the grading time significantly, because it means that the analysis is very likely to come laid out in a particular order (the order of the deleted subquestions, see related discussion in §4.2), and is more likely to have all the parts I am looking for it to have, such that I do have to decide how much they seem to understand what they did not explicitly address.

There is a balance to be found between being able to move ahead and having students work out theory. I try to lecture about the components that I feel there is less payout for deducing, as well as the pieces that seem necessary to set them up for successful theory building. While lecturing directly allows more material to be covered, it can make it more likely that students can perform an analysis without a deep understanding of what they are capturing. When students build (parts of) the theory, their understanding is always being tested, and weaker understandings are more clearly exposed. I also find that students retain advances better when they were a part of making them. Further, in-class problems and homework assignments can be scaled to go faster or slower by giving students more or less structure. For example, if more pieces of the puzzle are laid out for students, the instructor is able to have students self-guide through more content in a single homework assignment.

5 Conclusion

I have outlined the pedagogical approach I take in my courses, specifically in my mid-level phonology course, along with its benefits and drawbacks. I will conclude by sharing some student feedback, reflective of six iterations of the course (2016-2020).

Students generally feel positive about their experience in the course, and proud of what they have accomplished. Students often acknowledge that it was different from other courses, as with the student who commented, “I normally like a clear, explicit list of things to know, but from going to class it was always

clear to me what the new strategy or insight was. Making the connection between class data, strategy and homework data could be difficult for my group, but I loved that challenge.” Students frequently reference their personal progression in how they viewed the assignments, as with the student who said, “While I was initially daunted by the intensity of the homework assignments, I quickly came to genuinely enjoy working through the phonology problems, and figuring out some crafty way to get around the problem presented by the data.” Overall students point to the benefits of the challenging homework assignments, as in the following comment: “While analyses were at times frustrating, they greatly improved my comprehension of crucial [...] concepts and their applications.”

Students will also frequently state in feedback that they had (at least an aspect of) the experience I try to create; for example: “I am actively engaged in class because I want to find out what the solution will be,” “I am not sure if I will ever really be able to apply this new knowledge in my life, but I found the material interesting in and of itself, and the logic/problem solving skills that this class asks one to develop are fairly ubiquitous in any aspect of life,” and “I also thought that the homework assignments were time-consuming, but that they improved my critical thinking skills immensely.”

While the above comments are more typical, I do receive student feedback that reflects that the approach does not work for everyone. For example, “I’m someone who finds it very helpful to learn concepts/rules/definitions/etc. in a way that’s very clearly, straightforwardly laid out, like via Powerpoint presentation, so it was often very difficult for me to follow the examples we did in class” and “The overall layout of the course is very stressful for the student. Topics covered in class must not only be represented but expanded upon in the assignment, which requires taking intellectual risks that a student is often not comfortable with without guidance.”

My goals are summed up well by this student comment: “[The] class material [...] pushes you to the edge of your academic comfort zone without it being impossible or making you feel inadequate. By the end of the course, I felt I had learned so much.”

The alternative title of this article is a quote from Jorge Hankamer and I will also end with a paraphrase of his advice for teaching this kind of course: Before telling students anything, should ask yourself whether it really needs to be taught, or whether the information could be elicited from them.

References

- Asher, R.E. (1982). *Tamil*, vol. 7 of *Lingua Descriptive Studies*. North Holland Publishing Company, Amsterdam.
- Barkaï, Malachi & Julia Horvath (1978). Voicing assimilation and the sonority hierarchy: evidence from Russian, Hebrew and Hungarian. *Linguistics* 16, 77–88.
- Buck, Carl (1933). *Comparative Grammar of Greek and Latin*. University of Chicago Press, Chicago.
- Carr, Philip (1993). *Phonology: An Introduction*. St. Martin’s Press, New York.
- Chomsky, Noam & Morris Halle (1968). *Sound Pattern of English*. Harper and Row, New York.
- Ito, Junko (1986). *Syllable Theory in Prosodic Phonology*. Ph.D. thesis, University of Massachusetts Amherst.
- Kenstowicz, Michael (1994). *Phonology in Generative Grammar*. Blackwell, Cambridge Massachusetts.
- Kenstowicz, Michael & Charles Kisseberth (1979). *Generative Phonology: Description and Theory*. Academic Press, San Diego.
- Kuroda, S.Y. (1967). *Yawelmani Phonology*. MIT Press, Cambridge Massachusetts.
- Newman, Stanley (1944). *The Yokuts Language of California*, vol. 2. The Viking Fund Publications in Anthropology, New York.
- Sapir, David J. (1965). *A Grammar of Diola-Fogny*. Cambridge University Press, Cambridge, UK.