Verb strings and other weavings: An exploration of grammatical structures, visual arts, and language teaching

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Introduction

In the language classrooms I've studied in, art has taken a few specific roles. It has been a topic of vocab lists, which I find useful as an artist who wants to talk about their work. It has also been used as a way to prompt discussion in the target language. And finally, it has been used to introduce and teach topics of culture.

I have taken a Spanish Cinema class and an Art History class taught in Spanish, both of which integrated art through all three categories. These are all interesting and useful ways that art appears in the classroom. However, as someone whose primary artistic interests lie in the patterned and structured fiber arts, I've come to want more out of art in the classroom. I want to talk about art and language in a way that reflects the systematic planning and restrictions that weaving requires.

When I weave in my preferred medium, bandweaving, I have to plan or choose the pattern, then measure out the warp to match that pattern. I then put it on the loom by placing each individual thread in the right space. Finally, once I get to weave, I follow the pattern, picking up individual threads on each row to create intricate motifs. I use math often when I weave, but I also use my linguistic knowledge. Weaving patterns and resources aren't always available in English, and bandweaving patterns don't have
a standard pattern notation. Patterns are often written in ways that are not bound by any language, but they require knowledge of the weaving structure to decipher how the pattern translates into the medium. This process has always felt similar to doing linguistic problem which has piqued my interest as to how exactly weaving, especially weaving patterns and structures, could be connected to linguistics.

**Background**

**Arts and education**

Several studies have explored some of the applications of visual arts in the language classroom. Shiobara & Niboshi (2022) discuss the utility of crafts classes for Elementary Japanese students as a space where students can use English. Craft classes can encourage language use as long as some standards are in place surrounding interactions, such as requiring students to request materials rather than helping themselves. By having a variety of craft materials and projects available, students were more interested and engaged in the class, and experimented outside of class with the language formulas introduced for the crafting context. Knapp (2012) provides a variety of ways that paintings can be utilized in university German classes of varying levels. For beginners, describing a painting may require using prepositions and learning new vocabulary. Intermediate learners can write analyses of an artwork, or they may use them as inspiration for creative writing. Paintings for advanced learners can introduce cultural concepts surrounding artistic periods related to literary ones, further unlocking an understanding of target language literature.
For students with an interest in the arts, it can provide an opportunity to further connect with the language. A study by Thulasivanthana (2020) found that English language learners in a four-week study had greater language skill test results when in a class with visual arts activities than in a class without any arts-integration. Students in the study also reported feeling more likely to recall lessons from the visual arts classes.

While specifically implementing weaving in the language classroom has not been widely researched, weaving has made its foray into the math classroom. Trimble (2019) reported on a two-week program at an elementary school where 3rd-grade math students learned about pattern drafting, measured a warp, dressed a loom, and wove a wall hanging for the school. The students were able to use what they learned in their classes and apply them to making art.

**Weaving, textiles, and linguistics**

Within the field of linguistics, weaving and textiles play multiple roles in research. Tran & Hach (2022) analyze the professional jargon of the Bay Hien Weaving Village in Ho Chi Minh City, Vietnam. The professional jargon in this community is highly specialized and cannot be understood by others not in the field nor by weavers from other areas of the country. Furthermore, it is a language system of its own that contributes to the linguistic diversity of Vietnamese. Weaving culture does not only foster linguistic diversity within the artisan community, but can also expand into the language of the general population. Tyshchenko (2020) discusses how the language of weaving appears in modern sayings, riddles, and proverbs in West and East Slavic languages.
Looking to the vast weaving practices from the Americas also offers opportunity for linguistic research. Pérez (2018) documents textile-related terminology and ethnographic notes in the Zapotec Communities in Oaxaca, Mexico, as part of an effort to better record and understand the language, cultures, and textile traditions of the region.

Language is also an important component of some weaving practices. Kaur (2020) describes the role of trade language in transforming Kashmiri carpet patterns into code and the interpretation of the code to be woven. The code is interpreted in multiple modalities (top to bottom, bottom to top, left to right, right to left, etc.) to complete repeating patterns on a carpet. When carpets are being worked on by teams of weavers, a few members will interpret and read aloud the code while weaving, while others will listen and weave the instructions. Often teams will simultaneously weave the patterns on the same piece in the different modalities. Tuck (2006) argues that in Indo-European language speaking populations, weaving and metric poetry are intertwined cultural artifacts. Accounts from the 19th century across Central and Southwest Asia report repeating songs as a method of communicating patterns to teams of weavers. Ancient Greek metric poetry contains analogies between textiles and song. In some regions, songs and rhythmic patterns are still used today to memorize and weave motifs. Because of the complexity of weaving patterns, the feat of memorizing long sequences of numbers is aided by mnemonic devices, such as songs and poems.

Additionally, some languages and cultures use similar terminologies to discuss weaving as well as speaking and/or writing. Nosch (2014) outlines the meanings of ancient
Greek words, particularly those used in Homeric texts, that have both textile meanings and literary ones. The semantic relationship between weaving and constructing a narrative is embedded in the language. Some of these words even have modern parallels, such as ancient Greek *hyphainein* and modern French *tramer*, which both mean “to weave” and “to contrive or plan.” Similarly, Zürn (2020) discusses how Chinese writers in the Han dynasty wrote about the act of writing through weaving and textile terminology.

**Weaving Language**

While all of this research covers various connections between linguistics, education, and textile arts, investigations about the act of embedding language into weaving are more difficult to find. One project, Francesca Capone’s *Weaving Language*, a series of art books, does connect its two titular topics in such a way. In *Weaving Language I: Lexicon*, Capone and other contributors (2022) discuss a wide range of ideas about this. A metaphorical connection between elements of weaving and the building blocks of language provides an overarching theme for the book. This poetic system of language, where tapestry techniques represent prepositions, and fiber types represent pronouns, allows one to derive meaning from a weaving and permits a weaving to be embedded with communicative themes.

Another approach in the book flips this intersection to give heavier weight to the field of linguistics, where Parrish (2022) discusses a method for generating weaving drafts from the word vectors of verbs. The generated patterns that Parrish creates are not always the most beautiful and they do not always reflect the visuals speakers may
associate with different words. However, this is the most similar the weavings get to spoken language. There isn’t much reason for the sounds and words we use to be the way they are. If there were, we would expect words in different languages around the world to sound more similar. Language has patterns, but they are a different kind to the patterns we see in a lot of art.

One has to look to Urbanczyk (2021) to specifically explore the intersection of linguistics, weaving, and language acquisition. She suggests a method to use weaving and knitting, specifically grid patterning, to teach reduplication in Salish languages. Not only do these methods distance students from technical linguistics formalisms that may confuse or alienate students, but they also connect to practices of Salish culture that are familiar to learners. Urbanczyk also introduces the idea of using weaving and knitting for other parts of language learning, including expansion of the technique beyond reduplication, workshops that teach craft while introducing target language vocabulary, and creative games in which students use reduplication patterns to create artwork.

**Motivations and Process**

The framing of this project is heavily inspired by the conclusion of Urbanczyk (2021). After proposing and discussing the applications and purpose of using weaving to teach reduplication, she writes:

So far, I have only discussed using graph paper to find repeating patterns in words, and haven’t discussed how to relate language learning in general to weaving and knitting activities. There are many ways that weaving and knitting
can be used to enhance language learning, other than by the parallels of repetition in language. One clear direction would be to have weaving and knitting workshops and introduce language related to those activities. One could make a weaving or knitting game or contest, where learners use reduplication patterns to guide their creative works. (155-156)

The implications of Urbanczyk’s proposal seem to be further reaching than just that of teaching Salish languages. The proposal introduces a way to use a form of artistic expression that has structure and technical limitations while also offering the ability to create an infinite number of unique products to teach language. Perhaps hinted at by the previous sentence, this is similar to the way that human languages are bound by different rules, but human languages can all express infinite sentences of increasing complexity. Weaving and other such artistic practices could be ideal artistic forms to explore linguistic structures.

Urbanczyk inspired three major questions that I sought to investigate.

1. Can you use linguistic patterns to guide a creative work?
2. Are there other parallels between weaving and language?
3. Can weaving enhance language learning?

To address these, I set off to design and weave pieces inspired by different linguistic patterns from languages that I have experience teaching and/or learning. Given the scope of this project, it would be impossible for me to provide an answer to the final question, but I can explore how weaving may enhance my own learning.

I chose to focus on bandweaving as the medium and constraint of this project for two major reasons. First, while I have experience weaving a variety of products on a
variety of types of looms, I have been weaving bands on inkle and backstrap looms more frequently than any other kind of weaving in the past few years. I have also been working through a number of traditional Latvian bandweaving patterns and techniques as a way to improve my technical ability and my understanding of pattern design. This means I am better prepared to explore linguistics through bandweaving than I would be with another form of weaving (or another craft, like knitting). Second, inkle looms are portable, easy to set up, and the band can often be completed faster than other weavings. As this project had a time constraint of a single academic quarter, bands gave me the highest chance of producing a number of varied patterns and weavings.

**Methods**

Before discussing each of the pieces that I produced, I would like to first briefly address the overall way in which the design of each piece was approached. I selected a number of features from different areas of linguistics. While it would still be interesting if morphology could inspire different weavings, as Urbancyzk suggests with reduplication, it is further evidence towards broader applications of weaving for language learning if the weavings could relate to anything from phonetics to syntax to prosody.

For each feature, I collected language data relevant to the feature and searched for the occurrence of the various patterns. I then selected what elements of the linguistic structure were most important to convey in the final product and began experimenting with possible methods of turning those features into a pattern. Features were
“translated” into weaving through the colors of thread, the shapes of motifs, or a combination of the two.

Using SeiZenn, an online tool developed by Jeff Bigot (2023), the bands have been documented so that any other weaver may be able to recreate these bands or remix and further develop the patterns.

The Weavings

Band I: English Voice

*Figure 1: The English Voice band, section corresponding to present tense constructions: simple present, present continuous, present perfect, and present perfect continuous*

*Figure 2: The English Voice band, section corresponding to past tense constructions: simple past, past continuous, past perfect, and past perfect continuous*
Figure 3: The English Voice band, section corresponding to future tense constructions: simple future, future continuous, future perfect, and future perfect continuous

The Pattern

Warp: 8/2 cotton in dark blue

Weft: 8/2 cotton in dark blue, additional 8/2 supplementary weft in light blue, yellow, and white

Each of the motifs in this pattern corresponds to the verb forms of the verb strings in active and passive versions of sentences. This includes past, present, and future tenses, with each tense further divided into the simple tense, perfect aspect, progressive/continuous aspect, and the perfect progressive/continuous aspect. Example sentences in order with the labelled verb forms are in the pattern appendix.
Figure 4: Warping pattern for the English Voice band, along with the brocade pattern showing the following verb forms from top to bottom, left to right: Auxiliary verbs in present tense, present tense, past participle, present participle, infinitive.

The following table describes all the brocade features of the band:
<table>
<thead>
<tr>
<th>Pattern Feature</th>
<th>As Woven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary and modal verbs</td>
<td>Light blue weft brocade</td>
</tr>
<tr>
<td>To be</td>
<td>Yellow brocade</td>
</tr>
<tr>
<td>Lexical/main verb</td>
<td>White brocade</td>
</tr>
<tr>
<td>Past tense</td>
<td>3 brocade rows</td>
</tr>
<tr>
<td>Present tense</td>
<td>4 brocade rows</td>
</tr>
<tr>
<td>Future tense</td>
<td>5 brocade rows</td>
</tr>
<tr>
<td>Past participle</td>
<td>Four rows of brocade, the third of which is a broken line</td>
</tr>
<tr>
<td>Present participle</td>
<td>Four rows of brocade, the middle two of which are broken lines</td>
</tr>
<tr>
<td>Infinitive</td>
<td>Four rows of brocade, all of which are broken lines</td>
</tr>
</tbody>
</table>

**Artist's Statement**

I was inspired to turn this grammatical feature into a band by one of the linguistics classes I was taking while developing patterns for this project. As I explored the changes that one makes in the verb string to turn a sentence in the active voice to the companion passive sentence, I was fascinated by the regularity with which this pattern occurred yet how bizarre some passive sentences could be when using verb
tenses with long verb strings (1). While some of these complex passive sentences are grammatical, they are not sentences that we would likely say.

(1) Active: Nora will have been walking the dog.

Passive: The dog will have been being walked by Nora.

The change from active to passive is not too complicated, it just requires some knowledge of verb forms. After changing the subject of the active sentence to the object of the passive one (with the addition of the preposition “by”), and vice versa, one needs to make some changes to the verb string. This requires identifying 2 things: the lexical verb and its form.

(2) My friend eats the pizza

(3) The student was writing an essay.

In example (2), the lexical verb, eats, is in the 3rd person, present tense form. It is also the only verb in the sentence. In example (3), however, there are 2 verbs. The lexical one is the one that expresses information about the action or state, rather than the grammatical information that an auxiliary verb conveys. The lexical verb here is writing, and it is in the present participle form. The passive versions of these sentences are below.

(4) The pizza is eaten by my friend.

(5) An essay was being written by the student.
In these passive sentences, two changes have been made to the verb string. The first is that the lexical verb has been changed to the past participle form. *Eats* becomes *eaten* and *writing* becomes *written*. Second, the verb *be* is inserted just before the lexical verb. The catch here is that the form *be* uses is the form that the lexical verb had in the active sentence. In (4), *be* takes the 3rd person, present tense form *is*, and in (5), *be* takes the present participle form *being*. Any additional verbs in the string remain the same.

This process is bidirectional. A passive voice sentence can be rewritten in the active voice by first identifying the lexical verb (which will be in the past participle form) and the form that the *be* verb is in (it will be right before the lexical verb). Then, delete the *be* verb, and change the lexical verb to the form that the *be* verb was in.

In creating a weaving reflecting this process, I wanted to include both the change of form that the lexical verb undergoes in addition to the way that the form of the *be* verb matches the form of the lexical verb in the active sentence. To show this, I used color to represent 3 different kinds of verbs in a verb string: the lexical verb, the *be* verb, and the other auxiliary and modal verbs that remain the same throughout these conversions. I then used shape/form to represent the verb form.

These verb strings are represented by brocade weaving on a dark blue background. The two columns running along the length of the band represent the active and passive voice. The parts of the sentences that change are in white and yellow brocade, while the auxiliary and modal verbs are in light blue.
I wanted to weave each of the 12 major verb tenses commonly cited in teaching materials, but given my pattern, some of them would look too similar. To create more visual distinction, I chose to modify the style of the brocade strings in light blue that don't change from passive to active. I used the overall tense of the string to determine how many rows of brocade would be used for these auxiliary verbs. For past tense, there are 3 strings, for present, 4 strings, and for the future “tense,” formed using the modal verb “will” and a verb in the infinitive, there are 5 strings.

Below is a photo of the project in progress. The blue background ended up bleeding a lot during the process of finishing the band. This ended up tinting all the brocade threads a bit indigo, thus muting the overall palette. While my intent for this piece was for it to be brightly colored, the bleeding served to make the colors somewhat more cohesive and is a reminder of how a weaving goes through changes even after it has been removed from the loom.
Figure 5: The English Voice band on the loom.
Figures 6-7: The first half of the German Syntax band, read from left to right, bottom to top.
Figures 8-10: The second half of the German Syntax band, read from left to right, bottom to top.

The Pattern

Warp: 8/2 cotton in white, dark brown, and yellow; 8/4 cotton in green

Weft: 8/2 cotton in white

There are 8 motifs in this pattern. The weaving order of the motifs is determined by the sentences woven. The pattern of motifs, along with the corresponding example sentences, is detailed in the pattern appendix. Each row of motifs corresponding to a sentence is followed by three rows where all pattern threads are dropped, and every 2-4 rows of motifs are separated by 3 rows of plain weave. The plain weave rows are not strictly necessary, but help manage the warp floats on the back of the band.
Figure 11: Warping pattern for the German Syntax band, along with the pickup pattern showing where each row of motifs would go.
Figure 12: Motifs for the different constituent roles. In order from left to right along with the abbreviations used in the pattern appendix: Subject (S), Direct Object (D), Indirect object (I), Negation (NEG), Verb (V, AUX, MOD), Adjunct - Time (A), Adjunct - Reason and Manner (A), Adjunct - Place (A)

Artist’s Statement

Turning German syntax into a band was one of the first ideas I had for this project. German, like most other Germanic languages other than English, predominantly uses the verb-second (V2) word order. V2 is a structure in which the first verb occurs after the first constituent of a clause. In the following examples, the first constituent of the clause has been underlined. Often, this is a single word (6, 7), but the constituent can be longer (8, 9).

(6) Ich esse Schokolade

I eat chocolate

(7) gestern hat der Hund den Knochen gefressen

yesterday had the dog the bone eaten

The dog ate the bone yesterday

(8) der Hund frisst den Knochen

the dog eats the bone

The dog eats the bone

(9) in der Stadt schneit es

in the city it is snowing
It's snowing in the city

When learning German, this was something that stumped me for a while. I couldn’t figure out the pattern. A sentence structure like English, with a simple subject followed by a verb and object, is allowed in German, so I could still formulate some sentences. However, when I wanted to play around with word order, like moving the prepositional phrases or adverbs to the front of a sentence, I couldn’t seem to get it right. After a while, my German instructor realized that I was missing out on this essential element of word order and she was able to quickly explain it to me. It gets far more complicated for sentences with dependent clauses, so I chose to focus on just the simple independent clauses for this piece.

Another aspect of German syntax that interplays with the V2 order is that different elements of a sentence can move around much more freely than in English. Because the role that each constituent plays in a clause is marked by a determiner, not only can adverbs and prepositional phrases, as in sentences (2) and (4), be moved around, but so can the object. The English sentence “The dog eats the bone” is not equivalent to “The bone eats the dog,” however, with the appropriate case marking, the bone can occur before the verb in German without changing the meaning.

(10) den Knochen frisst der Hund

the (accusative) bone eats the (nominative) dog

the dog eats the bone
I had initially conceptualized some sort of artistic weaving for this band that only vaguely represented the verb-second concept in German syntax. There would be a single line running along the length of the band, and a few symbols would repeat randomly around that line, each row having one symbol in front and a few after.

As I started to develop the pattern, I realized that it could be improved greatly by having each symbol represent a different kind of constituent. And then, if I was going to be labelling types of constituents, it would be interesting to include the rules surrounding the ordering of adverbs, adjectives, and prepositional phrases. While not a hard and fast rule, these adjuncts generally are ordered by the kind of information they contain, starting with adjuncts related to time, then cause, modality, and finally location.

In my German lessons, this order was accompanied by a catchy memory tool, TeKaMoLo, which stands for temporal, kausal, modal, lokal. When any number of adjuncts occur in a sentence, they generally follow this order (11). When one of these is moved to the first position, or is otherwise moved, the rest of the adjuncts remain in their order (12).

(11) Ich bin letzte Woche mit dem Bus nach Frankfurt gefahren
     I have last week with the bus to Frankfurt went
     time modality location

     Last week I went by bus to Frankfurt

(12) mit dem Bus bin Ich letzte Woche nach Frankfurt gefahren
     with the Bus have I last week to Frankfurt went
Last week I went by bus to Frankfurt

I used three different German grammar books to collect sentences to weave (Beck & Gergel, 2014; Fehringer, 2003; Stocker & Young, 2012). After collecting a number of sentences along with translations and notes on the slight changes in meaning that the word order variation causes, I marked down the types and order of constituents within each sentence. These constituent types (subject, object, adjunct, etc.) were each given a basic 3-string baltic pickup pattern on a 3x3 grid. The pattern for this is entirely text-based, and requires a weaver to change letters (i.e. S for subject) into the corresponding pattern.

I divided the sentences into two sections; the first half represents the more “default” or neutral word order, which has the subject in the first position. The second half represents word order with more movement and variation. Each section is divided into small groupings of sentence structures with the same or similar constituents, to show the variation possible.

If I were to weave this piece again, I would make two changes. First, I would weave it to be read from top to bottom, rather than bottom to top. When weaving a band, one starts at the bottom and works up, which means that a pattern has to be read in reverse. I did not do this, so it reads in a somewhat unconventional manner. Second, I would add different motifs for when a constituent is a pronoun. Whether or not a

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1 Typically a response to a question about where and when someone took the bus.
pronoun is used changes the word order necessary, and this isn't clear in the finished band.

Band III: Arabic Triconsonantal Roots

Figures 13-15: The Arabic Triconsonantal Roots band, Forms 1 and 2
Figures 16-18: The Arabic Triconsonantal Roots band, Forms 3, 4 and 5

Figures 19-21: The Arabic Triconsonantal Roots band, Forms 6, 7 and 8
Figures 22-23: The Arabic Triconsonantal Roots band, Forms 9 and 10

The Pattern

Warp: 8/2 cotton in white, grey, and purple

Weft: 8/2 cotton in white, yellow, red, and light blue

This band is woven with a simple brocade pattern with four weft threads. Each pattern is represented by 3 rows, though the middle row displays the vowels, and the first and third rows display the consonants. Additionally, for patterns where one of the root consonants is geminated, that feature is represented in all 3 rows. Each pattern is separated by 1 row. Each form is separated by a row of blue thread that runs over most of the white threads. The full chart of patterns and forms is in the pattern index.
Figure 24: The warping pattern for the Arabic Triconsonantal Roots band

The brocade and color key for the pattern sounds is as follows:

<table>
<thead>
<tr>
<th>Pattern Feature</th>
<th>As Woven</th>
</tr>
</thead>
<tbody>
<tr>
<td>/a/</td>
<td>Red weft over 1 white thread</td>
</tr>
<tr>
<td>/aː/</td>
<td>Red weft over 3 white threads</td>
</tr>
<tr>
<td>/i/</td>
<td>Yellow weft over 1 white thread</td>
</tr>
<tr>
<td>/iː/</td>
<td>Yellow weft over 3 white threads</td>
</tr>
<tr>
<td>Pattern Feature</td>
<td>As Woven</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>/u/</td>
<td>Blue weft over 1 white thread</td>
</tr>
<tr>
<td>/u:/</td>
<td>Blue weft over 3 white threads</td>
</tr>
<tr>
<td>/t/</td>
<td>Blue weft over 3 white threads below the vowel row,</td>
</tr>
<tr>
<td></td>
<td>Red weft over 3 white threads above the vowel row</td>
</tr>
<tr>
<td>/n/</td>
<td>Red weft over 3 white threads below the vowel row,</td>
</tr>
<tr>
<td></td>
<td>Yellow weft over 3 white threads above the vowel row</td>
</tr>
<tr>
<td>/st/</td>
<td>Yellow weft over 3 white threads below the vowel row,</td>
</tr>
<tr>
<td></td>
<td>Blue weft over 3 white threads above the vowel row</td>
</tr>
<tr>
<td>geminate root</td>
<td></td>
</tr>
<tr>
<td>consonant</td>
<td>White weft over 1 purple thread</td>
</tr>
</tbody>
</table>

**Artist's Statement**

One of the features of Arabic that has most intrigued me over the years is the way of deriving words from triconsonantal roots. Take, for example, the root following root (13), which has the meaning “select, pick, choose, elect.”

ن-خ-ب (13)

nxb/

While this root alone holds meaning, it is not an independent word. To derive words from roots, a pattern is applied to the root. These patterns include vowels and some select consonants that are placed before, after, or between the sounds in the root. For
example, the verb meaning “to elect, to pick, to choose” is formed by adding the short vowel /a/ after each root consonant (14).

لَحْب /naxaba/
‘to elect, to pick, to choose’

Plenty more words can be derived from the root (15-20). I have used translations from the Hans Wehr dictionary (1976), a commonly used bilingual dictionary for learners.

نَخب /naxb/
‘selection, choice’

نُخبة /nuxba/
‘selected piece, the pick’

إِنتِخاب /intixa:b/
‘election’

ناخب /na:xib/
‘elector, voter, constituent’

مُنتَخِب /muntaxib/
When I started learning Arabic patterns in class, I had the sense that there wasn’t much connection between the different ones and that they would all have to be memorized separately. Despite this, they remained a fascinating feature that required a bit of practice to figure out how to apply. However, once a pattern clicked, it was very fun to derive lots of words using it.

In designing a pattern for this band, I knew I wanted to incorporate as many different patterns as possible. To do so, I flipped through an Arabic grammar (Ryding, 2009) and recorded all the patterns I could find. For each pattern, I recorded the part of speech and the form.

Each root has the potential to be used in any of 15 different verb forms. However, forms 11-15 are rare, and most roots are not used in all forms, only a select few. I have only included forms 1-10 in this band. Each form has some semantic connotations. Additionally, each form has associated patterns for verbal nouns and adjectives. Forms 1 and 2 are the most common and include many different patterns, but the other ones are more limited, and the pattern of a word can be used to easily identify which form it is.
After recording patterns for forms 1-10, I organized them in two different ways: grouped by form and grouped by part of speech. Within the sections of both groupings, there were repeating features, something that I didn’t expect to see. I ended up only weaving the patterns organized by form, but given more time, I would have also woven the patterns organized by part of speech.

This band pattern went through several iterations, and while it was one of the earliest designs I conceptualized, it took a lot of work to get it to its final structure. I knew I wanted 3 lines running the length of the band that would represent the 3 consonants in the roots, but the main question was how to represent the patterns.

There are 3 different vowels in Modern Standard Arabic, each of which has a long and short variant. These 6 vowels along with a few consonants are used to derive new words, and I originally wanted to represent all of them. After some experimentation, however, I realized that it would be too complicated for this project to accurately show all the consonants. Instead, I decided to focus on any consonants that were distinctive to a given form. For example, the following list of form 7 patterns (written using the standard root for communicating patterns, فعِل, /ʕal/) all contain the additional consonant, /n/ (21).

(21) اِنفَعَل

/ infaʕala/

يَنفَعِل

/yanfaʕilu/

اِنفِعال

/infiʕaːl/
The /n/ isn’t a feature shared with any of the other forms, it is unique to Form 7. As such, /n/ was a consonant I wanted to include in the weaving. On the other hand, regardless of form, all the active and passive participle nouns start with /mu/ (with one exception in Form 1), so it wasn’t something I wanted to represent in the section of the band organized by form. If I had gone on to weave a section organized by part of speech, the /m/ would be an essential part, as it would be one of the defining features of those noun patterns.

After identifying the 3 consonant structures that were distinctive to the forms, /n/, /t/, and the consonant cluster /st/, I assigned each vowel a color, and by using a brocade weaving technique, I could assign vowel length by changing the length of the floats. For the 3 consonant structures, I created 3 different two-color pairings of floats that would go above and below the vowel sequence. Initially, I also had a separate symbol that represented all other consonants. However, after warping the band and trying this out for a few inches, the extra consonant symbol made the already complex band too complex for the scope of this project and would have substantially lengthened the weaving process. Because I dropped this feature after warping the band, I had to then modify the pattern to work with the existing warp. The unevenly sized white stripes then are out of place, since their sizes were initially determined by the longest strings of sounds that would have to fit in each space.
One feature of this band that is somewhat unique from a weaving perspective is that there are 4 different warp threads that all surface in different places as brocade floats. Some rows have all four colors as floats in different places. It created a very thick, sturdy band that didn’t soften up the way most bands usually do after letting them soak in water.

While I am pleased with how visible the repeating features for each form are, I find myself wishing the pattern were more broadly visible, not just a series of small dots and lines. Each row is also read left to right, while Arabic is written right to left. If I were to reweave this band, those would be the first things I would change.

Band IV: Spanish Resyllabification

Figure 25: The Spanish Resyllabification band, section corresponding to the sentence: ‘Mis amigos están en el centro.” [My friends are downtown].
Figure 26: The Spanish Resyllabification band, section corresponding to the sentence:
‘Las escuelas de esa ciudad tienen muchos estudiantes.” [The schools in that city have a lot of students]

Figure 27: The Spanish Resyllabification band, section corresponding to the sentence
“Las obras de arte están aquí.” [The works of art are here]
Figures 28-29: The Spanish Resyllabification band, section corresponding to the sentence “Mi cara estaba pegada al vidrio del acuario, mis ojos trataban una vez mas de penetrar el misterio de esos ojos de oro sin iris y sin pupila.” (Cortázar 1956/2014)

[My face was pressed to the glass of the aquarium, my eyes tried again to penetrate the mystery of those eyes of gold without iris, without pupil.]

The Pattern

Warp: 8/4 cotton in white, yellow, and orange

Weft: 8/4 cotton in white

Nearly every row of this piece was woven by manually picking up and dropping the threads needed for each section of the pattern to recreate the “before” and “after” of the syllabification for each sentence as documented in the pattern appendix. A yellow section represents a vowel, orange represents a consonant, and white represents the syllable breaks. Each sentence was also divided by 5-6 rows where only the white threads were left on the top side.

\[2\] Own translation
Figure 30: The warping pattern for the Spanish Resyllabification band

Artist’s Statement

Through both conscious and unconscious effort, my variety of Spanish was somewhat solidified while living in Spain in 11th grade. My Spanish teacher there spent some time having us practice small variations in how we pronounce certain consonants and
vowels, but I acquired many other phonological and prosodic features of the language without any instruction.

One of the coolest “rules” of Spanish pronunciation that I’ve learned in the years since was resyllabification. It was exciting to test it out and hear that I was already doing it without ever thinking about it. I have also gotten the opportunity to teach this feature to learners, and it’s cool to watch as students learn about it, try it out, and hear how dramatically it can change the sound of their productions.

Resyllabification is a matter of word boundaries and syllables. A word is made up of sounds (at least in spoken languages) and based on the rules of the language, the sounds are divided into syllables. These rules are why the 2 syllables of *bluntness* are *blunt-ness* and not *blun-tness* or *blu-ntness*.

The way Spanish divides sounds into syllables also takes into account word boundaries. Consider the following words:

<table>
<thead>
<tr>
<th>English</th>
<th>Spanish</th>
<th>Spanish Syllables</th>
</tr>
</thead>
<tbody>
<tr>
<td>the (masculine plural)</td>
<td>los</td>
<td>los</td>
</tr>
<tr>
<td>eyes</td>
<td>ojos</td>
<td>o-jos</td>
</tr>
</tbody>
</table>

If someone wanted to say ‘the eyes,’ *los ojos*, the rules about how to divide syllables have to do some extra work across the word boundary. The sounds have to be rearranged. The first word ends in a consonant, and the second starts with a vowel; those two sounds then are merged into a syllable when spoken (22). This is called resyllabification.
Certain Spanish syllables are preferred, and others are likely to shift to become more like the ideal ones if given the opportunity. A syllable made of a consonant and a vowel (CV) is a strong one, unlikely to change. A syllable that begins with a vowel, such as V or VC, is a syllable that would like to have a consonant before it. So when a syllable with an extra consonant at the end, like CVC (or in our example, los) comes before one starting with a vowel, the consonant at the end will be dropped from the first syllable and added to the second.

I have come to enjoy writing the resyllabifications of sentences. Take sentence (23a) and the syllabification of the individual words (23b).

(23a) Mis amigos están en el centro

    my friends are downtown

(23b) Mis / a-mi-gos / es-tán / en / el / cen-tro

    CVC / V-CV-CVC / VC-CVC / VC / VC / CVC-CCV

Underneath the syllabification of the words in (23b), I have reduced the sounds to consonants (represented by C) and vowels (represented by V) and underlined the syllables starting with a vowel—the syllables that would like a consonant at the beginning. In this example, all of these syllables are quite lucky since there are consonants at the ends of the syllables before them. When the sentence is spoken,
the syllables get rearranged so that there are no longer any of those syllables that begin with a vowel (23c).

(23c) mi-sa-mi-go-ses-tá-ne-nel-cen-tro

CV-CV-CV-CVC-CV-CV-CVC-CVC-CCV

When considering grammatical features to weave, I wanted to include features from different areas of linguistics, from phonological features to syntactic ones. When listing phonological rules that could be interesting for this project, the very first one that came to mind was resyllabification. I also thought it would be a simpler pattern since it can be easily reduced to a representation of Cs and Vs and still be clear.

It ended up being slightly trickier than expected. There are a few things I wanted to be represented in a final project:

1. Before and after resyllabification
2. Consonants and vowels
3. Syllable boundaries

Like all my other weavings, there are two major variables: color, and form. Assigning these variables to these three points starts easy. The 1st point, the before and after, is the least problematic. Like with my English Voice band, two paired structures can be represented by viewing a band horizontally with two rows of patterning.

It becomes more difficult with the last two. Weaving on an inkle loom is typically a two-shaft activity; it creates a plain weave structure that can be modified to create patterns by holding certain strings up over certain rows and dropping them in others. If
each horizontal (on this finished band) row of the pattern is to show both the binary of consonants and vowels, along with the spacing between them, 3 different parts need to be represented. A two-shaft loom means that I usually must choose 2 colors for each stripe along the length of the band. That meant these three elements needed to be represented by form rather than color.

I started with a pattern that included 2-color alternating stripes with four different kinds of blocks.

1. Color A - long block - represents vowels
2. Color A - short block - represents consonants
3. Color B - long block - represents syllable boundaries
4. Color B - short block - the space between a vowel and a consonant

This can work as a pattern. I could put this on a loom and weave it. However, there are two major problems. The first is that the long blocks would shrink, thus being difficult to distinguish from the short blocks. Second, the pattern isn’t very legible. Regardless of the color scheme I chose, it would be difficult to see the structure.

While I could have workshopped more with form, I decided to try again with color. After all, if I were to color all the consonants orange in the before and after of the example (1b, 1c), and all the vowels yellow, leaving white spaces between the syllable boundaries, it looks cool and is way more legible than my attempt with weaving form.

______________________

3 There is a three color, 2-shaft style of inkle weaving, but I get a headache every time I try to figure it out, so I ruled it out for this project.
Figure 31: The before and after resyllabification of sentence (23) with consonants and vowels represented by color

The question was then, how do I weave three colors (orange, yellow, and white) on a 2-shaft loom? Thankfully, I am not the first person to ask this question, and multiple solutions are available online. However, one thing about my pattern that makes it extra difficult is that it's not the same sequence of colors in the “before” row and the “after” row. Most of the solutions don’t handle this too well. Additionally, I wanted the strong structure of 2-shaft weaving on the borders and the small gap between the two horizontal rows. I had to come up with an alternative method.

I decided to keep everything else as simple and easy as possible with this band, since I was creating a new-to-me method of weaving. Using a larger 8/4 cotton instead of the smaller 8/2 cotton I used with most of the rest of this project meant I could get bigger rows and stripes and spend less time setting up the loom. The space between the “before” and “after”, along with the borders, is the same plain white as the spaces between syllables so that the colors pop.

Almost every other vowel row was easy to weave, but all the other rows required individually picking up the threads I wanted on top and ensuring that they were correctly aligned between the threads that wouldn’t be on the front-facing side. There are ways that would have made this easier. However, because I chose a simple warp
with not too many threads, it was a slightly faster process than I expected, and looked just as good as I had imagined it would.
Band V: English Plurals

Figures 32-35: The English Plurals band

Pattern

Warp: 8/2 cotton in white, red, yellow, and orange

Weft: 8/2 cotton in white

The motifs in this pattern are randomly generated using a spreadsheet described in the artist’s statement, but the two figures below demonstrate the pickup patterns for
the plural morphemes that are used after every random motif. No pattern is given in
the pattern appendix for this band.
Figure 36: The warping pattern for the English plurals band and the pickup pattern for the voiced and voiceless variations of the plural endings

Figure 37: The pickup pattern for the vowel, [ɨ]

Artist's Statement

To make most English nouns plural, the suffix /-s/ is added. However, it has 3 possible pronunciations, [-s], [-z], and [-iz]. The following words (24) demonstrate these three pronunciations.

(24) tips [tɨp-s]

dogs [dɑɡ-z]
buses [bʌs-iz]

The very first full phonetic analysis that I remember doing in my Phonetics and Phonology class was determining when and why each of these pronunciations occurs. While I’m not going to show here how to derive those rules, I will explain how each of the pronunciations surface.

The easiest ones to look at are the first two pronunciations, [s] and [z]. There is only one difference between these two sounds: [s] is voiceless, and [z] is voiced. Otherwise, they are pronounced in the same manner and location in the mouth. When a singular noun ends in a voiceless sound, the voiceless [s] is added to make it plural (25). When a singular noun ends in a voiced sound, the voiced [z] is added to make it plural (26).

(25) tip /tɪp/ -> tips [tɪps]  
cat /kæt/ -> cats [kæts]

(26) dog /dɑɡ/ -> dogs [dɑɡz]  
key /ki/ -> keys [kɪ]

This isn’t too complicated, but it doesn’t explain the [ɪz] pronunciation. For these, we have to consider how some words would sound if we didn’t have an [iz] pronunciation as an option for the plural morpheme. The words in (27) end in a voiceless and voiced sound, respectively.

(27) bus /bʌs/  
judge /dʒʌdʒ/
If we follow the same rule as used in (25) and (26), we get the following, incorrect, plurals (28).

(28) \( \text{buses } \{b\_\text{ass}\} \)

\( \text{judges } \{d\_\text{z}\_\text{i}\_\text{z}\} \)

Without a vowel to separate the last sound from the plural suffix, the resulting consonant cluster is hard to pronounce, as well as hard to understand from the perspective of a listener. This is because both [s] and [z] are part of a category of sounds called \textit{sibilant}. When one of them occurs right after another sibilant, it causes the aforementioned problems for English speakers. Because of this, if a sound ends in a sibilant, such as the [s] and [dz] in (27), a vowel, [i], is added before adding the plural morpheme. And because all English vowels are voiced, when [i] is added, the [z] is added after it, regardless of whether or not the singular noun ended in a voiced or voiceless sound (29).

(29) \( \text{buses } \{b\_\text{asiz}\} \)

\( \text{judges } \{d\_\text{zi}d\_\text{z}\} \)

So in an effort to make a band that conveyed all this, I needed to abstract things a bit. Two things determine what pronunciation the plural morpheme will take, both of which are exclusively about the very last sound of the singular noun: the voicing and whether or not it is a sibilant.

I thought I could somehow weave motifs that represented words (not any specific word, just the concept of one), and then using the rules, make them all “plural”
For this band, I chose to use a Baltic Pickup warp, a common warp for making patterns (a modified 3-pattern thread Baltic Pickup is used for the German Syntax band). For this band, I used seven pattern threads, but I doubled each one. The red threads would represent voiced sounds, and the orange ones, voiceless sounds.

I first created my “vowel” and my “plural marker,” two motifs that I could add to the end of a “word.” The “vowel” came in one color, red, since vowels in English are all voiced. And the “plural marker” came in two variants, prominently red for the voiced version, and prominently orange for the voiceless one. Then I needed to make some words. I wanted to have the “words” randomly generated, and after some trial and error, I figured out how to make a spreadsheet generate motifs that would match the parameters of my warp. I started generating some motifs of varying lengths and set off to weave them.

I picked a few kinds of rows that would represent the sibilants. These were rows that ended similarly to how my “plural marker” ended. After weaving each “word”, I added the parts needed to make it plural.

Compared to the vowels and past tense marker that I designed to be easy to weave and look good, the randomly generated motifs didn’t always look as nice. After a few of them, I realized that certain patterns worked better than others, particularly ones that had longer stretches of the two colors and didn’t switch between them too often. Because English doesn’t create words completely randomly out of all the sounds that exist in the language but uses specific combinations of sounds more often than others,
I decided it would be okay to start using the motifs I generated that I knew would look better.

A change that I would make if I were to weave this again would be to not let the randomly generated color switches dictate the color of each row, but only those threads being reintroduced into the front on a given row.

I have also been working on the spreadsheet since finishing this weaving, modifying the probabilities of the squares that constitute the pattern to better match the kinds of patterns that look best in Baltic Pickup. I hope to keep working on this, and since a random pickup pattern generator could be a useful tool for any band weaver looking to experiment with patterns.
Discussion

I return to the three guiding questions that inspired this project to discuss the results, applications, and what I have learned from designing and making these 5 weavings.

Can you use linguistic patterns to guide a creative work?

In short, yes. The parallel outlined earlier between structured artistic mediums and languages lends itself well to conveying language through weaving. Using language to guide creative works can take a lot of forms, but the kind of work inspired by the patterns and structures occurring in language is an exciting area for creative exploration.

The kinds of patterns that occur in a lot of traditional bandweaving patterns are not the kinds that occur in the linguistically-informed bands that I have made. Many bands have forms of symmetry, including reflectional, rotational, and glide-reflectional. Most of the bands I have made that utilize traditional Latvian patterns may change between motifs and forms of symmetry every few repetitions, but within each repeating section, there is a kind of patterning that these language bands do not have.

The patterns that surface in the bands in this project reflect patterns from linguistic sources rather than artistic ones. Their purpose is not aesthetic, but communicative. The Arabic Triconsonantal Roots band, in particular, shows clear repetition within each section, yet it is also perhaps cryptic in appearance, alluding to some kind of code hidden in its sequence of colors, dots, and lines. While linguistic patterns can clearly guide creative work, when these patterns are used as the basis for art, the resulting
work is a unique kind of creation, somehow similar in form and repetition yet unlike in appearance to other non-linguistically-inspired works within the same mediums.

**Are there other parallels between weaving and language?**

Again, this project suggests that there can be more parallels than just the parallel with reduplication that Urbanzcyk (2021) proposes. Additionally, these parallels exist in different spheres of language. The bands reflect syntactic, morphological, prosodic, and morphophonological rules, and I believe that even more linguistic patterns could be represented through weaving.

**Can weaving enhance language learning?**

As mentioned, this question is so broad that I cannot definitively answer for anyone but myself. However, the process of designing these patterns did help me learn more about languages I am learning and solidify my knowledge of my native language, English.

Two salient examples of this are the German and Arabic bands. German syntax was a source of confusion and frustration for me when I was first learning it, and even after discussing it in my German classes, I still struggled with it. I am not sure if I can formulate better sentences now than I could have before making the band. However, while working on it, I started to pick up on patterns that allowed me to spot potential errors. I would then go back to consult my sources and more often than not, I had copied down the sentence in question incorrectly. As someone who has taken
linguistics classes on syntax, I inherently trust that there are patterns to word order, but this experience indicated to me that with a bit more time, I could acquire an intuitive sense of these patterns. This is a hopeful prospect for someone who has, at times, felt discouraged by the process of learning German.

Similarly, when we started discussing triconsonantal roots in my Arabic class, I was under the impression that the patterns for derivation were so numerous and varied that a process of brute-force memorization was a viable (and maybe ideal) option to acquire all of them. After collecting all the patterns, I started to see that there were repeating patterns not only when organizing different parts of speech into the respective forms, but also when organizing by part of speech. This was another discovery that made me more hopeful about my potential for learning Arabic patterns.

While this is good news for a potential application for language learning, it does suggest that the designing of the weaving patterns is the more important part than actually producing the work. However, when considering it as a tool for working with language learners, this begins to shift.

Urbanczyk (2021) uses weaving and knitting as a way to move from the complex linguistic terminology that can alienate students. Additionally, including more modalities for students to approach a concept provides more opportunities for something to click. If the simple stating of a rule doesn’t work for some students, maybe collecting language data and playing around with it until they start noticing the patterns will. And if that doesn’t work for some students, then maybe the process of making something with those patterns will. And if that isn’t working, then perhaps getting to see and hold
and feel the final product will. While this may not work for everyone, it does offer a lot of different ways for students to learn, and for students who do latch onto more than one of these steps, it provides opportunities to reinforce or deepen language knowledge.

I believe that in weaving this project, I have become a more optimistic language learner with a better grasp of some specific concepts. I see this project as a proof of concept for something that could help in a language or linguistics class as a way of reframing or aiding the processing of linguistic rules.

**Conclusion**

This project encompasses a project that I hope to continue. I have more linguistic patterns that I want to explore through weaving. These include the differences in vowel spaces between languages, case marking on German determiners, and classifiers in Mandarin Chinese. I hope that I have accurately documented the theoretical framework and the process of designing these patterns so that the steps to take to design and weave more linguistic rules are clear.

Furthermore, these parallels between linguistics and art are not necessarily exclusive to bandweaving as an art form but are parallels that could be explored through other weaving forms and crafts. Some obvious candidates are other woven structures, like tapestry and rug weaving, along with other previously mentioned mediums, such as knitting. Additionally, crochet and cross stitch are other crafts that have a kind of structure that lends itself well to this sort of practice. Given the relationship between
weaving patterns and song outlined in Tuck (2006), musical exploration of linguistic patterns is another fascinating area for further work that moves the applications of this project away from solely the visual arts.

Bringing Urbancyzk's (2021) language game to an actual classroom setting is the clearest example of where this research could go next. Students could explore language features through familiar artistic pursuits. Given the number of languages and features that this process applies to, this is a potentially viable classroom activity that can be adapted to a variety of classes.

Finally, while this project is framed around linguistics and language patterns, it does not escape me that the process of “translating” language patterns to art for educational purposes could apply to other fields of study. Language is not the only area where learning to find, recognize, and apply patterns, systems, and structures is a useful, or essential, skill. What if we could weave math, computer science, poetry, or music? How could doing so help students explore patterns and apply their knowledge?

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