

# Design Recommendations for Developing Visual Learning Material on German Prosody<sup>1</sup>

## Introduction

Verbal interaction consists to a considerable degree of interactionally meaningful prosodic elements which are important for the management of turn-taking, marking important information, discourse structure, attitudes or affect, grammar as well as pragmatic meanings (Blühdorn, 2013; Clennell, 1997; Cole & Shattuck-Hufnagel, 2016; Hirst, 2005; Pierrehumbert & Hirschberg, 1990; Schegloff, 1998).

Nonetheless, learning and teaching prosody as part of foreign language learning is challenging as learners are usually not aware of the role that, for instance, intonation plays in their native language and thus do not necessarily recognize the importance of learning intonation of a foreign language (Blühdorn, 2013). Still, some knowledge of prosody is essential in order to “precisely deliver the intention of the speaker and to effectively communicate with the native speakers in the actual speaking situation” (In & Han, 2015: 48) and to avoid cross-cultural misunderstandings caused by intonation features (Clennell, 1997; Gumperz, Jupp, & Roberts, 1979). As Hirst (2005) notes, “[e]verybody agrees that prosody contributes to the meaning of an utterance” (p. 334), although we do not always know how.

In order to contribute to the evaluation and development of intuitive and user-friendly learning material for (German) prosody for advanced learners, we conducted a series of thorough usability tests with potential learners (*participants*). Pairs of participants worked together to make sense of six different learning material drafts which each featured a different, existing visualization method for different aspects of prosody, such as intonation, stress, and rhythm. The usability and usefulness of the systems was assessed both quantitatively and qualitatively taking both participants’ measurable performance as well as their subjective evaluations and sense-making strategies into account.

The first part of this section takes these tested materials as point of departure (#SECTION). I briefly summarize the aspects of each system that worked well, and which aspects should be changed if the system was to be the basis for learning material (#SECTION). Finally, I sketch out what a revised version of each system could look like. In the second part of this section, I suggest a set of materials based on the tested systems and the discussed usability issues (#SECTION).

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<sup>1</sup>This document is based on chapter 9 from Schümchen (2019).

## Redesign Recommendations for the Tested Materials

In this study, I addressed usability issues of the tested materials that were related to the way prosodic information was represented (iconically or symbolically), and how much prosodic detail a visualization included. In the following, I consider each system and discuss possible approaches to redesign based on the results of this study. The systems and their redesigns are summarized in Table 1.

### Hat Pattern, Continuous Contour, and Tadpoles: One Redesign for All

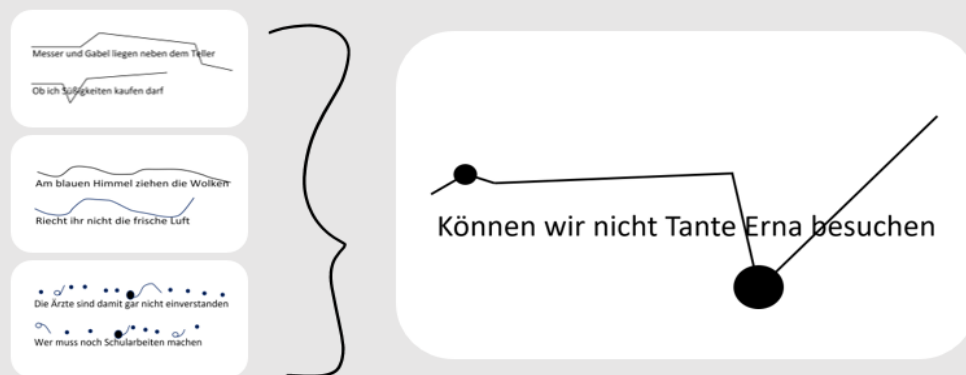


Figure 1: Redesign Recommendations for the Hat Pattern, Continuous Contour, and Tadpoles

The three visualization systems *hat pattern*, *continuous contour*, and *tadpoles* each use more or less stylized lines to visualize intonation contours. The *tadpole* system furthermore represents stress and rhythm by means of differently sized and colored dots. The benefits and shortcomings of the hat pattern, the continuous contour, and the tadpoles are very similar, as I will outline below, which is why I am going to suggest the same redesign for all three systems. In the following, I will first briefly review the benefits and shortcomings of each system, and then discuss the suggested redesign in more detail.

**THE HAT PATTERN.** The hat pattern was, as the usability test analysis showed, particularly praised for its simplicity. The participants considered the hat pattern intuitive, easy to understand, and easy to follow, and the system afforded quick and direct engagement with the it. The main shortcoming of the hat pattern is the lack of indication of stress.

**THE CONTINUOUS CONTOUR.** Also the continuous contour was praised for its simplicity and the overview it provides for the whole intonation contour of the sentence. Although the system was initially considered intuitive, the participants were challenged by the organically flowing line which did not provide clear contrast in pitch. In addition, also this system lacks an indication of stress.

**THE TADPOLES.** The tadpoles include a rich prosodic description of the sentences which was considered positive, especially in terms of the indication of stress. On the reverse, the system included too many details (differently sized and colored dots) and too little information about the meaning of the different visual cues (e.g. the ‘tail’ on some of the dots). Moreover, the system evoked associations with sheet music, which was misleading for the participants – both for participants who were familiar with sheet music and those who were not. The focus on rhythm furthermore produced some choppy, staccato readings of the sentences.

**THE REDESIGN.** The redesign recommendation maintains the stylized representation of intonation and adds indications of stress directly onto the line. Primary and secondary stress are represented by differently sized dots. All other dots, which were part of the tadpole system, have been removed in order to prevent staccato realizations. The visualization is superimposed on the typed target sentence.

### Meandering Text: Reuniting Words

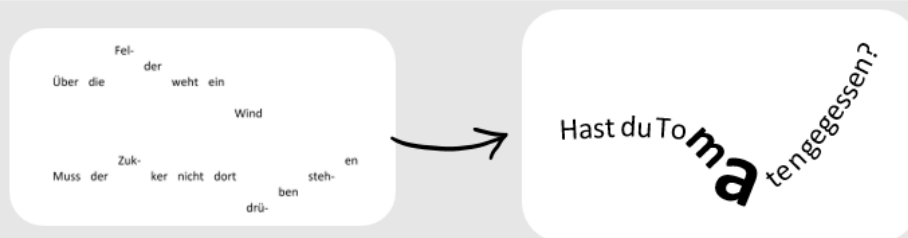


Figure 2: Redesign Recommendations for the Meandering Text

The participants in the usability test regarded the meandering text as intuitive, easy to understand, and as providing a good overview of the pitch movements in the whole sentence. Criticism of the system included lack of stress indicators and reduced readability due to the chopiness of the text.

The redesign of the meandering text maintains the principal layout of the system. Instead of dividing the words by syllable, however, the words of the target sentence are positioned closely together to better resemble spoken language. The movement of the text itself runs more smoothly but is still stylized, with similar trajectories like the hat pattern. Furthermore, stress is represented by larger, bold letters to give the syllable more ‘weight’. Finally, a question mark is added to the interrogative in order to link rising intonation to questions (at least questions like the one in the example – additional information regarding different question types and their intonation contours should also be part of the final learning material).

## GAT2: Simplification of Symbols

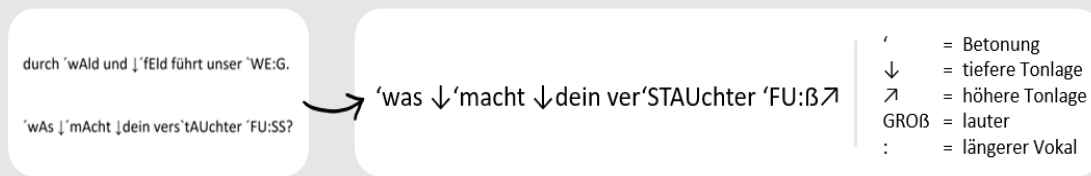


Figure 3: Redesign Recommendations for GAT2

GAT2 is a transcription system for spoken German, which is based on Jeffersonian transcription conventions with alterations to make it “more compatible with linguistic and phonetic analyses of spoken language” (Selting et al., 2009: 353). In the constructive interaction sessions, GAT2 was valued for its prosodic precision but at the same time regarded too complicated and little intuitive. Several participants mentioned, however, that they considered the system useful if descriptions had been given. Generally, the iconic systems have a higher usability than the symbolic systems and are thus to be preferred as learning materials. Nonetheless, I will make recommendations for the adaptation of GAT2 for the purpose of learning German prosody as part of language learning.

For the redesign, the uppercase letters and the colon, which most participants recognized as symbols for prominence and lengthening, respectively, remain. Other than the period and the question mark, the participants recognized the colon as specialized symbol, perhaps due to its unconventional placement in the sentence. The period and question mark, however, were not explicitly recognized as symbols specific to the system and, more importantly, as representations of specific pitch movements. They are thus replaced by arrows as less conventional, but more intuitive symbols. The production issue around “FU:SS” is resolved by replacing “SS” with “β”. Although these alterations will probably already increase usability, a legend of the meanings of the symbols is included. As part of a complete set of materials, a short description of the system including some examples should be added as well in order to ensure that the users associate the correct prosodic categories with the symbols. Generally, GAT2 is perhaps more suitable for the most advanced learners within the target group of adult advanced learners of German.

### GToBI: No Recommendations

Finally, GToBI is not recommended as basis for learning material as the usability issues around the system were too severe.

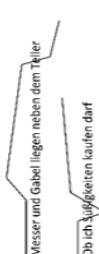

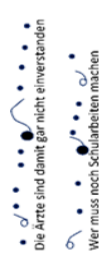

System	Keep	Change	Example of Redesign
<b>Hat pattern</b>	 <p>Messer und Gabel liegen neben dem Teiler Ob ich vorbeikommen darf</p>	Stylized line Add stress	
<b>Continuous contour</b>	 <p>Am blauen Himmel ziehen die Wolken Reicht ihr nicht die frische Luft</p>	Line to represent intonation Add stress Reduce detail	
<b>Tadpoles</b>	 <p>Die Ärzte sind damit gar nicht einverstanden Wer muss noch Schularbeiten machen</p>	Dots to represent stress/rhythm Different sizes Remove hollow dots Simplify/stylize intonation contour	
<b>Meandering text</b>	 <p>Über die weicht ein Wind Musik der Ker nicht dort stehen</p>	Up-and-down movement Add stress No division of words	<p>Hast du <b>To</b> <b>ma</b> <b>ten</b> <b>ge</b> <b>tes</b> <b>sen</b> <b>?</b></p> <p>**</p>
<b>GAT2</b>	<p>durch 'wAlD und ↓'fEld führt unser 'WEG. 'wAs ↓'mAcHt ↓dein vers'tAUChter 'FU:ß?</p>	Uppercase letters Colons Arrows Replace "↓" And "?" by other symbols Simplify / / and / / Replace "SS" in FU:SS by β Add descriptions/key and examples	<p>↓ = Betonung ↓ = tiefere Tonlage ↓ = höhere Tonlage ↓ = lauter ↓ = längerer Vokal</p> <p>'was ↓'macht ↓dein vers'tAUChter 'FU:ß?</p>
<b>GTOBI</b>	<p>SL L<sup>HH</sup> A<sup>H</sup> L<sup>S</sup> Die drei Männer sind begeistert SL H<sup>*</sup> H<sup>*</sup> L<sup>HH</sup> H<sup>*</sup> H<sup>S</sup> Können wir nicht Tante Erna besuchen</p>	Generally not suitable for the purpose as L2 learning material	

Table 1: Redesign Recommendations

\* A version of this redesign has been tested in two additional studies which were presented at the EuroSLA29 conference in Lund, Sweden (Niebuhr, Schümchen, Alm, & Fischer, 2019).  
\*\* I am grateful to Antje Hey for introducing me to this visualization.

### Conclusion of Redesign Recommendations and General Design Concerns

The redesigns roughly maintain their visual profile in terms of how prosodic detail is visually represented. This means that the hat pattern, continuous contour, and tadpoles still consist of a visualization which is superimposed on the written words, while the visualizations in the meandering text and GAT2 are still integrated in the layout of the text. A way to further increase usability of the materials is to determine whether there is a general difference between superimposed and integrated visualizations. On the one hand, presenting the visual and the text as two separate systems superimposed on top of each other may increase the time it takes to process the relationship between the two modalities. On the other hand, integrating both into one (cf. redesign suggestion for the meandering text) might result in other processing problems. More research in this area is needed, for instance comparing different redesigns with each other.

More generally, one way to improve the realizations of questions with the correct intonation could be to redesign the material in such a way that the interrogative target sentences are immediately recognized as such, for example, by embedding the target sentences in short, authentic dialogue sequences. To avoid a potential reinforcement of the stereotypical 'all questions go up'-thinking that was evident in this study, more intonational variation should be introduced. For instance, sentences that are syntactically recognizable as questions but that have different intonational contours (rising and falling) could be used to convey that not all questions in German end in rising intonation. Furthermore, in order to improve interactional competences, other first pair parts (i.e. turns that make a specific type of next turn relevant, such as question-answer sequences) that function as questions but are not questions in the strictly syntactic and semantic sense, could be included in order to broaden the learners' understanding of 'question intonation', again embedded in a context that includes at minimum one relevant second pair part including the appropriate prosodic realization.

Lastly, as the analysis has shown, bodily behavior, e.g. the tracing of intonation contours on surfaces and in the air, is inherent to the participants' process of making sense of the visual annotations they worked with. This knowledge could be instrumentalized and used for the design of learning material, for instance, drawing from nudging theory (Thaler & Sunstein, 2008) to combine prosody and embodiment meaningfully and intuitively. Within nudging theory, specific behaviors are helped on the way in various ways drawing from behavioral psychology and behavioral science in general. Keeping this in mind during the conceptualizing of learning material, embodiment can consciously be enabled and encouraged. What this can mean in practice is described in the next section.

## German Prosody: An Example Set of Learning Materials

The following set of materials is an example of the kinds of materials that could be developed on the basis of the quantitative and qualitative findings of the usability study.

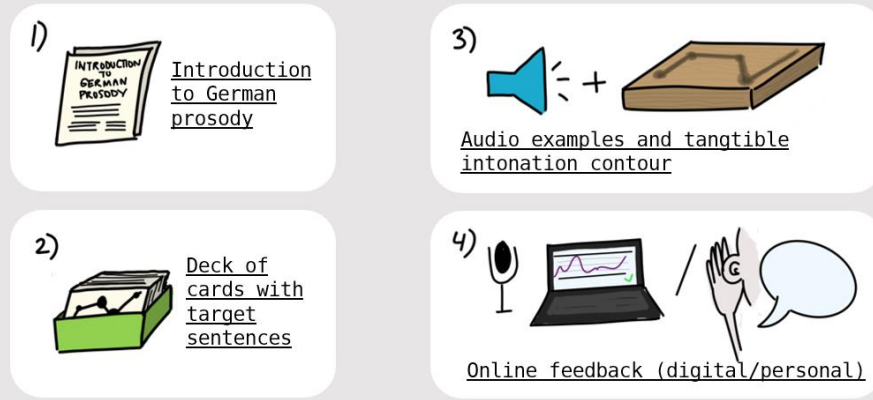


Figure 4: Example Set of Learning Materials

The suggested materials on German prosody in an advanced language learning context that I suggest consist of a set of four complementary components:

- 1) a written introduction to prosody,
- 2) a deck of cards with target sentences (text +visualization),
- 3) audio examples and a tangible object representing an intonation contour, and
- 4) online feedback.

### Component 1: Introduction to Prosody



The first item of the set is a short, written introduction of the concept of prosody, relevant categories, and a short description of the particularities of German intonation. If the target group is homogenous regarding their native language, the last point can be illustrated by means of contrastive examples that highlight the fact that languages have different prosodic profiles. The introduction may already feature some of the visualizations used in the remainder of the material in order to put the visualizations into context right away.

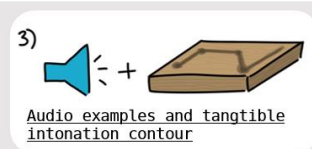
## Component 2: Deck of Cards



The next item is a deck of cards that consists of a collection of several example sentences (both declarative and interrogative). Through the introduction, the learners have been primed for the topic and can now be introduced to examples. The sentences are selected from corpora or other sources of spoken German in order to give the learners a representation of authentic spoken German that they might encounter in the wild. While the tested material in this study was selected with regard to its phonetic balance, the learning material proper should not only take into account the learners' ability to produce a phonetically correct sentence but should also contribute to training their interactional competence (In & Han, 2015; Szczepek Reed, 2012; Tøndering & Morris, 2015; R. F. Young, 2011), i.e. their ability to engage in meaningful interaction with other speakers of German. The visualizations create additional awareness of the different prosodic categories such as intonation and stress combined into one visualization. Each card illustrates prosodic properties of one or several example sentences in relation to each other and their progression over time at one glance.

Previous research in foreign language prosody teaching supports this initial focus on raising awareness (Clennell, 1997; Couper, 2017; Derwing & Munro, 2005; Paunović & Savić, 2008; Schmidt, 2012). The visual design should follow the most general design principles for document design, for instance the conscious use of gestalt principles to facilitate the learners' interpretation of spatial cues (Schriver, 1997; Weinschenk, 2011; R. O. Young, 2011). In line with the positive effects that stylized and visually high-contrast visualizations yielded, prosodic changes, especially regarding pitch and stress, should be clearly marked, for instance by clear turning points (cf. hat pattern) and unambiguously differently sized dots to mark stress (cf. tadpoles, but even more pronounced) without too many gradations.

## Component 3: Audio Examples and Tangible Intonation Contour



The next component consists of two items. Visual material alone is not enough to convey something so auditorily complex as intonation and stress to prosodically untrained users. Therefore, the first item is a set of audio recordings of the example sentences (cf. component 2) produced by native speakers and in accordance with the depicted contours. Based on the finding that some participants in the study regarded their produced rising intonation as too extreme and exaggerated although it was



within the normal range for a German interrogative with rising intonation, these authentic audio examples sensitize (cf. Blühdorn, 2013) the learner to prosodic peculiarities such as the normal pitch range within an interrogative sentence. Furthermore, relating the visual to the audio helps to comprehend the finer details of the visualizations as well. Participants in the study frequently struggled with the concept of the non-nuclear pitch accents, which could be easily resolved by an audio example. If the material is used in the classroom, the teacher can perhaps replace audio recordings. In this case, detailed instructions for the teacher as to what to pay special attention to while reading the sentences aloud should be provided.

The audio examples are complemented by a second item, a tangible object (or several). This object was inspired by participants' iconic gesturing and is intended to give the learner a more embodied experience of the example sentence (see also Flood et al., 2014). The object is a (wooden) board with the intonation contour of an example sentence carved into it. The carved line is about 1.5 centimeters wide and 0.5 centimeters deep with smooth edges that invites tracing it with the fingers. At the points where stress is indicated, the carving is deeper. The depth varies in correlation with the size of the dots on the cards – the bigger the dot, the deeper the indentation on the board. This analogy reflects the study participants' embodied behavior. At the same time, the deeper indentations require more energy to trace (as one has to push their finger a bit deeper into the indentation to maintain contact with the board) and thus afford a more emphasized realization of the corresponding syllable.

In order to give learners the opportunity to try out the sentences for themselves first, the audio examples should not be given out before the deck of cards. The tangible contour could potentially be handed out before working with the audio as well.

#### Component 4: Online Feedback



Finally, the last component is related to the aspect that was missing in the constructive interaction sessions, namely expert feedback. Depending on whether the material is used by an individual learner at home or as material in a classroom, the learner's realization of an example sentence is either recorded via a microphone and analyzed by a software that delivers the learner a visualization of their realization compared to a model realization or heard and assessed by a trained teacher (in the latter case, the learning material set would also have to include a quick-guide for teachers/tutors regarding assessment of learners' sentence realizations). The software option's visual feedback would preferably be given in real-time so that the learner gets an immediate feedback for their performance and can adjust their next realization accordingly. The

software's visual representation will probably be in the form of a line in a co-ordinate plane with the x-axis representing time and the y-axis pitch. Stress is again represented by differently sized dots.

### **The Materials in Different Learning Contexts**

I have briefly mentioned the different settings in which the material can be used, for instance, by individual learners in their homes or by groups of learners in a tutored classroom. The different scenarios pose various challenges to the materials and require appropriate adaptations. If the starting point for this suggested set of materials is the individual learner who directly accesses the material e.g. from a website, the carved board will probably not be part of the learner's set. In this case, more detailed descriptions or a two-dimensional model of the board could be supplied. Another possibility is to include an additional, large-scale printable that corresponds to the board's measurements, with the line depicted in different shades of grey. An accompanying instruction invites the learner to trace the line and apply more pressure the darker the grey.

If the material is used in the classroom, special attention should be paid to two aspects, namely, students' embodied displays of understanding and how feedback is given. First, the recognition of learners' embodiment as a resource for displays of understanding can be harnessed by teachers checking for understanding. This is especially relevant at the beginning where learners may not be entirely familiar with the terminology yet. In such case, "attending to a gesture and speech in this case would allow a teacher to recognize the disparity between the students' productive ideas about [the topic of interest] (expressed in gesture) and the terminology they used" (Flood et al., 2014: 14). This effort to integrate gesture and the body as an interactional resource not only in collaborative sense-making but also in learning ties in with similar efforts that have been made, for instance, in the natural sciences, especially within mathematics, physics, and geo-science education (Alibali & Nathan, 2012; Edwards, 2009; Flood et al., 2014; Kastens, Agrawal, & Liben, 2008; Nemirovsky, Rasmussen, Sweeney, & Wawro, 2012; Roth & Lawless, 2002), where the body is used as an active resource for learning. Alibali and Nathan (2012) and Edwards (2009), for instance, report evidence that mathematical thinking is an inherently embodied activity, and Kastens et al. (2008) see embodied displays of understanding as an opportunity to gain insight into the "students' thought processes, even when the students are not able to articulate their understandings or misunderstandings in words" (p. 2). Second, then, the teacher should be aware of the way feedback is given. To this end, the teacher or tutor should receive additional detailed descriptions of which prosodic aspects the student should pay special attention to and maybe even instructions on how to visualize a learner's production in real-time, for instance, on a blackboard or with the aid of digital resources as the basis for subsequent feedback.

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