

TEACHING LINGUISTICS

A tactile IPA magnet-board system: A tool for blind and visually impaired students in phonetics and phonology classrooms

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This article describes a tool that can be used by blind and visually impaired students in phonetics and phonology classrooms: a tactile International Phonetic Alphabet (IPA) magnet-board system. This tool consists of IPA magnets and phonological rule symbols that are printed and embossed, so as to be readable by both sighted and visually impaired individuals. A user of the tool can lay out phonetic and phonological data on the magnet board for communicative, organizational, or problem-solving purposes. Since the magnet board can be read both visually and tactually, it can serve as a collaborative space that can be used by both sighted and visually impaired members of the classroom. Potential uses include group work in class and as an augmentation to chalkboard problem-solving demonstrations. The tool can complement already extant options for blind and visually impaired students and facilitate collaboration between sighted and visually impaired students. Here, we describe the tool, exemplify some potential uses, and offer suggestions for further improvement.*

Keywords: phonetics, phonology, IPA, Braille, blind students, visually impaired students

1. INTRODUCTION. In this article we describe a tool that can be a useful addition to a larger array of tools and strategies that address the pedagogical needs of blind or visually impaired students in phonetics and phonology classrooms. The tool is a magnet-board set with embossed magnets (both printed and raised) of symbols for the International Phonetic Alphabet (IPA; International Phonetic Association 1999, 2005), phonological rule writing, and syllable structure.

Magnetic classroom tools have been used by blind and visually impaired students in other technical university classroom settings, such as chemistry (Smith 1981, Supalo et al. 2008). Such tactile tools, of which magnet sets are only one type, not only are cost-effective, but have also proved to allow blind students to better engage with course material, increasing the likelihood that blind students will stay involved in the sciences (Supalo et al. 2008:246).

This tool is intended to be only part of a broader range of approaches in offering reasonable accommodations to blind students in phonetics and phonology classrooms, providing a real-time, dynamic way to engage with data via repositionable symbols that can be read by sighted and visually impaired individuals alike. This tool does not substitute for a visually impaired student's own note taking, nor does it replace other strate-

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gies. For example, instructors can and should learn to modify their speech habits, including saying things out loud that they otherwise might not have. (This will benefit other students in the class, as well.) See Wells-Jensen 2005 for a discussion of additional strategies.

We, the authors, are not experts in teaching blind or visually impaired students. In fact, for most of us, it was the first time thinking about this particular pedagogical situation. Much as described in Wells-Jensen 2005, we sought advice by reading the LINGUIST List archives, emailing linguists who are blind with specific questions, and generally crowdsourcing ideas among our colleagues—we started from a place of ignorance and ‘an honest lack of relevant information and experience’ (Wells-Jensen 2005: 221). However, with 11 percent of undergraduate students reporting having a disability (US Department of Education 2013), it is important for faculty and staff on college campuses to consider these issues proactively.

In an ideal situation the instructor may be educated, experienced, and well supported in teaching phonetics and phonology to a wide range of students, including those who are blind and visually impaired. Likewise, a visually impaired student may be experienced at learning in a university environment and have access to and knowledge of appropriate learning techniques and technology. However, the amount of training available to instructors may vary greatly, and at some point, every instructor will be inexperienced. The visually impaired student’s experience with university-level learning may also vary. Far from the ideal, some classroom situations may involve a relatively inexperienced instructor, with little to no pedagogical training in regard to visually impaired students, and a visually impaired student just entering college, still becoming accustomed to university-level work and to the resources available at that particular campus.

We encourage instructors and students alike to be as educated and trained in the relevant pedagogical and technological approaches as possible.¹ The tool we describe here, however, is intended to be usable by anyone, even instructors previously inexperienced with teaching blind or visually impaired students. It is low cost and has a shallow learning curve. We offer it here in case others may benefit from it or improve upon it. We first describe the tool (§2) and explain its potential uses (§3), before examining challenges and suggestions for further improvements (§4). Applications beyond the phonetics and phonology classroom, and beyond linguistics, are addressed in our conclusions (§5).

2. DESCRIPTION OF THE TOOL AND MATERIALS. The tool we developed is a set of tactile magnets to be used with multiple magnet boards, which we call the TACTILE IPA MAGNET-BOARD TOOL. The tool consists of a set of magnets, organizational boxes for the magnets, and magnet boards, as shown in Figure 1.

The magnets are of two main types: (i) printed tactile magnets (i.e. embossed) of symbols for the IPA, phonological rule writing (including e.g. +, –, arrows, and brackets), and syllable structure (e.g. σ and connecting lines), and (ii) dual print/Braille magnets of the phonological features. The printed tactile magnets have embossed print symbols, that is, raised images, such as the tactile [ʃ] shown in Figure 2. (It may be hard to observe from the photograph, but the black part is also raised.) These tactile images can be read by

¹ Willoughby & Duffy 1989, Castellano 2005, and Algozzine & Ysseldyke 2006 contain useful information and references for an instructor new to teaching blind or visually impaired students. Though they focus on education at the primary and secondary levels, much of the information and many of the recommendations are translatable into a university classroom setting.



FIGURE 1. The tactile IPA magnet-board tool.



FIGURE 2. A tactile magnet: ʃ.

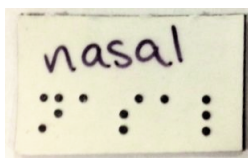


FIGURE 3. A dual print/Braille magnet: nasal.

touch by a visually impaired student and read visually by a sighted person.² This contrasts with the dual print/Braille magnets, such as ‘nasal’ in Figure 3, in which the blind student reads the Braille and the sighted person reads the accompanying printed word.

The tactile IPA and rule-writing symbols were made using a ‘Pictures in a Flash’ (PIAF) machine, which can be used to emboss printed images. These embossed pages were adhered to regular magnetic sheets and then cut out into individual magnets. The feature magnets were made by first using Microsoft Word to type the features in Braille using the Braille font in 24-point size,³ then ink-printing the simulated Braille dots onto thermal paper, and finally embossing the print dots on the PIAF so that it could be read tactually as Braille.⁴ These feature labels were adhered to magnetic sheets, and the Roman ink-print forms of the words were written in pen on the magnets, though these also could have been machine printed.

² There is a Braille encoding of IPA called IPA Braille (Englebretson 2008, 2009). It would be possible, and in most cases preferable, to make magnets with dual standard print/IPA Braille symbols instead. In this scenario a Braille embosser could also have been used instead of a PIAF.

³ 24-point size is recommended for the Braille font as it is close to the standard size for Braille (Duxbury Systems, http://www.tsbtigers.org/TSB/Vision/Brailleinfo/braille_font.htm).

⁴ A free download of the Braille TrueType fonts is available from Duxbury Systems Inc. at <http://www.duxburysystems.com>.

We created multiple copies of all but the most rarely used symbols and made even more copies of the most commonly used ones, including common English vowels. Rotated symbols were not distinguished on the magnets for flexibility—for example, the [e] magnet could be turned upside down to provide another schwa, if necessary. Classroom needs may vary and the flexibility to make additional magnets over the course of the term would be desirable.

Several personal-sized magnet boards were purchased, two of which can be seen in Fig. 1. These are from Learning Resources, with dimensions of 9" × 11.5".

We organized the magnets based on the layout of the IPA charts, since users of the tool either would already be familiar with that layout or would be in the process of learning it. We purchased two clear plastic organizational containers, sized 13.7" × 8.6" × 1.37", with push-tight lids. Ours were from Primary Concepts (item #7400). We added guide charts on the inside of the top cover of these containers, as shown in Figures 4 and 5. Our guide charts were strictly print, though if we were to use this system again, we would make the guide charts tactile as well.

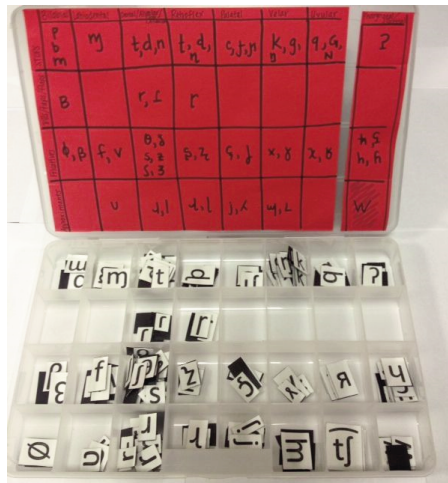


FIGURE 4. The organization of the consonants.

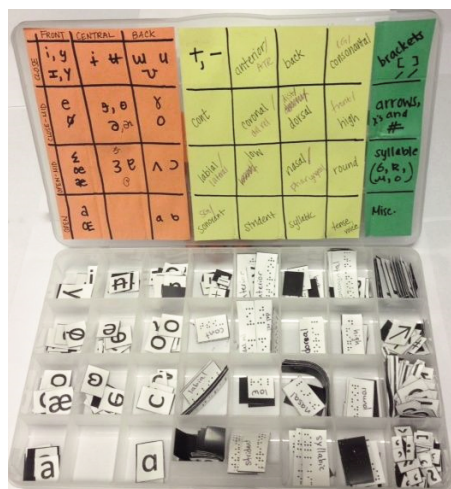


FIGURE 5. The organization of the vowels, phonological features, and rule-writing symbols.

3. USING THE TOOL. Here we describe three potential uses for the tool: (i) as a temporary ‘chalkboard’, (ii) as a medium for a visually impaired student to work through problems independently, and (iii) as a medium for sighted and visually impaired students to work on problems collaboratively.

In many introductory phonetics and phonology classrooms, a substantial amount of in-class time is spent working problems. Any information available before class, such as data sets, can be made available to a blind or visually impaired student ahead of time, formatted for an electronic device with which the student is comfortable, such as a laptop or Braille notetaker. The student can then refer to the data set during class. But this type of information—the type that one might put on a handout—may be but a small portion of the information in some class sessions. It is quite common for unanticipated data and examples to arise in a problem-solving session or to be generated based on questions during a classroom discussion.

The tactile IPA magnet-board system can be used to simulate the chalkboard in real time. For example, consider cases where students work in small groups during classroom time to solve different problems and then ‘report out’, teaching their problem to the class as a whole. When students report out by teaching their problem, they might write on the chalkboard: if small groups were working on phonology problems, students might write the distribution charts and proposed rules on the board. One student may start explaining while other students in the group write the relevant information on the board. In these cases, the magnet boards can be arranged by a sighted individual to reflect the information being put on the chalkboard, and thus be readable by a visually impaired student. Just as sighted students can refer to the chalkboard as the small group teaches its problem, a visually impaired student can refer to the arranged magnet board. It is important to note, however, that as both the chalkboard and the magnet board are meant to be erased, all students in the classroom are responsible for deciding what to take more permanent note of and how. The magnet board is no more permanent than the chalkboard and is not a substitution for note taking, but rather a temporary work space and communal reference point.

Likewise, this technique can be used during lecture to supplement the instructor’s verbalizing of the material and any prepared material. This might be especially useful during complex phonology problems, where there are a lot of data and patterns to keep in mind at once, or during the explanation of data that arose during discussion and thus were not prepared ahead of time.

In addition, the visually impaired student can use the tool to work on problems and data either independently or in small groups in class. The dual print/tactile nature of the tool creates a transparency between the visually impaired student and sighted members of the class and facilitates sighted instructors’ ability to check in on a visually impaired student’s progress while working on a problem in class, in order to offer correction or redirection if necessary, just as they would do by looking at a sighted student’s work.

Examples of prepared boards can be seen in Figure 6, showing a distribution chart for the phones [t] and [ʃ], and Figure 7, showing the syllable structure of *plant*. The tool may also be especially useful in cases where the organization of items conveys information, such as in determining a natural class based on a phoneme inventory and in using a feature chart to properly describe such a natural class.

We now describe in more detail two classroom activities that make use of the magnet boards: one to practice applying and understanding syllable structures, and the other to strengthen IPA transcription and reading skills.

The magnet boards may be used to draw, manipulate, and compare syllable structures. Our set of magnets included symbols for syllable parts, for example, σ , O, R, and

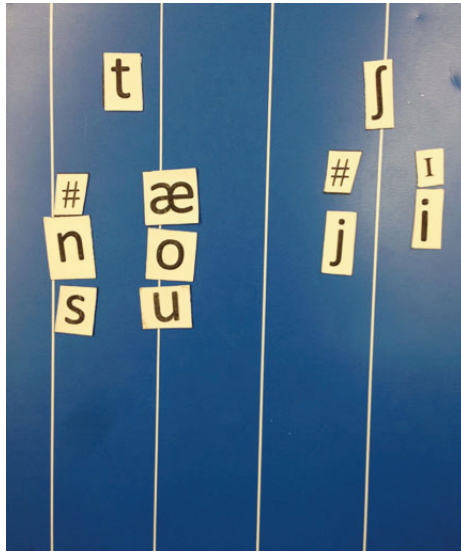


FIGURE 6. Using the boards to work phonology problems: a distribution chart.

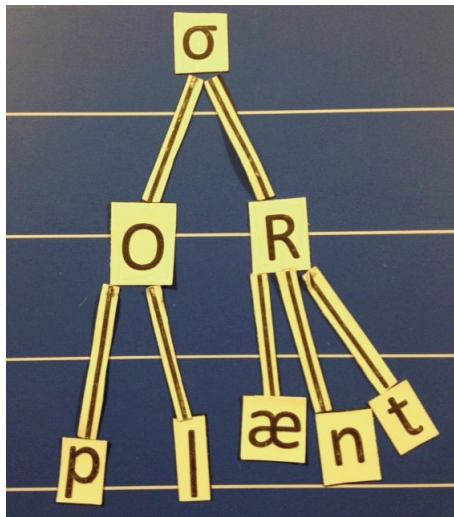


FIGURE 7. Using the boards to draw syllable trees.

straight lines to connect adjacent levels of each tree, as seen in Fig. 7. These symbols can be manipulated to form generalized syllable structures and to draw the syllable structure for any given word. To practice applying syllable structures, students can be instructed to work in pairs. First each student independently creates a skeleton syllable structure that is a possible English word (but contains no phonetic material). The students then give their skeleton syllable structures to their partners, who fill them in with phonetic material to create a possible English word, at the same time checking their partners' work—is there a possible English word with the proposed syllable structure? Finally, the students explain their answers to their partners, creating another opportunity for peer feedback and questions—the partners can double-check that the English word is transcribed and syllabified correctly. The magnet boards can be used by both

members of a team as a workspace. Throughout the process, the instructor can visually check the magnet boards and offer feedback, including manipulating the magnets.

Our second example also illustrates the use of the magnet boards to facilitate communication between sighted and visually impaired individuals in the classroom. The following activity is designed to practice IPA transcription and reading skills, using a ‘think-pair-share’ model (Lyman 1981). First, the students are instructed to work on their own and transcribe three English words into IPA. (This is the ‘think’ portion of the activity.) After a short time, the students are paired up and told to exchange their lists of transcribed words (just the transcriptions, not the English orthographic representations) with their partners and, independently, write the English words for the transcriptions they receive (still ‘thinking’). After a few minutes, the partners share their answers with each other, and discuss any challenges or problems they encountered. Were the words transcribed correctly? Is there more than one way to transcribe a particular word? Were the words decoded into English orthography correct? (This is the ‘pair’ part of the activity.) After a few minutes, the class comes together again as a whole to discuss trends—what challenges arose in the pairs? Where were the transcription difficulties? What was most challenging in reading the IPA? (This is the final stage—the ‘share’ portion.) The dual print/tactile nature of the magnets means that they can be set up and read by anyone in the classroom, giving the instructor flexibility in implementing unplanned, inclusive, in-class activities.

4. CHALLENGES AND RECOMMENDATIONS FOR IMPROVEMENT. The biggest challenge we faced was the amount of time it took to find the relevant magnets. Given the size of our containers, each cell had to hold more than one symbol. For example, due to space constraints, we had [p], [b], and [m] all in the same cell in our box, so a user would have to pull all of the magnets from that cell and sort through them in order to find the relevant one. If we had used larger containers with more cells, users would have been able to find the relevant magnets more quickly.

A separate challenge was the size of the magnet boards. Larger-sized boards would have been preferable, as they would accommodate more related material at once. To approximate this, users sometimes put two smaller boards together, but that was not physically stable. We would recommend adding at least one larger magnet board to the set. Related to this, we also found the magnet boards easier to use at a table. The classroom chair with a small writing surface attached did not provide users with enough stable working space.

5. CONCLUSIONS. The repositionable magnets described here can be manipulated by a visually impaired student for purposes of understanding or illustrating the spatial arrangement of data, in showing feature sets, or in solving phonology or transcription problems. The magnets are dual tactile/print and thus can be used, repositioned, and read by both sighted and visually impaired students, thereby also facilitating collaborative work. It is important to note that the tool is meant to complement other strategies and is not a substitute for traditional note taking, as the information on it is ephemeral. All students should be prepared to take notes using a mechanism they are comfortable with, which might involve a Braille notetaker or laptop and/or some other individual accommodation(s) that are beyond the scope of this article.

The tool is suitable for blind and visually impaired students who have basic Braille literacy and are capable of reading tactile print. Visually impaired students with those skills should find it accessible even if they enter the course knowing nothing about the IPA or distinctive features. Moreover, the tool can be modified in certain ways, allow-

ing flexibility depending on the individual student's circumstances and goals. The raised-print IPA symbols we used could be substituted with IPA Braille symbols (Englebretson 2008, 2009). In most cases, using IPA Braille symbols would be preferable and would support students who are visually impaired in developing the Braille literacy skills that are necessary to engage fully in the community of professional linguists (Englebretson 2008, 2009, Wells-Jensen 2005). The development of such skills necessary in professional life has been found to also help students succeed in college (Getzel 2008). However, there may be situations—including, but not limited to, cases where the student is not a Braille reader—where raised font would be preferred. If desirable, the entire tool could be modified to use only raised Roman print.

While this tool is intended for use in a phonetics and phonology classroom, such a tool may have applications in other courses as well, especially those that involve working problems on the board and in which all of the relevant material cannot necessarily be prepared ahead of time. Fields that use symbolic representation of information, use a finite set of symbols, and involve information conveyed through simple diagrams, trees, and charts may benefit from this type of tool. Within linguistics, a tool like this would be useful in a syntax class, where trees could be drawn and revised on the boards using a set of magnets including lines and phrasal and head nodes, such as NP, VP, V, and so forth. A mathematical linguistics classroom might also benefit from such a tool.

Some permutation of this type of tool might be useful in fields outside of linguistics, such as music, math, logic, and foreign-language instruction. For example, we are aware of tactile magnet-board systems used in chemistry classes. Smith (1981) describes the design and use of a magnet-board system for representing Lewis structures, balancing chemical equations, and building organic molecules. Smith expresses a motivation for representing spatial organization very similar to our own: 'it is essential that every student have access not only to a list of the elements with their atomic numbers and weights but also to the physical arrangement of the elements' (1981:226).

The magnet board could be useful for instruction in the phonetics and phonology of other languages, and could be modified for languages with non-Roman alphabets. Orsini-Jones et al. 2005 and Orsini-Jones 2009 describe the difficulty foreign-language teachers who are accustomed to teaching sighted students experience when trying to adapt their instruction to blind students, describing a 'tension between the reasonable anticipatory adjustments that lecturers can put in place and the necessary ad hoc ones that will be needed for a disabled student with very specific needs' (Orsini-Jones et al. 2005:146). The magnet board could be helpful in addressing this need for in-the-moment teaching tools by providing a tactile medium of communication to complement other mediums of communication already in use in the classroom.

The tool described here and its use in a classroom can be part of a larger expression of supportive, inclusive attitudes and practices of instructors and peers. Undergraduate students who are visually impaired tend to take longer to graduate and have higher dropout rates than their sighted counterparts (US Department of Education 2003). The literature suggests that institutional support, the presence of skills and tools that enable independence, and the attitudes and practices of faculty and peers play large roles in determining student outcomes in college (Getzel 2008, Scott 2009). Students with visual impairments tend to do much better academically when instructors use methods of teaching that are inclusive and accessible (Fichten et al. 1990, Getzel 2008).

A discipline-appropriate magnet-board tool such as this one can be part of a strategy to create an accessible classroom. It is a low-cost option that can improve students' in-class experience amid the generally high costs of supporting a visually impaired student

on a college campus (Scott 2009). We hope that the magnet-board system might foster creative use of class time, communication, and interactive problem solving in an inclusive classroom.

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