

# PhET Faraday's Law - Gatech Interviews Notes

Notes from Sonification Interview videos

- FL tested with #605, 606, 607 (Early Sep)
- FL tested with #603, 602, 608, 609 (Late Sep, early Oct)
- These interviews are working from v1.4.0-jump.9 build of FL (currently 1.4.0-dev.54)
  - A number of changes have been made based on feedback from the Early Sep. group which has not been tested w users.
  - The fundamental issues with the experience with text alerts remain
    - These issues can be addressed with switch to explicit grab/release interaction

#603

- PhET io sonification wrapper 1.0.0-dev.77
- Listened to most of DOM descriptions, and self initiated movement

## Too many alerts and too long

Problem:

1. Users not waiting to listen to whole alert - just listening to the first part: "magnet at center of play area"
2. Lots of alerts are being fired (see #603 during exploration around coil @ ~2:00). Distracting from the sonification.
3. "Far from 4 loop coil. Very close to 2 loop coil." is too long.

Option 1:

- Text alerts only state proximity relative to coils
- Remove play area location from text alerts as they are redundant
- Put closest coil first in text alert.
- Shorten from "Far from 4 loop coil. Very close to 2 loop coil." to "2 loop coil very close, 4 loop coil far."
- Fire alerts only when thresholds are crossed, not on every stroke / key-up event.

Option 2:

- Use a grab/release interaction
  - State coil proximity on "grab"
  - State coil proximity change on release.
  - See [PhET Faraday's Law - Grab and Release Interaction Sketch](#)

Aside:

- The original design was to only fire alerts when certain thresholds were passed. In the dev version alerts are being fired regardless whether a threshold was transitioned
- Pauses between text alert messages makes people think that's all there is.

## Remove Coil to the Left / Right alert when very close to the coil

Issue:

- The alert for "coil to left / right" can come across as jarring when already near the coil.
- Example, some confusion for #603 after that alert "4 loop coil to the right" (2:50 - 2:54).
- However, same user (#603) used the text cue at 36:15 and knew to move left to the coil, and again at 43:10 to find 2nd coil
  - #608 also found the prompt very helpful

Aside:

- The original intention of this alert is to help users "set up" their magnet so they know when the coil is to the left or right.

## Confusion over the coil collision sound

Problem:

- Multiple users associated the "bong" sound with some sort of goal
  - #603 - interpreted the organ sound and the subsequent bong as a "bullseye"
  - #608 - interpreted the bong sound as "being in the coil".
- When coil is bumped, a "bong" sound is heard, but text alert says: "magnet at center of play area". There's a disconnect with the two.
  - Example: For #603 at 2:25, magnet inside coil and hit the top of coil. "bong" sound heard, but text alert says: "magnet at center of play area".
    - Text alert creating confusion because it's not describing what the "bong" sound means

Option 1:

- Remove text alert all together and just have the "bong" sound.

Option 2:

- When collision occurs, text alert should just say: "bumped a coil".

Aside:

- Play area edge bump and text alert is an example where this works well: edge bump sound is accompanied by an alert saying the magnet is at the edge

## Sliding Cue

Problem:

- None of the surveyed users used the slide move (#603, #608)

## Shorten the Play Area Edge Text Alert

Problem:

- The play area edge bump text alert is a bit too long.

Option 1:

- Change: "Magnet at middle-right edge of play area"
- To: "At edge" or "At edge of play area",

Option 2:

- Remove edge bump text alert (edge bump sound may be sufficient).

Aside:

- Alert seemed good. User immediately reversed directions (#603)

## Tweak Circuit Mode Radio Button Text Alert

Problem:

- Not every user listens to the full text alert when switching modes.
- The two text alerts start off sounding the same.

Suggestion:

- Currently:
  - "Circuit now has two different coils"
  - "Circuit now has one coil"
- Change to:
  - "Two different coils now connected."
  - "One coil now connected".

## Add coil location to scene summary and circuit description

Problem:

- Scene summary currently lacks any information to establish the location of the coil in the play area.
- Motivation: much of the text descriptions and alerts describe magnet and coil, and yet the coil is not mentioned at all in the scene summary.

Fix:

What	Currently	Proposed
Scene summary	<p>"Faraday's Law is an interactive sim. It changes as you play with it.</p> <p>The play area has a light bulb circuit, and a moveable bar magnet. There are controls that change what is connected to the circuit, flip the bar magnet, and reset the sim.</p> <p>Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys.</p> <p>If needed, check out keyboard shortcuts under Sim Resources."</p>	<p>"Faraday's Law is an interactive sim. It changes as you play with it.</p> <p><b>At the centre of the play area is a coil*</b> connected to a light bulb circuit. There is a also moveable bar magnet.</p> <p>Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys.</p> <p>Additional controls that change what is connected to the circuit, flip the bar magnet, and reset the sim. If needed, check out keyboard shortcuts under Sim Resources."</p> <p>*Change "is a coil" to "are two different coils" if both coils are showing.</p>

Circuit PDOM description (1 coil)	"In circuit are a light bulb, a 4 loop coil, and a voltmeter. The coil is sideways, with openings on the left and right."	"Connected to the circuit are a 4 loop coil, light bulb, and a voltmeter. The coil is <b>at the centre of the play area</b> . The coil is sideways, with openings on the left and right."
Circuit PDOM description (2 coils)	<p>"In a circuit are a:</p> <ul style="list-style-type: none"> <li>• Light bulb</li> <li>• 4 loop coil</li> <li>• 2 loop coil</li> <li>• Voltmeter</li> </ul> <p>The coils are sideways, with openings on the left and right."</p>	<p>"Connected to the circuit are a:</p> <ul style="list-style-type: none"> <li>• light bulb</li> <li>• 4 loop coil</li> <li>• 2 loop coil</li> <li>• volt meter</li> </ul> <p>The coils <b>are at the centre of the play area</b>. The coils are sideways, both with openings on the left and right."</p>

## Descriptiveness Concerns

- "In 4 loop coil." ... #603 had some confusion about what that meant. (7:40)

## Add "Select magnet" to the instructions for moving it

Problem:

- Currently the scene summary and PDOM description of the magnet states they keys to move the magnet but omits the fact they need to select it first.

Suggested fix:

What	Currently	Proposed
Scene summary	"Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys."	"How to play with the magnet: select magnet; move using arrow keys, W A S D, or 1 2 3 keys."
Magnet PDOM description	"Use the W A S D keys to move the magnet in four directions. Use 1 2 3 keys to slide magnet left and right."	"How to play with the magnet: Select the magnet; use the W A S D keys to move in four directions; use 1 2 3 keys to slide left and right."

## Notes

- #603
  - 22:55 - figures out association of sound with being in the 4 loop coil
  - 23:11 - figures out closer you get the more intense the sound
  - 25:00 - trying to figure out what the bong sound is and why it happens.
  - 29:00 - changed rate of speech, the pause throws user off. Increasing rate helps
  - Didn't feel descriptions were enough
  - Knew there was a coil and magnet, and poles.
  - 30:00 - discovers volt meter
    - unchecks it but the volt mete is still visible. something wrong?
  - 33:50 - asked what happens when magnet moved through coil at different speeds
    - doesn't know if it does anything because it just tell him that it's in the centre of the play area.
  - 35:00
    - Wasn't sure there was more than 1 way to move the coil
    - Didn't know you can press and hold
    - Looking for a change in the description as a result of moving faster, but the text alerts remain the same (issue with text alerts disconnected w sonification)
  - 36:44
    - Prompted to switch coil modes
  - 39:00-16
    - Flipping poles, but after flipping had no way of remembering the polarity. Said: "I guess that's something you just have to remember"
    - But the description is in the PDOM. Is that enough?
  - 42:00
    - Confusion over an empty Level 2 header
  - 43:00
    - Was reminded there was already a 2nd coil. User forgot and was prompted.
  - 43:30
    - Searching for 2 loop coil.
    - Text alert said "to the right" an49d used that as a cue.
  - 44:30
    - properly describes the magnet position relative to the 2 coils and knows there's a the difference between the coils because of the different bump sounds.
  - 49:00
    - Describing the sounds. Knows the more intense organ sound is important, but admits to explore it more

- ⚠ Text alerts are getting in the way.
- 52:12
- 53:00
  - Asked what happens when you move magnet quickly and said they couldn't tell the difference in sound.
  - Asked about the differences in coil sounds
  - Can't figure out if there's a difference. Spent so much time figuring out positioning that wasn't focusing and remembering the difference in sounds between the 2 coils.
- 56:04
  - Identifies that the sounds in the 2 loop coil are lighter and not as deep compared to the 4 loop coil
  - Says that the sounds from the 2 loop coil "all of them" are a pitch higher.
- 58:16
  - Asking to describe the sounds when flipping magnet, but magnet is inside the coil
  - can hear a difference between the different polarity.
- 1:00:00
  - Asked to describe the sim as if to a friend.
  - Described it has something to do with magnet and electricity, and differences between two coils
  - Hasn't quite figured out the purpose of the N and S poles
- 1:01:00
  - Asked whether this will help someone with impairment understand FL?
  - Answers tentatively, it's a memory thing - keep remembering what state it was previously
- 1:02:00
  - Said it would be great if there was some way to get a quick reference "this is what it is and this is where you are"
  - You have to tab or shift-tab to find out stuff and it can be confusing.
- 1:04:00
  - What do you like / dislike?
  - Dislikes not knowing what's going on.
  - Says they would like to be oriented "on my own". Feels like they will need to find a sighted person.
- 1:06:00
  - Compare to other sims used previously?
  - Said having some previous experience does help. Knows to use arrow keys, knows to more through descriptions.
  - Didn't get a good sense what is happening in FL.
  - Said this one is a more complex, says he feels stupid. Still hasn't figure out what the point of the N and S poles are.
- 1:09:00
  - ⚠ Wasn't clear that the N and S poles are **ON** the magnet. Didn't make the association.
- 1:10:40
  - Asked about whether the sound and descriptions worked well together
  - Says they worked well, but had to get used to the presence of the pause that was throwing them off.
  - Increasing speech rate helped.
  - Doesn't like when the tones and descriptions overlap each other - not clear
    - Doesn't think there was a problem with overlapping
    - Says can hear both description and tones comfortably - one isn't louder than the other
- 1:12:20
  - Asked if there was a instance where the sounds and description really helped make something clear.
  - Tones and the dings with description let them know they hit something key.
  - Associates the presence of sound with getting to the "meat of things"
- Sim's capabilities meet my requirements - Agree.
- Using the sim is a frustrating experience - somewhat agree
- Using the sim is easy to use - somewhat disagree
- I have to spend too much time correcting things in the sim - strongly disagree
- Sound were helpful - strongly agree
- Sounds were interesting - strongly agree
- Sounds were pleasant - strongly agree
- Sounds were easy to understand - strongly agree
- Sounds were relatable to their ideas - strongly agree
- Easy to matych sounds to the meanings - strongly agree
- It was difficult to understand how the sounds changed from one variable to the next - strongly disagree (more of a memory issue)
- Sounds were fun - somewhat agree
- It was boring sound - disagree
- Confusing - disagree
- Easy to understand what the sounds mean - Strongly agree
- The sim was complex - somewhat agree
- The sim is easy to use - somewhat disagree
- I need a technical support to use this - disagree
- Functions were well integrated - somewhat agree
- Too much inconsistency in the sim - disagree
- I think others will learn to use this sim quickly - somewhat agree
- I found it awkward to use - neutral
- I felt confident using this sim - somewhat disagree

#608

- 3:00 - appears to be having problems figuring out that focusing on the magnet is where you begin.
  - looking through the PDOM multiple times, and the Control Area, but can't find where to begin.
- 4:10 - comments about missing something
- 5:30
  - Asked what she was looking for, and was told to switch modes from Browse to Forms mode
  - ? How often does this situation come up? Should instructions be put somewhere (i.e. in the Help or scene summary?)
- 7:30
  - "I'm very confused" - can't seem to figure out how to get to magnet and move it

- 9:40
- 9:48
  - Still very confused. Was manipulating the coils and not getting what she wanted. Instructed to go and find the magnet.
- 9:50
  - Managed to find the magnet
  - ? Is the text cue not strong enough? Just says: "Bar magnet, move in 4 directions"
- 14:20
  - was moving magnet around, got it into the coil, bumped the coil
  - ? Is the bump sound enough?
- 16:02
  - Moved magnet around a lot. Bumped it along the edges a lot
  - Edge bump alert can be better.
- 18:02
  - User slides the magnet
  - No other audio cues because far from coil
- 18:40
  - Previously asked to turn on field lines
  - Now turns them off. Did not explore the PDOM to hear the updated description.
- 19:13
  - Asked to describe the sim
  - Describes the sim as having a coil, a circuit, magnet, and a voltmeter (although not sure what that is)
  - Not sure what the lightbulb is for
- 19:40
  - Knows the magnet can go in the coil because it's open on both ends
- 20:10
  - Asked how they navigated through the sim
  - Was using the arrow keys and getting no where
    - ? Possible the text description did not help either. The description says to use arrow keys but didn't say the context in which to use them.
  - Eventually was able to move magnet with WASD keys
- 20:50
  - Asked if used any other keys to move the magnet
  - Said used the 1 2 3 keys and it slid the magnet, but didn't give any additional description.
- 21:40
  - Asked about the descriptions from the screen reader
  - Said the descriptions were very specific
  - Also said didn't realize that the 1 2 3 keys wasn't sliding just inside the coil
- 22:25
  - Asked about the amount of time spent using Browse Mode
  - Didn't know they were in Browse mode. Thought they were interacting with the sim.
- 23:00
  - Asked what happens to the description as you move the magnet through the coil.
  - Says the descriptions tells the position relative to the coil
  - But still doesn't know what the voltmeter is for.
- 24:00
  - Asked which coil can generate the highest voltage
  - Was confused. Didn't really recall there were two coils.
  - Thought it was very confusing
- 25:15
  - Playing w sim again to try to better understand the two coils
  - Moving magnet around.
  - Hears the prompt for "coil to left / right" and was able to navigate to it properly.
- 25:35
  - Hits the coil and realizes it makes a different sound.
- 26:00
  - Asked again which coil generates more voltage
  - correctly identifies 4 loop coil generates more because it has a bigger and deeper sound.
- 26:30
  - Asked about the polarity
  - Responded by saying the magnet goes toward the coils different
  - Says the poles repel each other.
  - User is not clear about its purpose
- 28:37
  - Asked about the sliding
  - But said they couldn't tell the difference.
- 29:19
  - After playing some more, still couldn't answer the question
  - Couldn't tell a difference between the movement at different speeds.
  - ? Instructions for sliding isn't clear.
  - ? doesn't sound like the ticking sounds for magnet movement happens during a slide.
- 30:10
  - Asked about the sounds and what they mean.
  - Said that when the magnet is inside the coil, there's a "hitting a spring" sound.
- 31:46
  - ASked what the clicking sound means
  - just says that the magnet is moving
- 33:10
  - Has a strong association with the "spring hitting the table" sound.
  - associates the "humming sound" with the magnet interacting with the coils.

- 33:35
  - Asked what happens when you move the magnet through the coil
  - Says there's a "spring" sound.
- 35:51
  - Hears the organ sound, but doesn't know what is happening
- 36:45
  - Asked what happens when the magnet touches the coil
  - Thinks it might be the low humming sound
- 37:40
  - After some hints, realizes that the bong sound is when the magnet touches the coil
- 39:17
  - What happens when you flip the magnet
  - magnet makes a clicking sound and an organ sound
- Sim's capabilities meet my requirements - Agree.
- Using the sim is a frustrating experience - Agree
- Using the sim is easy to use - disagree
- I have to spend too much time correcting things in the sim - disagree
- Sound were helpful - strongly agree
- Sounds were interesting - strongly agree
- Sounds were pleasant - strongly agree
- Sounds were easy to understand - strongly agree
- Sounds were relatable to their ideas - agree
- Easy to match sounds to the meanings - agree
- It was difficult to understand how the sounds changed from one variable to the next - disagree
- Sounds were fun - strongly agree
- It was boring sound - strongly disagree
- Confusing - strongly disagree
- Easy to understand what the sounds mean - agree
- The sim was complex - somewhat disagree
- The sim is easy to use - somewhat disagree
- I need a technical support to use this - somewhat agree
- Functions were well integrated - neutral
- Too much inconsistency in the sim - strongly disagree
- I think others will learn to use this sim quickly - somewhat agree
- I found it awkward to use - strongly disagree
- I felt confident using this sim - somewhat agree
- I needed to learn new things in order to use this sim - strong disagree
- 44:55
  - How would you describe this sim to a friend
  - "I would describe it as incredibly confusing." "There were a lot of pieces and I didn't know what to do with them until you told me."
  - Didn't like how you had to go in and out of Forms mode. "Found that incredibly frustrating."
- 47:30
  - Would you see this sim as being helpful for others learning the concepts.
  - Said the descriptions were good and perhaps not use as much sounds.
- 48:40
  - How would you improve the simulation
  - Label the items so they know it is interactable.
  - Thought the checkboxes were confusing
- 49:30
  - Asked to elaborate on having more descriptions
  - Felt that the sounds and descriptions were competing with one another
  - Couldn't pay attention to both at the same time.
  - Was relying more on the description - they made more sense than the sounds did
- 50:20
  - Compared to Friction, how does this one compare?
  - Found FL more difficult because of all the pieces and playing with each one individually.
- 51:00
  - Asked to comment on overall experience
  - Said that once she figured out what was happening, everything became more clear
  - Found that 2 coils was more difficult than 1.
  - Liked knowing where everything was like "the coil was to the left."
- 51:52
  - Asked about not knowing about the voltmeter was
  - Guesses that it's somehow measuring the electricity between the magnet and the coil
  - Hadn't realized that the sound was associated with the lightbulb or voltmeter

#602

- 0:00 to 10:30
  - Exploring sim
- 0:10:33
  - Enabled field lines and wondering about whether the field lines changed
  - Wondering what they're supposed to be showing.