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Speed Eleusis: Variation on an Old Educational Card Game

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In this article, we describe a fun and engaging card game called Speed Eleusis that teaches the process of scientific discovery and publication, including such practices as replication and retraction. Much like the traditional game of Eleusis and its variant Eleusis Express, this game involves students competing to model a pattern displayed in a sequence of ordinary playing cards. Speed Eleusis, however, features a quicker pace and is easier to manage. Although developed for introductory physics and physical science labs at a four-year university and two-year college, Speed Eleusis should prove ideal across a wide range of science subjects and age groups, especially during the first week of instruction.

Eleusis

The card game Eleusis is the brainchild of Robert Abbott and first appeared in a 1959 *Scientific American* column by famed mathematics educator Martin Gardner.^{1,2} The educational value of this game of pattern exploration and discovery centers on its ability to mimic the scientific method. In 2006, John Golden simplified the game, which he called Eleusis Express.³ It is Golden's version that the authors modified to create Speed Eleusis.

Fun yet informative, Speed Eleusis serves as an ideal activity for the first day of physics instruction, a time in which students are eager but apprehensive. In a recent article in *The Physics Teacher*, physics educator Donald A. Smith suggested Eleusis as a simpler alternative to Mao, a similar card game.⁴ Speed Eleusis is even simpler yet, as we will soon discuss, and can teach many aspects of the scientific process that Eleusis cannot. The authors have facilitated Eleusis Express and Speed Eleusis in introductory physics labs at Fresno City College (Key) and California State University, Fresno (Walkup). In their opinion, students enjoyed Speed Eleusis even more than Eleusis Express. Its fast pace and intense pressure further elevated engagement in the classroom.

Rules of Eleusis Express

Speed Eleusis is based on Eleusis Express, so it will help to discuss the rules of Eleusis Express to a reasonable depth. Eleusis Express is played by four to seven people or teams with decks of standard cards. One team is designated as Nature; all other groups are called Research Teams.

Nature decides on a rule and secretly records it. This Secret Rule defines a specific sequential pattern of cards based on only the card's (a) value, (b) suit, (c) color, or (d) any combination of the above. For example, the Secret Rule could be "All face cards" or "All diamonds, increasing by 2." A few rules to note:

- Aces count as 1 and are not considered a face card.
- The Jack, Queen, and King are counted as 11, 12 and 13, respectively.

- Face cards can be treated as distinct from numbered cards.
- The sequence of cards is cyclic; that is, a King is followed by an Ace.

To begin play, Nature first places a starter card down that matches the Secret Rule. Research Teams take turns offering to Nature a card they think matches the Secret Rule. Nature then states whether the card matches the Secret Rule or not, at which point the card is placed in the sequence according to the following:

1. A card that matches the Secret Rule is placed horizontally in the card pattern.
2. A card that fails to match the Secret Rule is placed vertically below the last card that matched the Secret Rule.

Speed Eleusis negates the need for the second rule.

Figure 1 shows both scenarios. Initially, Nature laid down the A_{heart} . The first Research Team played the 3_{diamond} but this did not match the Secret Rule, so the card was placed below the A_{heart} . The next Research Team played the Q_{clubs} , which matched the Secret Rule, so the card was placed horizontally in the sequence, and so on. In all, the card sequence $A_{\text{heart}} - Q_{\text{clubs}} - 3_{\text{heart}} - 6_{\text{spade}} - 9_{\text{heart}} - 8_{\text{spade}}$ matches the Secret Rule. A Research Team that surmised the Secret Rule was "Odds then evens, alternating between black and red" could declare "Discovery!" at which point this Research Team would assume the role of Nature.

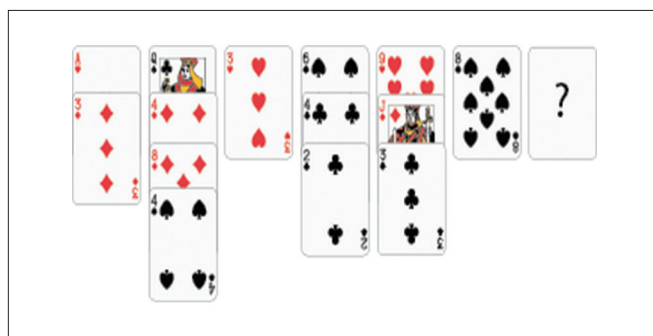


Fig. 1. Eleusis pattern showing "hits" (displayed along the horizontal) and "misses" (displayed along the vertical). The Secret Rule here was "Odds then evens, alternating between black and red."

Eleusis Express incorporates more rules to govern score keeping, instances where students do not have a card they think matches the Secret Rule, and other issues that arise during play. For the sake of brevity, we refer the reader to the complete set of Eleusis Express rules in Ref. 3.

Connection to science

Eleusis Express effectively models many aspects of the sci-

entific process. The connection between Eleusis and scientific discovery is that the “game” of science rests on uncovering patterns in Nature through scientific experimentation in much the same way that Research Teams predict the Secret Rule.

For example, the identity of each card and the known relationship between them mirror *scientific facts*. In Fig. 1, all Research Teams will agree that the third card played is the Q_{clubs} and that the Q_{clubs} follows the A_{heart} in the pattern. These facts are readily observable and no reasonable person would dispute them. Each team surmises a pattern, then selects a card they think will test their pattern, akin to formulating a *hypothesis*. To test their hypothesis, they offer the card to Nature to determine whether it matches the Secret Rule, much like performing an *experiment*.

The pattern a team adopts is analogous to a *model*, that is, a pattern they think can predict future card revelations. At some point, all Research Teams will agree that a certain model matches the Secret Rule (even though it might not), at which point the model takes the form of a *law*.

Eleusis serves as an entertaining manifestation of *inductivism*, where observations of nature lead to models that (hopefully) strengthen as more of the pattern is revealed. The concept of refutability, one of the cornerstones of science, also surfaces strongly during the game. Each team forms a model, but the appearance of a card in the sequence that contradicts their model ultimately destroys it. The finality of the refutation is not lost on students, who typically moan loudly when a card they think matches the Secret Rule is rejected by Nature.

Eleusis raises myriad higher-order, cognitively rich questions students can ponder such as:

- Can a scientist ever uncover the Secret Rule for certain no matter how many cards are played? Does this affect how we should respond to announcements of scientific discoveries?
- How would you use Speed Eleusis as an analogy to Occam’s Razor?
- Research inductivism and empirical falsification. Does the game mimic one better than the other?

All known Eleusis versions rely on the game facilitator knowing the Secret Rule. Naturally, no one truly knows the Secret Rule, but there appears to be no way to play the game without this condition. We suggest informing students of this weakness before play begins or asking students to explore this condition as a post-play activity, as listed above.

Those interested in reading a more detailed discussion of the connection between games like Eleusis and the scientific process are urged to read the work of Romesburg.⁵ As we will see, Speed Eleusis reinforces this connection to science but allows students to explore the manner in which scientific teams conduct themselves that Eleusis Express fails to address.

Speed Eleusis

Rules of Speed Eleusis

Speed Eleusis changes the role of Nature. Instead of letting teams uncover the Secret Rule by playing their own cards, Nature in Speed Eleusis reveals one-by-one all of the cards matching the Secret Rule. After each card unveiling, Nature pauses to allow Research Teams to guess the pattern vocally and (hopefully) before another Research Team does. As such, the pace of Speed Eleusis is much quicker than Eleusis Express.



Fig. 2. Sample Eleusis pattern. The card with the question mark simply notes the sequence continues, with the next card in the sequence as yet unplayed.

An example card sequence displayed by Nature is shown by the sequence of cards in Fig. 2, where the Secret Rule shown could be “Odd-valued, increasing by two, alternating clubs and spades.” Or, perhaps it is “Increasing by 2,” “All black,” or even “All even, two clubs then two spades.” The fun aspect of Speed Eleusis is discovering this rule before the other Research Teams do at the risk of being mistaken.

Once a Research Team thinks they have uncovered the Secret Rule, they can claim “Publish!” but, after doing so, must announce their model to all other Research Teams, akin to publishing. Nature will neither confirm nor deny their model and will continue displaying more cards that match the Secret Rule.

Unlike Eleusis Express, Speed Eleusis allows other Research Teams to declare “Replicate!” if they agree with a prior discovery of the Secret Rule. On the other hand, if they disagree with the published Secret Rule and have a rule of their own, they can declare “Publish!” as well.

Each team begins with 50 points from which it can gain or lose points based on the following:

- After claiming “Publish!” a Research Team earns five points plus one point for every card that is flipped thereafter, but only if their Secret Rule is correct.
- If the Research Team claiming “Publish!” turns out to be incorrect, they lose five points plus one point for every card that is flipped thereafter.
- The same scoring scheme above applies to “Replicate!” except five points changes to two points.

If a team that has previously claimed “Publish!” begins to doubt their model, it can declare “Retraction!” To retract a publication or replication incurs a cost of two points, but the retraction allows them to no longer be held liable for its earlier discovery. (See the rows corresponding to Cards 7-8 in Table I.) It can also declare “Publish!” once again if it wishes, but only after retraction.

The game ends once all teams have claimed “Publish!” or “Replicate!” or 25 cards have been played, at which point Nature reveals the Secret Rule. Scores are then tallied, with the team scoring the most points declared the winner. Table I shows a sample tally.



Fig. 3. The appearance of a Joker in the pattern appears often in science and, as Speed Eleusis play demonstrates, a common source of confirmation bias.

Sometimes Nature reveals behavior that competing Research Teams interpret completely differently. Unlike Eleusis Express, such behavior can be modeled in Speed Eleusis using the Joker. Consider the example shown in Fig. 3. Those Research Teams who have announced a discovery that depended on the Secret Rule “Two clubs, then two spades” will naturally interpret the Joker as being only a club, therefore not only

Table I. Sample scoring sheet tabulated after play ended and Nature revealed the Secret Rule “Red increasing by 1.” Here, Publ, Rep!, and Retr!, refer to “Publish!,” “Replicate!,” and “Retract!,” respectively. Note the penalties incurred by Research Teams for publishing or replicating an incorrect model. In Round 10, all Research Teams had either declared “Publish” or “Replicate” of the same model, therefore ending the game.

Speed Eleusis Scoring Sheet (sample)						
Card	Team 1	Team 2	Team 3	Team 4	Team 5	Notes
2 diamond	–	–	–	–	–	–
3 diamond	–	Pub! (–5)	–	–	–	T2: “Diamonds, increasing by 1.”
4 diamond	–	(–1)	Rep! (–2)	–	–	T3 replicates T2’s model.
5 diamond	–	(–1)	(–1)	Rep! (–2)	–	T4 replicates T2’s model.
6 diamond	–	(–1)	(–1)	(–1)	–	–
7 diamond	–	(–1)	(–1)	(–1)	–	–
8 heart	–	Retr! (–2)	Retr! (–2)	Retr! (–2)	–	T2, T3, T4 retract T2’s model
9 heart	–	0	0	0	–	T2, T3, T4 no longer lose points
10 dia- mond	–	0	0	0	Pub! (+5)	T5: “Red, increasing by 1”
J diamond	Rep (+2)	Rep (+2)	Rep (+2)	Rep (+2)	(+1)	T1, T2, T3, T4 replicate T5’s model
Total	52	41	45	46	56	Group T5 wins!

supporting their own model but refuting their competitors’ models. However, those Research Teams that had previously claimed the discovery “All black” will claim the Joker is a club or a spade. Those left out of the scoring to that point can seize the moment by claiming that the Joker represents any numbered card, pointing to a different Secret Rule (e.g., “All numbered cards.”)

Nature produces Jokers all the time and, in turn, scientists often interpret the Joker in a manner that fits their own world view (and grant funding). For example, various physicists will interpret an unexpected spike in an energy spectrum as evidence for a particular theory they favor. Still, other physicists will claim that the Joker should be ignored; that is, it represents a spurious event or anomaly caused by error, fraud, or the inherent unpredictability of nature. Resolving these disagreements consumes a lot of energy among scientists.

Benefits of Speed Eleusis

With no need for dealing card hands and its simpler scoring scheme, Speed Eleusis is easier to manage than Eleusis Express. Indeed, there is no need for playing cards at all — instructors can post the cards in a PowerPoint and display them one by one with a press of the Enter button. (The reader can download a PowerPoint for displaying Eleusis cards by visiting the link in Ref. [6]. This PowerPoint document offers alternatives to face cards for students who may be unfamiliar with playing cards.)

Speed Eleusis elevates the pressure on Research Teams to publish before the others to garner an additional five bonus points. Researchers the world over face similar pressure. Much like what often happens in Speed Eleusis play, Research Teams often “jump the gun” claiming a discovery prematurely. The premature announcement of cold fusion offers an illustrative example.

Speed Eleusis mimics many other aspects of research in ways that Eleusis Express cannot. For one, the game allows for Research Teams to replicate another team’s discovery, earning points in the process if the original team’s pattern holds true. Without replication, scientists can lay claim to models, no matter how sloppy their reasoning or experimental procedure, with credibility often linked more closely to the wishes of the researchers or the public rather than scientific reality. Our news media highlights the problem with a lack of replication, impatiently announcing exciting claims without pausing to see if other scientists can generate similar results.

This game also offers Research Teams the ability to retract discoveries they previously announced, but not without incurring a penalty. And much like what happens in science, those Research Teams that announced replication of this errant discovery will almost universally retract their claims in succession.

Discussion

Like Eleusis Express, Speed Eleusis can be played in labs spanning a wide range of science subjects. The age range that can effectively play the game appears similarly wide, even down to the elementary school level.

On a final note, we do not suggest replacing Eleusis Express with Speed Eleusis entirely. Eleusis Express models the act of performing experiments to test hypotheses and therefore more closely models the scientific method. Speed Eleusis, on the other hand, more closely mimics the process of publication. Playing both Eleusis Express and Speed Eleusis therefore covers a wide range of issues encountered in science and teaches a richer scientific vocabulary.

Acknowledgments

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References

1. R. Abbott, *Abbott's New Card Games* (Stein & Day, New York, 1963).
2. M. Gardner, *Origami, Eleusis, and the Soma Cube* (Cambridge University Press, New York, 2008).
3. J. Golden, "Eleusis Express," logicmazes.com (2006), <http://www.logicmazes.com/games/eleusis/express.html>, accessed on Feb. 12, 2019.
4. D. A. Smith, "Learning the rules of the game," *Phys. Teach.* **56**, 146–148 (March 2018).
5. H. C. Romesburg, "Simulating scientific inquiry with the card game Eleusis," *Sci. Educ.* **63**, 5, 599–608 (1979).
6. J. Walkup, "Speed Eleusis: Demonstrating the scientific process/vocabulary," California State University, Fresno (December 13, 2018). PowerPoint document retrieved from <http://fresnostate.edu/csm/physics/documents/EleusisPresentation.pptx>, on Dec. 13, 2018.

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And the Survey Says ...

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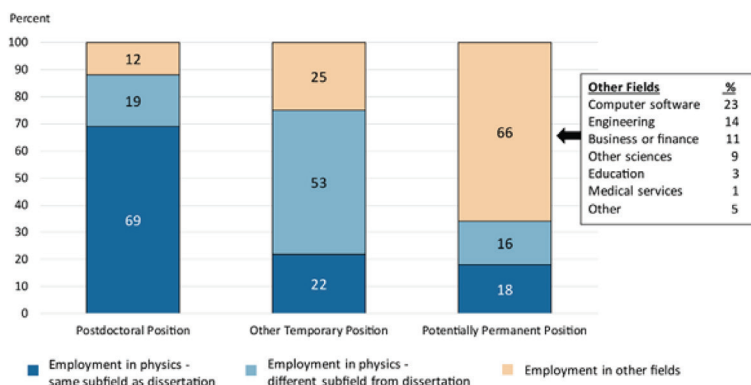
Dissertation subfield and employment

Having examined the employment of new physics PhDs by sector and by type of position (postdoc, temporary, or potentially permanent), we now turn to the degree recipient's subfield and their employment. Recall that almost half of the physics PhD recipients graduating from U.S. institutions who stayed in the U.S. accepted postdoctoral appointments. About 40% accepted a potentially permanent position and 8% took a temporary position that was not a postdoc.

As seen in the figure, most of those who accepted a postdoc were working in physics in the same subfield as their dissertation. While 75% (= 53% + 22%) of those who accepted some other temporary position were also in physics, almost 80% ($\approx 53\% + 25\%$) were working in a field outside their dissertation subfield. Finally, about one PhD recipient in three who accepted a potentially permanent position were working in physics, with about half of those in the same subfield as their dissertation.

In April, we will look at the starting salaries for new physics PhDs. Susan White is the Interim Director of the Statistical Research Center (SRC) at the American Institute of Physics. She can be reached at swhite@aip.org. All the reports from the SRC are available at www.aip.org/statistics.

Employment Field of New Physics PhDs, Classes of 2015 & 2016 Combined



Note: Employment in physics means an individual's primary or secondary employment field was in physics or astronomy. Data include only U.S.-educated PhDs who remained in the U.S. after earning their degrees.

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