The Princess and the P-value

Research Fables from the Sisters Grinn, No. 5

By Jeanne Grace, PhD, RN

Abstract: I started writing the fables in 1996, when I took over teaching the undergraduate research course. At first, they were "buried treasures" hidden in the on-line course materials (it was a hybrid course, and we were trying to get the students to develop internet surfing skills) for students to find. Then, as there were more of them, I started explicitly assigning them for student reading. As I've had time, I've written fables for areas where students seem to get "stuck" on basic concepts in research. Two of the fables have "readers' theater" versions that I use in class for traditional students. Casting the parts is always fun. Enjoy!

The entire series of Dr. Grace’s research fables are available in this repository. Patrons may access the series by clicking on Dr. Grace’s name in the item record.

Penelope Penultimate lived in the pastoral kingdom of Positivism. She was a princess. She was also a pragmatist. Hard times had fallen upon her kingdom, and she was forced to abandon her research agenda and take orders and flip burgers just like the common folk of her age. After a hard day at the short order grill, her UNCLE, Duke Johns Hopkins would comfort her, reminding her that "breeding will tell, after all," 1. Pragmatic Penelope inventoried her assets and decided that a strategic marriage to an eligible noble in some richer country would be in her own, and her kingdom's best interest. 2 So with patriotic perseverance, she sent abroad polite postcards inquiring about possible permanent positions for princesses.

And one day, an answer arrived. Prince David, heir apparent to the throne of Dubious, was seeking a consort of suitably royal blood. The elegant calligraphy on ivory vellum not only solicited Penelope's resume, 3 but invited her to visit at her earliest convenience. Penelope packed her bag, stuck her crown in her backpack, and hit the road.

Travel from Positivism was not easy, although in the past it had been accomplished by various post-modern critical theorists. Penelope was forced to walk, and hop freight trains, and finally hitchhike to reach her destination. And though she did her best to dust off her clothes and position her crown, she arrived at the Prince's gate quite disheveled. The chamberlain greeted her with proper deference but obvious reluctance. David's grandmother, the dowager queen Daniella, took one look and retreated to her bedroom for a fainting spell. The ladies in waiting tittered when Penelope's crown started to sneak off past her right ear, and even Queen Darla, the kindest of women, felt judgmental flutterings of regret for having invited Penelope,
sight unseen. Was it be possible that this dusty, eager, slightly tattered young woman could be a princess? She seemed so...so...common!

And yet, it appeared that David was interested, intrigued and attracted to this young woman, who spoke so knowingly of rush hour production schedules and adventures on the road as well as research designs she had known and loved. David was touched by her spunk and her commonsense approach to life, and he began to fall in love. Although she had traveled far from Positivism, Penelope had not abandoned all her upbringing: She was formulating a study hypothesis about a suitable husband, and recognized a personal preference for rejecting the null.

Had matters been left to David and Penelope, true love might have developed smoothly. But the murmurings of the more conservative courtiers were becoming too loud for the King and Queen to ignore. Penelope was pleasant and eager and enthusiastic, but she was informal, even bumptious and downright rowdy. Could she possibly be a real princess, and not an imposter? Dowager Queen Daniella demanded a test, before the situation got out of hand, and the King and Queen reluctantly agreed. They summoned the court scholars, to determine what test might be applied.

The scholars searched the ancient texts, and finally came up with an answer. "My Lord," said the senior scholar, "Penelope has recently been forced to live a common life, so we cannot establish her royalty by simple observation or her recent record of publications. But there is a reliable and valid test: If she is truly of royal breeding, she retains the sensitivities of true royalty. We propose a test, of which Penelope must remain unaware. We will place a single dried pea under her mattress. A true princess will be sensitive to its presence, despite its small size."

And so the scholars concealed the pea under Penelope's mattress before she retired for the night. And in the morning, she appeared for breakfast quite fatigued. "Did you sleep well, my dear?" inquired Queen Darla. Penelope replied that indeed, she had not slept soundly, but had tossed and turned all night. The King and Queen were prepared to accept this trial as adequate proof of Penelope's princesshood, but Daniella and one scholar (who had studied in Inference) declared that the results of one trial, with one mattress, could easily have occurred by chance. Queen Darla was unwilling to be so inhospitable as to repeat the trial twenty times over (as was the tradition of Inference), but did agree to an alternative. Declaring her concern for Penelope's comfort, she caused twenty goosedown mattresses to be placed on Penelope's bed, and she allowed the scholar to place the pea at the bottom of the stack. Again, Penelope tossed and turned all night, and appeared in the morning even more fatigued. Daniella grudgingly agreed that the null hypothesis of non-princessdom had been rejected at the .05 alpha level, but argued that for a matter of such great importance to the kingdom, the .05 alpha level was far too liberal.
So Queen Darla arranged for 100 mattresses to be placed on Penelope's bed, 50 goosedown and 50 swansdown. And again, the pea was placed at the very bottom. Penelope was too tired to comment on the new bedding arrangement, which required her to step onto the mattress stack from a very tall ladder. And yet, she again tossed and turned all night, and in the morning was truly exhausted. Now even Queen Daniella and the final skeptical scholar were convinced. "Verily," pronounced the scholar, "she is a true princess! We have rejected the null hypothesis at the .01 alpha level." With embarrassment mingled with pride for their cleverness, they revealed the test and their conclusions to Penelope.

As a true and pragmatic Positivist, Penelope could not help but appreciate the elegance of the study design and the procedural operationalization. But as a princess who had been deprived of three nights sleep, she harbored some royal resentment. When Queen Daniella and the scholar had finished their explanations, she smiled sweetly and bowed deferentially. Then, raising her head, she innocently inquired: "Oh, my most revered and sage elders, I can see that you have designed this test with utmost consideration for the risk of making a Type I inferential error, and surely there can be none. But you made the alpha level more stringent without increasing the sample size. What have you to say about the resulting increased possibility of Type II error and the accompanying beta level?"

Queen Daniella's face showed grave concern, and the senior scholar looked absolutely ashen. "By the great gods Cohen and Cohen! We neglected to perform the power calculations prior to conducting the experiment!" They hurried away immediately to calculate the effect size and consult the sacred tables.

For her part, Princess Penelope Penultimate retired to her bedroom, extracted the pea from the bottom of her bedding, and allowed her suppressed glee to break forth as she climbed the ladder to her resting place. "Breeding will always tell, but not necessarily right away! When I've rested, I'll remind those pesky pea-placers that power calculations have no purpose in the presence of a statistically significant p." And she fell asleep with a smile upon her lips.

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1 Actually, neither the Duke nor Penelope was very clear on what exactly breeding would tell, and to whom, and whether it would be believed under cross-examination, but the thought was somehow reassuring, just the same. Back to the story...

2 It was either that or get a research grant funded somewhere. Back to the story...
3 narrative not to exceed five pages, no print reduction allowed, one inch margins required. Back to the story...

4 None, is, of course, a mostly harmless exaggeration of the true state of affairs, which at .01 alpha level is 1/100. Back to the story...

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