I'm So Sure!

I have here some figures which I want you to take home in your heads, which I know are concrete.
— James McSheehy
San Francisco Supervisor, 1917–1941

The story has it that Archimedes (272–212 BCE), after many brain gymnastics one Sicilian night, settled into his overfull tub and water spilled out onto the floor. Deranged with glee, he is said to have leapt excitedly to his feet and dashed jaybird bare through downtown Syracuse, exclaiming that he had discovered the solution for determining the volume of irregular objects.

I can see in my mind's eye a pack of journal publishers chasing Archimedes down the street: "Hey, Archie! *Archie!* Your IMRAD! Show us your IMRAD!—and by the way, here's a towel."

The IMRAD template—Introduction, Methods, Results, and Discussion—for reporting results of scientific research is the model observed almost universally in academic writing and indeed is now all but mandatory for articles intended for scientific-journal publication. According to Sollaci and Pereira,[1] the IMRAD boilerplate saw its first uses in the 1940s. However, its roots could be said to reach back much earlier than that.

You can already see the same logic in *Rhetorica ad Herennium*, a discourse on rhetorical reasoning and disputation written in 90 BCE and attributed to Cicero.[2] In Book I, the author lists "six parts of a discourse: the Introduction, Statement of Facts, Division, Proof, Refutation, and Conclusion". In Book II, Cicero goes on to say that these six philosophic principles are expressed empirically in the form of "individual arguments, according to (1) Proposition; (2) Reason; (3) Proof of the Reason; (4) Embellishment; and (5) Résumé".

For each of the Ciceronian "arguments", try substituting (1) Introduction; (2) Methods; (3) Results; and (4) Discussion—plus (5) Conclusions, which a lot of IMRAD-based journals require. Sound familiar? (Besides "Conclusions", many journals say that IMRAD should be AIMRAD, wherein the A stands for "Abstract"; should IMRAD be changed to *AIMRAD-C?*)

Fine, fine, Word Hawk—what does all that have to do with the title of your column up there?

Just this: Your scientific research is essentially a proposition—an "argument", in the Ciceronian sense. You have summarized your work in the Abstract, stated its relevance in your Introduction, shown what you did in your Methods, and explicated the outcome in your Results. But now you must assess your work's significance and speculate on how it is related to current and continuing research in your Discussion and Conclusions. To do that, you might need to use what intelligence officials call "expressions of estimative probability".

Every morning in the White House, with the daily papers, the director of national intelligence plops on the desk of this nation's chief executive a top-secret document called the President's Daily Brief. In it, national security advisers attempt to assign verbal values to world crises. After conjuring with different scenarios, senior intelligence officials distill and debate the day's security status and assess how likely each one is to involve or jeopardize the United States and its global interests.

An article called the "The Greater Barrier"[3] published by the Central Intelligence Agency (CIA) Center for the Study of Intelligence discussed the assignment of likelihoods to the various possible outcomes and described how meanings are analyzed and shaded:

Now, what tools do we have to work with to make these precise qualifications? Well, we have the words "probable," "possible," "likely," "certain," and their antonymic forms; we may qualify these qualifiers with the words "very," "slightly," "surely," "almost," "highly"; we have the phrases "it is believed that," "it is concluded that," "the available evidence indicates that," and a dozen others.

continued

That discussion led Word Hawk to ask himself, "But what is the difference between 'probable' and 'likely'? Between 'very' and 'highly'? Can one attach quantifiers to the qualifiers?'"

Yes, according to Sherman Kent in a now-classic 1964 CIA treatise. He and his "co-worrier" Max Foster even derived the following odds table[3]:

Kent–Foster Table of Estimative Expressions	
Expression	Estimate of certitude
"Certain"	100%
"Almost certainly"	93%, give or take about 6%
"Probable"	75%, give or take about 12%
"Chances are about even"	50%, give or take about 10%
"Not probable"	30%, give or take about 10%
"Almost certainly not"	7%, give or take about 5%
"Impossible"	0%

But Kent and Foster decided that to have "stuck to these words exclusively would have imposed intolerable restraints upon the prose." Therefore, to reflect finer shades of possibility and probability within each broad category, they refined their table[4]:

Kent–Foster Orders of Likelihood (Refined)	
Term	Meaning
"Almost certainly": 93%, give or take about 6%	virtually certain all but certain highly probable highly likely odds [chances] overwhelming
"Probably": 75%, give or take about 12%	likely we believe we estimate
"Chances are about 50–50": 50%, give or take about 10%	chances are about even chances are a little better [or less] than even
"Possibly": 50% or more [open ended]	conceivably could may might perhaps
"Probably not": 30%, give or take about 10%	improbable unlikely we believe that . . . not we estimate that . . . not we doubt; it is doubtful
"Almost certainly not": 7%, give or take about 5%	virtually impossible almost impossible some slight chance highly doubtful

Building partially on Kent and Foster's work, Rachel Kesselman[5] studied numerous intelligence estimates from the 1950s through 11 September 2001. After analyzing the frequency of phrases that expressed probability, she assigned additional quantifiers. She also included expressions used in the fields of weather forecasting and medical research.

In a range from 100% ("certainty") down to 0.0% ("impossibility"), her "Kesselman List of Estimative Words" assigns these values and descriptors to the intermediate categories:

Values	Descriptions
99%–86%	"almost certain"
85%–71%	"highly likely"
70%–56%	"likely"
55%–46%	"chances a little better [or less]"
45%–31%	"unlikely"
30%–16%	"highly unlikely"
15%–1%	"remote"

Although they are in no way intended as substitutes for statistically significant estimates of confidence, the expressions in this column can be useful in writing or speaking *about* your findings or those of others, if not stating the findings themselves.

So when you are writing your next grant proposal or groping for just the right word to use in the abstract of that killer research paper, you might consider using some of the words in this column. As someone has written, be careful that your "possibly" doesn't turn out to be someone else's "probably".

Chuckle of the Month:
First hydrogen atom: "I feel so awful today! I can't find my electron."
Second hydrogen atom: "Are you sure?"
First hydrogen atom: "Yes, I'm positive."

References

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5. Kesselman R. Verbal probability expressions in national intelligence estimates: a comprehensive analysis of trends from the fifties through post 9/11 [master's thesis on the Internet]. Erie, Pennsylvania: Mercyhurst College; May 2008 [cited 2009 April 21]. Available from: www.scribd.com/doc/2959133/verbal-probability-expressions-in-national-intelligence-estimates.