Cortez rainbow wrasse – Thalassoma lucasanum – terminal male

Photo CC BY-SA 3.0 - Javontae Murphy
ANALYSIS

SCOTOPIC (ROD) VISION

Detectability
\[ Q_{\text{rod}} = \sum_{\lambda} I_{\lambda}(\lambda) R_{\lambda}(\lambda) T(\lambda) A_{\text{rod}}(\lambda) \]

Internal contrast
\[ C_c = \frac{Q_{c,a}}{Q_{c,b}} \]

Conspicuousness
\[ Q_{c,b} = \sum_{\lambda} I_{\lambda}(\lambda) T(\lambda) \]

PHOTOPIC (CONE) VISION

Absolute chromatic signal
\[ C_{\text{abs,\lambda}} = P_{\text{abs},\lambda} - P_{\text{abs},\lambda} \]

Rewritten for comparisons
\[ C_{\text{abs,\lambda}} = \ln(Q_{\text{abs},\lambda}) - \ln(Q_{\text{abs},\lambda}) \]

COMPARATIVE ANALYSIS BY INDEPENDENT CONTRASTS (CAIC)

\( \alpha, \beta, \) and \( \gamma \) are independent evolutionary events

RHODOPSIN SEQUENCING

Purifying selection: low \( K_s/K_a \)
Positive selection: high \( K_s/K_a \)

Tourasse and Li (2000) found much lower \( K_s/K_a \) in transmembrane regions: likely structural constraints

(c) Liz Neeley 2005
visual pollution

“Just as people are finally tuning in to the remarkable communications systems on reefs, we may be overwhelming these systems with static.”
When scientists announced the discovery of water on Mars recently, Rush Limbaugh drew the obvious conclusion: It was all part of a conspiratorial plot:
gut reaction
Climate-Science Communication and the Measurement Problem

Dan M. Kahan
Yale University

This article examines the science-of-science-communication measurement problem. In its simplest form, the problem reflects the use of externally invalid measures of the dynamics that generate cultural conflict over risk and other policy-relevant facts. But at a more fundamental level, the science-of-science-communication measurement problem inheres in the phenomena being measured themselves. The “beliefs” individuals form about a societal risk such as climate change are not of a piece; rather they reflect the distinct clusters of inferences that individuals draw as they engage information for two distinct ends: to gain access to the collective knowledge furnished by science and to enjoy the sense of identity enabled by membership in a community defined by particular cultural commitments. The article shows how appropriately designed “science comprehension” tests—one general and one specific to climate change—can be used to measure individuals’ reasoning proficiency as collective-knowledge acquirers independently of their reasoning proficiency as cultural-identity protectors. Doing so reveals that there is in fact little disagreement among culturally diverse citizens on what science knows about climate change. The source of the climate-change controversy and like disputes over societal risks is the contamination of the science-communication environment with forms of cultural status competition that make it impossible for diverse citizens to express their reason as both collective-knowledge acquirers and cultural-identity protectors at the same time.

KEY WORDS: identity-protective cognition, science literacy, climate-science literacy, evolution
"How much risk do you believe global warming poses to human health, safety, or prosperity?"

![Graph showing risk perception by political ideology]

- Extremely high
- None at all

**N** = 1,898. Nationally representative sample, June 2013 (YouGov). Subjects “color coded” based on response to risk-perception outcome variable. X-axis reflects subject score on composite scale that aggregates responses to 7-point party identification item and 5-point “liberal-conservative” ideology item (α = 0.82).

**Kahan (2015) Advances in Political Psychology**
How much risk do you believe global warming poses to human health, safety, or prosperity?

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Kahan (2015) Advances in Political Psychology
Figure 16. Polarized and nonpolarized societal risks. $N \approx 1800$. 

Kahan (2015) Advances in Political Psychology
“Members of the public DO trust science. Members of culturally opposing groups distrust EACH OTHER when they perceive they are at risk.”

- Dan Kahan, Aug 2013
Risk Perception and Communication Unplugged: Twenty Years of Process

Baruch Fischhoff

Over the past twenty years, risk communication researchers and practitioners have learned lessons, often at considerable personal price. For the most part, the mistakes that they have made have been natural, even intelligent ones. As a result, the same pitfalls may tempt newcomers to the field. This essay offers a personal (even confessional) history of the field over this period, identifies a series of developmental stages. Progress through the stages involves consolidating skills needed to execute it and learning its limitations. Knowing about their existence might speed the learning process and alert one to how much there still is to learn.

KEY WORDS: Risk perception; risk communication; risk management; environment.

INTRODUCTION

Biology teaches us that “ontogeny recapitulates phylogeny.” That is, the development of the individual mimics the evolution of the species. For example, a human fetus acquires an increasingly differentiated cellular structure, as did the precursor species to homo sapiens.

Over the past 20 years or so, risk communication research has undergone its own evolution. At each stage, it has made progress toward acquiring some new skills, only to discover that there were additional, more complicated problems to solve. Every year (or, perhaps, every day), some new industry or institution discovers that it, too, has a risk problem. It can, if it wishes, repeat the learning process that its predecessors have undergone. Or, it can attempt to short-circuit that process, and start with its product, namely the best available approaches to risk communication.

One possible obstacle is being too isolated to realize that others have faced the same tasks. A second is being too headstrong to admit that help is needed. A third is not having a chance to observe others’ learning process. As a result, newcomers may be condemned to repeat it. Few risk communication researchers or practitioners can claim to have gotten it right the first time. If what they tried first made sense to them at the time, it may tempt others. Although the ensuing mistakes may be intelligent ones, they are still not been avoided. More than a generation, this may be one.
Table I. Developmental Stages in Risk Management (Ontogeny Recapitulates Phylogeny)

- All we have to do is get the numbers right
- All we have to do is tell them the numbers
- All we have to do is explain what we mean by the numbers
- All we have to do is show them that they’ve accepted similar risks in the past
- All we have to do is show them that it’s a good deal for them
- All we have to do is treat them nice
- All we have to do is make them partners
- All of the above

risk = OMG! x WTF!
credibility

competence + goodwill + trustworthiness
Gaining trust as well as respect in communicating to motivated audiences about science topics

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Edited by Baruch Fischhoff, Carnegie Mellon University, Pittsburgh, PA, and accepted by the Editorial Board April 3, 2014 (received for review October 31, 2013)

Expertise is a prerequisite for communicator credibility, entailing the knowledge and ability to be accurate. Trust also is essential to communicator credibility. Audiences view trustworthiness as the motivation to be truthful. Identifying whom to trust follows systematic principles. People decide quickly another's apparent intent: Who is friend or foe, on their side or not, or a competitor or competitor. Those seemingly on their side are deemed warm (friendly, trustworthy). People then decide whether the other is competent to enact those intents. Perception of scientists, like other social perceptions, involves inferring both their apparent intent (warmth) and capability (competence). To illustrate, we polled adults online about typical American jobs, rated as American society views them, on warmth and competence dimensions, as well as relevant emotions. Ambivalently perceived high-competence but low-warmth, “envied” professions included lawyers, chief executive officers, engineers, accountants, scientists, and researchers. Being seen as competent but cold might not seem problematic until one recalls that communicator credibility requires not just status and expertise but also trustworthiness (warmth). Other research indicates the risk from being enviable. Turning to a case study of scientific communication, another online sample of adults described public attitudes toward climate scientists specifically. Although distrust is low, the apparent motive to gain research money is distrusted. The literature on climate science communicators agrees that the public trusts impartiality, not persuasive agendas. Overall, communicator credibility needs to address both expertise and trustworthiness. Scientists have earned audiences’ respect, but not necessarily their trust. Discussing, teaching, and sharing information can earn trust to show scientists’ trustworthy intentions.

First, scientists may misunderstand the sources of lay beliefs: People are not idiots. The public’s issue with science is not necessarily ignorance. The public increasingly knows more about climate change’s causes. Psychology undergraduates at least can judge both science and nonscience arguments by the amount and reliability of their evidence. Different lay people hold different models of science, some more classical (seeking a single, true answer) versus others more Kuhnian (acknowledging multiple answers to negotiate and debate, accepting scientific uncertainty). Hence, potential divides between scientists and the public are not merely about sheer knowledge in any simple way.

The second, often-neglected factor is the other side of attitudes. Attitudes are evaluations that include both cognition (beliefs) and affect (feelings, emotions). Acting on attitudes involves both cognitive capacity and motivation. Attitudes show an intrinsic pressure for consistency between cognition and affect, so for most attitudes, both are relevant. When attitudes do tilt toward emphasizing either cognition or affect, persuasion is more effective when it matches the type of attitude. In the domain of climate change, for example, affect and values together motivate climate cognition. If public attitudes have two sides—beliefs and affect—what is their respective role in scientific communication?

Communicator Credibility

Science communicators try to persuade the public that they are honest brokers of scientific evidence, that is, that they are credible. In an attitudes research literature spanning decades, communicator credibility demonstrably has two components. Expertise is only one crucial prerequisite for communicator credibility. Perceived expertise entails the knowledge and ability to be accurate.
warmth: competence
Modified from Fiske et al (2006 - 2014)
“Research suggests that narrative communication is encoded using a unique cognitive pathway”

“Research suggests that narrative communication is encoded using a unique cognitive pathway.”

stories are:

• more interesting

“Research suggests that narrative communication is encoded using a unique cognitive pathway”

stories are:

• more interesting
• more understandable

“Research suggests that narrative communication is encoded using a unique cognitive pathway”

stories are:

• more interesting
• more understandable
• more believable

“Research suggests that narrative communication is encoded using a unique cognitive pathway.”

stories are:

- more interesting
- more understandable
- more believable
- more persuasive

THE SET-UP

Act 1

Act 2

Act 3
THE SET-UP

Act 1

Act 2

Act 3
Act 1

THE SET-UP

Act 2

CONFRONTATION

Act 3
Act 1: The Set-Up
Act 2: Confrontation
Act 3: Resolution
Communication Tools and Resources

Prepping for media coverage on a new paper? Getting ready to meet with a legislator? Wondering how to share insights from your science in a way that’s meaningful to a non-scientist? Here are a few of our go-to resources:

Escape from the Ivory Tower by Nancy Baron

This book will lead you through many of the foundational concepts and communication skills we cover in our trainings, from knowing your audience and articulating your ‘So What’ to understanding policy and media culture and an introduction to social media. Full of insight from scientists, policymakers, and journalists that we have worked with, as well as tried-and-true methods from Nancy and the COMPASS team, you’ll find that this frank, practical, and entertaining guide will help you up your communications game and make your science matter.

The Message Box

Our most fundamental tool no matter who you’re preparing to communicate with, this is a powerful way to distill what you know and why it matters for your particular audience. A short description is included in the download. It is also covered in Chapter 8 of Escape from the Ivory Tower. If you’re going to tackle one thing to hone your messages, do yourself a favor and work on your message box.
AND
BUT
THEREFORE
“The question is, does this system I’ve devised help us in the evaluation of literature? Perhaps a real masterpiece cannot be crucified on a cross of this design.”

- Kurt Vonnegut
Upcoming Shows

**BAD MEDICINE**
Brooklyn, NY
Tue, Sep 29th

**BAY AREA SCIENCE FESTIVAL**
San Francisco
Mon, Oct 26th
The Story Collider

David Moinina Sengeh: Whose Story Is It?

BAD MEDICINE
Brooklyn, NY
Tue, Sep 29th

BAY AREA SCIENCE FESTIVAL
San Francisco
Mon, Oct 26th
where to begin?
how to end?
how much science?
THE UNIVERSE IS NOT MADE OF ATOMS. IT'S MADE OF TINY STORIES.

This and countless similar iterations attributed to Muriel Rukeyser
Left

I am the left brain.
I am a scientist. A mathematician.
I love the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
Always in control. A master of words and language.
Realistic. I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

Right

I am the right brain.
I am creativity. A free spirit. I am passion.
Yearning. Sensuality. I am the sound of roaring laughter.
I am taste. The feeling of sand beneath bare feet.
I am movement. Vivid colors.
I am the urge to paint on an empty canvas.
I am everything I wanted to be.

R) Citron & Goldberg (2014) Metaphorical sentences are more emotionally engaging than their literal counterparts. *Journal of Cognitive Neuroscience*. 26, 2585-2595

2) Hasson et al. (2012) Brain-to-brain coupling: a mechanism for creating and sharing a social world. Trends in Cognitive Science. 16(2):114-121

2) Hasson et al. (2012) Brain-to-brain coupling: a mechanism for creating and sharing a social world. Trends in Cognitive Science. 16(2):114-121
to educate
1. to educate

2. to defend science
1 to educate
2 to defend science
3 to excite
1. to educate
2. to defend science
3. to excite
4. to build trust
1. to educate
2. to defend science
3. to excite
4. to build trust
5. to tailor messages
1. to educate
2. to defend science
3. to excite
4. to build trust
5. to tailor messages

Traditional goals
1. to educate
2. to defend science
3. to excite
4. to build trust
5. to tailor messages

Traditional goals

Strategic goals
2013 Scientist Survey: Goals

“How big a priority ... for your colleagues?”

Respondents believe they value all communication goals more than their colleagues; biggest discrepancy is associated with “trust”

<table>
<thead>
<tr>
<th>Goal</th>
<th>Own priorities</th>
<th>Colleagues' priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>defensive</td>
<td>5.96</td>
<td>5.72</td>
</tr>
<tr>
<td>knowledge</td>
<td>5.88</td>
<td>5.35</td>
</tr>
<tr>
<td>excite</td>
<td>5.59</td>
<td>5.18</td>
</tr>
<tr>
<td>trust</td>
<td>5</td>
<td>4.18</td>
</tr>
<tr>
<td>messaging</td>
<td>4.96</td>
<td>4.44</td>
</tr>
</tbody>
</table>

All questions had a range of 1-7 where 1 was the “lowest priority” and 7 was the “highest priority”

Dudo & Besley (2014) AEJMC
it’s your story
tell it well
STORIES ABOUT SCIENCE
HANDS-ON WORKSHOP

Carnegie Mellon January 2016
INTRODUCTIONS
AERIN JACOB: LESSONS FROM THE MAN WITH A MACHINE GUN

UPCOMING SHOWS

TAMPA
Feb 1, 2016

WASHINGTON
DC
Feb 10, 2016

BROOKLYN
Feb 16, 2016
AERIN JACOB: LESSONS FROM THE MAN WITH A MACHINE GUN

UPCOMING SHOWS

TAMPA
Feb 1, 2016

WASHINGTON
DC
Feb 10, 2016

BROOKLYN
Feb 16, 2016
finding stories
THEME
facts: feelings
pitching: feedback
write: refine
The story spine*

• Once upon a time... and every day...
• But, one day...
• Because of that...
• Because of that...
• Because of that...
• Until, finally...
• And, ever since then...

From Addams, *How to Improvise a Full-Length Play.*
(Don’t be scared by the title, that’s not what we’re doing here.)
perform: feedback
3
Story Checklist

• Starts and ends in action?
• Has clear stakes?
• Has a likable character?
• Has momentum?
• Clear Beginning, Middle, End?
• Evoked emotion?
START WHERE YOU ARE
USE WHAT YOU HAVE
DO WHAT YOU CAN

- ARTHUR ASHE