Linguistic Oddities: An Artist Explorer at Mathematics Conferences

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Abstract

An analysis of metaphorical and natural language in mathematics discourse from an artist's perspective, observed in conference lectures and explored in my ongoing studio practice, part of the infiltratemathematics.wordpress.com blog. Spatial and physical language allude to the conceptual spaces of mathematical thought, captured by notation with iconic and symbolic properties.

Introduction

The language developed to express mathematics has made it possible to talk about complex subjects in such a concise way as to allow new technologies and new modes of thought, but the layering of shorthand upon shorthand is what obfuscates the subject to the outsider. According to Peirce's theory of signs, much mathematical writing is dominated by symbols, which unlike the icon or index are given their significance by convention [1]. Knowledge of those conventions is a huge barrier to non-experts in engaging with the content and workings of mathematics. As an artist fascinated by the existence and content of mathematics I have been attending mathematics conferences, observing the metaphorical and natural language used between experts to explore their common field. Johnson describes the schemata that we use in this way as "primary means by which we construct or constitute order and are not mere passive receptacles into which experience is poured" [2]; metaphorical language cannot be considered entirely auxiliary to the thinking that it frames. I have been analysing live and recorded lectures, publishing my notes alongside photographs of responses in my studio practice on the blog infiltratemathematics.wordpress.com. Although the mathematics remains opaque to me, this allows me to respond to the cultural context of what I see rather than interpreting it completely according to the conventions of the discipline, as in Latour and Woolgar's study of scientific culture [3]. In this paper, I present observations and studio experiments responding to a lecture given by Andre Neves on Min-max theory and its applications [4], a summary of exploratory work borne of an outsider's sincere fascination with the discipline. All quotes are given verbatim for accuracy of linguistic analysis.

Thinking, Speaking and Writing

"I will explain how to find an infinite number of minimal hypersurface [sic] in a manifold, or that's the idea" [4]

This introductory sentence has the feeling of an instruction video. The math is already proved, if it's in a paper in the conference, but the last words admit the possibility of failure. The demonstration of "how to" is for the audience to create the mathematical meaning in their minds. The notation written on the blackboard is not always read out, for example a symbolic definition (M^{n+2}, y) is written before he says "compact Riemannian manifold". This may be because it is already known to the audience and is a given, or because it is a specification of which particular instances this applies to and is easier to write than to say. In the former case, this implies that some of the writing done in mathematics is a matter of rigour, included to ensure precision but extraneous to the immediate task of aiding understanding by specific people in a specific context; this piece of writing is for posterity. In the latter case, the fact that some technical definitions are more easily written than spoken attests to the importance given to writing over speaking, also showing an emphasis on recording for posterity.

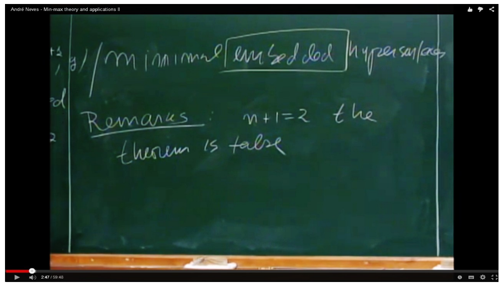

Figure 1. *Screenshot of the blackboard with "embedded" highlighted.*

"*Remarks. One is that if n plus one equals two, the theorem is false. And the reason is because of uh one word I forgot to write which is. Then there's an infinite number of minim- oh yeah I wrote it. OK. Then the reason is because of this word. [draws a square around 'embedded']*" [4]

He uses the written word as a metonym for the requirement in the theorem. Those scrawled letters, a thin layer of chalk on the surface of a blackboard, have no direct effect on the mathematics, but they are what he indicates with an accusatory box as the reason. In *Laboratory Life,* Latour and Woolgar describe the steps that transform a set of samples taken from lab rats into a smoothly-drawn curve that becomes the focus of scrutiny, "used in 'evidence' in part of an argument or in an article" [3]. Similarly, it seems, it is the scrawled writing that is talked about, used to refer to the mathematics that governed its production. Watching a lecture, I noticed a speaker beating the chalk out of a blackboard eraser, puffs of dust the only visible trace of who knows how many lectures guiding minds though strange, hypothetical territories.

Figure 2. "*From the Platonic Realm to the Floor Beneath the Blackboard"*

Metaphorical Language

"Franks and Bangert in 92 showed that every two-sphere admits an infinite number of closed geodesics. Of course, they're gonna be badly immersed and they're gonna have lots of self-intersection." [4]

Every two-sphere *admits* closed geodesics, allowing them in. "Admit" suggests a confession, a compromise, welcoming somebody into your house. The two-sphere, a definition defining a surface, now allows itself to be defined in a different way, as a thing that contains an infinite number of closed geodesics. The definition gives rise to a conceptual entity that then re-evaluates itself in the phrasing of its description. The word "immersed" suggests a smaller thing engulfed by a larger thing, like a person immersing themselves in a swimming pool.

The geodesics are described as “badly immersed”. What does 'good' and 'bad' mean with reference to mathematics, when to be admitted as such it must be correct? G. H. Hardy said that “a *mathematical proof should resemble a simple and clear-cut constellation, not a galaxy in the milky way”* [5]. Conversely, bad or ugly mathematics might be the less neat, the sprawling. This tallies with AI expert Juergen Schmidhuber's articulation of aesthetic experiences, which describes “*the subjectively most beautiful [as] the one with the simplest (shortest) description, given the observer's particular method for encoding and memorizing it*” [6]. Perhaps the geodesics are described as badly immersed because those self-intersections are somehow uncomfortable for the human mind.

“So we have I think yes two or three versions of this conjecture.[...] In the first problem he gave he states immerse and then later on he asks for just a number of minimal embedded surfaces. I think the reason he puts immersed here is because he knows that just on s2 with any metric the result is false.” [4]

This passage has a trace of archaeology to it; he is unpicking the intentions and thoughts of a predecessor using the incomplete information provided by their writing. The difference between “embedded” and “immersed” also comes to the fore. The presentation suggests that “embedded” is a more demanding term than “immersed” --- an immersed object is allowed to self-intersect. The distinction between these two words is interesting; dealing as we are with breadthless objects in multi-dimensional conceptual space, the terms cannot have their usual, physical meaning. The word “embedded” suggests a tight, solid fit, a piece of shrapnel embedded in an oak door. “Immersed” remains fluid, a casual, easy dip.

Figure 3. “*Immersion, Embedding”*

Imagined Journeys

“What I will explain now is how to find these minimal hypersurfaces. So in our theorem we are as far from hyperbolic as possible and usually in these type of problems there's a big difference between this hyperbolic world in which it's very rich in topology and so you find the geodesics are the minimal surface [...] or your manifold is a sphere in which case we have no topology at all.” [4]

At the beginning of this speech Neves focuses his sentences on the “I”, then later moving on to focus on “we”, alternating with “you”. The “I” refers to his activity as an explainer, identified with himself as an individual. The initial “we” refers to his work in collaboration on the paper, focusing then on the written/proven mathematics. There is a later instance, "*in which case we have no topology at all",* which seems more of a public "we", referring perhaps to the mathematics community. When he begins to use "you", the phrases are structured in a more how-to, action-based way. The emphasis then has shifted to an unknown second-person, who is attempting a number of things, whose results or strategies Neves predicts or advises according to his experience. He's done the work; this imaginary person must, then, be attempting to follow not in the writing of the mathematics, but the understanding and model-building within their own mind.

Brian Rotman describes the narratives implied by mathematical writing as combining the actions of the implied Subject, to whom the directions to consider, add, etc. are directed, the Agent, imagined to do impossible work such as calculating an infinite sum, and the Person, the reader of the text who constructs mathematical meaning in their mind. He identifies assertions in mathematics as using a language of prediction: "*In making an assertion the Subject is claiming to know what would happen if the sign activities detailed in the assertion were to be carried out*." [7]

Conclusion

Although I am an outsider to the field, careful analysis of the language used to frame the doing of mathematics opens up some surprising ideas. The location of that 'doing' and its relationship to speech and writing is far from straightforward. The language casually used by experts offers strong indications about their experience of doing mathematics, which is something that outsiders can only normally access through anecdotal reports. Recording responses in my artistic practice alongside written analyses makes it possible to explore unfamiliar ideas in playful ways, through verbal and non-verbal responses that reflect mathematics' multi-faceted nature. Although this interdisciplinary study is unconventional, it is the first step in a project aimed at fostering interaction across the borders of the discipline, in the hope of developing the public profile of mathematics and promoting access to fascinating modes of thought.

References

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