

## **Attending to emotion in a metaphor for success in physics with poetic analysis**

Brian Zamarripa Roman,

*Department of Physics, University of Central Florida, 4111 Libra Drive, Orlando, FL 32828*

Amy Vary Schwandes, and Jacquelyn J. Chini

*Department of Physics, University of Central Florida, 4111 Libra Drive, Orlando, FL 32828*

In previous work guided by Feminist Standpoint Theory, we explored woman participants' metaphorical expressions for success in physics. However, some participants pointed out to the researchers that the (re)presentation of their metaphors in scientific prose was lacking the intended emotional expression. In this study, a participant (A.V.S.) joined the research team to interpret her metaphor about blowing a dandelion. Following Colby & Bodily's (2018) poetic analysis, we apply Ricoeur's hermeneutic phenomenology in the interpretation process, which highlights the relationship between interpreters, the text and the metaphor author. Our poetic analysis also applies found poetry to (re)construct the transcript in ways that provide fresh insights and emphasizes the emotions embedded in the original expressions. This collaborative poetic analysis seeks to introduce qualitative methods to the physics education research community that tend to the emotional connotations of interview data and elevate participant perspectives with fidelity.

## I. INTRODUCTION

This current work builds on past work intended to expand conceptualizations of success in physics from a feminist standpoint via metaphor analysis [1,2]. We elicited metaphors of success in physics from women in physics, which captured aspects of success salient to the participants. The metaphors were interpreted with feedback from the participants; however, after translating the metaphors into scientific prose, there was a perceived lack of intended emotions. For example, a participant, Citlali (pseudonym), described: “[success in physics is like] the exhilaration of jumping out of an airplane.” In the original analysis, we interpreted this as “exhilaration that emerges from observing unprecedented results in a research project that you developed.” During member checking, Citlali stated:

I have read what you wrote several times. While it is technically accurate, it loses the flavor of excitement. Maybe that is necessary in trying to technically describe an emotion? I have tried to come up with better words, but not truly appreciating what the final product should look like, I have failed.

Citlali’s email highlighted the need to capture her intended emotions and led us to question our approach. We use Feminist Standpoint Theory (FST), our guiding theoretical framework, to center women in order to address the structural inequalities they experience [3]. However, if their intended emotions are not included in the scientific representations of their voices, then we fail the purpose of representing the world in relation to their interests [4]. Thus, not attending to emotions limits the knowledge which can arise from considering emotions in our epistemology [5,6].

This concern with being faithful to participants’ voices demanded us to seek novel methods of representing the participants’ intended meanings [7]. To capture the emotional essence of a participant’s metaphor, we follow the poetic inquiry of Colby and Bodily [8]. This consists of restructuring the transcript of a participant’s metaphor of a Dandelion into a poem, while interpreting it through the lens of Ricoeur’s hermeneutics to reach insights hidden in the contexts [8–10]. This study also serves as an example of how poetic inquiry can be used to explore qualitative data in PER.

## II. METHODOLOGY

### A. Guiding frameworks

In line with qualitative case studies in PER, we recognize that people’s interpretation of their own lived realities guides their actions and that knowledge is socially constructed [11]. These tenets of social constructivism lead us to seek a deeper understanding of a single participant’s perspective about success in physics [12,13]. Furthermore, FST centers the interaction of power in women’s lived realities by making claims that marginalized populations are positioned to have

more relevant insights regarding issues concerning them, and thus research should start from their perspectives [3,4]. Centering power also demands we find ways to mitigate power imbalances between researchers and participants. Thus, the lead researchers (BZR & JJC) worked closely with the second author (AVS), a participant, to address the high-inference nature of interpreting metaphors [14,15]. BZR and JJC recognize AVS as an author in this work since she was deeply involved throughout the analysis and writing. This has been done traditionally in participatory research and other DBER studies *with* participants [16–18].

In addition to concerns of misrepresenting expressed emotions, emotions are central to this study since they significantly influence the learning process. Psychology research has demonstrated emotions significantly affect task performance, engagement, and achievement [19–23]. Education studies have revealed emotions such as boredom, fear, anxiety, and anger negatively impact learning gains and engagement, while emotions such as joy, happiness, and excitement positively affect interest in courses [24–29]. Biology education researchers have also noted that women in introductory biology were more affected by negative academic emotions that could lead them to self-deprecating cycles [30]. Studies in PER have revealed links between emotions of control (e.g., frustration, calmness) to performance [31]; emotions towards physics topics to engagement [32]; stress to retention [33]; and emotions to shifts in reasoning [34,35]. These correlations between emotions and learning highlight the value of considering emotions in PER to better understand their effect on learning.

The PER studies mentioned above attempt to capture students’ emotive expressions by representing dialogue as transcripts with detailed notations of inflections and pauses as well as cartoon comics for visual aid [34–36]. We use poetic inquiry “to evoke emotional responses that bring the readers closer to the work, and to permit silenced voices/stories to be heard” (p. 230) [37]. More specifically, we use found poetry, which is the restructuring of texts into poems [38], to “stress moments of subjective feeling and emotion in a short space” (p. 6) [39]. Reconstructing transcripts into new forms also leads to thinking about data in new ways, leading to new insights [38]. To guide the analysis of the transcripts, we apply Ricoeur’s hermeneutics as done in Colby and Bodily’s poetic analysis [8].

Ricoeur’s [10] hermeneutics focus on a process of interpreting texts. Ricoeur recognizes text is “someone saying something to someone about something.” Since text becomes distanced from its intended meaning when an author is not present to explain, the distanced text (the something being said) is primarily understood in terms of the worlds of new interpreters. This naïve understanding demands consideration of the dialogue’s original contexts (who said something and to whom was it said) for a deeper understanding of the author’s intended meaning (the “about something”). Once this deeper meaning is attained, it can

then be inspected to reach deeper understandings of interpreters and their worlds influencing their interpretation, what Ricoeur calls appropriation [8,10,40,41]. The process of interpretation is central to analyzing metaphors, which often lack explicit explanation, and thus it is appropriate to implement Colby and Bodily's hermeneutic poetic analysis [8,10].

### B. Data collection

In the original study, eleven participants were recruited via email sent to the researchers' department to participate in a study regarding women's perspectives of success in physics. Metaphors were elicited during an hour-long semi-structured interview conducted by BZR with a prompt to complete the sentence "success in physics is like..." with a metaphor. Individual follow-up meetings were scheduled two months after the interview, where participants explained and coded their metaphors with BZR to develop initial interpretations, as detailed in past work [1].

For this proof-of-concept study, we focus on AVS's metaphor. BZR felt the first interpretation of AVS's metaphor lacked the emotions AVS had expressed during the interview. AVS had also expressed desire to contribute to the project and was available for a prolonged analysis. Unfortunately, Citlali (whose response was used in the introduction) was unavailable for co-analysis.

### C. Positionality

We recognize that power differentials exist between the main researchers (BZR and AVS) due to their backgrounds, such as BZR's status as a man doing research centered on women, which likely provides him privileges in academia.

BZR is a man who comes from a Mexican Puerto Rican background. His education background is in physics, and he is a graduate student who has been enrolled in school full time since the beginning of his education.

AVS is a white woman who received a degree in economics, taught high school chemistry for several years, then returned to college to pursue a degree in physics for her personal benefit. At the time of this study, AVS is teaching high school physics, while still being enrolled in physics courses. However, she is not pursuing a degree in physics.

### D. Methods

This poetic analysis, guided by Colby and Bodily's work [8], consists of three steps: (1) presenting the original text and explaining what is said in it; (2) reading behind the text, consisting of explicating the original context of what was said and reshaping the text to develop a deeper understanding; and (3) reading in front of the text, consisting of constructing a poem which captures the essence of the intended meaning, opening the text and poem to possible interpretations, and considering our worlds that led to our interpretations. For the analysis, BZR and AVS met for four

one-hour-long weekly meetings at AVS's home nearly a year after the initial interview. Distance from the initial dialogue and text is needed for interpretation, yet time may introduce memory bias. Since BZR and AVS are the closest people to the original context, their interpretations, however biased, remain relevant. Future analysis would be conducted within a year after interviews to distance the text and minimize bias. The meetings were recorded and transcribed to refer to the analysis.

## III. ANALYSIS

### A. (Re)presenting the transcript

The first step of the poetic analysis is to represent the original text and explain what is being said to achieve a surface understanding of the expression's content. This step is what was done in our initial interpretations of the metaphors and is what Tan et al [40] calls a "naïve understanding" since it does not consider the context that motivated the expression. The transcript follows typical punctuation agreed upon during the follow up meeting.

BZR: So success in physics is like...

AVS: Hm. Um. You know that plant? It's a weed. I think it's a dandelion. The one that grows in with a puff ball? And then you blow on it and make a wish? That's success in physics.

BZR: How so?

AVS: Um. Because it starts with just this little idea. And then it grows into these possibilities. And all you have to do is breathe and then they go into the universe. To be explored by other people. And that's success in physics.

The following explanation was developed after the initial follow-up meeting where AVS explained the metaphor:

Success in physics is developing ideas about the universe, discussing the ideas, and sharing those ideas to further be developed by the community and the general public.

This naïve understanding made explicit the content of the metaphor, which highlights the value of developing ideas about physics with other physicists; however, BZR and AVS noticed it minimized the emotions AVS had expressed. During the poetic analysis meeting we explored the reasons for the lack of emotions and realized that BZR felt a scientific demand to leave out the implied emotions. In the following subsection we proceed with the poetic analysis to expand the naïve understanding by reading *behind the text* and recognizing the context of the original expression.

### B. Reading behind the text

In this section we proceed to read *behind the text* [10] by making explicit the original contexts of who said the metaphor and to who it was said. BZR and AVS reviewed

the transcript and audio of the initial interview to make explicit the intentions of AVS and the cultural and sociological context of the dialogue. Afterwards they proceeded to discuss the meaning of the metaphor. This discussion was recorded and transcribed, then reviewed in a later meeting to ensure agreement. This discussion informed the analysis of the restructured transcripts.

AVS and BZR focused on the pauses and emphasized words in the original recording to explore the meaning behind them. Timing the pauses slowed down the analysis to elaborate on their purpose. This led to the following transcript with timed pauses, elevated volume in **bold**, and a higher pitch in italics:

BZR: So success in physics is like-

AVS: Hm. [3.744s] Um. [2.464s] You know that plant?

It's a weed. I think it's a dandelion. [.409s] The one that grows in with a puff ball? And then you blow on it and make a wish? [1.107s] **That's** success in physics.

BZR: How so?

AVS: Um. Because it starts with **just** [.235s] this **little** idea [.866s] and then [.534s] it **grows** into these **possibilities** [1.025s] and all you have to do is *breathe* and then they *go* [.781s] into the **universe** [.503s] to be **explored by other people**. [1.137s] And **that's** [.323s] *success in physics*.

The metaphor began with large pauses and AVS identifying the plant as a weed. AVS explains how there were many thoughts on her mind about classes, research, and her personal life, which made it hard to remember the name of the plant. She clarifies that the pause after “make a wish” was not to emphasize the wish, but to provide time for a response. AVS mentions it is important to minimize the importance of the “wish” because, as she explains, wishing is not real unless there is a plan.

AVS explains that the pauses leading to “possibilities” served as emphasis to the words and provided time to digest the emotions she wanted to elicit, reflecting her training as a teacher to provide processing time. The pause after “possibilities” served as a stopping point and a transition. Those emphases culminated at “breathe,” which was said with a strong softness as if AVS was releasing pressure.

The “breathe” was quickly followed by “then they go,” where “go” was the most vocally emphasized word of the metaphor. Attention was then drawn to “the universe,” which was followed by a reflective pause that then concluded with “to be explored by other people.” The final “success in physics” was then emphasized similar to the “breathe” expression.

The transcript is then reconstructed to emphasize the intended expressions and elaborate on their meaning. This consisted of removing the first portion of the dialogue that only served the purpose of identifying the plant and using the pauses as line breaks to slow down the reading:

Because it starts with **just**  
this **little** idea  
And then it **grows**  
into these **possibilities**.  
And all you have to do is *breathe*  
and then they *go*  
into the **Universe**  
To be **explored by other people**  
And **that's**  
*success in physics*

AVS explains that “just” and “little” served to emphasize that an idea does not have to begin as a grand idea. “Grows” was emphasized to reflect the process needed to make wishes happen, which coincides with mentions in the interview of her passion for sharing her ideas of quantum mechanics with physicists and conducting research as a plan to grow them.

AVS explains how “possibilities” was important in eliciting emotions of hope. At the time of the interview, she was in therapy to process overwhelming situations in her life. She was dealing with a professor who overly stressed the difficulty associated with studying physics and she was unmotivated by research since she felt her advisor was more interested in conversations about physical phenomenon than the social benefits of physics. This compelled AVS to share a “naïve hopefulness,” as she put it, to inspire others who are overwhelmed by negative messages to dream big.

AVS explains the “breathe” as the personal action that must be implemented to materialize the possibilities. “Go” was heavily emphasized to highlight the external, uncontrollable aspects of the process. This reflected the uncontrollability of others thinking about her ideas and hoping for positive results from computer analysis performed in her research at the time.

Her results and ideas would then be the seeds that go out to the emphasized “universe.” In this context, AVS wanted her ideas and results to go out into the field of physics. AVS had a desire to have her ideas not only get passed down to others, such as students, but passed up to other researchers to question and theorize on.

### C. Reading in front of the text

In this section we read *in front of the text* by focusing on the intended meaning of the metaphor and opening the text to the possible ways it could be interpreted by others [8,10]. To do so, the metaphor was decontextualized from physics and reconstructed by AVS into the found poem in Fig. 1. Then we explored how the meaning was appropriated by us.

In the poem, AVS highlights the meaning of the metaphor with formatted text positioned in intentional places. The poem begins with “just” at the top highlighting that an idea can start small, which is further emphasized by “little.” The line spacing before “grows” depicts the next step and is shifted left to signal the start of a process. It is met with “into these possibilities” shifted right to mark the next step. The “possibilities” is a bigger text to indicate the



Fig. 1. Found poem by AVS titled “Dandelion”

growth that is needed, which leads to “Breathe” after a line break. This “Breathe” is capitalized to indicate importance of the action and is a softer shade as a relaxation. After a large line break is “GO!” indicating the leap of faith that is necessary to let uncontrollable processes take their own course. AVS emphasized the importance of this with the large size and capitalization of the word. The “Universe” is then the destination of the ideas, followed by a large line break before “explored by other people,” depicting it as the ultimate goal.

Now we turn to exploring possible interpretations of the metaphor by a broader audience. We agreed that AVS’ metaphor can be applied in a myriad of contexts since ideas are developed in all aspects of life. This generalizability of her metaphor can serve as a source of hope for others looking to develop their ideas, regardless of context.

The next step in the analysis is to explore our appropriations of the metaphor meaning (i.e. the way we make the meaning our own) [10]. In exploring our appropriations of the meaning, we saw that the metaphor can be applied to the development of this project itself. AVS decided to no longer pursue a degree in physics because she recognized a misalignment with her personal values of service and a life without constant negative messaging. However, by discussing her idea of success in physics, BZR and AVS developed that idea and grew it into possibilities that manifested and turned into this paper and the associated poster. Together they have taken this idea of success and have put it out into the Universe of PER where it can be explored by other experts in the field. AVS has experienced success through this project and plans to continue as she is transitioning into becoming a physics education researcher. AVS has also become committed to looking for other communities devoted to service and is actively looking for a spiritual community with similar values as her own.

The reconstruction into a poem led BZR to a new insight when he thought the poem took up too much empty space for a four-page paper. BZR suggested to make the poem smaller; however, AVS quickly responded that the large spacing was intentional. As she explains, AVS needs space to breathe, to grow, and to express herself. AVS explicitly mentioned how meeting in her home allowed her the freedom to express herself comfortably. She also highlighted that she prefers to take up space on large tables while studying and tends to ask for extra scratch paper during tests to have more space for notes. Taking it a step further, AVS expressed her need for space to live a balanced life where she can hold on to her values, which is one of the reasons she chose to not continue pursuing a physics degree.

#### IV. DISCUSSION

This poetic analysis was inspired by a need to represent the emotions captured in AVS’ metaphor of success in physics as a Dandelion. The analysis allowed the researchers to reveal insights about what AVS initially meant to get across in her metaphor, why she chose not get a physics degree, and ways in which she is still successful in physics.

We found that AVS chose to portray a very positive perspective of success in physics to inspire students whose professors constantly emphasize the struggles in physics or whose advisors are less focused on the social benefits of physics. AVS wanted to do the work of highlighting the beauty of physics to inspire future physicists, however that should not be a student’s responsibility. As educators, we can and should be “making physics connect” [42] to the communal goals possible with a physics career, which has been demonstrated to facilitate interest in STEM [43].

Reconstructing the transcript into a poem also revealed the value of providing space to participants: providing space in time to answer and explain difficult questions [44], physical space by interviewing in spaces where they feel comfortable [45,46], space in writing to express themselves in their words [47], space to theorize on their own perspectives to support their agency [48,49], and space in authorship to give credit for their work [50]. Thus, poetic analysis can be valuable to researchers intending to analyze and represent emotional interview data in ways that lead to fresh insights and amplify marginalized voices.

The overarching study on success in physics could benefit from applying this analysis to all participant interviews. However, we recognize this demands additional effort from participants and the increased time lapse may introduce greater biases. Thus, future studies should be designed with poetic analysis in mind to prepare participants and minimize the time between interviews and analysis.

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