

MONSTERS, LOVERS AND FORMER FRIENDS: EXPLORING RELATIONSHIPS WITH MATHEMATICS VIA PERSONIFICATION

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Writing in this journal, Furinghetti (1993) proposed the following: “Mathematics is a discipline that enjoys a peculiar property: it may be loved or hated, understood or misunderstood, but everybody has some mental image of it” (p. 34). In this article, I introduce a novel method for exploring people’s images of mathematics, as well as an initial set of approaches for analyzing the resulting data. *Personification* is the attribution of human qualities to non-human entities (Inagaki & Hatano, 1987). The method of *eliciting personification*, which requires participants to attribute human qualities to non-human entities, takes advantage of a naturally occurring means through which (some) people discuss the nuanced emotional relationship they have with those entities. Eliciting personification is discussed here both as a method for examining pre-service teachers’ relationships with mathematics and as a method for getting this same population to reflect on how this relationship may affect students.

How the eliciting personification method emerged

Eliciting personification arose as a response to my dissatisfaction with research on people’s relationships with mathematics. This dissatisfaction was not centered on research results. Rather, my dissatisfaction centered on research methods. I was interested in understanding what mathematics looked like through the eyes of my students. Specifically, I wanted to be able to empathize with my students’ mathematical experiences. Mathematics education research seemed like a logical place to search for methods that would allow me to achieve this goal. However, the available research predominantly relies either on assessment instruments (*e.g.*, Likert scale surveys, concept mapping, responses to vignettes or videotapes, and linguistic analyses) or case studies (see Philipp, 2007). These methods did not produce results that allowed me to empathize with my students. I believe the method presented in this article, eliciting personification, comes closer to this goal. It is not proposed as a replacement for other methodologies; rather, it is seen as a complementary method.

It is important to mention that other non-standard methodologies, similar to personification, have been used to study young students’ relationships with mathematics. For exam-

ple, Picker and Berry (2000) asked 7th-grade students from five countries to draw a mathematician. Examining the images of mathematicians created by students yielded insights into the type(s) of person children believed became a mathematician and, in turn, revealed some of their own beliefs about mathematics. However, in terms of personification, Picker and Berry’s study examined students’ relationship with mathematics by asking them about the type of person that would choose to be friends with mathematics, instead of asking the students directly about their own relationship with mathematics. Elicited personification targets the relationship with mathematics more directly than draw-a-mathematician tasks by asking about participants’ own relationship with mathematics. The personification approach is also arguably more appropriate for use with adult research subjects than Picker and Berry’s approach.

As mentioned above, personification is the attribution of human qualities or traits to a non-human entity. Personifying is a naturally occurring human behavior (Hill, 1930; Inagaki, & Hatano, 1987; Piaget, 2007). It serves as a means of expressing complicated and/or vivid emotional relationships with non-human entities. For example, fishing-boat captains commonly personify their vessels by giving them names and attributing personalities and moods to them. In fact, several cultures consider it bad luck for captains not to engage with nautical vessels in this way.

In my personal discussions with colleagues regarding mathematics, statements such as “mathematics is a fickle mistress” are not uncommon. This personification of mathematics paints an image of the speaker’s relationship with mathematics that highlights the alternating frustrations and joys that are often associated with work on a difficult mathematics problem. The statement also suggests that the speaker’s prolonged attention to mathematics often interferes with familial responsibilities.

The personification of mathematics is not limited to those who have chosen careers closely tied to mathematics. Buerk (1982) studied a group of math-phobic adult women and examined how their relationship with mathematics changed in response to a series of mathematical interventions. Although, personification was not intentionally elicited in Buerk’s study, it emerged naturally as a means through

which her study's participants expressed their relationships with mathematics and how it had changed:

I feel like I have given birth to this new little creature, "math," and I have to take it home with me and where is it going to fit into my life now? [...] Need to know if I "let math into my life," what would I do with it? (I have an image of opening my screen door, and a short furry 2-legged creature trotting in. (p. 23)

In this excerpt, mathematics is treated as a flesh and blood creature, and the affordances of this treatment are used to communicate the speaker's relationship with mathematics.

Acquiring elicited personification data

Although personification occurs naturally, it is also possible to elicit personification directly. In order to explore their relationship with mathematics via personification, I gave 36 pre-service elementary and middle school teachers enrolled in a mathematics content course I was teaching the following prompt:

Your assignment is to personify Math. Write a paragraph about who Math is. This paragraph should address things such as: How long have you known each other? What does he/she/it look like? What does he/she/it act like? How has your relationship with Math changed over time? These questions are intended to help you get started. They should not constrain what you choose to write about.

Below is a character development paragraph from one of the participants. I use this excerpt as a launching point for discussing possible approaches to analyzing elicited personification data:

Mathonious was a very sensible young boy from Athens, Greece. Not many people liked him but at age 6 he became the best of friends with a young girl named Kukla. Every day they would hang out together and while Mathonious was a sensible young boy, Kukla began to notice that over the years he was becoming more and more complex. Kukla had noticed this and suggested that they see the oracle in order to find a solution. The oracle was known for simplifying and clarifying things for people in order to better their lives and though the oracle did great things, there were always consequences for those who do not listen to her advice. Mathonious met with the oracle and she told him that though he thought his complexity was a good thing it was confusing and hurting those closest to him; she warned him that if he did not revert to his more sensible simple self soon he would lose those closest to him and become a terrible beast; feared by many. He returned to Athens to tell Kukla his prophecy and when he did he was not very serious about it. In fact he did not seem to care about the oracles' [sic] advice or warning at all. Because he did not simplify himself to those around him the consequences of the prophecy came true and a horrid exiled beast he did become. He was indeed feared by many. The people feared him so much that they dehumanized him and called him MATH,

which stood for mental abuse to humans. Despite his awful new nature, Kukla wanted to try to understand him desperately so that maybe he could return to the boy he once was and they could be friends. However, every time she attempted he would cast her away.

The above paragraph describes the relationship between Kukla, the character the author attributes to herself, and Mathonious, which is a personification of mathematics. It paints a rich picture of the author's relationship with mathematics. However, since personification data is novel in mathematics education, there is no well-defined set of approaches for performing an analysis of a set of such elicited personification data.

Analyzing data using character summaries

The initial approach to analyzing personification discussed in this article is to use open coding (Strauss & Corbin, 1990) to summarize each participant's Math-character. The compilation of a list of all characters produced by a particular group then serves to summarize the types of relationships with mathematics present in that group. For example, in the above excerpt, the writer describes Mathonious in terms of two characters. The first character is a young boy that Kukla befriends. However, this relationship deteriorates and he becomes a former friend, with whom Kukla is trying to rekindle a friendship. The second character is a terrible beast, which is feared by many. Both of these characterizations, the terrible beast and the former friend, encapsulate the writer's relationship with mathematics in a concise way.

After the participants' assignments were sorted into similar character categories, three themes emerged from the scripts. The first and most common theme was that of a monster or other evil creature. The terrible beast from the excerpt was subsumed under this category along with other goblins and ghouls. This theme depicted mathematics as a cruel, unattractive and unforgiving entity that often took pleasure from the suffering of others. The second common theme was that of a former friend. Mathematics was described as someone with whom the pre-service teacher once had a healthy and sometimes even happy relationship, but at some point the relationship had soured. This theme also occasionally involved descriptions of repeated attempts on the part of the pre-service teacher to mend the relationship. The last type of character, which only occurred once, involved a lover who was loathed by friends, family and even strangers. The loving relationship with Math was therefore kept hidden. The lover character will likely resonate with readers who have encountered deleterious comments when discussing their profession. I discuss this lover excerpt in more detail later in the article.

I interpreted the Kukla excerpt as drawing upon both the monster and former friend themes. However, I sought a more detailed analysis of participants' relationship with mathematics than that which is afforded by identifying common character themes. I develop such an analysis below.

Personification as a conceptual blend

Conceptual blending involves taking the elements of two mental spaces and blending them together to form a new

space. It has been used to analyze a number of mathematics education related phenomena, including proof construction (Zandieh, Roh & Knapp, 2014) and the concept of infinity (Núñez, 2005). Conceptual blending is a crucial way in which people make sense of and communicate complicated and multi-faceted phenomena (Fauconnier & Turner, 2002). For example, in order to make sense of the statement, “My karma ran over my dogma,” one needs to blend a road-kill space in which a car runs over a dog and a theology space in which the words karma and dogma are defined. The resulting blend allows for the interpretation of the sentence’s meaning—my karma overcame my dogma.

Personification can be conceptualized as a kind of conceptual blend (Fauconnier & Turner, 2002). In the case of eliciting personification of mathematics, a mathematics space and a human relationship space are blended to form a space that allows for the communication of one’s complex emotional relationship with mathematics. The rich experiences and vocabulary associated with the human relationship space serve as a platform for discussing emotional relationships with mathematics. This relationship would otherwise be difficult to discuss with the same level of depth and detail since vocabulary and images associated with emotion are primarily housed in the human relationship space, not the mathematical space.

Analyzing elicited personification using conceptual blending

As mentioned earlier, the Kukla excerpt describes mathematics as both a best friend and a terrible beast. These two characterizations are quite different and coincide with different categories in the character summary analysis. So I use separate blending diagrams to describe each. First, the best friend: this characterization in the human relationship space maps to comfort with, and enjoyment of, mathematics in the mathematics space. A best friend characterization does not imbue the same level of passion for mathematics that a mistress or lover characterization would. However, it still portrays mathematics as something the author likes to spend time with. This personification of mathematics provides a level of detail in regard to how much the author enjoyed mathematics.

Some of the details about the best friend are also revealing. The best friend is sensible, this human trait can be assumed to map to understandability of mathematics, since a reasonable definition of sensible is “readily perceived”. Additionally, Mathonious is presented as male. This is in line with research that points to mathematics being perceived as a male dominated discipline (e.g., Keller, 2001; Picker & Berry, 2000). Lastly, there is a timeline of Kukla’s relationship with Mathonious. This timeline can be assumed to coincide with the timeline of the writer’s relationship with mathematics. The details of this blending analysis are summarized in Figure 1.

Let us pause to compare the writer’s best friend characterization to her hypothetical response to a Likert-scale item that asks for her level of agreement with the statement “Mathematics is enjoyable and stimulating to me”. This item is borrowed from Bessant’s (1995) factors influencing mathematics anxiety (FIMA) assessment. The excerpt’s author

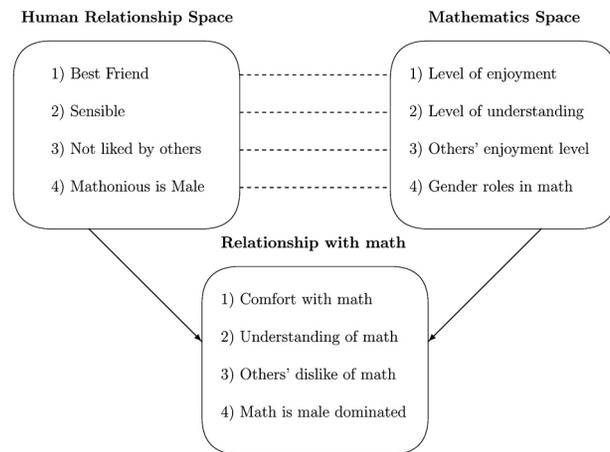


Figure 1. Best friend conceptual blending diagram.

might reasonably answer, “strongly agree,” given her best friend characterization. On the other hand, a mathematician who characterizes mathematics as a fickle mistress might reasonably answer “agree” to this statement. This is because the fickle mistress might be occasionally frustrating and hence not always enjoyable. Given our discussion of the Likert-scale item, “Mathematics is enjoyable and stimulating to me,” it might be reasonable for the mathematician to only answer “agree,” while the excerpt’s author might answer “strongly-agree” to the same question. This points to the Likert-scale question not capturing the tangible emotions involved. The fickle mistress captures a level of passion for the subject that is not imbued by the best friend character. The Likert-scale item does not capture this dimension. Certainly, eliciting personification is not a replacement for survey methods, but it does have particular advantages in terms of detailing emotional relationships.

Now, let us return to the elicited personification excerpt. The excerpt describes Mathonious getting progressively more complex and this complexity causing Kukla and Mathonious to grow apart. Complexity can be assumed to be a part of the mathematics space that stands in opposition to the previously mentioned sensibility from the best friend part of the human relationship space. Complexity, a mathematical trait, is not generally associated with emotions. However, describing this complexity in association with a personification of mathematics allows the excerpt’s author to describe the complexity as “confusing and hurting.” Complexity is described as the root cause of the deterioration of Kukla’s relationship with Mathonious.

Mathonious is now re-characterized as a terrible beast. This replaces the positive emotions associated with a best friend with the fear associated with a beast. This characterization, much like the best friend characterization that preceded it, provides a level of detail in regard to the emotions involved. The excerpt’s author could have chosen to describe simply growing apart, which would entail a level of apathy toward mathematics. However, she instead chose to use a terrible beast and draw upon the fear that this characterization entails.

Interestingly, the excerpt’s author describes repeated attempts to rekindle the friendship that can be mapped onto

attempts to understand mathematics. However, notice that Mathonious casts her away. So the blame for the poor relationship with mathematics is the fault of Mathonious, not Kukla. What this means in terms of the mathematics space, is that the excerpt’s author blames mathematics, an abstract entity, for her lack of understanding and enjoyment of the subject. A summary of this analysis can be found in Figure 2.

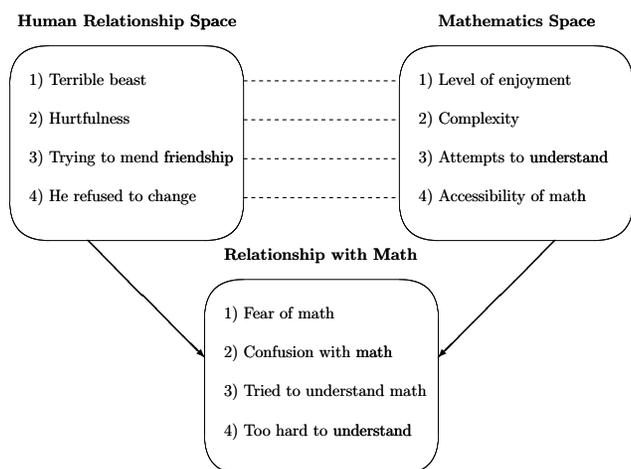


Figure 2. Terrible beast blending diagram.

The Kukla excerpt drew upon both the former friend and monster themes identified in the character summary analysis. For contrast, now consider the excerpt that drew upon the lover theme:

Mathius is the Greek god of math. We’ve known each other since I started school and I had always had a strong infatuation with him until I got into 7th grade when I came to love him. As with any love there is always some give and take. Whenever I would meet him and understand what was happening I would love him so much. But, when things would get too complicated and I couldn’t understand him anymore I would get frustrated, but I didn’t blame him. Even through tough times I still love him, it just takes more effort to keep that love going.

Because he is a Greek god he was made to be beautiful, but only to the people that choose to understand him and love him. He has the body of a Spartan from 300 and a face as handsome as Ryan Gosling’s. Others who come to hate him see him as more of an evil Greek god with ugly features. When people who hate him see him they see a hunchback, pot-belly, and the face of a chemical burn victim. Because others often see only these ugly features and not his beauty shining through, I often avoid telling others about my feelings for Mathius. Not everyone sees that he is kind and wise and those people judge my love for him.

The lover excerpt communicates a much more positive relationship with mathematics than the previously discussed Kukla excerpt. Much like the Kukla excerpt, the lover excerpt associates complexity from the mathematics space,

with rough patches in the author’s relationship with mathematics, in the mathematics space. However, unlike the Kukla excerpt, the author “doesn’t blame him,” and positive feelings for mathematics are maintained, albeit with a little more effort. In fact, she expresses that those that have similar relationships with mathematics “choose to enjoy and love him.” This implies that the author believes that those who do not have positive relationships with mathematics have chosen not to nurture their relationship with mathematics.

Physical appearance from the human relationship space plays an important role in the lover excerpt. It is associated with the level of enjoyment of mathematics from the mathematics space. The writer establishes a distinction with the handsomeness she sees—comparing Math’s face to a well-known heartthrob—and the unattractive being that others see. This contrast emphasizes that she is aware that others have very different relationships with mathematics than her own. At the end of the excerpt, she even states that she commonly hides her relationship with Mathematics from others that do not have similar relationships with mathematics. A summary of this analysis is shown in Figure 3.

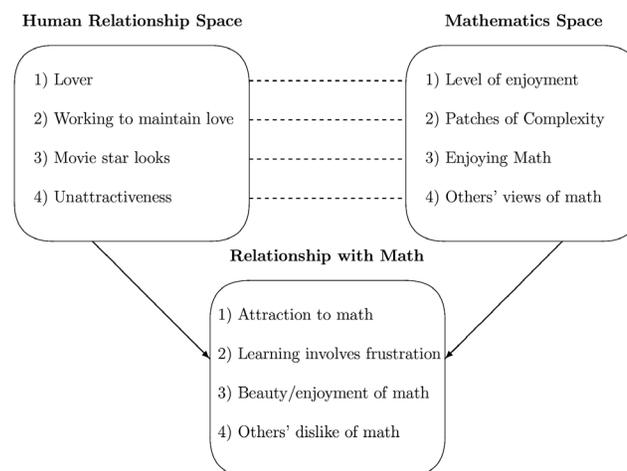


Figure 3. Lover blending diagram.

Empathizing with data

When reading both the discussed excerpts, it is natural to empathize with the authors. The experience of having a friendship turn sour in spite of repeated attempts to salvage it is common. Similarly, having a lover that others disapprove of is also a common human experience. Most people have either undergone these experiences first hand or been exposed to someone who has. By relating these experiences to their relationships with mathematics, the writers of these excerpts help the reader to understand the nature of their relationship with mathematics and how it evolved. In short, the data come closer to the original stated goal of allowing me to empathize with my students and come closer to understanding what mathematics looks like from their eyes.

Eliciting personification is an indirect way of examining someone’s relationship with mathematics. However, as illustrated by the above excerpts, it can paint a particularly vivid image of this relationship. The created image is certainly a

dramatized version of a participants' relationship with mathematics due to the nature of the personification task. However, I do not view this dramatization as a detriment. Rather, I view this dramatization as helping to distill the essence of the relationship in a way that can be more readily empathized with.

The subtleties of conceptual blending

It is important to stress that when using a conceptual blending lens, not all attributes of both spaces are incorporated into the blend. For example, friends, monsters and lovers have agency, in the sense that outside of the conceptual blend they may act independently of the author of the excerpt. However, this aspect of the human relationship space is ignored in the blend. The reason it is ignored is because the agency aspect of the personal relationship space is in direct conflict with the inanimate nature of mathematics. Consequently, there is no sensible way to incorporate it into the blend. So agency is ignored in the analysis. Similarly, the car's wheels and the dog's bark were ignored when using conceptual blending to make sense of the sentence, "My karma ran over my dogma."

It is certainly the case that the data are open to different interpretations. As an example of an interpretation issue, consider the Oracle within the Kukla story. The Oracle does not fit cleanly into the blending of the human relationship space and the mathematics space since it is not intrinsically part of either space. So its role is less clear. Since Kukla initiates the visit to the Oracle, the Oracle may be interpreted as an attempt to seek outside assistance with her relationship with mathematics. Thus, the Oracle may be interpreted as representing seeking outside help from a teacher or tutor. However, since it is Mathonious to whom the Oracle gives unheeded advice, the Oracle may instead be interpreted as an outside source that convinces the excerpt's author that mathematics may grow to be too complex and difficult to continue liking. A third interpretation is that the Oracle is simply a mechanism for externalizing blame for the deterioration of the relationship with mathematics. These interpretation issues are not unusual when analyzing qualitative data. Part of the advantage of using conceptual blending as a lens is that the specific parts of the data that a researcher uses to draw conclusions become salient to the reader via the conceptual blending diagram.

Using personification to facilitate pre-service teachers' reflections

I have outlined the utility of elicited personification as a research method, but it is also valuable as an instructional method. The data discussed here, as well as a long line of research on pre-service teacher's beliefs and affect, point to elementary and middle school teachers having poor relationships with mathematics (see Philipp, 2007, for a review). This finding is particularly alarming given the effect teachers' orientations toward mathematics may have on their pupils (Thompson, Philipp, Thompson & Boyd, 1994). Thus, it is important to engage with potential teachers regarding this issue in order to make them more conscious of how their relationship with mathematics may influence the types of relationships with mathematics their future students may form.

Discussing the whole class's character summaries served to situate the pre-service teachers' experiences relative to their classmates. This discussion set up a need for introspection regarding how their relationships with mathematics may influence their students. Elicited personification excerpts were then used to facilitate this introspection. The following prompt, which extended the original personification task, was used to elicit these reflections:

Your relationship with Math is about to change drastically. You will be transitioning from spending most of your time getting to know him/her to spending most of your time introducing him/her to your students and helping them get to know him/her better. Write a script of you talking with Math about introducing him/her to your future students. If you and Math do not get along how do you think you can introduce him/her to your future students in ways that don't lead them to having the same type of relationship that you've had? Do you believe that's possible? How does Math feel about it?

The following excerpt is a conversation between Kukla and Mathonious taken from the follow-up assignment.

Kukla: I've come to ask something of you. [sic]

Mathonious: What could you possibly want from me? I'm a monster remember?

Kukla: Well you know so much and the kids need your knowledge so they can better themselves. Will you help me please? If not for me for the children.

Mathonious: I'll help the kids but how will this work if we can barely stand each other?

Kukla: well I feel like we should act professional and be able to set aside our differences in order to best benefit the kids.

Notice that the excerpt serves to facilitate its author's introspection. She discusses a begrudging acceptance of mathematics; she believes she is capable of acting professionally for the benefit of her students. One can infer that although she does not believe her personal relationship with mathematics can be mended, the assignment facilitated her awareness of the issues her relationship with mathematics may cause and she believes herself capable of not catalyzing deleterious relationships with mathematics amongst her students.

This type of begrudging acceptance of mathematics for the sake of students was present in all of the scripts produced by participants that generated former friend and monster type characters. The single exception was the lone student who wrote about mathematics as a lover. She wrote, "I love Mathius even more than before. He has come to mean even more to me and I can't wait to try to share that love with my students once I finally get into a classroom."

The begrudging acceptance of mathematics for the benefit of students exemplified in the Kukla excerpt above helps highlight the type of relationship that many pre-service teachers have with mathematics. They do not hold mathematics

itself in high regard, but make an effort to “act professional” in order to conceal the nature of their relationship with mathematics from their students. However, mathematics education research has highlighted that teachers’ orientations toward mathematics fundamentally influence their teaching of the subject (Thompson *et al.*, 1994). The method presented here helps engage pre-service teachers in thinking about how their own relationship with mathematics might potentially influence their students. Further research is needed to examine whether engaging pre-service teachers in this way mitigates the effect their own relationship with mathematics has on their teaching and, by extension, their students.

Discussion

In this article, I have introduced eliciting personification, a method in which participants describe their relationship with mathematics by describing mathematics as if it were a person. Two personification excerpts from pre-service elementary school teachers were used to illustrate the lens into participants’ affect provided by the method and several approaches to analyzing the data were discussed. This approach included using character summaries for summarizing the data, and conceptual blending, which was used for deeper analysis. The use of these techniques helped to distill a rich image of two participants’ dispositions toward mathematics and how it had evolved over time. Conceptual blending and character summaries are by no means a complete list of analysis approaches, and I encourage other researchers interested in using the eliciting personification method in their studies to experiment with other approaches.

Personification is not a replacement for the case study or assessment instrument methodologies used in past studies. The eliciting personification approach does, however, offer a particularly vivid window into study participants’ relationships with mathematics. This window allows both those participating in the method and researchers a novel way of engaging with their dispositions toward mathematics. Elicit-

ing personification has potential both as a research method in exploring mathematical disposition and as a method for teacher education that facilitates teachers’ self-reflection about their relationship with mathematics.

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Actions, then, are called just and temperate when they are such as the just or the temperate man would do; but it is not the man who does these that is just and temperate, but the man who also does them as just and temperate men do them. It is well said, then, that it is by doing just acts that the just man is produced, and by doing temperate acts the temperate man; without doing these no one would have even a prospect of becoming good.

But most people do not do these, but take refuge in theory and think they are being philosophers and will become good in this way, behaving somewhat like patients who listen attentively to their doctors, but do none of the things they are ordered to do. As the latter will not be made well in body by such a course of treatment, the former will not be made well in soul by such a course of philosophy.

From Aristotle (c. 325 BC) *Nicomachean Ethics*, Book II (Ross, W. D., Trans.). Available from *The Internet Classics Archive* (<http://classics.mit.edu/index.html>).
