

Uncovering the structure of metaphorical lay theories of teaching II

What do different teaching metaphors imply about students?

Michelle Wong¹, Stephen J. Flusberg² and Bridgette Martin Hard¹

¹Duke University | ²SUNY Purchase College

Metaphor plays a critical role in how people communicate and conceptualize complex activities like teaching. For example, a professor might be described as *molding impressionable students* (TEACHER AS A SCULPTOR), or *helping students grow* (TEACHER AS A GARDENER). Prior research has largely focused on what metaphors like these communicate about the role of teachers, but many teaching metaphors simultaneously describe the role of students (e.g., STUDENTS AS CLAY; STUDENTS AS PLANTS). We aimed to extend previous work with a recently developed method for mapping the structure of metaphorical concepts to examine the metaphorical entailments associated with students, rather than teachers. We presented participants recruited online with one of four common metaphors for the teacher-student relationship and found that different metaphors consistently bring to mind distinct, coherent clusters of student attributes and different intuitions about teacher and student responsibility and power – a finding we replicated with a larger sample and pre-registered analysis. Together with previous findings, this research suggests that teaching metaphors can efficiently capture and communicate structured beliefs about both teacher and student attributes.

Keywords: metaphors, lay theories, concepts, teaching, students

1. Introduction

As the COVID-19 pandemic reshaped the educational landscape in 2020, journalist Patrick Watson (2020) published an essay urging college professors to think differently about their role in the classroom. He invoked various metaphors to

describe how teachers typically approach their role, including acting like *rock stars*, *tyrants*, and *cops*. He then introduced alternative metaphors for how teachers *should* think about their role, including: “You are a *coach*. They are the *team*. They play and you *watch*.”

This example demonstrates the utility of metaphor for expressing a set of organized beliefs about a complex subject – in this case, how college instructors should conceive of their job. Metaphors play a critical role in such communications because they enable speakers to tap common knowledge of a familiar source domain (e.g., coaching a sport) to efficiently convey nuanced views about a complex or abstract target domain (e.g., college teaching) (Hard, Liang, Wong, & Flusberg, 2021; Lakoff & Johnson, 1980; Thibodeau, Crow, & Flusberg, 2017; Thibodeau, Matlock, & Flusberg, 2019). In other words, metaphors help make complex concepts more comprehensible by highlighting key similarities between a source domain and the target of conversation.

Research in cognitive linguistics has shown that metaphors are not rare, poetic additions to otherwise literal speech; rather, natural language is *saturated* with metaphorical expressions (Gibbs, 1994; Lakoff & Johnson, 1980). Consider the way that English-speakers talk about educational activities, such as learning, reasoning, and debating ideas – drawing on metaphors like IDEAS ARE FOOD, THEORIES ARE BUILDINGS, and ARGUMENTS ARE WAR. For example, if students have an *appetite* for learning, a complex lecture might provide *food* for thought, but if the core ideas seem *half-baked*, the lesson could be difficult to *digest*. As students *build a foundation* of knowledge, they learn to *attack the weak points* in an argument, *shoot down off-target* criticisms, and *defend* their views using logic and reason.

Researchers have argued that metaphors like these not only aid in communicating complex ideas, but also reflect and shape how people think about the world around them (Gibbs, 1994; Lakoff & Johnson, 1980; Thibodeau, Matlock, & Flusberg, 2019). For example, one study found that the metaphor people endorsed for describing the role of police officers (POLICE AS GUARDIANS VS. POLICE AS WARRIORS) reliably predicted their attitudes towards law enforcement (GUARDIANS = more positive, WARRIORS = more negative) (Thibodeau, Crow, & Flusberg, 2017). That same study found that these metaphors shifted attitudes towards law enforcement in a metaphor-congruent fashion: Participants who read that police officers are *guardians* of a community subsequently expressed more positive attitude towards law enforcement than those who read that police officers are *warriors* of a community. Similar findings have been observed for a variety of other issues and topics, such as crime (Thibodeau & Boroditsky, 2011), the economy (Perkins, Toskos-Dils, & Flusberg, 2021), and climate change (Flusberg, Matlock, & Thibodeau, 2017). This work is broadly consistent with Lakoff and Johnson’s Conceptual Metaphor Theory, which claims that “our ordinary conceptual sys-

tem, in terms of which we both think and act, is fundamentally metaphorical in nature” (Lakoff & Johnson, 1980, p.3). On this view, metaphors play a critical role in cognition rather than serving as mere linguistic ornamentation (for a recent review of the literature on metaphor in language and thought, see Thibodeau, Matlock, & Flusberg, 2019).

In the domain of education, Watson (2020) is not alone in promoting metaphors to capture and communicate the intuitive beliefs or ‘lay theories’ that instructors hold about teaching (e.g., Chen, 2003; Hard et al., 2021; Low, 2015; Martínez, Sauleda, & Huber, 2001; Saban, Kocbeker, & Saban, 2007; Seferoğlu, Korkmazgil, & Ölçü, 2009; Shaw, Barry, & Mahlios, 2008; Tobin, 1990). For instance, Chen (2003) provided a classification scheme for identifying dominant teaching metaphors, isolating five distinct metaphorical orientations that each emphasize different aspects of teaching: TEACHING IS ART, BUSINESS, SCIENCE, POWER, and PERSONAL DYNAMICS. Art-oriented metaphors, for example (e.g., TEACHING IS SCULPTING, TEACHING IS PAINTING), emphasize more creative elements of teaching, while business-oriented metaphors (e.g., TEACHING IS MARKETING, TEACHING IS ADVERTISING) emphasize knowledge as a commodity that instructors deliver to their students. Chen noted that no single metaphor can capture the full complexity of teaching and that teachers may adopt different metaphors at different times. However, he recommended teachers to identify the dominant metaphors they endorse to gain insight into implicit beliefs guiding their teaching practice.

One possible limitation in work on metaphorical lay theories and metaphors for teaching specifically is that it often relies on researcher intuitions for identifying the conceptual *entailments* of different metaphors – the associated concepts, traits, or inferences licensed by the metaphorical comparison (but see Low, 2015; Hard et al., 2021; Thibodeau & Boroditsky, 2011, 2013). This intuitive approach has benefits of being fast, cheap, and easy, and has proven remarkably productive and influential in the literature on metaphor and thought (e.g., Kövecses, 2005; Lakoff and Johnson, 1980). Despite the utility of this approach for illuminating the variety of teaching metaphors, however, scholars have cautioned that relying exclusively on metaphorical patterns in language and intuitions to draw inferences about underlying beliefs or conceptual representations can lead researchers astray (e.g., Casasanto, 2008; Keysar & Bly, 1995; Murphy, 1996). For example, Keysar and Bly (1995) showed that intuitions about the original meaning of certain metaphorical expressions (e.g., “the goose hangs high”) may be inaccurate, shaped by knowledge of the conventional meaning of the idiom. A related set of experiments designed to test the cognitive representations underlying the SIMILARITY IS CLOSENESS metaphor (e.g., “our political views couldn’t be *farther apart*”) led Casasanto (2008, p.1047) to conclude that “linguistic metaphors

should be treated as a source of *hypotheses* about the structure of abstract concepts” (emphasis in original text) – but that such hypotheses should also be tested and confirmed (or disconfirmed) experimentally. In this way, quantitative methods may offer an important complement to more traditional qualitative metaphorical analyses.

1.1 Metaphors for teaching: Popular metaphors and their entailments

A recent set of studies aimed to develop a novel quantitative approach to confirm and extend existing qualitative analyses of different teaching metaphors. The approach involved first identifying the most popular metaphors that students endorse for the teacher-student relationship (Hard et al., 2021). A sample of current and recent college students evaluated six different metaphors for the student-teacher relationship that were derived from the teacher education literature (e.g., Shaw et al., 2008; Martínez et al., 2001; Saban et al., 2007; Seferoğlu et al., 2009). Of these six metaphors, the four most popular were:

1. GARDENER/PLANTS: “A teacher is like a gardener and students are like plants”
2. COACH/ATHLETES: “A teacher is like a coach and students are like athletes”
3. TOUR GUIDE/TOURISTS: “A teacher is like a tour guide and students are like tourists”
4. SCULPTOR/CLAY: “A teacher is like a sculptor and students are like clay”

Hard et al. (2021) then developed a systematic method for mapping the entailments of each metaphor, inspired in part by traditional psychometric methods that have been used to uncover the dimensional structure of personality traits and other psychological constructs. Although there are many possible entailments for different teaching metaphors (e.g., for what materials teachers use or how a classroom is organized), the authors focused on whether each of the four most popular metaphors reliably bring to mind specific clusters of teacher attributes and behaviors. Current and recent college students were recruited from an online sample and randomly assigned to consider one of the four popular metaphors and then rated how well each of the different college teacher attributes (e.g., “teachers are sensitive to their students’ needs”) fit that specific metaphor.

Next, the authors used an iterative exploratory factor analysis to identify the latent variables underlying the 44 teacher attributes and examine whether these differed across the metaphors. This method reduced the total set of unique attributes down to 20 and extracted five factors comprising four attributes each. These factors can be thought of as teacher ‘personality traits’, describing teachers along the dimensions of *nurturer*, *authority figure*, *community-builder*, *engaging communicator*, and *stimulator*. Further analyses revealed that these factors were

differentially associated with the different teaching metaphors; for example, the GARDENER/PLANTS metaphor was more strongly associated with nurturing attributes than were other metaphors. The metaphors were also associated with different beliefs about teacher responsibility and power to influence students' learning and development. For example, the GARDENER/PLANTS metaphor placed responsibility for student learning squarely on the teacher and suggested that teachers have much power to influence student learning and development. A follow-up study replicated this basic pattern of results using participant ratings on the reduced set of 20 attributes derived from the initial analysis.

Taken together, this research demonstrates that people endorse a variety of metaphors for the teacher-student relationship, that these metaphors bring to mind distinct clusters of teacher attributes across different metaphors, and that conceptually coherent metaphorical entailments can be identified and isolated in a principled manner. The results of this quantitative analysis largely converge with earlier qualitative analyses of such teaching metaphors, underscoring the complementary nature of these approaches while strengthening our confidence in the generalizability of these findings.

1.2 What about students?

Much of the research on teaching metaphors has focused, quite understandably, on the role of teachers – asking, for example, what different teaching metaphors entail for how teachers should behave in the classroom. This is the case in work aimed at the beliefs of teachers themselves (e.g., Chen, 2003; Tobin, 1990; Seferoğlu et al., 2009) and in work aimed at the beliefs students hold about teachers (e.g., Hard et al., 2021). But as the studies by Hard et al. (2021) demonstrate, every metaphor that describes the role of a teacher simultaneously describes the role of a student as well. As Watson (2020) urged in his essay to college professors teaching in the time of COVID-19: “You are a coach. *They are the team. They play* and you watch” (emphasis added). It thus remains an open question whether people draw reliable inferences about *student* attributes when processing specific metaphors for the teacher-student relationship.

1.3 The present studies

In the present set of studies, we aimed to address this gap in the literature and focus on metaphorical entailments associated with college students, rather than teachers. In two online studies, we sought to answer a primary question: How are different metaphors for teaching reliably associated with different clusters of *student* attributes? We also sought to answer several secondary questions focused on

replicating prior findings by Hard et al. (2021): Are different metaphors associated with different inferences about responsibility and power? Which metaphors for the student-teacher relationship are the most popular?

We focused on the same four metaphors for the teacher-student relationship identified by Hard et al. (2021) as relatively common and apt among current and former college students. In previous work, these metaphors were presented by highlighting the teacher first, followed by the student (e.g., “A teacher is like a sculptor, and students are like clay”). In the present studies, we reversed this order to focus participants on the students’ role within the metaphor (e.g., “Students are like clay, and a teacher is like a sculptor”).

In Study 1, participants were randomly assigned a metaphor and asked to rate the degree of fit between the metaphor and a set of attributes, this time describing students rather than teachers. Participants were also asked to rate, for the assigned metaphor, how much power students and teachers had for learning, and how much power teachers had to influence student learning and development. We aimed to identify: (1) the conceptual entailments or “traits” of being a student that are associated with each of the four metaphors, (2) any differences in perceptions of student/teacher responsibility and (3) teacher power across the metaphors, and (4) the relative popularity of the different metaphors. In Study 2, we replicated our findings with a new, larger sample and a preregistered analysis. Across both studies, we paint a picture of what each teaching metaphor implies about a typical college student.

2. Study 1: What are the student entailments of different metaphors for the teacher-student relationship?

The primary goal of this initial study was to identify whether the four popular, apt metaphors for the student-college teacher relationship studied in previous work (Hard et al., 2021) are associated with different student, rather than teacher attributes. The secondary goals were to replicate prior findings that metaphors for the student-teacher relationship generate different intuitions about teacher responsibility and influence and collect descriptive data on metaphor popularity. All measures used in the study, as well as relevant data and analyses are available through the Open Science Framework (OSF).¹

1. See here: https://osf.io/dj85x/?view_only=2dfc8cf050ea4eb8a627ec12ccdae8be

2.1 Methods

2.1.1 Participants

We recruited 220 participants to complete a survey through Amazon's Mechanical Turk (MTurk), a popular online crowdsourcing forum that offers users payment or Amazon credit to complete tasks, including psychological research studies (Buhrmester, Kwang, & Gosling, 2011). The study was administered using the online research platform CloudResearch,² which provides services to identify and recruit high-quality participants (Litman, Robinson, & Abberbock, 2017). We required that participants be a current or former college student living in the U.S. or Canada, with an approval rating greater than 95% on at least 100 prior MTurk tasks (known as Human Intelligence Tasks, or HITs). We excluded data from one participant who appeared to provide duplicated (copy and paste) responses to the free response items (i.e., their response included random symbols indicative of such behavior), and another who reported no college experience. Demographic characteristics for the 218 participants included in the final data set are shown in Table 1.

2.1.2 Measures and procedure

Participants were randomly assigned to view one of four metaphors for the student-teacher relationship:

1. "Students are like *plants*, and a teacher is like a *gardener*" (PLANTS/GARDENER)
2. Students are like *athletes*, and a teacher is like a *coach*" (ATHLETES/COACH)
3. "Students are like *tourists*, and a teacher is like a *tour guide*" (TOURISTS/TOUR GUIDE)
4. "Students are like *clay*, and a teacher is like a *sculptor*" (CLAY/SCULPTOR)

Participants were first asked to reflect on what their assigned metaphor means and to describe how it might be true; for example, how a student can be like "clay," and a teacher like a "sculptor." Participants then viewed a list of 44 statements describing student attributes or behaviors (e.g., "Students ask questions in order to learn") and were asked to rate how well each item fit the metaphor that they were given on a scale of 1 ("not well at all") to 7 ("extremely well"). The statements reflecting student attributes were generated by reviewing thematic analyses of free response data from the online supplement to Hard et al. (2021) and from the personal experience of the researchers. Participants were asked to rate how

2. See here: www.cloudresearch.com

Table 1. Demographic characteristics of participants in Studies 1 and 2

	Study 1 (<i>N</i> =218)	Study 2 (<i>N</i> =299)
Gender – Male	48%	48%
Race/Ethnicity		
White	76%	59%
Black	7%	10%
American Indian/Alaskan Native	0%	0.7%
Asian	8%	15%
Native Hawaiian or Pacific Islander	0%	0%
Hispanic/Latino	4%	7%
Other	1%	0.3%
Multiracial	4%	8%
College Status		
Graduated college	75%	52%
Currently enrolled	11%	36%
Attended college at one point but were not currently enrolled	14%	11%
Mean Age (SD)	37.2 (11.4)	24.3 (3.2)
Age Range	18–81	18–30

well each item fit their assigned metaphor, rather than whether they personally believed each item was true.

Next, participants answered four questions about how much responsibility college teachers have for students' learning, responsibility students have for their own learning, power college teachers have to influence what students learn, and power college teachers each have to influence how students develop as people. Participants rated these four items, each on a scale of 0–100, with 0 meaning “none at all” and 100 meaning “a great deal.” Although not a primary goal of the present study, we also collected participants' ratings of their favorite of the four metaphors, to check for consistency with prior findings by Hard et al., (2021). Participants viewed all four of the metaphors simultaneously, selected the metaphor that best fit their personal view of college teaching, and completed a basic demographics survey.

2.2 Results

2.2.1 How do student characteristics vary across metaphors?

First, adopting the approach of Hard et al. (2021), we performed an exploratory factor analysis on the 44 student attribute statements to identify the latent variables underlying the attributes that comprise the core student entailments. We performed an initial principal axes factor analysis (oblimin rotation) in SPSS. Based on the eigenvalues, a 6-factor solution provided the best fit for the data. The eigenvalues for the first six factors were: 18.51, 5.09, 2.14, 1.75, 1.59, 1.07, with the seventh being .89.

Though the intent of the factor analysis was to reduce numerous individual statements into a small set of core, comprehensible dimensions, the first factor appeared to group items based on not one, but *two* seemingly distinct traits to describe students: being *social* (e.g., “students help their classmates learn”) and being *self-disciplined* (e.g., “students keep track of the course schedule”). The combination of themes in this first factor was likely driven by the inclusion of the *ATHLETES/COACH* metaphor, which rated highly on items with both *social* and *self-disciplined* attributes. However, these traits are unrelated on their face, making the factor analysis results difficult to interpret or use to draw inferences. Thus, we used the factor analysis as a starting point for generating composite traits with a more coherent conceptual organization. We grouped collections of items that appeared to have a clear conceptual relationship and examined their reliability, with the goal of selecting an equal number of items (six) for each trait. The six traits were:

1. *social* (e.g., “Students study with their classmates”)
2. *driven* (e.g., “Students work hard”)
3. *self-disciplined* (e.g., “Students keep track of the course schedule”)
4. *open* (e.g., “Students are receptive to new ideas”)
5. *engaging with the teacher* (e.g., “Students ask the teacher for help”)
6. *developing* (e.g., “Students believe that learning is a work-in-progress”)

A complete list of items associated with each composite trait is provided in Table 2. Cronbach’s alpha values were $> .8$ for each of the six composite traits. The eight items that were not included either did not have a clear conceptual relationship with the six composite traits or reduced Cronbach’s alpha when included in the calculation.

Table 2. List of six composite traits and respective Cronbach's alpha values

Composite trait	Items	Cronbach's alpha (Study 1)	Cronbach's alpha (Study 2)
Social	Students help their classmates learn Students value their classmates' contributions in class Students rely on classmates for support Students are motivated by their peers Students study with their classmates Students compete against other students	0.938	0.942
Driven	Students set clear goals Students are driven to succeed Students actively participate Students work hard Students expect to be challenged Students believe in themselves	0.915	0.917
Self-Disciplined	Students study for multiple days before an exam Students study by quizzing themselves Students keep track of the course schedule Students study on their own Students believe in making changes to their study habits over time Students take careful notes in class	0.909	0.909
Open	Students are receptive to new ideas Students use the resources around them to learn Students apply what they learn to their own lives Students adapt their study strategies Students make careful observations Students are curious	0.830	0.832
Engaging with the Teacher	Students respect the authority of the teacher Students listen carefully to the teacher Students are open to the teacher's feedback Students ask the teacher for help Students engage in discussions with the teacher outside of class	0.826	0.843

Table 2. (continued)

Composite trait	Items	Cronbach's alpha (Study 1)	Cronbach's alpha (Study 2)
Developing	Students are motivated by their teacher	0.799	0.843
	Students have individual needs		
	Students are sometimes vulnerable		
	Students develop resilience		
	Students learn at their own pace		
	Students learn through their mistakes		
	Students believe that learning is a work-in-progress		

We next explored whether these composite traits varied across the metaphors. For each participant, we first calculated an average across the ratings that comprised each of the six composite traits. Next, we conducted a multivariate ANOVA across the six composite traits with metaphor (CLAY/SCULPTOR, GARDENER/PLANTS, ATHLETES/COACH, TOURISTS/TOUR GUIDE) as a between-subjects variable. Overall, metaphor condition significantly affected ratings of the composite traits, $F(18, 633) = 6.93, p < .001, \eta^2 = .165$.

Follow-up univariate analyses of variance revealed significant effects of metaphor condition on each of the individual composite traits: *social* ($F(3, 214) = 15.57, p < .001, \eta_p^2 = .18$), *driven* ($F(3, 214) = 17.00, p < .001, \eta_p^2 = .19$), *self-disciplined* ($F(3, 214) = 10.55, p < 0.001, \eta_p^2 = .13$), *open* ($F(3, 214) = 4.52, p = .004, \eta_p^2 = .06$), *engaging with teacher* ($F(3, 214) = 2.78, p = .042, \eta_p^2 = .04$), and *developing* ($F(3, 214) = 3.87, p = .010, \eta_p^2 = .05$).

We then conducted pairwise comparisons across the metaphor conditions using a Bonferroni adjustment for each of the composite traits. Figure 1 shows the pattern of differences across the metaphors for each composite trait, and Table 3 provides descriptive statistics. The ATHLETES/COACH metaphor promoted higher ratings of students as *social*, *driven*, and *self-disciplined* compared to the other three metaphors, but those three were not different from each other. The ATHLETES/COACH and TOURISTS/TOUR GUIDE metaphors promoted higher ratings of students' *openness* than did the PLANTS/GARDENER metaphor and the CLAY/SCULPTOR metaphor, but did not differ from each other. The PLANTS/GARDENER metaphor had marginally lower ratings of student *engagement with the teacher* than the other three metaphors did, which did not differ from each other. The ATHLETES/COACH metaphor entailed that students are developing more than the TOURISTS/TOUR GUIDE, but not the PLANTS/GARDENER and the CLAY/SCULPTOR metaphors.

Table 3. Means and standard deviations across the six composite traits. Pairwise comparisons across the metaphor conditions (using a Bonferroni adjustment) were conducted. Superscript letters next to the means indicate conditions for which differences were statistically significant ($p < .05$)

Assigned condition		Means for composite traits (SD)					
		Study	Social	Driven	Self- Disciplined	Resourceful	Engaging with the teacher
ATHLETES/ COACH (A)	Study 1	4.80 ^o PTC (1.30)	5.66 ^o PTC (1.15)	4.73 PTC (0.871)	5.07 ^P (1.12)	5.67 (0.964)	5.06 ^T (0.913)
	Study 2	5.04 ^o PTC (1.28)	5.71 ^o PTC (1.10)	4.78 ^{PTC} (1.31)	5.03 ^P (1.14)	5.82 PTC (0.97)	5.19 ^{TC} (1.13)
PLANTS/ GARDENER (P)	Study 1	2.89 ^A (1.55)	3.86 ^A (1.59)	3.15 ^A (1.31)	4.39 ^{AT} (1.36)	5.21 (0.935)	4.68 (1.46)
	Study 2	3.42 ^A (1.67)	4.15 ^A (1.65)	3.51 ^A (1.72)	4.48 ^A (1.54)	5.33 ^A (1.16)	4.76 ^T (1.25)
TOURISTS/ TOUR GUIDE (T)	Study 1	3.57 ^A (1.57)	4.35 ^A (1.59)	3.67 ^A (0.886)	5.20 ^P (1.16)	5.65 (1.38)	4.33 (1.42)
	Study 2	3.47 ^A (1.71)	4.04 ^A (1.45)	3.60 ^A (1.62)	4.99 (1.02)	5.28 ^A (1.03)	4.01 ^{AP} (1.55)
CLAY/ SCULPTOR (C)	Study 1	3.28 ^A (1.60)	4.27 ^A (1.54)	3.64 ^A (0.931)	4.86 (1.29)	5.70 (1.43)	4.45 ^A (1.56)
	Study 2	3.47 ^A (1.66)	4.1 ^A (1.34)	3.76 ^A (1.38)	4.58 (1.30)	5.34 ^A (1.05)	4.50 ^A (1.25)

2.2.2 Are different metaphors associated with different intuitions about responsibility?

Replicating the findings in Hard et al. (2021), metaphor had a reliable effect on ratings of how much *responsibility* college teachers have for students learning, $F(3, 214) = 9.58$, $p < .001$, $\eta^2 = .12$, as shown in Figure 2. We conducted pairwise comparisons across the metaphor conditions using a Bonferroni adjustment, which revealed that the ATHLETES/COACH metaphor significantly differed from the other metaphors, in that teachers were viewed as *less* responsible for student learning than they were for other metaphors. The CLAY/SCULPTOR metaphor promoted the highest rating of teacher responsibility, but it did not differ significantly from the GARDENER/PLANTS and TOURISTS/TOUR GUIDE metaphors.

Metaphor also had an effect on ratings of how much responsibility *students* said they had for their own learning, $F(3, 214) = 13.95$, $p < .001$, $\eta^2 = .16$. Pairwise comparisons indicated that the ATHLETES/COACH metaphor had the highest ratings for student responsibility, significantly more than the PLANTS/GARDENER, CLAY/SCULPTOR, and TOURISTS/TOUR GUIDE metaphors. The CLAY/SCULPTOR and TOURISTS/TOUR GUIDE metaphors were also significantly different from one another. The CLAY/SCULPTOR and PLANTS/GARDENER metaphors had the lowest ratings, but they were not different from one another.

2.2.3 Are different metaphors associated with different intuitions about a teacher's power to influence?

Metaphor condition had a small but reliable effect on students' ratings of how much *power* college teachers have to influence what students learn, $F(3, 214) = 6.04$, $p < .001$, $\eta^2 = .08$ (Figure 3). Pairwise comparisons across the conditions (using a Bonferroni adjustment) showed that the ATHLETES/COACH metaphor was associated with significantly lower ratings of teacher power compared to the CLAY/SCULPTOR and PLANTS/GARDENER metaphors. The CLAY/SCULPTOR, PLANTS/GARDENER, and TOURISTS/TOUR GUIDE metaphors did not significantly differ from one another.

Metaphor condition also affected students' ratings of how much power college teachers had to influence how students develop as people, $F(3, 214) = 9.76$, $p < .001$, $\eta_p^2 = .12$. Pairwise comparisons indicated that the CLAY/SCULPTOR and PLANTS/GARDENER metaphors prompted higher ratings of power to influence development than the ATHLETES/COACH and TOURISTS/TOUR GUIDE metaphors, but did not significantly differ from one another. The ATHLETES/COACH and TOURISTS/TOUR GUIDE metaphors also did not significantly differ from each other. The CLAY/SCULPTOR and PLANTS/GARDENER metaphors entail a more active leadership role of teachers in the classroom, and therefore, reflect similar intuitions for a teacher's power to influence.

2.2.4 What was the relative popularity of the different metaphors?

The most popular choice of metaphor to capture participants' personal view of college teaching was the ATHLETES/COACH metaphor (30.3%), followed closely by the PLANTS/GARDENER (28.9%) and TOURISTS/TOUR GUIDE metaphors (28.0%). The CLAY/SCULPTOR metaphor was the least favored (11.5%). Only 2% of participants indicated preferring a metaphor other than these four. These findings are highly consistent with prior findings by Hard et al. (2021).

Participants' preferred metaphor (excluding those who selected "other") was not influenced by condition, $\chi^2(9, N = 215) = 8.54$, $p = .481$. Similar to Hard et al.

(2021), this suggests that people have stable preferred metaphors for how they think about the teacher-student relationship.

2.3 Discussion

In this study, participants were provided with one of four metaphors for the student-teacher relationship and rated the degree to which a set of 44 statements describing student attributes and behaviors “fit” the metaphor. An exploratory factor analysis identified several latent variables underlying the attributes, analogous to students’ characteristics or ‘personality traits’. We used these results as a starting point to generate six composite traits that each captured a conceptually coherent cluster of attributes. We calculated strong, internal reliability for each of the six composite traits.

These six composite traits varied with each of the four metaphors, which suggests that different metaphors to describe the student-teacher relationship are associated with different entailments, and therefore paint different profiles of college students. For example, the *ATHLETES/COACH* metaphor consistently suggests students being more social, driven, and self-disciplined. The *TOURISTS/TOUR GUIDE* metaphor suggests students are open to using resources around them and being flexible, but less likely to develop as students to meet their learning goals.

The metaphors also differed in their implications for teachers’ and students’ responsibilities for learning. Consistent with prior findings, the *ATHLETES/COACH* metaphor holds students more accountable for their own learning than the other metaphors do. The metaphors also differed with respect to how much power the teacher has to influence a student’s development, with *CLAY/SCULPTOR* and *PLANTS/GARDENER* entailing the most power to influence and *ATHLETES/COACH* and *TOURISTS/TOUR GUIDE* the least.

Overall, the *CLAY/SCULPTOR* and *PLANTS/GARDENER* metaphors consistently suggested a high degree of teacher responsibility and a low degree of student responsibility, a finding that was consistent with Hard et al. (2021). This finding is also consistent with the fact that these metaphors are associated with students being less driven, self-disciplined, and open than other metaphors. Taken together, these two metaphors entail a more of a leadership role for teachers and more a passive role for students.

While these findings provide novel insights into the underlying conceptual structure of different metaphors for teaching – specifically what they imply about the roles of students – they rely on an analytical approach that differs from the work they build on (Hard et al., 2021). Hard et al. (2021) used an iterated exploratory factor analysis to reduce a larger set of 43 teacher attributes down to a core set of 20 and extracted factor scores that could be compared across the dif-

ferent metaphors. As described in the introduction, this analysis resulted in five conceptually coherent factors, uniquely associated with four attributes each, that comprised the teacher ‘personality traits’ or dimensions underlying participant ratings of the teacher attributes.

In the current study, factor analysis was used only as a starting point for creating similarly coherent composite traits because the first factor grouped together conceptually distinct student attributes. We, therefore, created our own clusters of attributes based on this factor analysis and our intuitions about the conceptual relatedness of the different student attributes included in the study. While this makes it difficult to align the results of the two studies, the current approach does have one major advantage over the approach of Hard et al. (2021) – namely, it provides a less relative window into what each metaphor implies about students. Because factor scores represent relative values, comparing different metaphors based on factor scores is effective at highlighting differences between metaphors, but obscures what each metaphor, taken individually, implies about students’ expected characteristics. The current approach compares metaphors based on absolute, rather than relative values (i.e., the raw ratings on each attribute), and thus reveals differences between metaphors while also providing more accurate information about what each metaphor implies about students’ expected characteristics. A main disadvantage of the present analytical approach is that it relies more heavily on researcher intuition, at least in part, to generate the composite traits. Thus, we aimed to confirm those intuitions by replicating these novel findings in Study 2.

3. Study 2: Replicating our findings

The objective of Study 2 was to replicate the findings of Study 1 using similar methods and a pre-registered design.³ In Study 2, we tested the reduced set of 36 student characteristic statements informed by the six composite traits in Study 1 (Table 2). We hypothesized that the six composite traits would generate strong reliability (Cronbach’s $\alpha > .8$) and would vary across the four metaphors in the same way found in Study 1. Because Study 1 sampled participants representing a diverse age range, including people who had not been in college for many years, we narrowed our recruitment in Study 2 to participants between the ages of 18 and 30, who are closer in age and experience to typical college students.

3. See here for our pre-registration <https://aspredicted.org/blind.php?x=bu77nt>.

3.1 Methods

3.1.1 Participants

We recruited 308 participants to complete the survey through Amazon's Mechanical Turk. We used the same recruitment criteria as in Study 1, but additionally required that participants be between the ages of 18 and 30 years old. Following our pre-registered exclusion criteria, we removed data from any duplicate IP addresses ($N=0$), participants who were not between the ages of 18 and 30 ($N=2$), had not attended college ($N=1$), and/or provided duplicated (i.e., copy and paste) responses to free response items as determined by the first author ($N=6$). Our final sample included 299 participants (see Table 1 for demographic data).

3.1.2 Measures and procedure

The materials and procedures were identical to Study 1. However, instead of viewing the complete list of 44 statements used in Study 1, participants only evaluated the reduced list of 36 statements corresponding to the six composite traits.

3.2 Results and Discussion

3.2.1 How do student characteristics vary across metaphors?

First, we tested whether the strong reliability of the six, 6-item composite traits derived in Study 1 would replicate in a new sample. We confirmed that our six composite traits consistently have strong internal reliability, as Cronbach's alpha was slightly higher on average than in Study 1 (all Cronbach's alpha values $>.83$) for each of the six composite traits.

Next, we tested whether the six composite traits varied across the metaphors as they did in Study 1. To preview, the results were, again, highly consistent. We conducted a multivariate ANOVA across the six composite traits with metaphor (CLAY/SCULPTOR, PLANTS/GARDENER, ATHLETES/COACH, TOURISTS/TOUR GUIDE) as a between-subjects variable. Overall, metaphor condition had a significant effect on the composite traits ($F(18, 876) = 11.23, p < .001, \eta_p^2 = .187$).

Follow-up univariate analyses of variance revealed significant effects of metaphor condition on each of the individual composite traits: *social* ($F(3, 295) = 20.17, p < .001, \eta_p^2 = .17$), *driven* ($F(3, 295) = 26.46, p < .001, \eta^2 = .21$), *self-disciplined* ($F(3, 295) = 11.93, p < .001, \eta_p^2 = .11$), *open* ($F(3, 295) = 3.83, p = .010, \eta_p^2 = .04$), *engaging with teacher* ($F(3, 295) = 4.50, p = .004, \eta_p^2 = .04$), and *developing* ($F(3, 295) = 11.41, p < .001, \eta_p^2 = .10$).

Figure 1 shows the pattern of differences across the metaphors for each composite trait. The overall pattern of differences is identical to that found in Study 1,

although whether particular metaphors significantly differed from others varied slightly in this replication, as described in Table 3. As in Study 1, the ATHLETES/COACH metaphor promoted higher ratings of social, driven, and self-disciplined traits than the other three metaphors, but the three metaphors were not different from each other. The ATHLETES/COACH metaphor also promoted higher ratings of student’s openness than the PLANTS/GARDENER metaphor, but not with the TOURISTS/TOUR GUIDE or CLAY/SCULPTOR metaphors. Unlike Study 1, for openness, the PLANTS/GARDENER metaphor was only marginally different from the TOURISTS/TOUR GUIDE metaphor. Unlike Study 1, in this replication, the ATHLETES/COACH metaphor promoted significantly higher ratings of engagement with the teacher than the other three metaphors, which did not differ from each other. Lastly, the ATHLETES/COACH metaphor entails that students are developing, more than the PLANTS/GARDENER and TOURISTS/TOUR GUIDE suggest. The PLANTS/GARDENER and TOURISTS/TOUR GUIDE also differed, with the former producing higher ratings of students as developing.

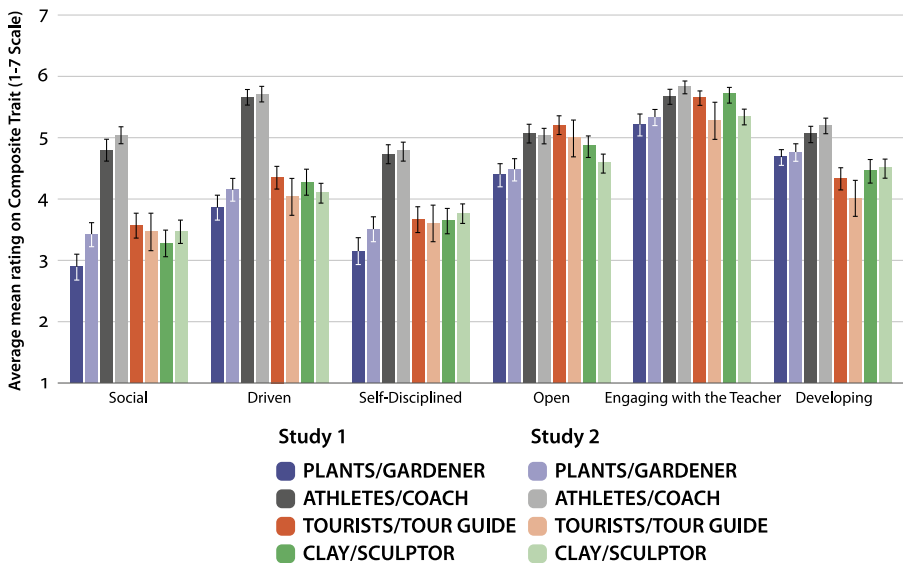


Figure 1. Mean ratings for each of the six factors in Study 1 and Study 2, as a function conceptual teaching metaphor that participants considered. Study 1 results are shown in solid bars, Study 2 results in dotted bars. Error bars show +/- 1 SEM

3.2.2 Are different metaphors associated with different intuitions about responsibility?

Replicating findings from Study 1 and Hard et al. (2021), metaphor had a reliable effect on ratings of how much responsibility college teachers had for students learning ($F(3, 295) = 12.75, p < .001, \eta^2 = .115$), as shown in Figure 2. As in Study 1, the ATHLETES/COACH metaphor suggested that teachers were viewed as significantly *less* responsible for student learning than they were for other metaphors. Unlike Study 1, the PLANTS/GARDENER metaphor, not the CLAY/SCULPTOR metaphor, promoted the highest rating of teacher responsibility, but it did not differ significantly from the CLAY/SCULPTOR and TOURISTS/TOUR GUIDE metaphors.

Metaphor also had a similar effect on ratings of how much responsibility students said they had for their own learning, $F(3, 295) = 17.36, p < .001, \eta^2 = .15$. Pairwise comparisons indicated that the ATHLETES/COACH metaphor had the highest ratings for student responsibility, significantly more than the PLANTS/GARDENER, CLAY/SCULPTOR CLAY/SCULPTOR, and TOURISTS/TOUR GUIDE metaphors, but the three did not differ from each other.

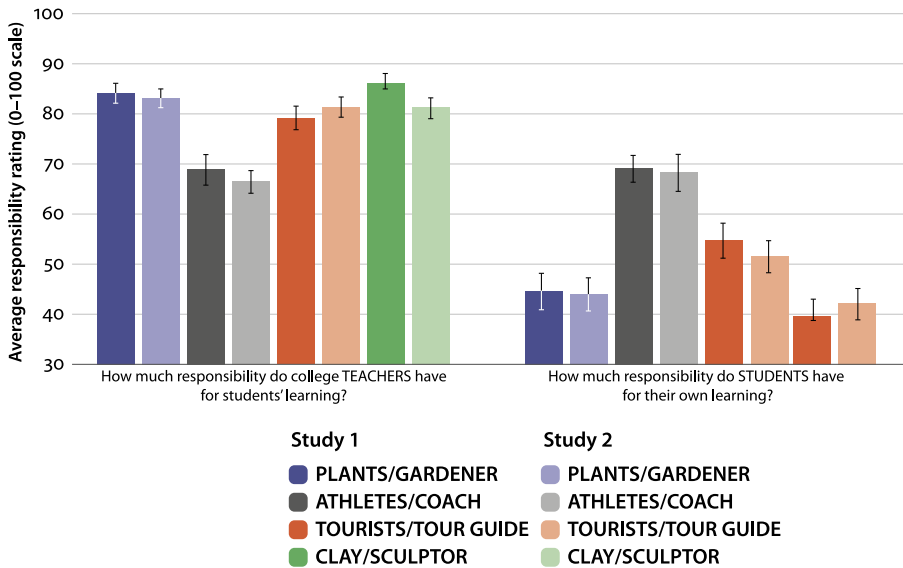


Figure 2. Mean ratings of teacher and student responsibility for learning in Studies 1 and 2, as a function conceptual teaching metaphor that participants considered. Study 1 results are shown in solid bars, Study 2 results in dotted bars. Error bars show ± 1 SEM

3.2.3 Are different metaphors associated with different intuitions about a teacher's power to influence?

As shown in Figure 3, we again replicated findings from Study 1 and Hard et al. (2021), metaphor condition had a small but reliable effect on students' ratings of how much power college teachers had to influence what students learn, $F(3, 295) = 4.18$, $p = .006$, $\eta^2 = .041$. Pairwise comparisons showed that the ATHLETES/COACH metaphor had lower ratings of how much power teachers have to affect what students learn compared to CLAY/SCULPTOR and TOURISTS/TOUR GUIDE metaphors, but not from the PLANTS/GARDENER metaphor as it was in Study 1. The CLAY/SCULPTOR, PLANTS/GARDENER, and TOURISTS/TOUR GUIDE metaphors did not significantly differ from one another.

The metaphor condition also affected students' ratings of how much power college teachers had to influence how students develop as people, $F(3, 295) = 9.07$, $p < .001$, $\eta^2 = .084$. Similar to Study 1, pairwise comparisons indicated that the CLAY/SCULPTOR and PLANTS/GARDENER prompted higher ratings of power to influence development, significantly more than the ATHLETES/COACH and marginally more than the TOURISTS/TOUR GUIDE metaphors. The ATHLETES/COACH and TOURISTS/TOUR GUIDE metaphors did not differ from each other.

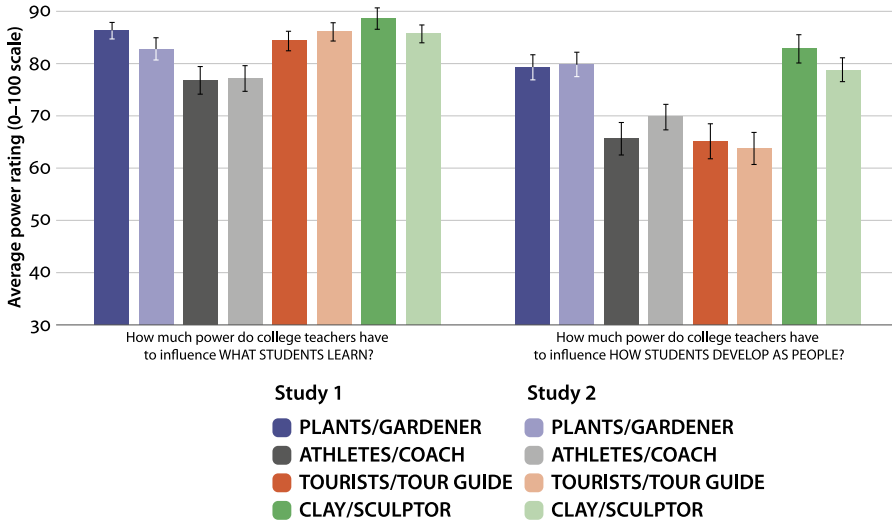


Figure 3. Mean ratings of teacher power to influence what students learn and how students develop as people, as a function of the conceptual teaching metaphor that participants considered in Studies 1 and 2. Study 1 results are shown in solid bars, Study 2 results in dotted bars. Error bars show ± 1 SEM

Taken together, the CLAY/SCULPTOR and PLANTS/GARDENER metaphor continue to imply a stronger leadership role for teachers in the classroom than do the TOURISTS/TOUR GUIDE and ATHLETES/COACH metaphors, and therefore, suggest a higher degree of teacher responsibility and power to influence.

3.2.4 What was the relative popularity of the different metaphors?

Consistent with Study 1, the most popular metaphor to fit participants' personal view of college teaching was the ATHLETES/COACH (34.3%), followed closely by the PLANTS/GARDENER (26.7%) and TOURISTS/TOUR GUIDE metaphors (26.3%). The CLAY/SCULPTOR metaphor was the least favored (11.7%). Only 1% of participants indicated preferring a metaphor other than these four.

As in Study 1, participants' preferred metaphor (excluding those who selected "other") was not influenced by condition, $\chi^2(9, N = 296) = 12.36, p = .194$. This finding continues to suggest that people have stable preferred metaphors for how they think about the student-teacher relationship.

4. General discussion

Across two studies, we investigated whether metaphors for the student-teacher relationship bring to mind coherent clusters of student attributes, building on the systematic approach developed by Hard et al. (2021) for mapping the entailments of metaphorical concepts. An online sample of participants considered one of four popular, apt metaphors for the student-teacher relationship and rated the degree to a collection of student behaviors and attributes 'fit' the metaphor. From these ratings, we created six composite 'traits' with strong internal reliability. Consistent with previous work on teacher entailments, these student entailments were differentially and consistently associated with the different metaphors, as described below. Participants' ratings of student and teacher responsibility and power also differed reliably across the four metaphors in a nearly identical fashion in both studies. In the following section, we summarize the different patterns of student 'traits' associated with each metaphor across the two studies.

4.1 Metaphorical Conceptions of College Students

Prior work by Hard et al. (2021) painted distinct portraits of college teachers based on the metaphor for the teacher-student relationship that participants considered. The present studies paint similarly distinct portraits of college students that align in several notable, metaphor-congruent ways.

Across both studies, the ATHLETES/COACH metaphor entails, more than other metaphors, that students are *driven* and *self-disciplined*. This metaphor also implies that students are more *social* in their academic behaviors. These entailments are congruent with prior findings that the ATHLETES/COACH metaphor brings to mind teachers who are more *authoritative* and *community-building* (Hard et al., 2021). Also consistent with this previous work, the ATHLETES/COACH metaphor implies that students hold more responsibility for their own learning than is implied by other metaphors. Speaking in absolute terms, the ATHLETES/COACH metaphor rated fairly high on all six composite student traits (mean scores between 4.73/7 – 5.82/7 across both studies), suggesting that this metaphor entails an engaged and well-rounded student no matter what dimension is being considered.

In contrast, the CLAY/SCULPTOR, PLANTS/GARDENER, and TOURISTS/TOUR GUIDE metaphors entailed that students are relatively less *driven*, which was consistent with the higher ratings of teacher responsibility and power and lower ratings of student responsibility. These findings were also consistent with the results of Hard et al. (2021). In absolute terms, ratings for the CLAY/SCULPTOR and PLANTS/GARDENER metaphors in particular seemed to entail a more active leadership role for teachers in the classroom, and a more passive role for students.

In absolute terms, the CLAY/SCULPTOR metaphor rated fairly highly on the *open* (mean scores between 4.58/7 to 4.86/7) and *engaging with the teacher* dimensions (mean scores between 5.34/7 to 5.70/7). The PLANTS/GARDENER and TOURISTS/TOUR GUIDE metaphors revealed somewhat similar patterns, with a few noteworthy differences. For instance, the PLANTS/GARDENER metaphor entailed especially low ratings on the *social* (mean scores between 2.89/7 to 3.42/7) and *self-disciplined* dimensions (mean score 3.15/7 to 3.51/7), while the TOURISTS/TOUR GUIDE metaphor scored somewhat higher on the *open* dimension (mean score 4.99/7 to 5.20/7), and somewhat lower on the *developing* dimension (mean score 4.01/7 to 4.33/7). While these differences were small, they do suggest that the metaphors imply subtly different student characteristics.

4.2 Limitations

The present studies recruited online samples of current and former college students, with Study 2 focused on those aged 30 and under. It is possible that a more diverse sample of current university students would generate different metaphorical preferences and entailments across racial, ethnic, gender, cultural, and socioeconomic groups. Given that metaphors are shaped by sociocultural contexts and experiences (Kövecses, 2005), we might also predict that students' differing experiences with the target domain of the classroom (e.g., classroom

sizes and pedagogical styles) might drive different metaphorical conceptions. Different experiences with the various source domains (e.g., sports, gardening) might have a similar influence. For example, a student who has played individual sports like archery or gymnastics, rather than team sports like basketball and football, may call to mind different, less social, attributes for students and different, less community-building, attributes for teachers, when considering the ATHLETES/COACH metaphor. In future work, we plan to recruit a larger, and more diverse sample of current college students and explore whether metaphorical preferences and conceptualizations vary across demographics, education level (i.e., college vs K-12), types of universities (e.g., public versus private; size), academic disciplines, and other aspects of experience.

Another limitation of the present work is that participants were asked to express their preferences for different metaphors, but the extent to which people endorse all four metaphors has yet to be evaluated. It is possible, even likely, that people can endorse multiple metaphors for the teacher-student relationship (cf. Chen, 2003). In addition, the present findings do not tell us whether the metaphor participants selected as their favorite represents their *ideal* conception of the college-teacher relationship or what they believe to be the *actual* way these relationships unfold. Future studies can examine how these conceptions may differ, and give insights into developing interventions that resolve differences between actual student experiences, and what students and teachers *want* their classroom experiences to be.

4.3 Implications for Research and Practice

Journalist Patrick Watson (2020) urged professors to adopt new metaphors for thinking about their role in the (virtual) classroom because he believed that some metaphors were more useful than others at shaping instructors' expectations and behaviors in the classroom. The present findings, taken together with work by Hard et al. (2021), suggest that different metaphors do paint different portraits of college students and their teachers that may well shape expectations and behaviors in the classroom. Specifically, the ATHLETES/COACH metaphor, which was found to be the most popular metaphor across both studies, implies assertive, community-building instructors (Hard et al., 2021) and students who assume responsibility for their own learning as they actively engage with challenges and with each other. To the extent that these approaches to teaching and learning enhance educational outcomes, convincing teachers and students to adopt the ATHLETES/COACH metaphor as a conceptual framework may lead to more productive classrooms.

However, there is much to be learned before we can be sure that this analysis is correct. Although the ATHLETES/COACH metaphor was the narrow favorite among the four metaphors we studied, the PLANTS/GARDENER and TOURISTS/TOUR GUIDE metaphors were preferred by a significant proportion of participants. We don't yet know whether these students who prefer or endorse particular metaphors embody the characteristics that are associated with them. For example, are students who prefer the ATHLETES/COACH metaphor more driven, self-disciplined, and social than students who prefer other metaphors? If so, how are these characteristics manifested in actual classrooms and student learning outcomes?

Additionally, we do not yet know the extent to which preferred metaphors, and their associated characteristics, are malleable. If metaphorical lay theories predict actual student behaviors, then metaphorical language may offer tools for novel educational interventions that influence academic attitudes and behaviors in ways that promote student success. Prior work suggests that metaphorical framing can shape how participants approach and attempt to solve a complex problem (e.g., Thibodeau & Boroditsky, 2011). Metaphorical framing can also influence students' intuitive lay theories about intelligence and subsequent academic performance (Blackwell et al., 2007). Importantly, interventions aimed at improving student performance by changing intuitive lay theories about intelligence and learning have been inconsistently effective (Sisk et al., 2018). This inconsistency may be in part due to the fact that these interventions have neglected other important educational lay theories, like conceptions of the teacher-student relationship. Together with prior findings from Hard et al. (2021), the present work offers a principled way to understand the structure of people's intuitive beliefs about the teacher-student relationship and thus provides an important step in developing interventions that could address these limitations.

4.4 Conclusions

Amidst the difficult challenges facing higher education during the COVID-19 pandemic, journalist Patrick Watson (2020) urged professors to adopt new metaphors for thinking about their role in the (virtual) classroom: "*You are a coach. They are the team. They play and you watch.*" Previous research has shown that metaphors like these are reliably associated with distinct, coherent clusters of teacher attributes and behaviors (Hard et al., 2021). The present work demonstrates that such teaching metaphors also bring to mind specific student entailments as well. Taken together, this work suggests that college teaching metaphors can efficiently capture and communicate structured beliefs about both teacher

and student attributes and behaviors, and that these entailments can be derived in a principled, systematic fashion.

Acknowledgements

The authors gratefully acknowledge Priyanka Fernandes for comments on an earlier draft. This research was supported by grants from Duke University Undergraduate Research Support Office to the first author, and the Charles Lafitte Foundation Program in Psychological and Neuroscience Research at Duke University to the first and last authors.

References

- Blackwell, L.S., Trzesniewski, K.H., & Dweck, C.S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child development*, 78(1), 246–263.
<https://doi.org/10.1111/j.1467-8624.2007.00995.x>
- Buhrmester, M., Kwang, T., & Gosling, S.D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high- quality, data? *Perspectives on Psychological Science*, 6, 3–5.
<https://doi.org/10.1177/1745691610393980>
- Casasanto, D. (2008). similarity and Proximity: When Does Close in space mean Close in mind? *Memory & Cognition*, 36(6), 1047–1056. <https://doi.org/10.3758/MC.36.6.1047>
- Chen, D.D. (2003). A Classification System for Metaphors about Teaching. *Journal of Physical Education, Recreation & Dance*, 74(2), 24–31.
<https://doi.org/10.1080/07303084.2003.10608375>
- Flusberg, S.J., Matlock, T., & Thibodeau, P.H. (2017). Metaphors for the war (or race) against climate change. *Environmental Communication*, 11(6), 769–783.
<https://doi.org/10.1080/17524032.2017.1289111>
- Gibbs Jr., R. W. (1994). *The poetics of mind: Figurative thought, language, and understanding*. Cambridge University Press.
- Hard, B.M., Liang, N., Wong, M., & Flusberg, S.J. (2021). Metaphors we teach by: Uncovering the structure of metaphorical lay theories of teaching. *Metaphor and the social world*, 46–70. <https://doi.org/10.1075/msw.19021.har>
- Keysar, B., & Bly, B. (1995). Intuitions of the transparency of idioms: Can one keep a secret by spilling the beans? *Journal of Memory and Language*, 34, 89–109.
<https://doi.org/10.1006/jmla.1995.1005>
- Kövecses, Z. (2005). *Metaphor in culture: Universality and variation*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511614408>
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. University of Chicago press.
- Litman, L., Robinson, J., & Abberbock, T. (2017). TurkPrime.com: A versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behavior Research Methods*, 49(2), 433–442. <https://link.springer.com/article/10.3758/s13428-016-0727-z>.
<https://doi.org/10.3758/s13428-016-0727-z>

- Low, G. (2015). A practical validation model for researching elicited metaphor. *Elicited Metaphor Analysis in Educational Discourse*, 15–37. <https://doi.org/10.1075/milcc.3.01low>
- Martínez, M.A., Sauleda, N., & Huber, G.L. (2001). Metaphors as blueprints of thinking about teaching and learning. *Teaching and Teacher Education*, 17(8), 965–977. [https://doi.org/10.1016/S0742-051X\(01\)00043-9](https://doi.org/10.1016/S0742-051X(01)00043-9)
- Murphy, G.L. (1996). On metaphoric representation. *Cognition*, 60(2), 173–204. [https://doi.org/10.1016/0010-0277\(96\)00711-1](https://doi.org/10.1016/0010-0277(96)00711-1)
- Perkins, K.M., Toskos Dils, A., & Flusberg, S.J. (2022). The perceived threat of demographic shifts depends on how you think the economy works. *Group Processes & Intergroup Relations*, 25(1), 227–246. <https://doi.org/10.1177/1368430220951621>
- Saban, A., Kocbeker, B.N., & Saban, A. (2007). Prospective teachers' conceptions of teaching and learning revealed through metaphor analysis. *Learning and Instruction*, 17(2), 123–139. <https://doi.org/10.1016/j.learninstruc.2007.01.003>
- Shaw, D.M., Barry, A., & Mahlios, M. (2008). Preservice teachers' metaphors of teaching in relation to literacy beliefs. *Teachers and Teaching: Theory and Practice*, 14(1), 35–50. <https://doi.org/10.1080/13540600701837632>
- Seferoğlu, G., Korkmazgil, S., & Ölcü, Z. (2009). Gaining insights into teachers' ways of thinking via metaphors. *Educational Studies*, 35(3), 323–335. <https://doi.org/10.1080/03055690802648135>
- Sisk, V.F., Burgoyne, A.P., Sun, J., Butler, J.L., & Macnamara, B.N. (2018). To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychological Science*, 29(4), 549–571. <https://doi.org/10.1177/0956797617739704>
- Thibodeau, P.H., & Boroditsky, L. (2011). Metaphors we think with: The role of metaphor in reasoning. *PloS one*, 6(2), e16782. <https://doi.org/10.1371/journal.pone.0016782>
- Thibodeau, P.H., & Boroditsky, L. (2013). Natural language metaphors covertly influence reasoning. *PloS one*, 8(1), e52961. <https://doi.org/10.1371/journal.pone.0052961>
- Thibodeau, P.H., Crow, L., & Flusberg, S.J. (2017). The metaphor police: A case study of the role of metaphor in explanation. *Psychonomic Bulletin & Review*, 24(5), 1375–1386. <https://doi.org/10.3758/s13423-016-1192-5>
- Thibodeau, P.H., Matlock, T., & Flusberg, S.J. (2019). The role of metaphor in communication and thought. *Language and Linguistics Compass*, 13(5), e12327. <https://doi.org/10.1111/lnc3.12327>
- Tobin, K. (1990). Changing metaphors and beliefs: A master switch for teaching?. *Theory into practice*, 29(2), 122–127. <https://doi.org/10.1080/00405849009543442>
- Watson, P. (2020, June 23). Teaching isn't for Rock stars. Retrieved January 29, 2021, from <https://medium.com/@patrickdkwatson/teaching-isnt-for-rock-stars-a7703fabb0f4>

Address for correspondence

Bridgette Martin Hard
Department of Psychology & Neuroscience
Duke University
417 Chapel Drive
Box 90086
Durham, NC, 27708
USA
bridgette.hard@duke.edu

Biographical notes

Michelle Wong received her BS degree from Duke University in a self-designed major titled Neuroanthropology in Pedagogy, Policy, and Practice. She is currently the Research Coordinator for the Duke BRITelab (Behavioral Research Informing Teaching Excellence) in the Department of Psychology & Neuroscience at Duke University. Michelle coordinates the lab's many projects at the intersection of psychology and pedagogy.

She also researches the connection between metaphorical language and educational beliefs and behaviors.

Stephen Flusberg is an Associate Professor of Psychology at SUNY Purchase College. He received his PhD in Cognitive Psychology from Stanford University and has published extensively on the role of metaphor in communication and thought.

Bridgette Martin Hard is an Associate Professor of the Practice in Psychology and Neuroscience at Duke University. She received her PhD in Cognitive Psychology from Stanford University and conducts research at the intersection of psychology and pedagogy as Principal Investigator of the Duke BRITelab (Behavioral Research Informing Teaching Excellence).

Publication history

Date received: 8 February 2021

Date accepted: 26 May 2021

Published online: 21 April 2022