The Short-Term Reliability of Metaphors as an Assessment Method

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Metaphors are assumed to be a means of accessing implicit aspects of cognition. Metaphors, therefore, have been increasingly used in educational science as an innovative tool to examine a broad range of constructs. However, there are both empirical findings and theoretical considerations suggesting that metaphors are also by experiences that are salient just in the moment of production of the metaphor. Therefore, we examined in a sample of N = 95 students and professionals whether the metaphors of learning and the underlying conceptualization of learning that influence whether students adopt a deep or a surface approach in learning remained stable across 3 weeks. Results showed that although the sources on which the metaphors drew were subject to change, the underlying conceptualization of learning remained stable. However, there were no differences in the stability of metaphors in both groups. It be can concluded, therefore, that metaphors can be used as an indicator for underlying constructs such as the understanding of learning.

Keywords: metaphors of learning, re-test reliability, inter-individual differences, stability of metaphors, approaches to learning, conceptions of learning

INTRODUCTION

As researchers in educational science, we are more than familiar with phrases like "learning is a process of knowledge construction" or "information needs to be connected". These phrases are so familiar to us that we sometimes forget that they are metaphors and not actual descriptions of learning processes – a phenomenon that should not be surprising because metaphors are an important part of human cognition. Metaphors allow us to connect abstract or new concepts to more concrete or familiar ones: Or in other words, the "essence of metaphors is understanding and experiencing one kind of thing or experience in terms of another" (Lakoff and Johnson, 1980).

In educational science, we use metaphors to describe scientific concepts in the area of teaching and learning. However, what does it mean if individuals like teachers or students use certain metaphors? Research has shown that significant amounts of teachers' and students' beliefs and thoughts about teaching or learning are implicit and difficult to express (Pajares, 1992). Moreover, when asked about constructs such as beliefs, conceptions, or their identity, many teachers and students answer in a way that is biased by what they expect the researcher would like to hear from them. As metaphors are largely used implicitly, they might help researchers to understand individuals' implicit cognitions. At the same time, metaphors might be helpful for teachers or students themselves, because they can guide their reflection to unveil their implicit thoughts, and thus make them better teachers or learners (Korthagen and Vasalos, 2005).

Over the last years, an increasing number of researchers have followed this line of thought and used metaphors to extract thoughts from teachers or students (Wan and Low, 2015). Evidently, in recent years, we have seen an increase in publications using metaphors as a methodological approach

from all kinds of scientific disciplines active in the area of educational science, such as second language education (Oxford et al., 2014), science education (Daane et al., 2018), educational psychology (Erickson and Pinnegar, 2017) and higher education (Bager-Elsborg and Greve, 2017; Korkmaz and Senol, 2014). Apart from being used in several disciplines, metaphors are also used to assess different kinds of constructs, for example identities (Erickson and Pinnegar, 2017) or conceptions (Saban et al., 2007), or attitudes (Ungar, 2016). Even though these constructs differ considerably, they have in common that they are usually at least partly implicit, but nevertheless influence individuals' practice in one way or other. Most importantly, all of these constructs are assumed to be not easily changed, as long there are no circumstances that provoke change, such as taking up a degree, being in a field placement, or being prompted to reflect the own premises. Surprisingly, however, there has been little research into the question of whether metaphors provide reliable information about stable constructs. In addition, the relationship between metaphors and other constructs may not be as straightforward as assumed. For example, we find evidence from cognitive science that individuals' metaphors are strongly influenced by the current context and therefore also depend on momentarily salient experiences (Steen, 2015). Therefore, in this study, we aimed at closing this research gap by exploring the stability of metaphors of learning are across a short period. To this end, we will first give a short overview on what metaphors are, how they are used to assess underlying implicit constructs, and which empirical and theoretical challenges are associated with using metaphors. Next, we will lay out the current evidence on the stability of metaphors and propose how metaphors can be used to distinguish between different understandings of learning, that in turn influence the approach to learning taken by an individual. Finally, we will present our study on stability of metaphors, indicating that even if sources of metaphors change, they still seem to express something similar.

In the last half of the 20th century, metaphors have received a lot of attention from researchers from as diverse domains as philosophy (Black, 1993), cognitive science (Gick and Holyoak, 1980), or cognitive linguistics (Lakoff and Johnson, 1980). Metaphors have been identified as more than a deviation from the "normal use" of language. Instead, metaphors are one of the basic mechanisms in which we perceive the world (Lakoff and Johnson, 1980). Because metaphors are based on the detection of similarities of new experiences with familiar experiences, they help to understand novel information, concepts, or information (Gentner & Holyoak, 1997, p. 32). Most researchers agree that metaphors always involve a situation or an object X that shares a similarity with a situation or an object Y (Indurkhya, 2016). The situation or object X that is characterized by the metaphor is often described as the "target", and the situation or object Y that is the medium of comparison as the "source" (Black, 1993). Within metaphors, one can discern different forms. Several authors differentiate between "conventional" and "novel" metaphors (Black, 1993; Indurkhya, 2016). In this classification, conventional metaphors are those metaphors that are part of everyday language ("I fall in love"/"students need to grasp the theory"), whereas novel metaphors are created intentionally.

Conventional metaphors are usually not used consciously. As they are often not visible as metaphors, Black (1993) refers to them as "dead" or "dormant" metaphors. Conventional metaphors pervade our language, and we rarely communicate without using them. Lakoff and Johnson (1980) postulate that metaphors in language also feed back into our conceptual systems. For example, the metaphors "Time is a Resource" and "Work is a Resource" bring us to think that leisure time is also a resource, thus influencing our concepts of leisure to be perceived as a valuable good that must not be wasted, thus thwarting the idea of leisure time. In contrast to conventional metaphors, novel metaphors are created more or less consciously. The way that source and target are linked can be more or less obvious (Indurkhya, 2016). For example, the metaphor "A teacher is like a shepherd watching over the sheep" (Wegner and Nückles, 2015b) draws on the obvious similarity between the teacher watching the students and the shepherd watching the sheep. However, metaphors can also connect objects or situations that at first sight do not carry any similarity, and the metaphor itself creates the similarity and thereby changes the perception of the target object or the situation (Black, 1993). This often happens in literature, when metaphorical texts are used to make an implicit statement about something else. For example, a mill and a student don't seem to have very much in common. However, in the metaphor "Teaching is like pouring water on a mill", the link between student and mill is created by an explanation that the student is like the gear drive, because with increasing input the student and the mill both turn faster (Wegner and Nückles, 2015b). The possibility of metaphors to change perceptions of a concept gives metaphors the power to guide reflection and to make individuals understand their implicit thoughts in a better, more profound way. On the other hand, this creation of similarities helps researchers to see these implicit thoughts, because they make aspects visible which otherwise would be hidden.

The benefits of metaphors have been exploited in different ways by researchers when using metaphors as a methodological tool. Across the studies using metaphors for the assessment of stable individual differences such as conceptions, three approaches can be discerned (Löfström et al., 2015).

First, conventional metaphors can be extracted from naturalistic data such as interviews (Martin and Lueckenhausen, 2005), or official documents by metaphor analysis (e.g., Deignan, 2005). In this approach, metaphors are not produced purposefully for the research, but researchers exploit the fact that individuals constantly produce metaphors without noticing, assuming that the metaphors reveal something about the underlying implicit cognitions. This approach is more common in linguistics than in learning sciences.

Second, written metaphors or metaphorical images are generated by the researchers. Participants are either asked to judge different metaphors (e.g., Lehmann, 2012; Thomson, 2015) or they are prompted to reflect on these metaphors (e.g., Ben-Peretz et al., 2003). In this approach, the metaphor is merely the stimulus to prompt participants to think about their underlying conceptions; the focus of the analysis is the reflection about the metaphors rather than the metaphor itself.

The third and most frequent approach is to purposefully elicit metaphors (Seung et al., 2015). Participants are asked to produce their metaphors, prompted by a broad range of stimuli and modes. In these studies, sample sizes vary considerably from small case studies (Bullough, 1991; Tobin and LaMaster, 1995) to several hundred participants (Inbar, 1996; Saban et al., 2007). Studies with large samples usually collect short answers, while smaller studies are mostly based on rather long reflective essays. Metaphors have been collected orally by interview (Wegner and Nückles, 2015b), in group discussions (Martínez et al., 2001), in written form (Saban et al., 2007; Wegner and Nückles, 2015b), in reflective essays (Bullough, 1991), but also from drawings (Lehner, 2016), or photos (Hamilton, 2016). The collected metaphors are usually categorized, and the categories are then often matched to educational theories (Low, 2015). For example, Martínez et al. (2001) grouped teachers' metaphors into three categories based on the educational paradigms, i.e., behaviouristic, constructivistic, and situative metaphors. Also, metaphors have been matched to already established categories for the construct under consideration. For example, Löfström and Poom-Valickis (2013) analyzed whether students' metaphors of teaching were related to different roles of teachers and classified the metaphors according Beijard (1995). Such purposefully elicited metaphors are the technique used most often in educational science. They have the advantage that they can be easily produced, and often this method can be employed in the context of professional development programs. Moreover, this method sustains the individuality of each participant, because they are no preformed categories the participants have to react to, and many studies report surprising answers which help to better understand what teaching or learning can mean to the individuals in certain situations. Additionally, the elicitation process prompts reflection among the participants.

However, due to the large spectrum of answers, the manifold possibilities to extract the data, and the qualitative nature of the data, elicited metaphors are not as easy to use as a research tool and their use brings about several challenges, which are repeatedly reported in the literature (Low, 2015). To address these challenges, researchers have to develop valid research procedures. Low (2015) argues that almost all steps from the production of metaphor to the categorization to the matching of metaphors to more abstract constructs are very challenging. Especially the categorization of metaphors into higher-order groups of different conceptual understandings (for example by linking them to educational theories) poses challenges. For example, both Low (2015) as well as Löfström et al. (2015), point out that the same source of metaphor can be followed by a very different explanation. The expression "learning is like eating", for example, has been found to elicit a whole range of explanations, such as "you need it for survival" or "if you eat too much, you get sick", or even "you take up contents and incorporate them into your body". Metaphors should, therefore, not be interpreted context-free and the assignment to categories should not be carried out only on the base of the sources of metaphors, but there is a need for further explanations.

Apart from these methodological challenges that might be solved by accurate research procedures, there is an even larger challenge, which lies in relating metaphors to other constructs. Even though many articles link metaphors to stable constructs such as conceptions or identity or beliefs, they do not explicate how metaphors and these stable individual differences are related to each other. Most studies refer to Lakoff and Johnsons' cognitive metaphor theory, stating that by using metaphors, individuals can communicate aspects of experiences that are otherwise difficult to express. However, there are different interpretations of Lakoff and Johnsons' theory (Murphy, 1996).

Some researchers seem to adhere to a version of the cognitive metaphor theory labeled as the "strong view" (Murphy, 1996). The strong view implies that the metaphor has a status similar to a conception. Just as a conception, the metaphor organizes cognition. Thus, the metaphor of learning influences directly the way a student perceives the learning environment, the kind of learning orientation a student follows, the learning strategies that are chosen, and what kind of support by the teacher the students expect. For example, a person uttering the metaphor of learning as "being filled" would interpret all information on learning under the premise of this metaphor. This person would expect the teacher to be the main responsible person in the learning process and would make little use of deep learning strategies aiming at engaging actively with the learning contents. In contrast, a person who follows the metaphor of learning as constructing a building would rather use learning strategies that focus on connecting knowledge to create new insights and would take on the responsibility of the learning process for herself. Thus, the individuals' metaphors work as a lens for thought or as Martínez at al. (2001) called them "blueprint for thinking", because the metaphors directly influence the individuals' information processing and ultimately their practice.

However, most studies base their interpretation rather on what Murphy (1996) calls the "weak view", and assume that underlying constructs such as the individuals' conception influences the kind of metaphor produced by the individual. Therefore, when asked to produce a metaphor, a person with a certain conception would implicitly single out aspects of another experience that map onto this conception (Haser, 2005). Thus, a person who has the conception of teaching as transmission would implicitly find more identical elements between learning and being filled than between learning and building, and thus would rather choose to describe learning in terms of being filled rather than constructing a building. In this interpretation, the conception is the relevant construct, and metaphors should be treated as an indicator of underlying conceptions. Even if the metaphor changes, it might still express a similar conception of learning.

However, Steen (2015) challenges both assumptions and argues that metaphors are neither a product of implicit processes nor do they directly influence practice. Instead, he assumes that metaphors are deliberately produced to explicitly communicate a certain aspect of a concept. According to Steen, to process deliberate metaphors one has to represent actively the source of the metaphor in one's situational model. Consequently, when producing an elicited metaphor, a speaker might represent the target concept (i.e., learning) and then actively search for a source concept that might convey an

TABLE 1 | The assumptions of the relationship of metaphors to other constructs.

Assumption: Metaphors are…	Theoretical explanation	Relation of metaphors and conceptions
A lens for thought and action	Strong view Lakoff and Johnson (1980)	- Metaphors directly influence cognition - Metaphors are relevant on their own - A change in the source of metaphors should only occur if the individual develops further - Change in the source of metaphors should directly have consequences for the individual's thought and action
An indicator or underlying conceptions	Weak view Murphy (1996)	- Metaphors are used by individuals to express their implicit conceptions - The metaphor itself is not relevant for thought and action, only the underlying conceptual content - The changes in the metaphors are only relevant if the conceptual content changes, too
A snapshot of salient experiences	Deliberate metaphor theory Steen (2015)	- Metaphors are a result of momentarily salient cognitions - Metaphors are not relevant for thought and action - Changes in metaphors are not meaningful for changes in underlying conceptions, but for different kinds of experiences that can be made within a context

aspect that is represented explicitly in this spontaneously produced situational model. For example, if at a moment in the situational model a dislike of learning is the salient experience, the speaker would deliberately look for another activity that is disliked, such as going to the dentist. If in contrast the momentarily salient experience is sitting passively in a lecture, a person might describe learning as being filled, even though in another situation they might have chosen the metaphor of constructing a building. Thus, in contrast to the assumptions made by cognitive metaphor theory, metaphors might not necessarily assess some underlying and rather stable construct such as a conception, but might instead give a picture of the experiences that are explicit and salient at a certain moment. In this case, metaphors would be rather a *snapshot* of salient experiences, and thus the occurrence of certain metaphors in a given sample would rather be informative about the typical experiences made in a certain context than on stable characteristics of the individual. In this case, metaphors would not be a suitable tool to assess rather stable constructs and could only be used to assess momentarily cognition. Context differences in the occurrence of metaphors would rather due to differences in the salience of certain experiences at a given moment, triggering different metaphors in the individuals, than to differences in the conceptions of individuals.

Most notably, the three different theoretical assumptions (weak view of cognitive metaphor theory, strong view of cognitive metaphor theory and deliberate metaphor theory) have implications for assumptions on the stability of metaphors and thus on the use of metaphors as an assessment tool. If metaphors would act as a lens, a change of the source of metaphor would imply also a change in thought and ultimately in action. In contrast, if metaphors were an indicator, a person could utter different metaphors at different points of time, however, they all should point towards the same underlying conception, and thus be all grouped into the same category by the researchers. Finally, in the view of metaphors as snapshots of salient experiences, changes in metaphors might not be due to changes in the underlying constructs, and the assignment to a different category would not imply a change in underlying conception. Instead, the differences in the metaphors between two measurements would give information on how the context of individuals changed and

what kind of associations are made salient by the context. If there are many changes in the metaphors, it would imply that there is a broad range of different kinds of experiences that can be made in this context (such as a broad range of courses with different affordances). Small changes would imply rather little changes in the kind of experiences (such as the same type of courses). **Table 1** summarizes the three theoretical assumptions outlined above.

Principally, stability of metaphors can be assessed by longitudinal studies. However, virtually all longitudinal studies using metaphors analyzed changes in metaphors of teaching or learning after transgressing into another setting; that is, situations in which changes in conceptions are expected. Consequently, studies mostly found changes instead of stability in metaphors. For example, Wegner and Nückles (2015a) analyzed 30 university students' spontaneously produced metaphors of learning when entering higher education and after 1.5 years. Even though almost half of the students used the same source of metaphors at both measurements, the authors found systematic changes towards more sophisticated metaphors. This result seems to be in line with Donche and van Petegem (2009) who found an increase in meaning-directed learning within the first years in higher education. In a longitudinal study, Strugielska (2008) asked 21 students for metaphors on different concepts within the thematic field of learning. She found that at the first measurement, only 10% of the answers formed a coherent set (e.g., the teacher is a guide, teaching is setting a route, the learner is traveling), and there was no coherent set at all at the second measurement, thus rendering analysis of underlying conceptions difficult. Thomas and Beauchamp (2011) interviewed teachers before and after their first year of teaching on their metaphorical descriptions of their identity as a teacher. The researchers found that metaphors shifted from describing their role as supporter of the students towards being in a survival mode (e.g., "a survivor of the Titanic who didn't have a lifeboat and had to swim to shore" p. 765). A similar observation was made by Leavy et al. (2007) in a study based on in-depth reflected metaphors. Irish and US-American preservice teachers had to engage several times in active metaphor construction, revisions, and discussion of their metaphors of teaching as part of their study program. At the first measurement, roughly half of both groups' metaphors were classified

as behavioristic as in Martínez et al. (2001), but in the US-American sample, a large number of metaphors were classified as "self-referential" because they just focused on emotional-motivational aspects of fulfilling the task of teaching, such as being troubled. After teacher candidates underwent a school based teaching placement, in both samples there was a strong increase in constructivist metaphors.

Taken together, most studies found little stability in metaphors. However, this might not indicate low reliability of metaphors but can instead be attributed to the fact that in those longitudinal studies the external context of the participants changed between the points of measurements. Additionally, the occurrence of self-referential and incoherent metaphors poses problems for analyzing the stability of metaphors.

Interestingly, metaphors that are not related to the constructs under consideration and lack conceptual content, such as information on the processes or goals of teaching or learning, for example, "Learning is like a picnic because it's nice" (example taken from Low (2015), p.26), or "a teacher is like a survivor of the Titanic who didn't have a lifeboat and had to swim to shore" (Thomas and Beauchamp, 2011) are reported in several studies. Low (2015) argues that such answers are not real metaphors because they do not focus on conceptual similarities, and that researchers should design their research procedure in a way that reduces such answers. However, the number of studies reporting self-referential metaphors suggests that there might be more to them than just being a methodological artifact that needs to be reduced. Wegner et al., 2020 analyze the difference between "learning-oriented" metaphors, which provide information on goals and processes of learning and "self-referential metaphors", which mostly carry information on motivation and emotions in learning. In two studies, they showed that students with self-referential metaphors resemble learners with a "surface approach" to learning, as it has been described first by Säljö (1979), whereas students choosing learning-oriented metaphors resemble learners with a "deep approach". A deep approach in learning is usually associated with the use of learning strategies that focus on understanding, drawing connections and thinking critically about the contents. Moreover, deep approach learners follow an intrinsic motivation rather than being guided by external incentives. In contrast, surface approach learners are mostly externally motivated, and in their studying, they rely rather on rehearsal strategies and rarely aim at "seeing the bigger picture". Thus, the contents are treated rather as separate bits. However, as Biggs and Tang (2003) make clear, surface learners can nevertheless be prompted to use deep learning strategies by changing the course requirements. On the other hand, also deep approach learners may use rehearsal strategies, if the contents require it, for example when learning vocabulary. The distinction between deep and surface learning has been supplemented by a third approach to learning, the so-called "strategic" or "achieving approach" (e.g., Biggs, 1987). These learners' motive is mostly to compete and achieve good grades, regardless of whether they are interested in the contents themselves. According to Entwistle (1997) the main difference between learners with a surface approach and a deep approach is that surface approach learners does not lay in their learning-

strategies or their motivation, but refers to the question whether learners have developed a complex conceptual understanding of learning that they base their decisions on how to learn on, or whether they approach learning merely as a task given to them. The same applies to the strategic approach, which is not aimed at processing the contents, but rather at optimally fulfilling the requirements. While surface learning are more or less unenthusiastic about this task, strategic learners aim to excel in learning. Therefore, strategic leaners tend to achieve higher than surface learners (e.g., Byrne et al., 2002).

Interestingly, Wegner et al. (2020) found that learners with self-referential metaphors agreed more to the rather simplistic mental model of learning as the intake of knowledge than students with learning-oriented metaphors. Moreover, students with self-referential metaphors were more keen on reducing work-load, more certificate-oriented and more ambivalent about studying than students with learning-oriented metaphors (see also Wegner and Nückles, 2015c). In contrast, students with learning-oriented metaphors were more likely to use strategies as critical processing or relating and structuring. Finally, students with learning-oriented metaphors received better grades. This observation also supports the idea that rather than being a methodological problem, self-referential metaphors indicate that an individual has little understanding about the actual process and possible outcomes of learning, but rather sees learning as a task that has been given to him or her. Consequently, when asked to describe a metaphor, these students come up with metaphors linking learning to motivational aspects in fulfilling this task ("learning is like cleaning") rather than on actual learning processes ("Learning is like weaving a net") or concrete learning outcomes ("Learning is like getting a key").

To sum up: The current empirical evidence on changes in metaphors does not answer the question whether metaphors can indeed measure stable constructs. At the same time, so-called self-referential metaphors that on first sight might seem like an unwanted misunderstanding can actually provide valid information on how learners understand learning. Furthermore, theoretical considerations on the status on metaphors imply that rather than assessing stable constructs such as conceptions, metaphors might simply assess momentarily salient experiences. Therefore, we aimed at closing this gap by looking closer into how stable metaphors are across a short period of time.

RESEARCH QUESTIONS AND HYPOTHESES

The goal of the study was to investigate whether spontaneously elicited metaphors should be treated as a *lens*, or as an *indicator* or should be rather treated as *snapshots for typical salient experiences*. We chose to analyze metaphors of learning because metaphors of learning have been shown to provide information on the general understanding of learning which in turn influences whether the learners follow a deep or a surface approach in learning (Wegner et al., 2020). Therefore, we investigated the reliability of metaphors as an assessment tool

TABLE 2 | Expected outcomes for each of the three alternative hypotheses.

Metaphors are…	Source of metaphor	Classification of metaphor	Differences in changes between students and professionals
a lens for thought and action	no to little change	no change	n.a
an indicator of conceptions	change	no change	no differences
as a snapshot of salient experiences	change	change	more change in students than in professionals

TABLE 3 | Overview over the categories used in the classification of metaphors.

	Description	Example	Typical sources
Self-referential	Answers describe learning as a task to be fulfilled and focus on motivational and emotional aspects mostly while fulfilling this task	"Learning is like sport, because you don't feel like doing that, but you want the result." "Learning is like climbing a gigantic mountain, because you cannot see the end, and it is tiring. But once you are on the top, going down is easier, and what stays is a feeling of pride and exhaustion."	doing sports, hiking, fighting, hard work, chewing gum, running a marathon
Learning oriented	Answers describe the processes and results of learning Or Learning is described as a process which changes the whole person or that indicate that learning is an inherent part of life Or Metaphors explicitly focus on the intended use for the knowledge	"Learning is like a growing mushroom, because learning means connecting new infromation with existing knowledge and happens only in exchange with others." "Learning is like [being] a bat, because without the works of a bat humanity would be suffocated by insects. We need to acquire knowledge and education and use it to change the world." "Learning is like the tides because it a continuous exchange. Every time something new is formed and still looks similar than before."	Solving a puzzle, collecting things, being filled, weaving a net, Growing, traveling, breathing

by examining the short-time stability across a period of 3 weeks. In our study, we examined how both the metaphorical sources individuals used to describe learning, and the classification of the answers as self-referential or as learning-oriented changed within 3 weeks. To this end, we compared the participants' answers at both times of measurement in terms of three alternative hypotheses on the stability of metaphors of learning (see **Table 2** for a summary):

– *Alternative 1. Metaphors are a lens for thought and action*: According to the strong view of cognitive metaphor theory, the metaphor directly influences thought and action. Therefore under this assumption, little or no change should occur in the sources of metaphors during this time, and consequently no changes in the classification of metaphors as self-referential or as learning-oriented are to be expected.
– *Alternative 2. Metaphors as an indicator*: According to the weak view of cognitive metaphor theory, metaphors serve as an indicator for underlying constructs, such as the students' understanding of learning. Under this assumption, therefore, changes in the sources the metaphors refer to are to be expected. However, in a short period of 3 weeks no change should occur in whether the metaphor is self-referential or learning-oriented, and thus, the classification of the metaphors should remain the same across this time.
– *Alternative 3. Metaphors as a snapshot of salient experiences*: (a) According to the deliberate metaphor theory, metaphors

are deliberately developed, and thus influenced by the experiences most salient at the present moment rather than by the general understanding of learning. Therefore, one would expect both changes in the sources of metaphors and changes in the classification of the answers. (b) The change in both sources and the categorization of the answers should be especially large if it is likely that different experiences are salient, for example, because different kinds of learning situations have been experienced. Therefore, we would expect students' metaphors to change more strongly than individuals that are not currently registered students, because students' main job is to learn, and they experience learning in very different arrangements (Entwistle and Peterson, 2004). Therefore, if metaphors are snapshots of salient experiences, we would expect stronger changes both in metaphors and in the classifications among students than among individuals that are not currently enrolled in an educational setting (non-students)

METHODS

Participants
Altogether, N = 95 people took part in the study. Participants were on average 30.4 (SD = 10.99) years old, 68.4% were female. Half of the individuals were studying in higher education (n = 47), the other half was already working as professionals (n = 48). Students

were on average 25 years old (SD = 2.46; 76% female) and non-students were 35.7 years on average (SD = 13.37; 60% female). Across all participants, more than 90% had completed the "Abitur", the highest degree in school in Germany. Half of the participants from the first measuring time t_1 (n = 46) completed the questionnaire on the second measuring time t_2. Again, half of them were students (n = 23) and the other half were professionals (n = 23), and there were no differences in the distribution of age and gender to t_1.

Questionnaire

Based on Wegner et al. (2020) participants were provided with an explanation and examples of what was meant by metaphor: *Metaphors help to express what complex issues mean to you. For example, you can describe yourself through a metaphor: "I feel solid as a rock in the waves because I am strong and prepared for anything that comes flowing towards me." Or an activity: "Discussing is like going to war, because in a discussion I attack my opponent with arguments, and he defends himself and fights back with other arguments." Now please try to find your own metaphor for learning!*

> Learning is like. . .
> *because* . . . (see also Saban et al., 2007).

At t_1, participants were asked to provide demographic information about age, gender, their current occupation, and their educational background. No such questions were included at t_2.

Categorization of Answers

Changes in the Source of Metaphors

For determining whether sources of metaphors had changed between both times of measurement, both answers were compared directly. In this analysis, we did not check whether the conceptual content was similar or not, but whether there were changes in the literal meaning of the sources of metaphors chosen by the participants. We distinguished three categories:

> 1 *Same source*: The source of metaphor did not differ or only marginally differed between the two points of measurement, only in the degree of elaboration, e. g. "*The digestive system, because I take in food, it is processed by my organs, it is used and selected. The most important information is kept, the rest is secreted (=forgetting),*" vs "*The digestive system, because the information is taken up, selected and processed*".
> 2 *Same overarching domain, but different source.* Participants had drawn at both measurements on the same domain and had used a similar justification, but had chosen a different source, e.g., "*Drawing a map, because I look where I am, how I can arrange everything, where there are still white spots, and how I can proceed to new areas and find new ways and change my old ways.*" vs "*Going on an adventure trip, because I start from my point of view, and maybe I know the goal, but this time I take a new route [. . .]*".
> 3 *Different domain and different source.* Sources of metaphors differed so strongly in both answers that there was no overlap

in domains anymore, e.g. "*Breathing, because you always do it and you continuously develop,*" vs "*Painting a picture, because you always add little pieces and in the end you see the whole and you know what it means.*".

The classification was done by two independent raters for all participants. Interrater reliability was very good, Cohen's κ = 0.892.

Changes in the Classification of Metaphors

To detect changes in the classification, all answers at both measurements were classified by the same scheme (see **Table 3** for the coding scheme and examples). To this end, we analyzed whether the metaphor and its explanation were directed to learning processes and/or learning outcomes (learning-oriented metaphors) or whether they were predominantly concerned with motivational or emotional issues when fulfilling the task of learning (self-referential metaphors). Two-third of all answers were classified by two raters. Interrater reliability was good, Cohen's κ = 0.82.

Procedure

The study was conducted as an online study. The link to the study was sent out via social networks. The link was opened by 185 people, roughly half of them completed the first questionnaire. Three weeks after the completion of the first questionnaire, the participants of the first study were sent a link to the second questionnaire with the same questions as at the first measurement. The answers of t_1 and t_2 were matched to each other by a code. On average, participants took 24.8 days (SD = 4.62, min = 22 days, max = 43 days) to respond to the second questionnaire. One student was excluded because the answer was not interpretable in terms of a metaphor.

RESULTS

Changes in the Source of Metaphors

Across the whole sample, 48.9% of the participants used more or less the same conceptual source at both measurements, 37.8% of the participants had changed their metaphor completely, and the remaining 13.3% of the participants had used a source from a similar domain but had changed the source within this domain (see **Table 4**). Even though half of the participants kept their sources, the number of changed sources of metaphors suggests that metaphorical sources are flexible and thus should not be treated as lenses for thought.

Changes in the Categories the Metaphors Were Assigned to

Across all participants, we found that at t_2 91.1% of the participants had produced metaphors in the same category as at t_1. Cohens' κ as a measure of re-test reliability was 0.78 (see **Table 5**), indicating that the stability of categories was higher than of the sources of metaphors. On this basis, we examined how

TABLE 4 | Changes of category in relation to changes in the source of the metaphor (N = 45).

The metaphor used	Learning-oriented vs self-referential		Sum
	No change	Changed	
…the same source	21 (46.7%)	1 (2.3%)	22 (48.9%)
…source from the same domain	6 (13.3%)	—	6 (13.3%)
…source from different domains	14 (31.1%)	3 (6.7%)	17 (37.8%)
Total	41 (91.1%)	4 (8.9%)	45 (100%)

TABLE 5 | Number and percentage of metaphors for each category at both t_1 and t_2, N = 45.

	Self-referential at t_2	Learning oriented at t_2	Total at t_1
Self-referential at t_1	11 (24.4%)	3 (6.7%)	14 (31.1%)
Learning-oriented at t_1	1 (2.2%)	30 (66.7%)	31 (68.9%)
Sum = Total t_2	12 (26.7%)	33 (73.3%)	45 (100%)

TABLE 6 | Metaphors of students and professionals at t_1 and t_2.

	Self-referential (%)	Learning-oriented (%)	Same source (%)	Same categorization (%)	N
Students t_1	40.4	59.6			47
Students t_2	36.4	63.6	47.8	86.4	23
non-students t_1	22.9	77.1			48
non-students t_2	26.1	73.9	47.8	95.7	23

changes in the classification of the metaphors were related to changes in the sources of metaphors (see **Table 4**). Only three participants used metaphors from different domains, that were categorized into another category. One person had changed the description of the source in a way that it was classified to another category.

In order to determine whether change in sources occurred significantly more often than change in the categories the metaphors had been assigned to, we compared the number of completely changed metaphors to the number of changed categories by a χ^2-test. It showed that the change in categories significantly deviated from the change in categories, $\chi^2 (1.45) = 14.40$, $p < 0.000$. The high stability of categorizations in comparison to the sources of metaphors can be interpreted as a sign that metaphors are indeed an indicator for underlying constructs rather than a lens for thought or a mere snapshot of salient experiences.

Differences Between Students and Professionals

Finally, we analyzed whether students were more likely to choose different sources of metaphors or to give answers that were more likely to be categorized differently. At t_1, 40.4% of the students, but only 22.9% of the non-students produced a self-referential metaphor (see **Table 6**). However, whis difference was only marginally significant, $\chi^2 (1.94) = 3.37$, $p = 0.053$, Cramers $V = 0.18$. No differences in the metaphors produced were found concerning age (30.27 vs 30.48 years), $t (93) = 0.09$, $p = 0.931$. At t_2, 36.4% of the students and 26.1% of the non-

students used self-referential metaphors, $\chi^2 (1.44) = 0.457$, $p = 0.34$, Cramers $V = 0.11$.

With regards to changes in the source, we found that the same percentage both of students and non-students had changed their metaphors in terms of the sources they used, $\chi^2 (1.45) = 0.000$, $p = 1.00$, and there were only small differences in changes in the categorization, $\chi^2 (1.45) = 1.198$, $p = 0.28$, Cramers $V = 1.63$. This lends further support for the rejection of the hypothesis that metaphors are just a snapshot of salient experiences.

DISCUSSION AND CONCLUSION

In our study we investigated on the basis of the stability of the sources and the categorization of metaphors of learning as whether metaphors should be treated as a lens for thinking about learning, as an indicator for underlying understanding of learning, or as a snapshot for salient experiences. Generally, roughly 40% of the sources, but only less than 10% of the categorizations changed within the period of 3 weeks. Moreover, there were no differences between students and non-students in terms of the stability both of metaphors and sources, even though students are more likely to be confronted with different learning-related situations within weeks, which might change what kind of experience is salient in the moment of generating the metaphor. In our view, the fact that the classification stayed more or less the same, even though the sources of the metaphors changed or were varied supports the hypothesis that metaphors of learning are rather an indicator for the general understanding of learning than a lens for thought or a mere snapshot of salient experiences. If they were mere snapshots, we

should see more changes in the classification of the metaphors, and on the other hand, if the metaphor itself would be the important construct influencing the individuals thought and action, we would expect less change in the sources of the metaphors.

However, some aspects need further consideration. Even though most participant's answers were assigned to the same category, we have to acknowledge that there were answers that changed the categorization. We can think of two reasons for this. First, given the problem that metaphors have to be classified by humans and that there is some leeway in the interpretation of the answers. This typically reduces the stability in classification. Secondly, even though there were just 3 weeks in between the two measurements, nevertheless it might be possible that there had indeed been change in the underlying understanding of learning. Finally, just as some individuals are more apt in generating a metaphor, it could well be that individuals use metaphors differently, and that some individuals produce metaphors more deliberately than others. This would mean, that for some individuals the assumption applies that their metaphors were just snapshots, while for the most they are indicators of underlying conceptions. At the same time, this also implies that the distinction between the strong and the weak version of cognitive metaphor theory might be too binary, that is, that metaphors might be something in between a lens and an indicator. While some people might understand the concept of learning through a certain metaphor (e.g., weaving a net), others might use the metaphor more to communicate their understanding in terms of an indicator (e.g., by expressing their dislike by describing learning as going to the dentist).

Another point that needs further attention is the fact that we used a dichotomous distinction of the metaphors, related to the distinction between deep vs surface approach, without considering the possibility of a strategic approach in learning. We chose this dichotomous distinction because both the strategic and the surface approach define learning as a task to be fulfilled, while the deep approach learners have an interest in learning itself. In this sense, strategic and surface learners are alike. However, because learners with a strategic approach perform better at learning and seem to be more apt in actually fitting their learning to the contents, further research should look more closely in how strategic approaches can be identified by metaphors.

Generally, there are some limitations to our study. The sample size was rather small and was a convenience sample. This might limit the explanatory power of the study, for example to ensure significance in the differences between non-students and students. Furthermore, there was no deep reflection on the metaphors in our study and the form of an online survey poses the problem that the conditions under which the answers are given vary greatly. Results may differ, if metaphors are produced within a long essay or if there is a more in-depth training on how to use metaphors. We also experienced some "experimental mortality", because only half of the participants took part in the second time measurement. Regardless, however, of the short reflection time and the other

limitations, the vast majority of participants came up with metaphors that were classified into the same category at both points of measurement, which lends further weight to the validity of the conclusions.

We do think from our research that metaphors are helpful in better understanding how students think about learning, and our results give some indication that metaphors have at least some reliability in assessing the general understanding of learning. However, as we have pointed out above, metaphors have been used for assessing a very broad range of constructs, and we might find different results for the stability of metaphors if they are used as an indicator for very stable constructs as identity, as compared to constructs that are more prone to change, such as emotions towards a certain activity (see e.g., Mellado et al., 2021). In order to use the great strengths of metaphors, such as to assess also implicit aspects of certain constructs, or the possibility to be used for a broad range of constructs carries the danger of becoming somewhat arbitrary, if there is little effort in establishing how metaphors and other constructs actually relate to each other. Therefore, given the rapidly increasing research body using metaphors, we would like to call for more methodological research ensuring for which kind of constructs metaphors pose a valid and reliable assessment tool.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the research project: EW analyzed the data and prepared the manuscript—CB prepared and conducted the experiment—MN contributed to the development of the research material, the data analysis and the preparation of the manuscript.

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