Psychology of Aesthetics, Creativity, and the Arts
2015, Vol. 9, No. 4, 385–393

1931-3896/15/$12.00 http://dx.doi.org/10.1037/aca0000024

Like the Machete the Snake: Integration of Topic and Vehicle in Poetry Comprehension Reveals Meaning Construction Processes

Cristóbal Pagán Cánovas
University of Navarra

Javier Valenzuela
University of Murcia

Julio Santiago
University of Granada

Metaphor and simile research has traditionally focused on the projection of content from vehicle to topic, thereby revealing new meaning in the topic. We show that the meaning of vehicles also changes during figurative language understanding. Participants read a poem that likens the temporal self to a snake being divided by a machete, and were asked to draw the snake. Against prototypical snake drawings, their snakes showed central characteristics of timelines: they were straight and oriented toward the right. These results suggest that figurative language understanding, and possibly all language understanding, is an integrative and creative process of the kind proposed by blending theory. The results also suggest that entrenched conventional patterns for mapping and integrating conceptual structures, such as the timeline, can play a central role in the meaning of highly creative figurative language.

Keywords: metaphor comprehension, meaning integration, figurative language, poetry, blending theory

Unidirectional Transfer Versus Interactive Blending

Language routinely prompts the mind to create novel meanings from the combination of existing ones. Figurative language, both conventional and innovative, makes this process especially visible (Gibbs, 1994; Lakoff & Johnson, 1980). In similes and metaphors, for example, a concept (the topic or target) is understood in terms of another concept (the vehicle or source). Favorite examples include sentences such as "lawyers are sharks" (in metaphor form) or "lawyers are like sharks" (in simile form). Using "lawyer" as the target for "shark" applies relevant features of sharks (such as being predatory and aggressive) to the concept *lawyer*. Some of these metaphorical combinations are very conventional and productive. For example, we use certain aspects of our knowledge about motion, distance, and location to create representations of temporal relations: "Saturday is approaching"; "last year seems so far away"; "time flies when I'm with her," and so forth

This transfer and integration of conceptual structures can also be seen in the so-called "literal cases." The meaning of *safe* in "the beach is safe" usually differs from that in "the child is safe," or in "dolphin-safe tuna." Moreover, the meaning of the same utterance can also vary dramatically depending on the scenario evoked in each instance. For example, "the beach is safe" can refer to a beach where people swim or play without danger, to a beach that has just been protected from an environmental disaster, to a good place to invest on property—as opposed to more risky locations in the interior or downtown, and so forth. The same form can prompt for multiple situations where very different elements, participants, roles, and actions are selected and integrated to create an appropriate meaning (Fauconnier & Turner, 2002, pp. 25–27, 142–143).

What is the best model for the fast, complex, and flexible cognitive processes that guide these combinations during meaning construction? Are there patterns that predetermine the integration of concepts? If so, how is the process optimized for local purposes, and how does creativity operate within the patterns? These are some of the central questions addressed by research on figurative language and thought, and particularly by metaphor research, which has become a burgeoning interdisciplinary field in the past decades.

All current theories of metaphor focus on how vehicles are used to understand topics (Camp, 2006), that is, on how features of the concept *shark* are transferred to the concept *lawyer* in "lawyers are sharks." Theories disagree on the mechanisms that transfer inferences from the vehicle to the topic: feature matching (Ortony, 1979), structure mapping (Gentner, 1983), or category inclusion (Glucksberg & Keysar, 1990), are among the main proposals. All theories, however, assume that no changes in meaning occur in the vehicle. Although both structure-mapping theory (Gentner, 1983)

This article was published Online First June 8, 2015.

Cristóbal Pagán Cánovas, Institute for Culture and Society, University of Navarra; Javier Valenzuela, Department of English Philology, University of Murcia; Julio Santiago, Department of Experimental Psychology, University of Granada.

This research was funded by the following grants: The European Commission (Marie Curie IOF: NARLYR 235129) to Cristóbal Pagán Cánovas; Junta de Andalucía and ERDF (Grant P09-SEJ-4772) to Javier Valenzuela and Julio Santiago; Spanish Ministry of Economy and Competitiveness (Grant PSI2012-32464) to Julio Santiago; Leverhulme fellowship (Grant VP1-2012-032) to Julio Santiago.

Correspondence concerning this article should be addressed to Cristóbal Pagán Cánovas, Institute for Culture and Society, University of Navarra, Edificio de Bibliotecas, E-31009 Pamplona, Spain. E-mail: cpaganc@unav.es

and the interactive property attribution model (a proposal within the category inclusion models; Glucksberg, McGlone, & Manfredi, 1997) suggest that the meanings of vehicle and topic interact in guiding the extraction of new inferences (as initially proposed by Black, 1962), the direction of inference is exclusively from the vehicle to the topic. To put it plainly, during metaphor processing, sharks do not become more lawyer-like because of having been used as a conceptual tool to better understand lawyers. The pervasiveness of this view of metaphor as unidirectional transfer reveals itself in the choice of the technical terms *vehicle* and *topic,* or *source* and *target*.

This same view is also adopted by conceptual metaphor theory (Lakoff & Johnson, 1980, 1999), which focuses on conventional metaphorical patterns used for speaking as well as for reasoning about many abstract concepts. Time is a classic example: people think about time as if it were motion in space (e.g., "my childhood is now far behind"; Clark, 1973). Under this view, time can profitably be conceptualized as space, since the latter is a more clearly delineated concept, but time would not be expected to affect the spatial concepts that provide its structure.

However, transfer models of metaphor have trouble explaining emergent meanings that are absent from both vehicle and topic. For example, when we say "Monday is approaching so fast," the speed of the object in motion depends on the emotional attitude of the observer. This is not an inference that we can project from our knowledge of motion through space, but a novel property that seeks to satisfy local purposes, namely, to express subjective time perception (Fauconnier & Turner, 2008). To explain emergent meanings, blending theory (Fauconnier & Turner, 2002) suggests an alternative to the direct mapping from source to target: a new conceptual package, the *blend*, is created ad hoc, by selectively projecting and adjusting elements from the inputs.

In blending theory there is no unidirectional, direct transfer between big domains (such as time and space), but opportunistic activation, association, and integration of *mental spaces* (Fauconnier, 1985), small conceptual packets built as we think and talk. Mental spaces flexibly combine entrenched structures and contextual information, for local purposes of thought and action. Two or more spaces project selected elements to a blended space or *conceptual blend*, forming a network. Elements from the inputs interact in the blend and produce a new whole with emergent properties, unavailable from any input, and built for the specific purposes of the network in context.

Take conventional, apparently straightforward, metaphors such as "lawyers are sharks" or "surgeons are butchers." According to the transfer view, in these examples we merely understand topics through vehicles: lawyers and surgeons through archetypical features of sharks and butchers. In both cases, however, inappropriate behavior is central to the meaning of the metaphor. These utterances suggest that lawyers and surgeons do not perform their typical activities with the required respect, accuracy, moral values, or any other relevant quality, as made available by the context. But *inappropriate behavior* is not an archetypical feature of the concepts *shark* or *butcher*: in general, sharks or butchers do perform their typical activities as required and expected from them. Explaining the idea of inappropriate behavior as the result of direct transfer from the vehicle to the topic is problematic.

For both metaphorical and literal cases, the blending model proposes a network of mental spaces, selective projection to a conceptual blend, and adjustment to context and goals. In the surgeon-butcher case, for example, we set up mental spaces for both concepts and come up with a blend in which the surgeon is striving to fulfill the goals of surgery by using the means and practices of the butcher. The emergent meaning arises from the conceptual clash in the blend (Grady, Oakley, & Coulson, 1999; Fauconnier & Turner, 2002, pp. 297–298). The final result is a network with a blend of topic and vehicle, where features of both inputs interact to produce inferences that can be projected back to the inputs. In this case, we have a hybrid of surgeon and butcher that is incompatible with most good surgical practices. This suggests that the surgeon in the topic is not performing as he should. The meaning does not reside in the vehicle alone, but in the blend and in its relation with both topic and vehicle.

As in all metaphors, we are indeed saying something about the topic: the surgeon in this case. However, the butcher, that is, the vehicle, also needs to be adapted to suit the purposes of the blend. In the surgeon-butcher metaphor it is not okay to import the butcher's goals, schedule, or training. Also, the default concept for the vehicle is just a point of departure that can be developed for the purposes of this network. In this case, certain versions of the concept *butcher* work better than others. Upon hearing "this surgeon is a butcher," the first specification of *butcher* that comes to mind is hardly that of a reputed professional trusted by the best restaurants in town. This is because the emergent meaning in the blend, *inappropriate behavior*, is influencing both components, and not just the topic. Constructing the full meaning of the metaphor requires a network with a blend connected to its inputs.

Our focus in the present paper is on what the neglected vehicles of metaphors and similes can tell us about the competing alternatives of direct transfer and blending. We put to a straightforward test the idea that the vehicle is not affected by its partaking into a simile, and show, for the first time, that this assumption is unwarranted: vehicles can, in fact, mesh with topics, and in predictable ways. The result of this interaction is a new conceptual whole, with emergent properties. For our test, we decided to start where these processes are taken to their limits, and therefore more clearly exposed: in poetry.

Verbal creativity, like any other type of creativity, does not operate from scratch: it combines and manipulates existing patterns (Lakoff & Turner, 1989). However, as we see, the application of fixed templates for metaphorical transfer (e.g., conceptual metaphors such as TIME IS SPACE or PEOPLE ARE ANIMALS) does not fully account for meanings built in context, in *creative*, opportunistic ways (e.g., "time flies when I am with her" or "my lawyer is a shark"). Since this nonpredetermined meaning construction is crucial in any aesthetic process, mapping patterns have so far proved ineffective for explaining how poetic effects emerge (Tsur, 2000). The blending framework has the potential to eliminate this dichotomy between patterns and creativity. Constructing a blend requires that predetermined mappings operate alongside the complex interaction between individual, semiotic code, and context. The aesthetic usage is probably the richest example of this interaction. To connect poetic language with some of the most conventional and entrenched templates for projections between concepts, we decided to investigate one of the classics of direct transfer models: mappings from space to time.

The Case of Time

The spatial nature of our concepts of time has long been noted in philosophy of knowledge (Guyau, 1890/1988). More recently, mappings between space and time have become the main case study for linguistic and psychological research on metaphorical projections between conceptual domains (Casasanto, 2009). Within the theoretical framework of conceptual metaphor theory (Lakoff & Johnson, 1980), time is a paradigmatic case of an abstract concept that needs to be built in terms of domains that are more clearly delineated in human experience (Lakoff, 1993). A considerable amount of cross-cultural evidence supports the psychological reality of space→time mappings (for recent reviews, see Boroditsky, Fuhrman, & McCormick, 2011; Santiago, Román, & Ouellet, 2011). In particular, many recent studies provide evidence for a mental timeline running in a direction congruent with the writing system (Fuhrman & Boroditsky, 2010; Ouellet, Santiago, Israeli, & Gabay, 2010; Tversky, Kugelmass, & Winter, 1991).

In one of the first studies on the orientation of time-space mappings (Tversky et al., 1991), participants associated earlier events with left locations in space, and later events with right locations. Evidence for the left-to-right orientation of the mental timeline has multiplied ever since; recent studies have examined response times to a variety of auditory and visual stimuli (Santiago, Lupiáñez, Pérez, & Funes, 2007; Santiago, Román, Ouellet, Rodríguez, & Pérez-Azor, 2010; Torralbo, Santiago, & Lupiáñez, 2006; Weger & Pratt, 2008), providing strong support for this hypothesis. The Tversky et al. (1991) study had already exposed cultural differences related to the writing system of participants. The causal role played by reading direction was confirmed by Casasanto and Bottini (2014).

While the evidence for space→time cross-domain mappings is strong, many details about the mental timeline still require further study. In particular, the conceptual metaphor framework does not address issues such as the adaptability of conceptual templates or the emergence of related meanings during online processing. As mentioned, semantic analysis shows that the representation of temporal relations through spatial relations emerges from a network of mappings that is far more complex than the binary projections of the time is space metaphor (Fauconnier & Turner, 2008). The psycholinguistic evidence, taken together, also shows that space→time mappings are flexible and adapt to context, goals, and cultural background (Santiago et al., 2011). A theoretical framework with a more adequate level of granularity is necessary for asking more detailed questions about the timeline pattern, such as preferred shape (and not only orientation), activation in relation with temporal/nontemporal and verbal/nonverbal tasks (see, e.g., Ulrich & Maienborn, 2010), the constraints on its creative use, its interaction with other conceptual templates, and so forth

In the present study, we wanted to find out to what extent the timeline pattern could influence creative mental imagery in figurative language understanding. We conducted two experiments to test whether the visualization of the second term of a poetic simile, with the words "like the machete the snake," would be modified by readers who established mappings between the image of the snake and the mental timeline.

The Poem

The text used consisted of the first five lines of the poem "Más allá del amor" ["Beyond love"] (1948), by the Mexican poet Octavio Paz (Paz, 1968), in the Spanish original:

> Todo nos amenaza:
> el tiempo, que en vivientes fragmentos divide
> al que fui
> del que seré,
> como el machete a la culebra

Our translation, as literal as possible:

> Everything threatens us:
> time, which into living fragments divides
> the one I was
> from the one I will be,
> like the machete the snake

This simile was chosen because of its particular connection of the snake image with time and the self. The fifth line of the poem, "like the machete the snake," prompts the reader to imagine a scene/event in which a snake is cut by a machete. This is the vehicle. The topic is complex and already metaphorical by itself: time is an agent that cuts the speaker's self into living fragments, separating "the one I was" from "the one I will be."

On the one hand, numerous studies have shown that understanding a sentence involves imagistic mental simulations (see Barsalou, Santos, Kyle Simmons, & Wilson, 2008, for a review), which depend on the instructions provided by the utterance and on prototypical categories derived from experience and culture. These simulations can contain detailed information about the mental image, including specific parameters such as shape (Zwaan, Stanfield, & Yaxley, 2002) or orientation (Stanfield & Zwaan, 2001). Thus, reading a text in which a snake is mentioned will prompt for an imagistic simulation that combines prototypical visualizations of this animal with the particular verbal cues in the utterance.

On the other hand, processing temporal expressions, such as the ones in the topic, causes the activation of a mental timeline (Santiago et al., 2007), a one-dimensional linear representation (a straight line) where points in space assume the meaning of temporal moments and facilitate the thinking about the order and duration of events (Coulson & Pagán Cánovas, 2014). In Western cultures, which use a left-to-right writing system, the mental timeline runs from left to right (Ouellet et al., 2010; Tversky, Kugelmass, & Winter, 1991): earlier times are mapped on the left side, later times are mapped on the right side, and time moves rightward from past to future. The timeline's shape and orientation are hardly compatible with the image of a snake.

Besides this incompatibility, it should be taken into account that the utterance "like the machete the snake" constitutes the second term of a particularly unconventional poetic simile. This makes predictions about meaning construction less than straightforward. As a matter of fact, the text gives no indications whatsoever about how the machete-snake image in the second term of the simile should be visualized. The text indeed *creates the opportunity*, *not at all the necessity*, to activate the timeline. Let us see briefly how it prompts for mappings related to time.

The first line sets a conceptual frame of threat. Who is threatened we do not know, but we do know that the speaker is included in the "us," and therefore is feeling threatened. The colon indicates that "time [el tiempo]" is here depicted as one of the agents that threaten "us." Time, in its role as this threatening agent, divides something into living fragments. In the next two lines, the "living fragments" are associated with the past self and the future self, each occupying one line and therefore one distinct intonational unit. The connector *como* (like) prompts the reader to use the preceding three lines ("time" + its relative clause) as the first term of a simile. This first term is conceptually quite complex: in this mental configuration, time is a metaphoric agent that cuts the speaker's self into living fragments, separating "the one I was" from "the one I will be." This complex concept is to be compared with what the machete (does) to the snake. The conceptual mappings suggested are clearly the following:

- machete → time as agent that divides/separates;
- snake → self-divided into living fragments corresponding to past and future selves; and
- violent cut performed by the machete upon the snake (omitted, with no verbal form in the second term of the simile) → division/cut/separation into living fragments caused by time on the self.

Completing the analogy will also require that the machete cuts the snake in two pieces ("the one I was," "the one I will be"), although not even this is made explicit. Beyond this aspect, there are no indications, explicit or implicit, about the shape, position, or orientation of the snake, nor any suggestions that these properties may be relevant at all. It is also important to note that, even if the timeline is activated during the first four lines, the necessity of projecting it onto the image of the snake is by no means obvious. The main function of the simile is to turn the complex, metaphorical, and very abstract concept in the topic into something much more concrete and emotional, by projecting the violence of the machete-snake scene. Thus the vehicle invites us to feel extreme pain, pity, revulsion, powerlessness, and so forth. Nothing indicates that the machete-snake vehicle is being used as an aid for representing diachrony or other temporal relations, as a timeline would be. Moreover, a simile, as opposed to a metaphor, does not invite the reader to identify the topic with the vehicle (X is Y) completely, but rather to keep them separate (X is *like* Y).

The text was chosen precisely because of the great freedom given to the reader for imagining the vehicle, combined with all of the factors that militate against an integration of vehicle and topic. Despite all of these unfavorable conditions, will the mental image of the snake acquire relevant properties of the "timeline-self" in the mind of the reader? This was the central question of Study 1. In particular, we tested whether the snake adopted a more straight shape and a left-to-right orientation, by asking readers of the poem to draw the snake.

If, despite all this, the snake acquires timeline properties, there is still the question of whether the resulting blend is just a side effect, or, on the contrary, it is used for making sense of the simile. To test this, we divided the participants into two groups: those who made the connections prompted by the simile and those who did not. We assessed meaning integration separately in each group.

Study 1: Timeline Snakes

Method

Participants. The experimental group consisted of 89 participants. An additional group of 27 participants served as control. All participants were native speakers of Spanish studying at the University of Murcia, and participated in exchange for course credit (89% female, mean age 21.9 years, age range 20–26). All materials and interaction with the experimenter were in Spanish.

Procedure. All participants in the experimental group were presented with a booklet composed of two sheets of paper. In the first one, the poem by Octavio Paz (Paz, 1968) was printed on the top half and a 17.5 × 15.5 cm empty square was printed on the bottom half. Printed instructions on the first sheet told the participants to read the poem carefully and then to draw the snake mentioned in the poem within the square supplied. They were told that there were no correct or incorrect answers. Only after completing this task, they were told to turn to the second sheet and fill in a questionnaire with five questions about their interpretation of their own drawing, aimed to find out whether they had assigned temporal meanings to the snake. The questions were:

1. What do you think the snake represents?
2. In what position did you draw the snake? Could you explain why?
3. Where was its head? Could you explain why?
4. Does the snake's head mean anything?
5. Is it indifferent for the machete to cut closer or further away from the head? If not, what is the difference?

Participants were told that there were no correct or incorrect answers to the questions; no time limit was specified.

Participants in the control group were given a single sheet of paper with a 17.5 × 15.5 cm empty square printed on the bottom half and were instructed to draw a snake (*culebra*) in any way they liked. They were also told that there were no correct or incorrect answers and carried out the task without time pressure.

Data analysis. The curvature of the snake was measured as follows. First, the number of curves of the snake was counted. Then, this measurement was qualified in order to take into account the width of the curves drawn. The following formula was used to calculate this index:

$$\text{Curv} = N_{\text{arcs}} \times \sum (r_n / l)$$

where r is the radius of each curve (that is, the distance between the outer point of each curve and the bisecting line of all arcs), which is then divided by the length of a straight line between the snake's head and its tail (l) (Figure 1). This means that given two snakes with the same length and same number of curves, the one with deeper curves will achieve a higher curvature index. Measurements were taken by two different coders, who were blind to the purpose of the study. Each coder measured one half of the responses.

The curvature index provided a highly skewed distribution, with most responses concentrated in low curvatures (between 0 and 1)

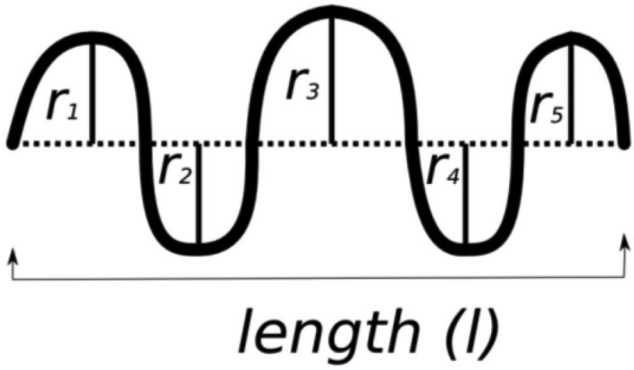

Figure 1. Applying the formula for the curvature index.

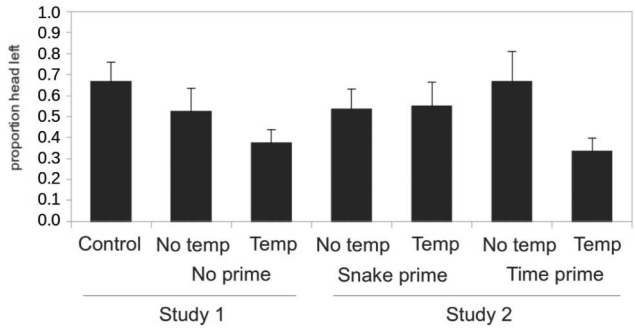

Figure 3. Proportion of snakes oriented leftward (error bars show SEMs). No temp: participants who do not make the temporal construal of the snake. Temp: participants who make the temporal construal of the snake.

with a long right tail. The distribution departed significantly from normality (Kolmogorov–Smirnov $d = 0.227$, associated Lilliefors $p < .01$). Therefore, this index was analyzed by means of nonparametric Mann–Whitney U contrasts.

Head position was analyzed only for horizontal snakes, which constituted the majority of data (97% of all participants in Studies 1 and 2), by means of binary logistic regression.

Results

The answers provided in the last sheet, especially Question 1 ("What do you think the snake represents?"), allowed us to separate those who assigned the snake temporal meanings ($N = 65$; 73.03%) from those who generated nontemporal interpretations (e.g., evil, threat, etc.; $N = 24$; 26.96%). Answers to Questions 2 to 5 were mostly coherent with the answer to Question 1 and also contributed to this classification (e.g., answers to Question 4 ["does the head of the snake mean anything?"] in the former group included sentences such as "it indicates the direction of time, which is the same as the snake's direction").

The control group provided a baseline for comparison (Figure 2). Control snakes had a mean curvature index of 3.27, and a majority of the horizontal snakes had the head on the left (66.7%; Figure 3). Consistent with present hypotheses, those in the experimental group who construed a temporal interpretation of the simile ($N = 65$; 73.03%) drew more straight snakes than the control group (Mann–Whitney U, $z = 4.05$, $p = .00005$). Moreover, snakes heading left were in the minority (Wald's chi-square = 6.21, $df = 1$, $p = .013$). Therefore, grasping the meaning of the simile was able to both straighten the mental image of the snake and revert its directionality to make it agree with the spatial characteristics of timelines.

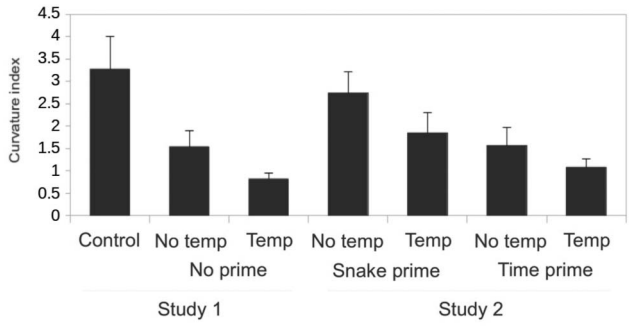

Figure 2. Mean curvature index (error bars show SEMs). No temp: participants who do not make the temporal construal of the snake. Temp: participants who make the temporal construal of the snake.

The nontemporal-interpretation subgroup ($N = 24$) also differed marginally from the control group in the degree of curvature of their snakes (Mann–Whitney U, $z = 1.92$, $p = .052$). Regarding head direction, leftward- and rightward-headed snakes were equally frequent in this group and the contrast with the control group was nonsignificant (Wald's chi-square = 1.00, $df = 1$, $p = .32$).

Finally, the snakes of the temporal-interpretation subgroup were less curvy than those drawn by the nontemporal-interpretation subgroup (Mann–Whitney U, $z = 4.05$, $p = .00005$). The shift in snake directionality was consistent with the change in curvature (37.5% leftward in the former vs. 52.4% in the latter), but did not differ significantly between the two subgroups (Wald's chi-square = 1.43, $df = 1$, $p = .23$).

These results agree with the creation of a conceptual blend: when the temporal connections in the simile are established, the mental images of the snake and the timeline become integrated, leading to more straight snakes facing rightward, as compared to a control baseline. Mere exposure to the text (without consciously assigning temporal meaning to the snake) was enough to straighten the snakes to a lesser (marginally significant) degree.

Study 2: Biasing the Blend Toward Time or Snake

In Study 2 we manipulated the availability of each input to the simile, by asking participants questions about either snakes or temporal sequences prior to their reading of the poem. We expected that the greater availability of either vehicle or topic would permeate inside the meshing of concepts and affect the curviness and orientation of the imagined snake. If a blend of snake and timeline is not just a side effect resulting from the proximity of both concepts, but plays a relevant role in constructing the meaning of the text, effects related to input availability should be stronger in participants who ascribed temporal meaning to the snake.

Method

Participants. There were two experimental groups for this task: the snake-primed group (snake group, for short), with 51 participants (88.2% female, mean age 21.6, age range 20–26), and the time-primed group (time group), with 67 participants (85.2% female, mean age 21.4, age range 20–24). All participants came from the same population as in Study 1. Assignment to conditions was random.

Procedure. The snake group answered a number of questions about the behavior, habitat or morphology of snakes (such as the relative length or width of a boa, a cobra, or an adder, the way snakes move, where different snakes live, etc.). Questions carefully avoided referring to the curviness of snakes. The time group was primed instead with a set of questions about time relations that are conventionally structured using the mental timeline (e.g., ordering a list of events that constitute a complex action, such as cooking an omelet, or ordering a list of movies or historical events chronologically). The questionnaires are provided in the Appendix.

After answering one of these questionnaires, both groups completed the same experimental task as in Study 1: they read the poem, drew the snake that was mentioned therein, and answered the same set of questions about the meaning of the snake, its head position, and so forth Again, no time limit was set, and they were told that there were no correct or incorrect answers.

Results

The two types of prime affected the interpretation of the snake: in the snake group, 21 participants (42%) built a temporal interpretation versus 55 (82%) in the time group, a significant difference (Wald's chi-square = 17.83, $df = 1$, $p < .001$). Compared to the experimental group in Study 1, in which participants read the poem with no prime, the snake prime decreased the temporal reading (Wald's chi-square = 11.82, $df = 1$, $p = .001$), whereas the time prime had no effect (Wald's chi-square = 1.75, $df = 1$, $p = .18$). It is thus possible that the construal of the temporal meaning was already at ceiling without prime. Alternatively, it is possible that the temporal pretask did not provide as strong a prime as the snake one.

Study 2 also replicated the main findings of Study 1: participants who established the temporal connections in the simile drew snakes that were significantly less curvy (Mann–Whitney U, $z = 2.86$, $p = .004$; see Figure 2) and marginally more rightward oriented (Wald's chi-square = 3.46, $df = 1$, $p = .06$; see Figure 3) than those who did not.

Consistent with the blending hypothesis, snake curvature differed between prime conditions in temporal-interpretation participants: the snake group drew curvier snakes than the time group (Mann–Whitney U, $z = 1.98$, $p = .047$; see Figure 2). The temporal-interpretation snake group also drew curvier snakes than the temporal-interpretation group without prime in Study 1 (Mann–Whitney U, $z = -2.79$, $p = .005$). Activating the snake source domain by means of the snake prime did increase the curvature of the snakes. In contrast, the snakes in the temporal-interpretation time group did not differ in curvature from those in the temporal-interpretation group without prime in Study 1 (Mann–Whitney U, $z = -0.67$, $p = .50$). Thus, the curvature index also showed that the temporal prime had no effect.

Participants in the snake and time groups who did not make a temporal interpretation of the snake showed means that went in the direction of curvier snakes in the snake group (see Figure 2), but this difference only approached significance (Mann–Whitney U, $z = 1.50$, $p = .13$). Thus, Study 2 again supported the predictions from the blending hypothesis, and showed that the results are not a mere side effect of prior exposure to the relevant conceptual domains.

Regarding snake direction, as mentioned above, temporal-interpretation participants in both prime groups drew marginally more rightward snakes than nontemporal-interpretation participants. Interestingly, this difference was completely due to the time group (Wald's chi-square = 4.19, $df = 1$, $p = .04$; see Figure 3), whereas the snake group did not show any differential tendency to orient the snake depending on whether they made the temporal connections in the simile or not (Wald's chi-square = 0.01, $df = 1$, $p = .92$). Comparisons with the temporal-interpretation group without prime in Study 1 showed that neither kind of priming exerted a statistically significant bias in head direction (snake priming: Wald's chi-square = 1.88, $df = 1$, $p = .17$; time priming: Wald's chi-square = 0.22, $df = 1$, $p = .63$).

Summing up, Study 2 showed that prior activation of the snake conceptual domain is able to reduce the number of participants who discover the temporal meaning of the simile in comparison to the group with no prime in Study 1. The temporal prime, instead, did not increase the number of participants who made a temporal construal. More importantly, Study 2 also replicated the main findings of Study 1: participants who made a temporal interpretation drew snakes that were less curvy and (marginally) more rightward oriented than participants who did not. Crucially for the predictions of the blending hypothesis, those participants who built the temporal meaning of the simile drew curvier snakes after the snake prime than both those who were not primed in Study 1 and those who were time-primed in Study 2. The temporal prime did not further decrease curvature as compared to the no-prime group, which is consistent with either a ceiling effect or a not strong enough prime.

Discussion

Contrary to expectations from most current theories of simile and metaphor, in the present study we have shown how the vehicle in a simile is adapted to fit central properties of the topic, even when no elements from the text prompt the reader to do so. When participants understood that the self-divided by time was like the snake, the snake became a time-affected object as well. To the best of our knowledge, the present study is the first to provide experimental evidence for the integration of the vehicle (or source) and the topic (or target) of a metaphorical representation into a new conceptual whole with emergent properties that affect both inputs. Readers flexibly adapted their visualization of the snake, in order to achieve a spatial configuration that is more suitable for representing temporal relations.

The temporal meaning of the simile even seems to have influenced the participants who did not provide a conscious temporal interpretation (in Experiment 1) or were under a snake rather than a time priming condition (in Experiment 2). They all produced snake drawings that were flatter than those from the control group, although their snakes were indeed significantly curvier than those

drawn by participants who made a temporal interpretation. This shows that Octavio Paz's text is particularly efficient in prompting temporal meanings, despite the fact that snakes, in Spanish and Mexican cultures as well as around the world, have strong symbolisms that are unrelated to time. Also, it suggests that the tendency to comply with entrenched conceptualizations of time is strong enough to compete with the default shape of snake drawings, even in groups of readers in which the snake meaning is predominant.

The side-view drawing of a snake is prototypically curvy and leftward facing, as our control group shows. The degree of curvature is the most relevant parameter, since it is the one more systematically grounded on experience: in real life, the orientation of snakes is random, but their curvature index is always far from a straight line. Despite this, participants who showed awareness of mappings with temporal relations flattened the snake drawings dramatically. Moreover, they also oriented the snake rightward. Both changes are consistent with standard spatial characteristics of timelines.

The hybrid visualization of the snake-timeline, with its conflicting but adequate emergent properties, is consistent with the creation of a conceptual blend. As predicted by blending theory, this local conceptualization selectively connects and integrates elements from its inputs. The emergent concept or simulation is not isolated, but remains connected to its components through a mental network: the blend of *self-divided by time* and *snake cut by a machete* makes sense because it facilitates the comparison between its two inputs, suggesting new insights into their relationship. Study 2 showed that it is possible to increase the influence of one input domain on the structure of the blend by increasing its availability.

Following blending theory, in the integration of these clashing inputs (curvy snake oriented leftward and straight timeline running rightward) two main principles compete: achieving an integrated blend versus maintaining the appropriate connections with the inputs (the *integration* and *web* principles; see Fauconnier & Turner, 2002, pp. 309–352). The result is a compromise between both principles and, consequently, an attempt to produce a hybrid: a timeline that still looks like a snake, or a snake with timeline features.

Our case study is particularly apt for exposing this cognitive operation at work. The stimulus poem presented numerous factors that made the blending of vehicle and topic less likely. The final integration was also hard to predict in its details: the attention focus was far from the spatial disposition of the vehicle, which seemed irrelevant; the complexity and abstractness of the topic made detailed connections difficult; and the novelty and poetic character of the text allowed great freedom for elaborating mental imagery in unpredictable ways. Despite all this, we observed a clear relation between making full sense of the simile and integrating its components.

Additionally, these results also provide new data supporting the psychological reality of the mental timeline as a robust conceptual pattern. The flattening and reversion of the default curvy, right-to-left snake in the condition involving time mappings indicates that the "timeline habit" is strong enough to interfere with a basic, prototypical feature in the pictorial representation of a mental image. The spatial structure is being adjusted to produce an optimal representation.

In summary, when processing similes and (quite probably) metaphors, people do not project conceptual features only from vehicle onto topic. They do not only understand one thing in terms of another. Our data show that both vehicle and topic are inputs from which people integrate selected elements into an emergent conceptualization. This process of integration is flexible and dynamic: vehicle, topic, and the resulting mix are mutually adjusted to satisfy competing principles and to meet the demands of context and goals.

Many questions remain as to the characteristics and boundary conditions of the blending effect reported here. Now that this particularly apt simile seems to have put us on the right track, the results need to be confirmed through further studies with many more than just one stimulus. This will not only confirm the validity of the blending hypothesis but also test its scope and its relation with various formal prompts. For example, as we argued, a simile seems to be inviting the reader to keep its terms more separate than those of a metaphor, and our text was particularly appropriate for keeping the terms separate. Will we find stronger blending effects in texts that make the integration easier? As for gender balance in the participant population, we also need to confirm that the preponderance of female participants in the present study is not influencing the results in any way, although, in principle, there seems to be no reason why it should. Moreover, further studies will surely raise increasingly sophisticated questions about the cognitive status of poetic/creative usages as well as of blending itself. Will vehicles and topics blend only in highly creative uses of language, such as poetry, or will it also occur in more conventional metaphors? How will the principles of blending (such as achieving a familiar and well integrated blend while maximizing relevant connections) interplay in determining the final result? Measurable spatial parameters in mental imagery seem a promising way to obtain relatively clean data about the cognitive processes at work in online cross-domain mappings.

References

Barsalou, L., Santos, A., Kyle Simmons, W., & Wilson, C. D. (2008). Language and simulation in conceptual processing. In M. De Vega, A. Glenberg, & A. Graesser (Eds.), *Symbols and embodiment: Debates on meaning and cognition* (pp. 245–283). New York, NY: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780199217274.003.0013

Black, M. (1962). *Models and metaphors*. Ithaca, NY: Cornell University.

Boroditsky, L., Fuhrman, O., & McCormick, K. (2011). Do English and Mandarin speakers think about time differently? *Cognition, 118,* 123–129. http://dx.doi.org/10.1016/j.cognition.2010.09.010

Camp, E. (2006). Metaphor in the mind: The cognition of metaphor. *Philosophy Compass, 1,* 154–170. http://dx.doi.org/10.1111/j.1747-9991.2006.00013.x

Casasanto, D. (2009). When is a linguistic metaphor a conceptual metaphor? In V. Evans & S. Pourcel (Eds.), *New directions in cognitive linguistics* (Vol. 24, pp. 127–145). Amsterdam: John Benjamins. http://dx.doi.org/10.1075/hcp.24.11cas

Casasanto, D., & Bottini, R. (2014). Spatial language and abstract concepts. *WIREs Cognitive Science, 5,* 139–149. http://dx.doi.org/10.1002/wcs.1271

Clark, H. H. (1973). Space, time, semantics, and the child. In T. E. Moore (Ed.), *Cognitive development and the acquisition of language* (pp. 27–63). New York, NY: Academic Press. http://dx.doi.org/10.1016/B978-0-12-505850-6.50008-6

Coulson, S., & Pagan Cánovas, C. (2014). Understanding timelines: Conceptual metaphor and conceptual integration. *Journal of Cognitive Semiotics, 1,* 198–219.

Fauconnier, G. (1985). *Mental spaces: Aspects of meaning construction in natural language*. New York, NY: Cambridge University Press.

Fauconnier, G., & Turner, M. (2002). *The way we think: Conceptual blending and the mind's hidden complexities*. New York, NY: Basic Books.

Fauconnier, G., & Turner, M. (2008). Rethinking metaphor. In R. W. Gibbs (Ed.), *Cambridge handbook of metaphor and thought* (pp. 53–66). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511816802.005

Fuhrman, O., & Boroditsky, L. (2010). Cross-cultural differences in mental representations of time: Evidence from an implicit nonlinguistic task. *Cognitive Science, 34,* 1430–1451. http://dx.doi.org/10.1111/j.1551-6709.2010.01105.x

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science, 7,* 155–170. http://dx.doi.org/10.1207/s15516709cog0702_3

Gibbs, R. W. (1994). *The poetics of mind: Figurative thought, language, and understanding*. New York, NY: Cambridge University Press.

Glucksberg, S., & Keysar, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review, 97,* 3–18. http://dx.doi.org/10.1037/0033-295X.97.1.3

Glucksberg, S., McGlone, M. S., & Manfredi, D. (1997). Property attribution in metaphor comprehension. *Journal of Memory and Language, 36,* 50–67. http://dx.doi.org/10.1006/jmla.1996.2479

Grady, J., Oakley, T., & Coulson, S. (1999). Conceptual blending and metaphor. In R. Gibbs (Ed.), *Metaphor in cognitive linguistics* (pp. 101–124). Philadelphia, PA: John Benjamins. http://dx.doi.org/10.1075/cilt.175.07gra

Guyau, J.-M. (1988). The origin of the idea of time. In J. A. Michon, V. Pouthas, & J. L. Jackson (Eds.), *Guyau and the idea of time*. Amsterdam, The Netherlands: North-Holland. (Original work published 1890)

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and thought* (pp. 202–251). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139173865.013

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought*. New York, NY: Basic Books.

Lakoff, G., & Turner, M. (1989). *More than cool reason: A field guide to poetic metaphor*. Chicago, IL: The University of Chicago Press. http://dx.doi.org/10.7208/chicago/9780226470986.001.0001

Ortony, A. (1979). *Metaphor and thought*. New York, NY: Cambridge University Press.

Ouellet, M., Santiago, J., Israeli, Z., & Gabay, S. (2010). Is the future the right time? *Experimental Psychology, 57,* 308–314. http://dx.doi.org/10.1027/1618-3169/a000036

Paz, O. (1968). *Libertad bajo palabra: obra poética (1935-1957)* [Freedom under parole: Poetic works (1935-1957)]. Mexico DF: Fondo de Cultura Económica.

Santiago, J., Lupiáñez, J., Pérez, E., & Funes, M. J. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review, 14,* 512–516. http://dx.doi.org/10.3758/BF03194099

Santiago, J., Román, A., & Ouellet, M. (2011). Flexible foundations of abstract thought: A review and a theory. *Spatial Dimensions of Social Thought,* 41–110.

Santiago, J., Román, A., Ouellet, M., Rodríguez, N., & Pérez-Azor, P. (2010). In hindsight, life flows from left to right. *Psychological Research, 74,* 59–70. http://dx.doi.org/10.1007/s00426-008-0220-0

Stanfield, R. A., & Zwaan, R. A. (2001). The effect of implied orientation derived from verbal context on picture recognition. *Psychological Science, 12,* 153–156. http://dx.doi.org/10.1111/1467-9280.00326

Torralbo, A., Santiago, J., & Lupiáñez, J. (2006). Flexible conceptual projection of time onto spatial frames of reference. *Cognitive Science, 30,* 745–757. http://dx.doi.org/10.1207/s15516709cog0000_67

Tsur, R. (2000). Lakoff's roads not taken. *Pragmatics & Cognition, 2,* 339–359.

Tversky, B., Kugelmass, S., & Winter, A. (1991). Cross-cultural and developmental trends in graphic productions. *Cognitive Psychology, 23,* 515–557. http://dx.doi.org/10.1016/0010-0285(91)90005-9

Ulrich, R., & Maienborn, C. (2010). Left-right coding of past and future in language: The mental timeline during sentence processing. *Cognition, 117,* 126–138. http://dx.doi.org/10.1016/j.cognition.2010.08.001

Weger, U. W., & Pratt, J. (2008). Time flies like an arrow: Space-time compatibility effects suggest the use of a mental timeline. *Psychonomic Bulletin & Review, 15,* 426–430. http://dx.doi.org/10.3758/PBR.15.2.426

Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language comprehenders mentally represent the shapes of objects. *Psychological Science, 13,* 168–171. http://dx.doi.org/10.1111/1467-9280.00430

Appendix

Questionnaires for the Two Priming Conditions in Experiment 2

Time-Related Questionnaire

1. Nombra 4 meses a partir de marzo de manera alterna (saltándote uno cada vez). [Name four months starting with March, skipping one each time].

2. Ordena estos acontecimientos por orden cronológico: (a) primer presidente negro de EEUU; (b) final de la II Guerra Mundial; (c) llegada del hombre a la luna; (d) caída del Muro de Berlín; (e) ataque terrorista a las Torres Gemelas de NY (e.g., a > b > c > d > e). [Order these events chronologically: (a) first Black president of the USA; (b) end of the Second World War; (c) first man on the moon; (d) fall of the Berlin Wall; (e) terrorist attack on NY Twin Towers].

3. ¿Qué comidas preceden a la cena? [Which meals precede dinner?]

4. Si hoy es martes, ¿cuántos días tardará el sábado en llegar? [If today is a Tuesday, how many days will it take for Saturday to arrive?]

5. ¿Qué vuelo desde Madrid tendrá una mayor duración, un vuelo a París o un vuelo a Berlín? [Which flight from Madrid takes longer, a flight to Paris or a flight to Berlin?]

6. ¿Cuál es el cuarto día de la semana? [Which is the fourth day of the week?]

7. Ordena estas películas desde la más antigua a la más reciente: (a) El Señor de los Anillos; (b) El Hobbit; (c) Lo que el viento se llevó; (d) El Padrino; (e) El Silencio de los Corderos (e.g., a > b > c > d > e). [Order these movies chronologically: (a) Lord of the Rings; (b) The Hobbit; (c) Gone with the Wind; (d) the Godfather; (e) The Silence of the Lambs.]

8. ¿En qué orden se hace esto? Para hacer una tortilla hay que: (a) darle la vuelta; (b) batir el huevo; (c) echar el huevo en la sartén; (d) cascar un huevo y ponerlo en el plato; (e) poner un poco de sal (e.g., a > b > c > d > e). [Order the following events: to make an omelette you have to: (a) turn it around; (b) beat the egg; (c) put the egg on the pan; (d) crack an egg and put it on a plate; (e) add a pinch of salt.]

9. Corriendo a la misma velocidad, ¿tardas más en atravesar una pista de baloncesto de lado a lado o una de fútbol? [Running at the same speed, would it take you longer to cross a basketball field or a football field?]

10. Ordena de la manera que tú creas que es más usual estos acontecimientos de la vida de una persona: (a) tener hijos; (b) retirarse; c) ir a la universidad; (d) encontrar trabajo; (e) hacer la selectividad (e.g., i > ii > iii > iv > v). [Order the following events in a person's life in the most usual order, according to your opinion; (a) have children; (b) retire; (c) go to University; (d) find a job; (e) get your SAT scores].

Snake-Related Questionnaire

1. ¿Cuál crees que es más larga, una culebra, una pitón o una cobra? [Which do you think is longer, a boa, a cobra, or an adder?].

2. ¿Y cuál es más gruesa? [And which is thicker?].

3. ¿Cuál de éstas asfixia a sus presas enrollándose alrededor y apretando (boa, cobra o culebra)? [Which of these kill their prey by constriction? (boa, cobra, or adder)].

4. ¿En qué habitat crees que vive la culebra? (aproximadamente) [What is a typical habitat for an adder? (approximately)].

5. ¿Qué serpiente crees que se desplaza más rápido (culebra, pitón o boa)? [Which snake do you think moves faster (adder, python, or boa)?]

6. Las serpientes que se desplazan por el agua, ¿nadan o bucean? [Do snakes that move through water swim or dive?]

7. Imagínate una serpiente durmiendo: ¿tiene la cabeza en el suelo o sobre su propio cuerpo? [Picture a sleeping snake: is its head on the floor or on its own body?].

8. ¿Cuál(es) de estas se sube(n) a los árboles (culebra, pitón, cobra)? [Which of these climb trees (adder, python, cobra)].

9. Imagínate que pisas una culebra. ¿Qué hace? [Imagine you step on an adder. What does it do?]

10. ¿Cómo reptan las culebras, avanzando de frente o de lado? [How do adders slither, advancing sideways or forward?]

Received October 12, 2014
Revision received April 21, 2015
Accepted April 25, 2015 ■