Metaphor and embodied cognition

(Metáfora e cognição corpórea)

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Abstract: *The present paper briefly describes recent advances in cognitive science on the embodied nature of human cognition with the aim to better situating contemporary work on embodied metaphor in language and thought. We do this by talking about key experimental findings in five areas main areas of research in cognitive science: perception, concepts, mental imagery, memory, and language processing (Gibbs 2006a) We also describe some psycholinguistic studies on embodied metaphor understanding, and offer some details on one series of experiments in regard to people's embodied understanding of the DIFFICULTIES ARE WEIGHTS primary metaphor. Our conclusion draws connections between the research on embodied cognition and contemporary linguistic and psychological work on embodied metaphor.*

Key-words: *cognitive science; embodied human cognition; primary metaphors; embodied metaphors.*

Resumo: *O presente trabalho descreve sucintamente avanços na ciência cognitiva a respeito da natureza corpórea da cognição humana com o objetivo de melhor situar o trabalho contemporâneo sobre metáforas corpóreas na linguagem e no pensamento. Fazemos isso por discutir achados de experimentos centrais em cinco áreas principais de pesquisa em ciência cognitiva: percepção, conceitos, imagem mental, memória e processamento da linguagem (Gibbs 2006a). Descrevemos também alguns estudos psicolinguísticos sobre a compreensão de metáforas corpóreas e detalhamos uma série de experimentos desenhados para investigar a compreensão corporificada de pessoas a respeito da metáfora primária DIFICULDADES SÃO PESOS. Nossa conclusão busca pontos de interesse comum entre a pesquisa sobre cognição corpórea e trabalhos na área da lingüística e psicologia sobre metáfora corpórea.*

Palavras-chave: *ciência cognitiva; cognição humana corpórea; metáforas primárias; metáforas corpóreas.*

Metaphor and embodied cognition

One of the key discoveries in the contemporary revolution in metaphor studies is the embodied nature of metaphorical thought and language. Although metaphor is traditionally seen as a special kind of poetic language, the demonstrations from cognitive linguistics that metaphor is a fundamental scheme of thought has cast metaphor in a new light within the scientific understanding of the human mind. Metaphor, far from being an ornamental aspect of language, is integral to the way people speak and think about a wide variety of human events and abstract concepts. Yet metaphor is not now just something we think by, it is a mode of being that arises from recurring patterns of embodied experience. When we talk, in English, of "My new research is off to a good start," we do so because movement along a path is a pervasive bodily experience in everyday life that provides an ideal foundation for thinking about the more abstract idea of progress toward some abstract goal (e.g., PROGRESS TOWARD A GOAL IS MOVEMENT ALONG A PATH TOWARD A DESTINATION).

Many metaphor scholars now examine, primarily through detailed linguistic analyses, the ways that language gives evidence of the embodied foundation of abstract thought. Our aim is to briefly describe several other advances in cognitive science on the embodied nature of human cognition in order to situate contemporary work on embodied metaphor in language and thought by talking about key experimental findings in five areas that are major foci of research in cognitive science: perception, concepts, mental imagery, memory, and language processing (Gibbs 2006a). Additionally, we describe some psycholinguistic studies on embodied metaphor understanding, and discuss one series of experiments devised probe into people's embodied understanding of the DIFFICULTIES ARE WEIGHTS primary metaphor. Our conclusion draws connections between the research on embodied cognition and contemporary linguistic and psychological work on embodied metaphor.

Perception

Our ability to perceive something in the world (e.g. looking at a bottle sitting on a table) seems to be quite different from our ability to act in the world (e.g., reach out and grab the bottle sitting on the table).

This traditional distinction between perception and action has had the consequence of scholars believing that perception is a relatively passive process by which information is received by a sensory organ (i.e., vision, audition, touch, taste, smell), and then transformed along some pathway through the nervous system until finally reaching some dedicated brain area (e.g., visual cortex). Only after one has veridically perceived something can we presumably then engage in motor processes to act on what it is that we have perceived (e.g., seeing and then reaching out to grab the bottle on the table).

But contemporary cognitive science reveals many demonstrations of the tight link between perception and action (Gibbs 2006a). Object perception is not an event that happens to us; rather it is something that we do by looking at the object. Our looking at something is a goal-directed task that demands the coordination of head position and eye focus to bring the object into the visual field. To do this, the world is conceptualized in part as patterns of possible bodily interactions, or affordances (e.g., how we can move our hands and fingers, our legs and bodies, our eyes and ears, to deal with the world that presents itself). Under this perspective, eyes themselves do not see. But to see is to explore the environment by means of the exercise of one's visual apparatus (e.g., one's eyes).

Are people aware of bodily possibilities when they see objects? A growing body of research has demonstrated that people readily perceive objects in terms of the possible bodily actions they afford. For instance, when observers are asked to view stairs of different heights and judge the one they could ascend in a normal fashion, they were consistent and accurate with respect to their actual stair-climbing abilities (i.e., judged climbing heights were a constant proportion of leg length) (Warren 1984). Similar findings have been reported for people's judgments of the capabilities of different people grasping of real objects, catching fly balls, using tools, climbing walls, and navigating through virtual reality environments (Gibbs 2006a). The results of these studies are consistent with the idea that anticipated bodily interactions are a significant part of perceptual experience.

Consistent with these findings, many scholars now argue that visually perceiving an object without touching it partly involves imagining how it may be physically manipulated (Gibbs 2006a; Gibson 1979; O'Regan 1992). This perception-action coupling suggests that perceiving an object

requires people to conjecture something that if pulled would bend, if thrown would knock something else aside, and if turned would reveal another side. You see an object and imagine how you might use it without doing so. For example, you may understand the chair in the corner of the room as something you could potentially sit on or stand on or lift to ward off a snarling lion if approached you. This idea can be extended to all objects and physical events in the world. In this way, perceiving something is not simply a visual experience, but involves nonvisual, sensory experiences such as smells, sounds, and movement of one's entire body, such as the feelings of readiness to take specific action upon the object.

Perhaps the most compelling evidence for the coupling of perception and actions comes from the large body of research on "mirror neurons." This discovery originated in work on monkey perception that accidentally revealed monkey ventral premotor cortex is active both when a monkey observes a specific action, such as someone grasping a food item, and when the monkey performs the same kind of action (Gallese 2000). Neurons in monkey premotor cortex discharge both when the animal performs a specific action and when it hears the corresponding action-related sound. Observations like this have also been extensively reported in human studies showing that there are shared motor representations for action, observation of another person's actions, and imitation and mental simulation of action. More recently, it has been shown that the mirror neurons system is directly involved in the perception of communicative action, in imitation, in basic forms of mind reading, and experiences of empathy (Stamenov & Gallese 2002).

Thus, there is a variety of research that demonstrates the embodied nature of perception such that our ability to perceive things and events in the world is tightly associated with our own tacit movements, as if we were engaging in those same actions that we see in the world. This conclusion will tie in nicely with current ideas about metaphor understanding where our ability to interpret metaphoric language rests on our abilities to imagine acting in relevant real-world ways.

Mental imagery

Close your eyes for a moment and try to imagine the face of a loved one. How is this act of perceiving in your mind's eye similar to your actually

looking at your loved one's face? We typically think of our ability to mentally imagine objects, people, or events as being somewhat related to vision, yet distinct from bodily action. The classic empirical work on mental imagery investigates possible correspondences between mental imagery and visual perception. For example, participants in one classic study were presented with two-dimensional drawings of pairs of three-dimensional objects. The participants' task was to determine whether the two represented objects were identical except for orientation (Shepard & Metzler 1971). Some of the figures required rotation solely within the picture plane, whereas others required rotation in depth "(into" the page). The general result was that, whether for two- or three-dimensional rotations, participants seemed to rotate the objects mentally at a fixed rate of approximately 60 degrees/second. For many years, psychologists assumed that cognitive abilities, such as those observed in mental rotation studies, demonstrate the tight link between visual perception and mental imagery.

However, recent work suggests that many aspects of visual and motor imagery share a common representational, and possibly neuropsychological, substrate. Wexler et al. (1998) examined the relationship between mental rotation and motor processes by asking participants to rotate a hand-held joystick in a direction either in congruence or in opposition to the direction of simultaneous rotation of a mental image. Prior to the main experimental task, participants practiced the joystick rotation task. A visual tunnel prevented participants from seeing their hands as they manipulated the joystick. Participants practiced rotating the joystick at one of two specific speeds (45 or 90 degrees/second) in both clockwise and counterclockwise directions until they were adept at the task.

During the main experiment, participants simultaneously performed both a mental imagery rotation task and the motor rotation task. The mental rotation task used two-dimensional block drawings. One figure was presented at the top of a display for 5 seconds. Immediately afterward, an arrow was briefly displayed indicating where a second figure would appear. The second figure then appeared and was either a rotation (of varying degrees) of the original figure or a rotation of a mirror reflection (flipped 180 degrees on its vertical axis) of the original figure. The participants had to indicate whether the second figure was identical to the first (and simply rotated) or a mirror image of the first figure. When performing the motor task, participants were instructed to begin rotating the joystick (in the

specified direction and at the proper speed) at the same time as the onset of the initial figure in the mental rotation task. The joystick rotation continued until the participant made a response in the mental rotation task.

The main finding in this study was that "clockwise motor rotation facilitates clockwise mental rotation and hinders counterclockwise mental rotation, and vice-versa for counterclockwise motor rotation" (Wexler et al. 1998: 86). Mental rotation was faster when it was in the same direction as the motor rotation than when the two rotations were in opposite directions. The speed of the motor rotation also influenced the speed of the mental rotation. People typically perform faster with practice across trials in a mental rotation task. Yet in this study, people who completed a first session of trials with a fast motor rotation speed followed by a second session with a slow motor rotation speed did not perform in this manner. Mental rotation speed decreased slightly for these participants in the second session compared to the first, indicating a tight link between mental and motor rotation speeds. In general, experimental work supports the idea of a tight, dynamic relation between mental and motor rotation. Our ability to form a mental image, and to do things with this image, is closely associated with our abilities to act in the real world.

CONCEPTS

What is your concept for a thing called a "chair"? The traditional view in psychology and philosophy argues that concepts are stored mental representations that enable people to identify objects and events in the real world. For example, your "chair" concept should capture the physical properties of chairs that are necessary and sufficient for membership apart from the contexts in which chairs appear. People presumably identify certain features or attributes of objects in the world, such as "that object has four legs and a place to sit," that match pre-existing summary representations in long-term memory (i.e., your concept of "chair").

Most theories of concepts assume that there is a single amodal symbol to represent a property across different categories. For example, there must be a conceptual symbol for the property "red" that is the same attribute in concepts as different as apples, wine, and fire trucks. Amodal symbols are language-independent, context-independent, and disembodied. But this

classical view of concepts has now been replaced by a theory that shows the embodied nature of both concrete and abstract concepts.

First, much research points to the flexibility of concepts, which is difficult to reconcile with traditional views of concepts as abstract, disembodied symbols. One set of studies asked people to provide definitions for categories, such as bachelor, bird, and chair (Barsalou 1995). An analysis of the overlap in the features participants provided for a given category revealed that on average only 47% of the features in one person's definitions for a category existed in another person's definition. A great deal of flexibility also exists within individuals when they are asked to provide definitions for concepts. When participants in the above study returned 2 weeks later and defined the same categories again, only 66% of the features noted in the first session were produced again in the second session. These results indicate that substantial flexibility exists in how a person conceptualizes the same category on different occasions, such that concepts may not exist in a summary form apart from our understandings of context.

Second, conceptual processing involves sensorimotor simulations. Concepts are not understood and stored as abstract, disembodied symbols, because crucial elements of relevant perceptual and sensorimotor information are used in conceptual processing. For example, evidence from cognitive neuroscience suggests that concepts are grounded in sensory-motor regions of the brain (Pulvermueller 1999). Thus, functional imagery studies demonstrate that processing man-made objects activates the left ventral premotor cortex (Grafton, Fadiga, Arbib, & Rizzolatti 1997). Comprehension of man-made objects may therefore depend on motor-based knowledge of object utilization (action knowledge).

One possibility, then, is that conceptualizing an object involves simulating one's action experiences with that object. For instance, imagining a chair in a living room evokes a very different chair than imagining a chair in a jet or a dentist's office. One study nicely illustrates how people imagine themselves in concrete situations to produce exemplars of concepts (Vallee-Tourangeau, Anthony & Austin 1998). Participants generated exemplars from common taxonomic categories, such as furniture and fruits, and from ad hoc categories such as "things dogs chase" and "reasons for going on a holiday." Afterward, participants described the strategies they used in generating these examples.

Several kinds of strategies were reported. "Experiential mediation" involved retrieving an autobiographical memory of a situation that contained individuals from the target category, and then reporting the category to which this individual belonged. When generating types of fruit, for example, participants first retrieved a memory of a grocery store, scanned across it, and reported the types of fruit present in the produce section. "Semantic mediation," on the other hand, involved first retrieving a detached taxonomy that contained the target category and then reporting its subcategories. Thus, when generating examples of fruit, people first retrieved the fruit taxonomy and then reported subtypes, such as tropical fruit, dried fruit, and citrus fruit.

Analysis of participants' self-reported strategies showed that people used "experiential mediation" about three times as often as "semantic mediation" for both common taxonomic and ad hoc categories. It is not surprising that situations are important for ad hoc categories, given that these categories arise out of goal-directed activity in specific contexts. Much more surprising is that concrete situations were reported just as often for common taxonomic categories, suggesting that they, too, are organized around embodied situations. In general, conceptualization of a category typically includes background information based partly on people's embodied simulations or acting in life-like situations. But each conceptualization represents a category in a way that is relevant to the background situation, such that different conceptualizations represent the category differently. In this way, concepts are not static, pre-coded entities sitting in mind, but arise in context from a tight coupling of cognitive and motoric processes that are most relevant in that situation.

PROBLEM SOLVING

Solving problems appears to be a highly cognitive activity that is the hallmark of the rational, intellectual mind. Rodin's famous sculptor of "The Thinker" symbolizes a person deep in thought, while motionless, trying to make some decision. We too often view ourselves as disembodied thinker with our bodies acting as mere vessels for our brains where cognition really takes place. To some people, the body in action interferes with high-level cognition as movement distracts one from concentrating on the task at hand. In some cases, we even close our eyes to better focus the mind's intellectual powers so as not to be disturbed by the real world around us.

But there is now abundant evidence in cognitive science that bodily actions enhance problem-solving and even creative thought. Complementary bodily action, indeed, appears to facilitate people's problem solving abilities. For instance, in one study, participants were shown two sets of 30 U.S. coins (i.e., different quarters, dimes, and nickels) and asked to calculate the amount in dollars and cents (Kirsh 1996). People were faster and more accurate in determining the sum when they were allowed to touch the coins than when they were not allowed to use their hands. Touching the coins appears to help people remember intermediate sums, in the same way that writing down the intermediate sums facilitates solving complex multiplication problems.

The claim that problem solving incorporates bodily action can also be demonstrated through a simple example of asking one to solve a long-division arithmetic problem such as how much is 3209 divided by 475? Most people when presented with this problem will pick up a pencil or pen and try to solve it on a piece of paper and not solve it by thought alone. When people attempt to do long division in this way, one can ask: what part of the problem solving ability is found "in" the head, what part can be attributed to the movements of the pencil on the paper, and what part is given by the actual numbers, and intermediate calculations that appear on the paper? An embodied perspective on cognition would answer this question by stating the difficulty in parsing problem solving into mind, body, and world regions, and would argue, alternatively, that all human thought incorporates the brain, the body and the world, in dynamic interaction. In this way, the problem solving mind emerges where brains, bodies, and world interact and is not located exclusively inside some mind or brain "container."

How people move their bodies may even influence creative problem solving. A recent series of studies showed how arm flexion elicits a systematic processing strategy that facilitates creative insight (e.g., the ability to engage in contextual set-breaking, restructuring, and mental search), but arm extension impairs insight processes (Friedman & Foster 2001). Furthermore, data from the same studies revealed that people solve more analogy problems when flexing their arms as opposed to extending them. These empirical findings are not due to participants' own affective states or moods that may arise from the activity of moving their arms in particular ways. Instead, motor actions, such as moving your arms in

particular ways, influence cognitive processes associated with creative insight and problem solving. Overall, problem solving is seen as a higher-level cognitive ability, yet is significantly, inextricably linked to bodily action in the real world.

MEMORY

To what extent are human memories tied to embodied action? You may be asked to recall some event from your life (e.g., what was the name of the first school you attended as a child?) and as you sit there trying to recollect the desired information, you may not realize how a strong impression that bodily activity is especially relevant to how that memory is encoded in mind or even the process by which you retrieve that information from memory. For the most part, theories of human memory and memory performance have assumed that our representation of both semantic facts and autobiographical, or episodic, memories is accomplished, once more, as something distinct from kinesthetic activity, because memories are abstracted away from experience.

Yet note instances where your memory for some fact or personal event seems rooted in physical action in the real world. If asked to recall some specific person's phone number, we often find it easier to do so with a phone in front of us so that our fingers can trace over the buttons that are pushed when we call that individual. Remembering what we are supposed to buy at the supermarket for dinner is often aided by us going down the aisles of the market and letting the needed items almost remind us that they are something we need to collect and purchase. Recalling the name of the first school we attended is facilitated by us imagining ourselves walking up to our school and perhaps looking at the sign indicating the school's name. Both semantic and episodic memories appear to have a close tie to real and imagined bodily action.

Various experimental studies now support this conclusion. For example, in one set of experiments, people were asked to retrieve specific autobiographical memories (e.g., going to a dentist office, waving at someone, placing a hand over one's heart) while in different body positions (Dijkstra et al. 2007). In some cases, the body position was congruent with the event to be recalled (e.g., laying down on a couch while trying to recall

a visit to the dentist), and in other cases, the body position was incongruent with the to be remembered event (e.g., standing with hands on hips while trying to recall a visit to the dentist). Participants were timed as they tried to recall the specific memories.

Most notably, an analysis of the timed recalls shows that people remembered specific events faster when they were in a congruent, as opposed to incongruent, body position. This was true for both younger and older participants. After the experiment, participants were called on the telephone and asked to recall all of the events they could that they had been asked to remember during the experiment two weeks earlier. Not surprisingly, memories originally recalled in body congruent positions were later remembered more so than ones retrieved from body incongruent positions. Overall, the results of this study support the importance of body-cognition congruity in memory. This study is representative of a growing literature showing how memories are fundamentally embodied.

LANGUAGE PROCESSING

Suppose someone says to you, "Can you please close the door?" How might you process the meaning of this expression? There is a traditional view that people ordinarily, automatically parse a speaker's utterance into some initial truth-conditional, semantic representation, such that people first analyze what expressions semantically or literally mean before richer conceptual and pragmatic information is brought to bear. Under this traditional perspective, language understanding results in symbolic, abstract, propositions that are distinct from anything to do with ordinary bodily experience.

But as with other aspects of higher-order cognition, cognitive science has now shown that embodied experience is essential to ongoing language understanding. For example, research demonstrates that appropriate bodily actions facilitate semantic judgments for action phrases such as "aim a dart" (Klatzky, Pelligrino, McCloskey, & Doherty 1989) and "close the drawer" (Glenberg & Kaschak 2002). For example, Glenberg and Kaschak (2002) demonstrate what they call the action-sentence compatibility effect (ACE). In one experiment, participants made speeded sensibility judgments for sentences that implied action either toward or away from the body (e.g.

"Close the drawer" implies action of pushing something away from the body). Participants indicated their judgment by use of a button box which contained a line of three buttons perpendicular to the participant's body. Presentation of the sentence was initiated when the participant pressed the center button, and yes or no responses (i.e., sensible or not sensible) were indicated by the two remaining buttons, requiring action either away from or toward the participant's body. Glenberg and Kaschak (2002) found an interference effect, such that comprehension of a sentence implying action in one direction (e.g., toward the body) interfered with a sensibility response to a sentence implying motion in the opposing direction (e.g., "close the drawer"). This result suggests that understanding language referring to action recruits the same cognitive resources needed to actually perform the action.

Another study in favor of embodied language processing investigated whether people mentally represent the orientation of a referent object when comprehending a sentence (Stanfield & Zwaan 2001). Participants were presented with sentences that implicitly referred to the orientation of various objects (e.g. The sentence "Put the pencil in the cup" implies a vertical orientation of the pencil). After each sentence, a picture was presented, to which participants answered whether the pictured object was in the previous sentence. For pictures that were contained in the previous sentence, the picture's orientation varied as to whether or not it matched the orientation implied by the sentence. Overall, participants responded faster to pictures that matched the orientation implied by the sentence than to mismatched pictures and sentences. This empirical finding was also interpreted as showing that people form analogue representations of objects during ordinary sentence comprehension, which is consistent with the simulation view of linguistic processing.

In recent years, the above findings on non-metaphorical language processing have been extended to how people ordinarily understand metaphorical discourse. There is significant work in cognitive linguistics that strongly points to the possibility that people understand at least some abstract concepts in embodied metaphorical terms (Gibbs 2006a; Lakoff & Johnson 1999). More specifically, abstract ideas, such as "justice" are structured in terms of metaphorical mappings where the source domains are deeply rooted in recurring aspects of embodied experiences (i.e., ACHIEVING JUSTICE IS ACHIEVING PHYSICAL BALANCE

BETWEEN TWO ENTITIES). Many abstract concepts, across many languages are presumably structured via embodied metaphors (e.g., time, causation, spatial orientation, political and mathematical ideas, emotions, the self, concepts about cognition, morality) across many spoken and signed languages (Gibbs 1994, 2006a; Kovecses 2002; Lakoff & Johnson 1999; Yu 1998). Systematic analysis of conventional expressions, novel extensions, patterns of polysemy, semantic change, and gesture all illustrate how abstract ideas are, again grounded in embodied source domains. Furthermore, there is a significant body of psycholinguistic research showing that people's understanding of a good deal of metaphorical language is deeply tied in embodied conceptual metaphors (Gibbs & Matlock 2008).

One new development is the idea that embodied simulations play some role in people's immediate processing of verbal metaphors, and language more generally (Bergen, 2005; Bergen, Lindsay, Matlock, & Narayanan, 2007; Gibbs, 2006b). People may, for instance, be creating partial, but not necessarily complete, embodied simulations of speakers' metaphorical messages that involve moment-by-moment "what must it be like" processes that make use of ongoing tactile-kinesthetic experiences (Gibbs, 2006b). More dramatically, these simulation processes operate even when people encounter language that is abstract, or refers to actions that are physically impossible to perform. Understanding abstract events, such as "grasping the concept," is constrained by aspects of people's embodied experience as if they are immersed in the discourse situation, even when these events can only be metaphorically, and not physically realized.

Various experimental studies employing both off-line and online methods provide evidence in support of these ideas about simulation and metaphor (Gibbs, 2006b; Gibbs, Gould & Andric 2006; Wilson & Gibbs 2007). Gibbs et al. (2006) demonstrated how people's mental imagery for metaphorical phrases, such as "tear apart the argument," exhibit significant embodied qualities of the actions referred to by these phrases (e.g., people conceive of the "argument" as a physical object that when torn apart no longer persists). Wilson & Gibbs (2007) showed that people's speeded comprehension of metaphorical phrases like "grasp the concept" are facilitated when they first make, or imagine making, in this case, a grasping movement. Furthermore, hearing fictive motion expressions, implying metaphorical motion, such as "The road goes through the desert" affects people's subsequent eye-movement patterns while looking

at a scene of the sentence depicted (Richardson & Matlock 2007). This suggests that the simulations used to understand the sentence, in this case involving a particular motion movement of what the roads does, interacts with people's eye movements. This simulation perspective on conceptual metaphor is generally consistent with claims that thought and language are continually situated within the interaction of brains, bodies, and world (Gibbs 2006b).

NEW STUDIES ON EMBODIED METAPHOR

Let's consider the idea that metaphoric language may be processed in terms of embodied metaphor via simulation processes by examining people's understanding of primary metaphors. For example, people frequently talk about their life problems as if they are physical burdens that they sometimes carry and must endure. One popular internet blog, written by Pastor Claude Thomas instructs both youth ministers and laypersons about the importance of Christian based counseling for taking care of each other through. One blog piece gives very specific advice titled "Share a burden and be a blessing" (August 7, 2008: http://pastorclaudethomas. net/category/pastor-claude-thomas). He writes,

> "If a person is weighed down or menaced by some burden or threat, be alert to that and quickly do something to help. Don't let them be crushed. Don't let them be destroyed. In the days of Jesus there was a religious group that was gifted at adding burdens to the already overburdened people. They were the scribes and Pharisees. Jesus said, "They bind heavy burdens hard to bear and lay them on men's shoulders; but they themselves will not move them with their finger" (Mt. 23:4). Don't increase burdens. Make them lighter for people. … Develop the extraordinary skill for detecting the burdens of others and devote yourself daily to making them lighter. Some of the burdens people carry are spiritual. Some are physical. Others are mental. Then there are emotional loads that people carry. … We can help others who are carrying a heavy load…"

This excerpt nicely illustrates one of the significant ways that people think and talk about their experiences using metaphor, specifically their conceiving of DIFFICULTIES AS PHYSICAL WEIGHTS. These "primary metaphors" refers to metaphorical mappings arising from positive correlations in people's bodily experience. ERRECT and ORGANIZATION IS STRUCTURE. Grady (1997) argued that the strong correlation in

everyday embodied experience leads to the creation of primary metaphors, such as   INTIMACY IS CLOSENESS (e.g., We have a close relationship), IMPORTANT IS BIG (e.g., Tomorrow is a big day), MORE IS UP (e.g., Prices are high), CAUSES ARE PHYSICAL FORCES (e.g., They push the bill through Congress), and UNDERSTANDING IS GRASPING (e.g., I've never been able to grasp transfinite numbers). These metaphorical correlations arise out of our embodied functioning in the world. In each case, the source domain of the metaphor comes from the body's sensorimotor system.

One set of psycholinguistics studies explored in greater detail people's understanding of one particular primary metaphor, DIFFICULTIES ARE WEIGHTS.

The research was primarily aimed at experimentally investigating the psychological reality of the above mentioned metaphor by understanding further the nature of its source domain (experiences with weights).

In other to do so, five psycholinguistics experiments were devised and presented to 5 groups composed of 25 male and female university students, aged 18 to 25 years of age, speakers of Brazilian Portuguese. Each of these five experiments are described in the next paragraphs. Some comments as regards both qualitative and statistical analyses for experimental results are presented as well as a brief conclusion which highlights the embodied as well as socio-cultural nature of the DIFFICULTIES ARE WEIGHTS metaphor.

The first experiment, a word-choice questionnaire, contained questions related to bodily as well as psychological effects produced by weight related actions. Each question was followed by two words (a positive and a negative one). Participants were asked to choose the word which, in their opinion, best answered the question. For instance, in answering questions such as "Does your body feel *pain* or *no pain* when lifting/carrying a heavy weight?" or "Does holding up a heavy weight make you feel like *laughing* or *crying?*", the participant had to circle the word *pain* or *no pain* for the first listed question and *laughing* or *crying* for the second one, as her/his answer.

An open question task tested further physical and psychological effects of weight related actions over the body. A set of 21 open questions about how dealing with heavy weights affects how the body physically feels or

the person subjectively feels were presented. Participants had to write short paragraphs/descriptions in answering questions such as: "You give someone a heavy weight to carry. Describe how you think his/her body feels)" or "You gradually transfer a heavy weight you are holding up onto another person's shoulders. Describe how your body and the other person's body feel". Responses were categorized into positive/negative bodily or psychological aspects of such experiences.

The third experiment, a priming task presented different textual contexts pertaining to the primary scenes of the DIFFICULTIES ARE WEIGHTS metaphor. Each of these short texts were followed by two metaphorical sentences. One, licensed by the DIFFICULTIES ARE WEIGHTS metaphor, the other, although plausible to the situation presented was drawn from another metaphor. Participants were to choose which sentence they believed was more adequate to the situation presented in the text. If, as Grady (1997: 24) puts it primary scenes are "minimal (temporarily- delimited) episodes of subjective experience, characterized by tight correlations between physical circumstance and cognitive response", it was hypothesized that presenting participants with physical descriptions of one's experience with weights was bound to allow, given two metaphorical sentences which denoted a possible cognitive link with the physical circumstance described, for a high level of agreement as regards the metaphorical sentence that most closely matched the scene described. For example, given the following situation "I was holding up a suitcase which weighs over 50 pounds all by myself but then someone came along and helped me carry it", and the two metaphorical sentences which followed it (a) The new assistant has been a great help in easing off my workload, and (b) I feel burnt out with so much work to do, it was felt that people, were Grady right regarding the nature of the primary scenes, would choose, in the case of the given example, sentence (a), since it is the metaphorical sentence directly related to the scene described.

The two remaining tasks, a picture-match task and a relatedness task, tested further the nature and constitution of the DIFFICULTIES ARE WEIGHTS metaphor. Task four, a picture task which showed stick-men performing different tasks with weights, was subdivided into three sub-tasks: a word-choice task, in which participants had to choose from a given pair of words the one which best fitted the action presented in the drawing; task two, which required participants to produce new words to describe the

depicted situation presented in the drawings and task three, in which they had to write short texts indicating which of the previously seen situations they would prefer to be involved in, and why. The aim of such tasks was again to find empirical evidence of the psychological nature of the metaphor under analysis. It was felt that, if not only a hardwired neural mapping involving a perceptual/conceptual domain exists for the DIFFICULTIES ARE WEIGHTS metaphor, but, if it is equally, on the course of cognitive development, enhanced by different sorts of experiences involving subjective and social-culturally shared beliefs, informants would choose randomly, either positive or negative descriptive words to describe weight-related actions and which weight-related scenes they would like to be part of.

Finally, experiment five, a relatedness task, in a similar vein to experiment three, tested further Grady's hypothesis of a correlation between source domain (perceptual) and target domain (conceptual) of the DIFFICULTIES ARE WEIGHTS metaphor. It was hypothesized that if primary scenes are indeed characterized by tight correlations between physical circumstance and cognitive response, as Grady (1997) puts it, presenting participants with physical descriptions of one's experience with weights would allow, given two metaphorical sentences which denote a possible cognitive link with the physical circumstance described, for a high level of agreement as regards the metaphorical sentence that most appropriately matched the scene described. Metaphorical sentences were categorized into highly related metaphorical sentences (HRS), related metaphorical sentences (RS), and unrelated metaphorical sentences (US), depending on the degree of sentence relatedness to the scene presented. For example: "Patricia is overloaded with problems" was considered a highly related metaphorical sentence to the situation: "John carried the 132lb luggage alone"; whereas "John was relieved of his problems", was an unrelated metaphorical sentence to "Luke held up the 110lb load".

Participants were asked to rate the metaphorical sentence which followed the situation presented on a seven point scale, where rate 7 meant highly related and rate 1, highly unrelated.

Data gathered from the whole set of experiments have consistently revealed that when solely physical aspects are at focus, weights are conceptualized as difficulties, however, when emotional or psychological aspects are at stake, this is no longer the case.

This became evident in the word-choice and open question tasks (Experiments 1, 2, and 4), in which people, had to choose between word pairs, generate additional words or write small descriptions of weight related actions or situations. When the body itself was the focus, participants, indeed, tended to choose words which denoted physical burden. On the other hand, when psychological/emotional aspects of weight-related experiences were at stake, they sometimes viewed the action/situation presented as challenging, the accomplishment of which brought a sense of self-satisfaction and happiness. For instance, when weight experiences involve other people, such as the transferring of a heavy weight onto someone else's shoulders or when such experiences may be conceived as the overcoming of obstacles, the presumed direct relation between source-target domains (i.e. weights – difficulties) tends to become blurred. In this regard, some of the participants wrote descriptions about how bad they would feel in passing a heavy weight for someone else to carry/lift up. Interesting expressions produced were: "I would feel bad about giving someone a heavy weight", or; "I would not feel happy or o.k. about giving the weight for another person to carry". Specifically, on the aspect of personal feeling of achievement, some participants would say that carrying/lifting up a heavy weight would "make them happy" or would give them a sense of well being. Some male respondents, for example, expressed that being able to carry/lift up or move around with a heavy weight meant something good for them since it revealed the overcoming of an obstacle or was, as they expressed, a display of strength, a sign of masculinity. This trend was absent from descriptions written by female participants, who tended to highlight the difficulties they would face in dealing with heavy weights. These findings appear to indicate that when social-culturally influenced subjective aspects of weight-related experiences are considered weights are not necessarily conceptualized as difficulties.

Results for experiment three, on the other hand, show that participants tended to choose more often the metaphorical sentence more closely linked to a physical situation pertaining to primary scene of the metaphor. This was made evident by the $t - test$ performed on the mean frequencies of participants' preferred choices. The results indicated a preponderance of metaphorical related sentences ($t = 8.65$; $p < 0.05$). Such a finding indicates that, as believed by Grady (1997), there seems to exist co-activation between source and target domains of the metaphor. The last experiment, however, although similar in purpose to experiment three,

revealed a rather contradictory picture. Statistical results for this experiment suggested that, contrary to Grady's theory of a link between perceptual and conceptual domains of primary scenes, people, in judging levels of relatedness between source and target domains, do not necessarily provide evidence as to the existence of such a link. As statistical evidence of what has just been stated, mean frequency for unrelated sentences was highest (M = 3.00, F = 9.42; p < 0.05), followed by those for related sentences, (M = 1.92), and highly related sentences, (M = 1.44). This finding seems to contradict the positive result obtained for experiment three, as regards participants' preferences for highly related metaphorical sentences to given physical circumstances. Possible explanations for the apparent contradictory results between the two experiments, could be linked to factors such as differing degrees of collaborative disposition between the different groups of voluntaries who took part in experiment three and in experiment five, respectively, or the interference caused by inferences possibly made by the participants as he/she read the prompt sentences and the target sentences of experiment five.

The results of both qualitative and statistical analyses help us draw some interesting conclusions as regards the nature of the DIFFICULTIES ARE WEIGHTS metaphor. Overall results from experiments one through four suggest that it is reasonable to conclude that for mere physical effects of weights over the body, weight-related experiences are indeed conceived as difficulties. This leads us to believe in the existence of a bodily (sensory-motor) basis for the emergence of the metaphor. However, the same cannot be said when emotions or subjective responses of a psychological/emotional nature are at play. Such findings are relevant for at least two reasons. While, it seems plausible to ascertain that from a solely neurophysiologic perspective there may indeed exist a sensory-motor embodied basis for the existence of the DIFFICULTIES ARE WEIGHTS metaphor, socio-cultural factors do appear to play a part in the mental images which people have internalized as regards weight-related scenes activated for the metaphor. This leads us to conclude that claims regarding the universality of such metaphors should be taken with certain reserve. Even if the claim that primary metaphor results from neural learning which involves co-activation of perceptual/conceptual domains seems plausible, as some results here presented have suggested (experiment 3), we can equally state that as the present study has also indicated, once the metaphorical mapping is established it will be further enriched by socio-culturally imposed values. Primary metaphors

may, thus, be understood as emerging in two stages. The first, at a very early stage of cognitive development in which perceptual/conceptual neural mappings are established, and a second one in which these mappings are dynamically and continuously enhanced by socio-cultural influences.

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