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The unembodied metaphor: comprehension and production of tactile metaphors without somatosensation

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Introduction: Proposals for embodied metaphor and embodied cognition have suggested abstract concepts are understood indirectly through the simulation of previous sensory experiences in a different domain. While exceptions have been observed for sensory deficits and impairments that are common, such as vision and audition, it is commonly assumed that somatosensation (proprioception, haptic touch, pain, pressure, temperature, etc.) is fundamental for the comprehension and production of sensory metaphors and much abstract thought in general. In this way, our past sensory experiences are critical to our understanding not just of the world around us but also of our sense of selves. This would suggest that Kim, who was born without somatosensation, would have difficulty understanding, using, or even thinking about many abstract concepts typically linked to different sensory experiences through metaphor, including a creation of a sense of self.

Methods: To examine her comprehension of sensory metaphors, Kim was asked to select the best sensory idiomatic expression given its context. Her friends and family as well as a representative sample of individuals online were recruited to complete the survey as controls. Additionally, we transcribed and analyzed six hours of unprompted speech to determine if Kim spontaneously uses somatosensory metaphors appropriately.

Results: Results from the idiomatic expression survey indicate that Kim performs as well as controls despite lacking any previous direct sensory experiences of these concepts. Analysis of the spontaneous speech highlights that Kim appropriately uses tactile expressions in both their concrete sensory and abstract metaphorical meanings.

Discussion: Taken together, these two studies demonstrate that what is lost in sensory experiences can be made up in linguistic experiences, as Kim's understanding of tactile words was acquired in the complete absence of somatosensory experiences. This study demonstrates that individuals can comprehend and use tactile language and metaphor without recruiting past somatosensory experiences, and thus challenges a strong definition of embodied cognition which requires sensory simulations in language comprehension and abstract thought.

KEYWORDS

embodied metaphor, embodied cognition, Conceptual Metaphor Theory, somatosensation, tactile perception

1. Introduction

A metaphor¹ is a linguistic device to understand one idea in terms of another. Appealing to other domains and concepts can deepen our understanding, allow for comparisons, and add in new perspectives. In particular, in describing and understanding abstract ideas, metaphor allows us to understand something that cannot be directly observed or sensed by appealing to something that can, according to Conceptual Metaphor Theory (Lakoff and Johnson, 1980, 1999), take, for example, the phrase *had a rough day*. In it, a basic idea like *disappointing* or *difficult* is expressed by an association with tactile experiences, even though the same idea may be articulated without sensory language, like *had a bad day*.

The exact nature of the association from a mental state, like *difficult*, to a tactile experience, like *rough*, has been treated differently by different schools of thought. In early proposals of Conceptual Metaphor Theory (Lakoff and Johnson, 1980), a “primary metaphor” simply requires an implicit association between the source domain, which is concrete and can be experienced through the senses, and the target domain, which is more abstract and can only be experienced through introspection (Lakoff and Johnson, 1980). An “embodied metaphor” makes this association explicit, proposing that our understanding of one abstract element is dependent on simulating a concrete sensory experience in the relevant modality-specific sensory cortex of the brain (Barsalou, 1999; Barsalou et al., 2003; Barsalou and Wiemer-Hastings, 2005). In the example of *had a rough day*, the somatosensory cortex would simulate past experiences of feeling rough textures like a swatch of sandpaper or the bark of a tree. In contrast, a non-embodied or unembodied metaphor would be simulated entirely in modality non-specific regions of the brain. Experimental evidence supports the notion of the embodied metaphor. For example, Lacey et al. (2012) used functional magnetic resonance imaging (fMRI) to show that, for seven participants, there was more activation in the haptic and visual areas of the brain for texture metaphors, *had a rough day*, than for non-sensory equivalents, *had a bad day*.

According to Conceptual Metaphor Theory, it stands to reason that if we use metaphors in language, we must also use them in thought (Lakoff and Johnson, 1999; Landau et al., 2010; Lakoff, 2014). And if we engage in embodied metaphor, we must also engage in embodied cognition. Consequently, the notion of embodied cognition suggests that abstract thoughts are processed *via* simulations of concrete sensory experiences. This idea has been taken in diverse directions in different fields, including linguistics, cognitive science, psychology, philosophy, and neuroscience, but in each of these fields, the central tenet remains: that which cannot be experienced directly through our senses is understood through a proxy sensory experience. As the notions of embodied metaphor and embodied cognition have been expanded and extended, it has

ballooned into a theory that is so large and multifaceted that it cannot be easily defined or tested (Wilson and Golonka, 2013; Casasanto and Gijssels, 2015). Even for the notion of the embodied metaphor, much more narrowly testable than embodied cognition, it remains unclear whether modality-specific regions of the brain are always activated during the processing of such memories. Casasanto and Gijssels (2015) review the large body of work that has examined the processing of metaphor in language and thought, concluding that there is a “a Grand Canyon-sized gap between the strength of many researchers’ belief in “embodied metaphors” and the strength of the evidence on which their beliefs should be based” (Casasanto and Gijssels, 2015, p. 334). Based on the perceptual and behavioral data, Casasanto and Gijssels propose the notion of the “mental metaphor,” which requires a mental association between source and target domains instead of a direct simulation of the source domain.

Exceptions to Conceptual Metaphor Theory have been observed for individuals with different sensory experiences who lack direct sensory perception of the target domain but are still able to use and comprehend the metaphor at hand. For example, individuals who are congenitally blind or deaf do not have any deficit in using or comprehending metaphors that make association with their impaired domain (Iran-Nejad et al., 1981; Minervino et al., 2018). And some sign languages are known to employ metaphors that represent knowledge or learning through an auditory source domain² despite the reality that most of the language users have no, limited, or impaired hearing (Zeshan and Palfreyman, 2019). Thus, rather than leading to the conclusion that sensory experiences can be, but need not be, recruited, the capacity of deaf and blind individuals to use metaphors has been viewed as demonstrations that somatosensation is special and exceptional, standing apart from vision and hearing. There is an entrenchment in the role of somatosensory experiences in embodied cognition (Wilson, 2008; Kiltner et al., 2012; Häfner, 2013). Sensory experience can now be taken to mean somatosensory experiences, appealing to the intero- and exteroceptive sensory experiences on the skin or deep tissue. We suggest that this is not due to the immutable connection of somatosensation to language and cognition, but rather to the lack of known individuals who have impaired or absent somatosensation.

In the present article, we provide the case study for Kim, a woman born without any somatosensation or sense of taste. She cannot sense, nor has she ever sensed, haptic touch, temperature, pain, or pressure. Her sense of body comes through vision rather than proprioception. With this case study, we challenge the proposal that cognition must be embodied. We do not claim that thought is never embodied, rather we argue that it simply need not be. Kim challenges not just the notion of embodied cognition but also the narrower, and more testable, notion of the embodied metaphor. Through an idiomatic expression survey and an examination of her spontaneous speech,³ we demonstrate that

1 We use the term *metaphor* in the broadest sense of the word, including all ways of understanding one concept in terms of another. This differs from, but includes, the more restrictive definitions often given to literary metaphors in which an object is described by directly equating it with another object, e.g., *time is money*, to the exclusion of other literary devices. As such, other literary comparisons like similes, e.g., *straight as an arrow*, or synecdoches, e.g., *lend a hand*, are included in the broader understanding of metaphor here.

2 For example, in Indonesian Sign Language, the sign for NOT-WANT-TO-KNOW-ABOUT that is used regarding gossip typically involves a gesture of removing one’s ear, despite the fact that the signer would acquire such gossip gesturally and not auditorily (Zeshan and Palfreyman, 2019).

3 Magnetic resonance imaging is contraindicated for Kim.

Kim uses and understands metaphorical language involving tactile expressions without processing them *via* sensory simulations.

2. Kim

Kim is a 43-year-old American female who congenitally lacks all somatosensation, including touch, pain, temperature, pressure, and proprioception. Her neuropathy is both rare and severe, a one-of-a-kind variant of Hereditary Sensory Autonomic Neuropathy Type II (HSAN Type II) not attested in any other individual. There have been documented cases of acquired neuropathies with individuals, like IW, who lost touch, vibration, and proprioception below the neck, while retaining pain and temperature sensation, as the result of viral illness (Cole, 1991, 2016).

As detailed in forthcoming work by Mason and colleagues, Kim lacks all small- and large-fiber somatosensory afferents on her body, neck, and head and has since birth. When Kim's vision of her own body is blocked, she cannot sense where her torso or limbs are in space or in relation to one another, nor can she sense if any object is making contact with her body.

Kim's other sensory systems are variably affected as well. Her hearing is normal, with normal-to-excellent hearing from 250 to 8000 Hz and normal speech discrimination and identification. Kim's vision is normal and uncorrected, with 20/25 vision in her left eye and 20/20 in her right eye, despite extensive corneal scarring, with normal color vision. Kim is ageusic and unable to reliably distinguish among sweet, sour, salty, bitter, or no taste. Kim is not anosmic, but has poor detection, discrimination, and identification of smells. Nonetheless, she does express food likes and dislikes.

Kim has intact motor nerves and functions. Her muscle strength is normal, but she uses a wheelchair and has motor limitations due to her lack of sensory feedback: she cannot walk or stand without assistance due to the difficulty of balancing without proprioceptive feedback. She has no reflexes and does not cough in response to liquids entering her trachea; she can cough deliberately. Kim has no observed autonomic deficits: she tears, sweats, and accommodates normally during near vision.

Since Kim cannot perceive somatosensory stimuli, she must rely on other senses and information to perceive the world around her. For example, to perceive the texture of a table, Kim relies solely on visually interrogating its pattern and to determine the hardness of an object, Kim listens to what kind of sound it makes when struck against a surface. In this way, Kim's understanding of words and concepts like *rough* and *hard* are mediated through different sensory experiences than the average person. And since Kim has never experienced somatosensation, she does not have any stored memories or experiences such that a simulation of those experiences can later be activated. Thus, if a metaphor is truly embodied, it is essential that past sensory experiences be activated and simulated, something that should prove impossible for Kim in many domains.

3. Methods

Kim's comprehension and production of sensory metaphors was examined in two ways. First, we conducted an online idiomatic expression survey to compare Kim's understanding of tactile,

taste, and body metaphors to a control population, including her friends and family. In Section 3.1, we introduce the participants, materials, and procedure for that task. Second, we qualitatively analyzed Kim's use of somatosensory metaphors in spontaneous and unprompted speech. The methods and motivations for the spontaneous production study are presented in Section 3.2.

3.1. Idiomatic expression survey methods

The idiomatic expression survey tests the comprehension of metaphors where the source domain depends on somatosensation, taste, or sense of body. This is tested by asking Kim and controls to select the appropriate idiomatic expression to complete a sentence. While Lacey et al. (2012) demonstrated that the somatosensory cortex can be recruited in the perception of tactile metaphors, e.g., *had a rough day*, relative to non-sensory expressions, e.g., *had a bad day*, the present study asks simply if Kim, who has never experienced those sensations such that they could later be activated and simulated, can comprehend these idiomatic expressions as well as the individuals who have those experiences and sensations to rely on. Thus, at stake in this study is not whether somatosensory (or taste) perceptual memories can be activated in the processing of tactile metaphors, but whether such simulation must occur to process tactile metaphors successfully.

3.1.1. Participants

In addition to Kim, two control populations were recruited to participate online. A total of 24 of Kim's friends and family were recruited directly through email and an additional 39 native speakers of American English were recruited on Amazon Mechanical Turk. Kim's friends and family were recruited to account for any potential differences between Kim's speech community and the average speaker of North American English as idiomatic expressions can vary greatly between communities in their frequency and use. The mean age of the participants was 41 years, spanning a range of 22–72 years. In that, 30 participants were identified as female and 33 as male. Participants spanned the continental United States, with higher concentrations in the Midwest and Mid-Atlantic as a result of direct-recruiting friends and family of Kim. No control participants reported any history of sensory or neurological impairments, disorders, or disabilities. An additional 16 individuals recruited through Amazon Mechanical Turk participated in this study but were excluded from all analyses as they failed basic attention checks.

3.1.2. Materials and procedure

The study was hosted on Qualtrics. Each question contained a short vignette of a sentence or two that ended in a choice of four idiomatic English expressions. There were four classes of idiomatic expressions included: tactile (e.g., *rough around the edges* and *hard as nails*), taste (e.g., *short and sweet* and *a bitter pill to swallow*), body part (e.g., *lend an ear* and *all skin and bones*), and visual or non-sensory fillers (e.g., *out of the blue*, *on cloud nine*, and *like a fish out of water*). Body part expressions, while not explicitly sensory in the same way as tactile and taste expression, were included as Kim has a different sensory experience with her

body: Sensory understanding of her body is primarily visual, not haptic, proprioceptive, or interoceptive. As Kim is not only aware of her condition but also that the present study was in some way interrogating the relationship between her condition and her language, each multiple-choice question contained a competing expression of the same class as the target and two distractors of a different class to ensure that she's not selecting sensory expressions spuriously. There were 80 questions in total; 30 questions were targeted for a tactile response with non-sensory filler distractors and 30 with targeted non-sensory filler responses and tactile distractors; and 10 questions were targeted for a taste response with body part distractors and 10 for a body part response with taste distractors. An example question, including vignette and responses, is provided in 1.

1. *Liza bought her first car and successfully negotiated the price down five thousand dollars. Liza:*

- a) drove a hard bargain. (Correct tactile response)
- b) made a rough guess. (Tactile competitor)
- c) missed the mark. (Non-sensory/filler distractor)
- d) hit the hay. (Non-sensory/filler distractor)

The complete idiomatic expressions survey, including instructions to participants, is available in the [Supplementary material](#).

Following the sensory idiom selection, participants completed a brief demographic survey. The entire survey took approximately 15 min. Participants were compensated, with compensation being optional for direct-recruited friends and family, at the rate of \$20/h. Informed consent was obtained for all participants and all procedures performed were approved by the Social and Behavior Sciences Institutional Review Board at the University of Chicago.

3.1.3. Analysis

The goal of this survey was to ask if Kim, who has never experienced somatosensation, taste, or a proprioceptive sense of body, is able to comprehend sensory metaphors and select the appropriate expression given the context. To test this quantitatively, a logistic mixed effects regression was fit to the accuracy of a given response (1,0) using the `glmmer()` function in the `lme4` package (Bates et al., 2015) in R (R Core Team, 2015). The model included GROUP (Control, Family/Friend, or Kim; treatment-coded with Control as base), METAPHOR (Non-sensory, Tactile, Taste, Body; treatment-coded with Non-sensory as base), and BIRTHYEAR (scaled) as fixed effects. All interactions that did not reach a significance threshold of 0.05 were pruned from the final model. In addition, preliminary models included maximally specified random effects structures, with by-subject and by-item random slopes and intercepts, which were progressively simplified until convergence was achieved.

3.2. Spontaneous production methods

The idiomatic expression survey was designed to test Kim's understanding of tactile metaphors. To test her production and active use of these metaphors, we transcribed and analyzed 5 h

54 min and 2 s of spontaneous speech, recorded in a variety of settings and with different interlocutors, including the researchers and Kim's family members. Topics of spontaneous speech included introductions with the researchers, discussions of Kim's life and experiences, including reflections on her participation in medical and linguistics research, and retellings of short videos or storybooks. All conversations took place in the Neubauer Collegium for Culture and Society at the University of Chicago and were recorded at 48,000 Hz with a Zoom H5 Handy Recorder using the Zoom XYH-5 unidirectional X/Y microphone capsule. The spontaneous speech was analyzed qualitatively rather than quantitatively since any appropriate and spontaneous usage of sensory metaphors demonstrates that Kim is able to produce them despite never having experienced their relevant sensations.

3.3. Limitations

This study necessarily involves only one subject since Kim's condition is unique. We know of no other comparable subjects, since the known population of people with somatosensory deficits do not lack all modalities of somatosensation on all parts of their bodies and/or had typical sensory perception at some point in their lives. Thus, people such as IW had first-hand experiential knowledge of haptic touch and proprioception into adulthood and continue to perceive pain and temperature (Cole, 1991, 2016). Such a presentation renders those with acquired loss quite different from Kim. The results cannot be confirmed by testing a larger population of people like Kim because such people do not exist. Nonetheless, in line with other singular individuals who have provided neurobiology with knowledge not otherwise obtainable, we argue that data from Kim provide invaluable insight that inform the human condition and faculty for language as no other can.

4. Results

In this section, we report the results of how Kim performed in the idiomatic expressions survey with comparison to the control group. This is followed by a discussion of Kim's use of idioms in spontaneous speech, which serve as a further test of our methodologies and hypothesis.

4.1. Idiomatic expression survey results

Results for the tactile expressions and non-sensory fillers are illustrated in [Figure 1](#). First and foremost, the inset included in [Figure 1](#) demonstrates that Kim and her direct-recruited family and friends performed with a high degree of accuracy on both tactile and non-sensory expressions. Note that accuracy here is defined as selecting the intended expression to complete the vignette consistent with linguistic norms and cultural expectations, but we acknowledge that some variation may be expected. Despite the inclusion of attention checks, 13 of the 39 controls recruited on Amazon Mechanical Turk performed near chance, indicative of inattentive responses. Due to this relatively bimodal distribution, the primary figure and subsequent analyses focus on Kim and her

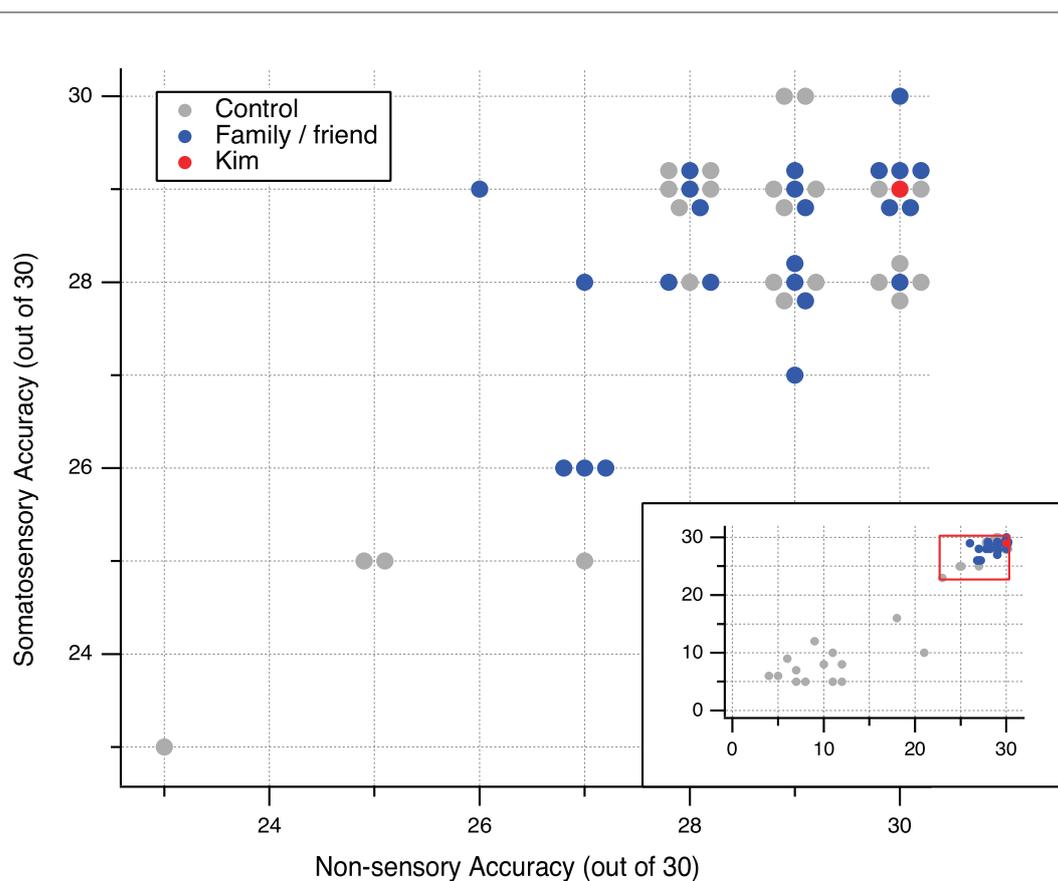


FIGURE 1

Number of expressions accurately selected given the context for the non-sensory (x-axis) and tactile (y-axis) expressions. The number 30 indicates that the accurate and anticipated expression was selected for every vignette, while 7.5 indicates performing at chance. The inset illustrates accuracy for all participants who passed the attention checks, but the primary pane focuses on the attentive participants performing well above chance. Note that Kim (in red) and all the direct-recruited friends and family of Kim (in blue) are performing near ceiling.

friends and family, and the remaining 26 controls who got at least 20 out of 30 non-sensory fillers correct.

The primary pane of Figure 1 illustrates that Kim, indicated in red, gave the anticipated and accurate response in all 30 of the non-sensory filler expressions and in 29 out of 30 of the tactile expressions. Kim's friends and family, indicated in blue, identified the anticipated and accurate response for a mean of 28.6 out of 30 questions in the non-sensory filler expressions (minimum 26, maximum 30, median 29) and a mean of 28.3 out of 30 for the tactile expressions (minimum 26, maximum 30, median 29). The attentive controls performed similarly, with accurate responses for a mean of 28.4 for non-sensory fillers and 28.0 for tactile expressions. Taken broadly, Figure 1 illustrates that Kim appears to perform as well as (or better than) controls, including her friends and family, in the selection of both tactile and non-sensory idiomatic expressions.

Results for the taste and body part expressions are illustrated in Figure 2. As in Figure 1, the inset on Figure 2 shows that a number of controls recruited online performed near chance despite the inclusion of attention checks. In the primary pane of the figure, we see that Kim, again indicated in red, gave the anticipated and accurate response on 9 out of 10 on both the body part and taste expressions, despite having different sensory experiences than controls for both domains. Kim's friends and family, indicated in blue, identified the anticipated and accurate response for a mean of 9.0 out of 10 questions in the taste expressions (minimum 6,

maximum 10, median 9) and a mean of 9.3 out of 10 for the body part expressions (minimum 8, maximum 10, median 9). The attentive controls performed similarly to Kim's friends and family, with accurate responses for a mean of 8.9 out of 10 for taste expressions and 9.5 out of 10 for body part expressions. At its core, Figure 2 shows that despite her different sensory experiences relating to tastes and her body, Kim performs similarly to controls and her friends and family in selecting the best sensory expression to complete a short vignette.

The results of the logistic mixed effects regression corroborate the visual interpretation of Figure 1. First and foremost, the positive intercept of the model reached the significance threshold of 0.05, suggesting that all attentive participants are more likely to select the accurate expression than an inaccurate one ($z = 8.98, p < 0.001$). There was no statistical difference between Kim and the controls either across-the-board or with respect to the different METAPHOR conditions (Non-sensory, Tactile, Taste, or Body).

4.2. Spontaneous production results

Kim's own spontaneous speech demonstrates that not only can she comprehend tactile metaphors without directly experiencing the sensations herself but also can use them spontaneously and appropriately. Again, at stake here is not whether she is activating

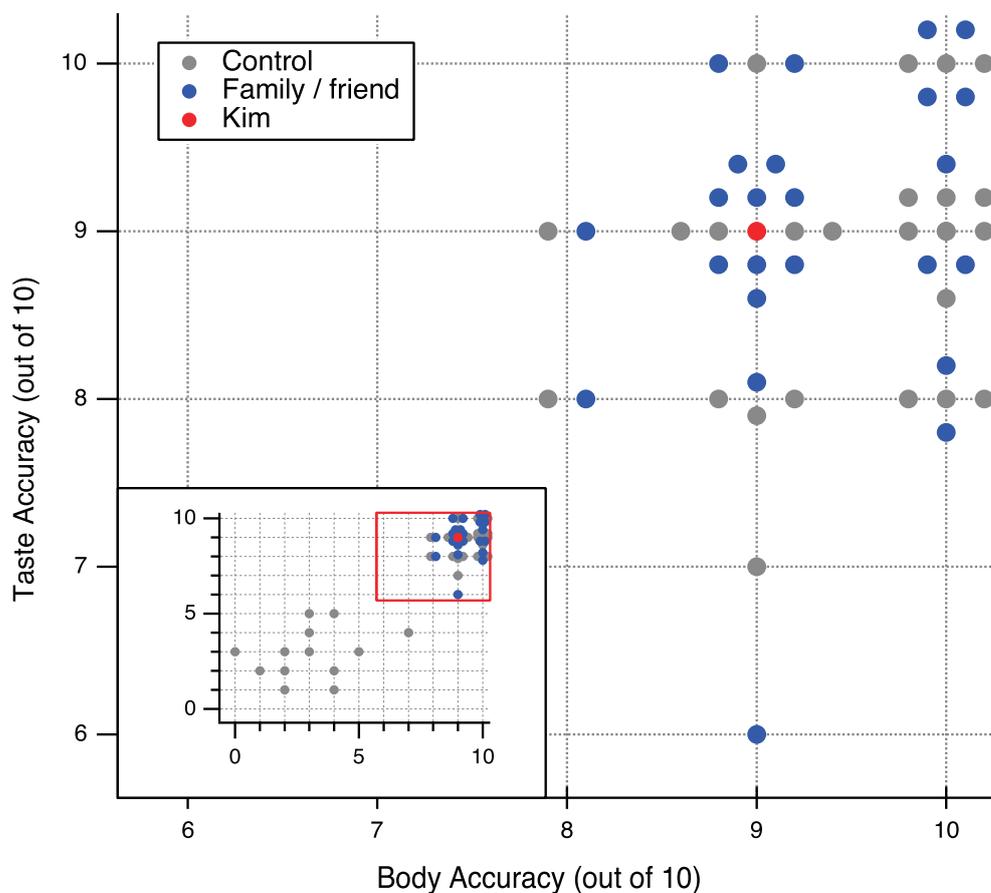


FIGURE 2 Number of expressions accurately selected given the context for the body part (x-axis) and taste (y-axis) expressions. The number 10 indicates that the accurate and anticipated expression was selected for every vignette, while 2.5 indicates performing at chance. The inset illustrates accuracy for all participants who passed the attention checks, but the primary pane focuses on the attentive participants performing well above chance. Note that Kim (in red) and all the direct-recruited friends and family of Kim (in blue) are performing near ceiling.

the modality-specific regions of her brain when using these metaphors, but whether she can use them at all without having previous direct sensory experiences.

To examine Kim’s use of tactile metaphors, we present one emblematic discussion in which Kim told a story of her experience with a personal care attendant. In this conversation, provided below in a slightly abridged format to remove some back and forth among Kim, her mother, and the researchers with elisions indicated by [...], Kim described an attempt to get a spill off her pants with a paper towel that resulted in the paper towel pilling and leaving fragments behind. This story was unprompted, but the researchers pressed Kim for her understanding of what a tactile word like *gritty* means. This passage is equally noteworthy for Kim’s spontaneous use of tactile metaphor as for her descriptions of the concrete tactile sensations themselves. Bolded text is added by the authors to emphasize metaphorical and concrete use of tactile language.

Kim: We were at work one day, and in the morning before [the personal care attendant] had gotten there I noticed there was something on my shirt. And so my mom, or people, had told me previously that if you like wet like

a paper towel and like rub it on your pants or whatever, it could help to get like stains out. So I had gone in the bathroom and I’d done that and I wet a paper towel and like tried to use [it to remove] the stain.

So when she was there at lunchtime and I noticed there was a lot of like what I thought were like white flakes on my pants. So I asked her if she could like get it off. And she couldn’t get it off and she was **having a hard time** and I was like– I didn’t get why. And she was like, “Oh well it’s real gritty.” And I was like, “What do you mean it’s gritty?” She’s like, “Well you know **the little pieces are like hard** and I can’t get it off your pants because the paper towel shredded and it became like–”. And I was like, “I have no idea what you mean.” I’m like, “**Gritty? You mean like rocks?**”

Here, Kim spontaneously uses the same tactile adjective (*hard*) in both the concrete source domain (“the little pieces are hard”) and the abstract target domain (“having a hard time”), demonstrating her ability to produce both appropriately. Kim’s use of a high-frequency tactile word like *hard* is perhaps not unexpected, but we

see her question the attendant's use of a low frequency word, *gritty*, not understanding the term in this context.⁴ We then asked her specifically about her understanding of the word *gritty*:

Researcher: Do you know— could you ever describe a person as being gritty?

Kim: Um. I don't know does it mean— would it be like if they're like kinda like from the streets and they're kinda like out there— they're kinda like a **little rough around the edges** that would be like a gritty person.

Here, Kim not only demonstrates her understanding of the metaphorical use of the tactile adjective *gritty* but also uses another tactile adjective (*rough*) metaphorically to describe the word in question. She thus demonstrates a reasonable understanding of the uses of both, despite her initial doubts. When asked if she would actually use *gritty* herself in this way, Kim indicates a preference for the concrete source meaning only, and provides some meta-commentary about how she conceptualizes tactile expressions:

Researcher: Would you ever use that? Or would you just under[stand] it if someone used it? Do you know?

Kim: I probably would understand it, I don't think I would use it. I mean to me, when I think "grit" I think like rocks. So, I would probably only use it in the sense of like it's gritty or like grits the food, I mean I know **grits the food obviously must be gritty because it's in the word** so—

Kim's mother: Yeah, but grits aren't gritty.

Kim: Well, when it's in the word, how could it not be gritty?! [...] Well, then to me, this is how I think about words. I think pretty literally about words, especially words about, like you know, sensation and things like that. [...] A lot of times words like we're talking about "gritty" or like "soft" or "hard" or, like I'm trying to think of examples, like "coarse". **My definitions come strictly from what other people have told me**, so that's where I'm getting it from.

Note that Kim claims that she uses words in their literal, or source domain, meaning, although we have just seen her use *hard* and *rough* metaphorically. Kim, like most individuals, holds beliefs about her language that may not align with her actual usage. Yet, even if Kim reports thinking about tactile expressions literally, she is still able to use and comprehend them in their metaphorical extensions, as evidenced by her own spontaneous speech. In short, the fact that she can and does use tactile metaphors supersedes any intuitions that she may have to the contrary. In addition, Kim expresses that her knowledge of these tactile words comes through linguistic rather than physical experiences. Thus, her tactile conceptualizations appear to be linguistically based,

⁴ The frequency of *hard* is 307.84 instances/million and *gritty* just 0.45 instances/million, according to the Subtlex database compiled from American English subtitles (Brysaert and New, 2009).

which leads her to the assumption that grits must be gritty because they share the same root. She argues against her mother's claim to the contrary on linguistic grounds as the words are homophonous and etymologically related.⁵ But Kim notably does not invoke experiential knowledge to argue with her mother that raw grits are in fact gritty. It is cooked grits that are not, and Kim does not have the sensory experiences to back that up. Again, it is possible that Kim's intuitions about her conceptualizations of tactile terms do not align with her linguistic knowledge, but, in this case, her behavior backs up her claim: she makes a linguistic rather than a sensory argument.

While this passage is concerned with a single low-frequency tactile adjective, it provides an interesting case study on the understanding and use of sensory expressions without the relevant sensory perception. It highlights that Kim relies on linguistic experience to understand tactile expressions when she has not had the requisite sensory experiences.

5. Discussion

Our brief survey of idiomatic expressions asked if Kim, who has never experienced somatosensation or taste, is able to comprehend tactile, taste, and body metaphors despite having no direct sensory knowledge of the source domain itself, like a *rough* surface or a *sweet* dessert. If Kim's comprehension of tactile metaphors were impaired by the fact that she has never experienced the relevant somatosensations (*roughness*, *softness*, *warmth*, etc.), then she would have had significantly more difficulty (and thus less accuracy) selecting the correct tactile expression than controls and her friends and family. But the results clearly demonstrate that Kim has a full understanding of these words and expressions despite never having perceived the concrete sensations themselves. The same is true for both taste and body part metaphors, where Kim has very different sensory experiences with these domains than controls. Taken in conjunction with the findings of Lacey et al. (2012), this study demonstrates that while our past sensations may be recruited in the perception and processing of sensory metaphors, such recruitment is not necessary to accurately comprehend sensory metaphors.

Crucially, our analysis of spontaneous speech shows that Kim does use tactile words metaphorically without hesitation or conscious awareness. As Kim can use these expressions freely, the passage in Section 4.2 demonstrates that metaphors using a somatosensory source domain can spontaneously be used and understood without directly embodying, or activating, those sensations. But moreover, it demonstrates that these metaphors can be used without a complete or confident understanding of

⁵ The word *grit* "sand", "gravel" is from Old English *gréot*, Old Germanic **greuto^m* with attestations from the 5th century; *gritty* (<*grit* + *-y*) is first attested in the 16th century. The food term *grits* has the same Germanic root, but subsequently diverged, and comes from the Old English *grytt*; it has been attested since the 8th century. While the food term *grits* has historically referred to any coarse-milled grains, in the US, it refers exclusively to coarse cornmeal which is cooked into a thick porridge. The two forms of *grit* have mutually influenced each other over time to converge on a single form (OED online, 2020).

the concrete sensory definitions themselves. Kim may have doubts about whether a table is rough or smooth and rely on visual interrogation of the surface and information conveyed to her linguistically by her friends and family, but she has no difficulty describing a person as “rough around the edges.” Thus, in much the same way as a blind or colorblind individual can use and understand an expression like “green with envy” or “in a blue mood,” Kim can understand and use tactile expressions without having experienced the source domain directly.

6. Conclusion

As this study shows, Kim’s use and understanding of tactile words cannot come through somatosensation; she may rely on visual interpretation of a surface, but she also crucially depends on knowledge acquired linguistically. Her understanding of the metaphorical use of tactile phrases also depends not just on introspection but also linguistic input. It is not surprising that she can understand and produce tactile words in language because that is how she has acquired them. Kim is so highly educated and has had such broad exposure to literary traditions that it would be surprising if the inverse were true. Separate testing of her lexical knowledge of tactile adjectives shows that she can appropriately define all the terms provided to her. For words like *rough*, she can define and use them in both the source sensory domain and the metaphorical domain, even if she cannot know for certain whether the physical object in question is rough to the touch. The linguistic knowledge can only take her so far because she still has gaps in her experiential knowledge, which highlights her different views from her mother for a low-frequency word like *gritty*.

Kim’s understanding of tactile words in both their concrete source and metaphorical target meanings complicates the proposal of primary metaphors, by which the target domain is understood through implicit association with the source domain (Lakoff and Johnson, 1980). For tactile expressions, the source domain is concrete and experienced directly through haptic touch and the target domain is abstract and experienced through introspection. Thus, the target domain can only be derived through the source domain. However, for Kim, this cannot be the case as she clearly has no direct sensory experience. For her, the sensory domain is not concrete but equally as abstract as the target domain. Therefore, it need not be the case that she understands abstract concepts like *hard-as-difficult* through association with physicality, since it would involve understanding the abstract through the abstract. This raises the question of whether a tactile metaphor like “had a rough day” is even a metaphor for Kim instead of simply a separate lexical entry for a word like “rough.” What does Kim gain by understanding the abstract through the abstract? Does Kim use sensory metaphors that she has no direct experience with simply because of their standardness and frequency in language? Or does appealing to texture, which she can experience visually and linguistically, still intensify the cognitive and expressive meaning beyond their semantic denotations?

The present findings further challenge stronger claims for the embodied metaphor where the associations between the source and target domains require a recruitment of the sensory system and a simulation of past sensations (Barsalou, 1999). Kim is fully able to

process and use tactile metaphors without ever having experienced tactile sensations such that she could later simulate them to understand the metaphorical extension. Simply put, it cannot be the case that somatosensory experiences are required to process tactile metaphors as Kim is clearly able to do so. That is not to say, however, that somatosensory information is never used in the processing and use of tactile metaphors, as Lacey et al. (2012) show that individuals who have access to somatosensory input use it; rather Kim shows that these metaphors can be understood without it. Similar findings have been observed for other sensory domains. The ability of congenitally blind individuals to understand visual metaphors has been established (Minervino et al., 2018) and metaphors that utilize an auditory source domain are commonly attested across sign languages (Zeshan and Palfreyman, 2019). For example, the sign for *news* involves a listening gesture in Indian Sign Language and Polish Sign Language. Just as hearing and vision are not necessary to process metaphors that rely on those senses, somatosensation is not necessary to process tactile metaphors. It is perhaps the uniqueness of Kim’s condition of never having experienced haptic touch or proprioception that allowed researchers to make stronger claims for the role of somatosensation in the embodiment metaphor than for vision and audition.

In the same vein, these findings challenge strong claims for embodied cognition, by which all cognition, not just metaphorical language, relies on the recruitment of the body’s sensory systems. Kim demonstrates that somatosensation cannot be any more required for abstract thought than vision and audition are. These strong proposals for embodied cognition that foreground proprioceptive experiences of one’s body and tactile experiences with the world in which one lives may stem from the fact that it is difficult for many researchers to even conceptualize the different relationship that someone like Kim has with her body and the rareness of conditions like hers. Yet Kim does exist and, despite her different sensory experiences with both her body and the world around her, is as capable of abstract thought and metaphorical language as the rest of us.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by University of Chicago Social and Behavioral Sciences Institutional Review Board. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

JP, LG, and PM contributed to the design and edited the manuscript. JP performed the research, conducted the analysis, and

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships

that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2023.1144018/full#supplementary-material>

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