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Abstract

Previous work showed that concrete experiences of weight influence people's judgments of how important certain issues are. In line with an embodied simulation account but contrary to a metaphor-enriched perspective, this work shows that perceived importance of an object influences perceptions of weight. Two studies manipulated information about a book's importance, after which, participants estimated its weight. Importance information caused participants to perceive the book to be heavier. This was not merely a semantic association, because weight perceptions were affected only when participants physically held the book. Furthermore, importance information influenced weight perceptions but not perceptions of monetary value. These findings extend previous research by showing that the activation direction from weight to importance can be reversed, thus suggesting that the connection between importance and weight goes beyond metaphorical mappings. Implications for the debate on interpretation of findings on the interplay between bodily states and abstract information are discussed.

Keywords

embodiment, judgment, weight, importance, conceptual metaphors

Weight and importance go side by side in everyday language. A “weighty matter” or an issue that “carries weight” refers to something that people find important. Recent research revealed that the relationship between weight and importance is not merely a matter of language use. In a series of studies, participants held either a heavy clipboard or a light one while they thought about a particular issue (e.g., fairness). Those participants who held the heavy clipboard considered the issue to be more important and thought more thoroughly about it than did participants who held a light clipboard (Jostmann, Lakens, & Schubert, 2009). These studies suggest that the experience of weight can influence people's judgments of how important an issue is. In the present research, we examine whether importance judgments can in turn influence perceptions of weight. Given the notion that abstract conceptualizations are grounded in bodily experiences (Barsalou, 2008), we hypothesized that the information that an object is important would affect how heavy it is perceived to be. In short, do important objects literally feel heavier?

Weight and Importance

In daily life, weight is associated with impact in many ways. On a physical level, the weight of an object determines how much energy people need to handle it. In general, dealing with heavy objects is more demanding because it requires more effort than does dealing with light objects, in terms of either

physical strength or cognitive planning. The human mind has adapted to this fundamental experience. Research on spatial perception showed that participants who were instructed to carry a heavy backpack perceived distances to be greater and hill slants to be steeper than did participants who carried a light backpack (Proffitt, Stefanucci, Banton, & Epstein, 2003). These weight-induced changes in spatial perception are arguably functional because they prevent people from engaging in activities that are metabolically costly (Proffitt, 2008; cf. Gibson, 1979).

Weight also signals the possible impact of using an object, which is generally more intense if the object is heavier. As reflected in language, people apply this knowledge figuratively to indicate psychological importance. For instance, weight indicates differences in potency (Osgood, Suci, & Tannenbaum, 1967) and serves as a metaphor for importance, even in domains where actual weight is irrelevant (e.g., “Her new book carries a lot of weight”). Notably, these abstract linguistic connections are still grounded in the physical

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experience of weight. As the aforementioned clipboard studies revealed, people find abstract issues more important when they hold a heavy compared to a light object (Jostmann et al., 2009), which suggests that psychological importance and physical impact are closely intertwined.

A possible explanation for the mental connection between weight and importance is provided by a metaphor-enriched perspective on cognition (Landau, Meier, & Keefer, 2010; cf. Lakoff & Johnson, 1999). In short, this perspective entails that people draw from knowledge about select attributes of entities and relations in the physical world to interpret and evaluate entities and relations in more abstract domains that are less easy to grasp. An important assumption from the metaphor-enriched perspective is that the concrete domain (e.g., weight) always serves as the source concept from which knowledge is derived, whereas the abstract domain (e.g., importance) is always the target concept to which this knowledge is mapped. Such mappings are assumed to develop early in life (cf. Inhelder & Piaget, 1958) and influence people's understanding of abstract concepts during the lifespan. In line with the assumption that the link between the concrete source domain and the abstract target domain is one directional, research has found, for instance, that information about how objects relate to one another in space influences how people construe abstract temporal relations, but activating information about time does not influence how people construe spatial relations (Casasanto & Boroditsky, 2008).

From a metaphor-enriched perspective, perceptions of weight thus influence importance judgments (see Jostmann et al., 2009), but thinking about importance is unlikely to influence perceptions of weight. A different prediction can be made, however, if one assumes that weight relates to importance beyond metaphorical mappings. Such a prediction would be justified from an embodied simulation account (Barsalou, 1999, 2008). According to this perspective, abstract concepts contain representations of bodily states that customarily occur during interactions with concept-relevant stimuli. When the concept is processed, associated bodily states become reactivated (i.e., "simulated") even when people are interacting with concept-irrelevant stimuli (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). Thus, the information that an object is important should make the object feel heavier even if the assumed impact of the object is generally not physical in nature (e.g., a book).

In the present research, we tested whether the felt weight of an object can be influenced depending on whether conceptual information is available about the importance of the object. To test this idea, we provided participants with a book that was or was not announced to be important and subsequently asked them to estimate the weight of the book. If the association between weight and importance is mainly metaphorical (see Landau et al., 2010), the presence of importance information should have no influence on perceived weight. By contrast, if weight perceptions embody the concept of importance (see Barsalou, 2008), one would expect the book to feel heavier when it is important.

Overview

We conducted two studies in which we ostensibly tested the weight estimate abilities of our participants. Their task was to hold a book and estimate its weight. We specifically chose a book as a target object because its weight is generally unrelated to its impact, unlike objects with a primarily physical purpose (e.g., a hammer). Information about the alleged importance of the book was given to a subset of our participants. We hypothesized that the book would be perceived as being heavier when it was presented as being important, compared to when no importance information was given.

Study 1

Methods

Participants and design. In Study 1, 55 psychology undergraduates from a Dutch university participated for course credit or financial compensation. Participants were randomly assigned to one of two experimental conditions (importance information: present vs. absent).

Procedure. The experimenter informed the participants that they would have to estimate the weight of a textbook (in grams), which was then handed to them. Half the participants were randomly chosen to receive the following information, which included a casual mention of importance: "This is the book you will weigh. It is used by students in this faculty, and it's a rather important book. Please hold it and estimate its weight." The remaining half of the participants received similar information but no mention regarding importance: "This is the book you will weigh; it is used by students in this faculty. Please hold it and estimate its weight." In the Dutch language, the words *weight* (*gewicht*) and *important* (*belangrijk*) do not sound similar, which made it unlikely that the weighing instructions activated associations with importance merely through word resemblance. After participants' weight estimates were recorded by the experimenter, they were thanked and debriefed.

Results and Discussion. We found that participants who were told that the book was important judged it to be heavier ($M = 1,523$ g, $SD = 691$) than did participants who received no importance information ($M = 1,047$ g, $SD = 584$), $F(1, 53) = 7.181$, $p = .03$, $\eta^2_p = .08$. Thus, Study 1 revealed that information about the importance of an object influences its heaviness even though the importance of the object was not physical in nature. This finding is in line with the idea that the abstract concept of importance is intertwined with weight-related sensations (cf. Barsalou, 2008). The finding does not fit with the interpretation of weight being merely a metaphor of importance (cf. Landau et al., 2010).

Study 2

The finding of Study 1, though suggestive, can be interpreted in more than one way. First, a possible alternative explanation is

Table 1. Study 2: Weight and Value Estimates as a Function of Information and Perceptual Input

Information	Perceptual input	Importance <i>M</i> (<i>SD</i>)	Effort <i>M</i> (<i>SD</i>)	Neutral <i>M</i> (<i>SD</i>)
Weight, grams	Looking at book	618 (378) ^a	820 (530)	783 (425)
	Holding book	944 (461) ^b	626 (436) ^a	591 (409) ^a
Value, euros	Looking at book	50.75 (3.50)	47.83 (3.62)	49.61 (3.89)
	Holding book	46.53 (3.21)	53.60 (3.06)	51.24 (3.40)

Note: Differing superscripts within row and within column indicate that means differ significantly ($p < .05$).

that the importance information caused participants to infer that the book would require more effort to read or work through, thus increasing its perceived heaviness. To control for this possibility, an additional experimental condition was included in Study 2, in which we provided no importance information but instead explicitly mentioned that the book would be effortful to read through. Second, it is possible that importance information would influence any judgments that are semantically related to importance (e.g., estimates of monetary value). To rule out this possibility, we asked participants in Study 2 to estimate the retail value of the book. To make a strong case for the importance–weight link, importance information should uniquely influence weight estimates but not value judgments.

Third, one could argue that the link between weight and importance is not embodied but instead operates on semantic associations. To test this alternative explanation, we included an additional condition in which participants were not allowed to hold the book in their hands but instead estimated its weight solely on the basis of sight. In general, weight estimations that are formed on the basis of visual information are especially susceptible to modulation by top-down semantic processing because they are established without involvement of sensorimotor brain systems (see Creem & Proffitt, 2001; Ellis & Lederman, 1998; Flanagan & Beltzner, 2000; Goodale, Milner, Jakobson, & Carey, 1991). We reasoned that merely seeing the important book would prevent embodied simulation of heaviness to occur but would not obstruct the alleged influence on weight perception of semantic associations between importance and weight (for a discussion of conditions in which simulation is unlikely to occur, see Niedenthal, 2007). Thus, if Study 2 revealed no differences in weight perception among participants who saw the book but did not hold it, we could rule out the possibility that the importance–weight link is simply a semantic association. Finally, Study 2 used a different textbook and presented all information and instructions in written form.

Methods

Participants and design. Participants were 102 social sciences undergraduates from a Dutch university who received course credits or financial compensation and were randomly assigned to one of six experimental conditions of the $3 \times 2 \times 2$ mixed design (information: importance vs. effort vs. neutral;

perceptual input: holding vs. looking at the book; judgment type: weight vs. value), with repeated measures on the last factor.

Procedure. Upon arrival in the laboratory, participants were led to a table and provided with a questionnaire that included all necessary information. The experimenter stayed in the same room and could unobtrusively observe whether participants followed the instructions. Participants read that they were to estimate the weight of a social sciences methods book lying on the table and then fill in the weight (in grams) and its estimated retail price (in euros). All participants learned that they would work with the book at some later point during their study. Depending on the experimental condition, the book was introduced either as being important or as requiring effort to read, or no extra information was provided. Participants then estimated the weight of the book, with directions either to not touch the book or to pick up the book and hold it in their hands. All participants also estimated the book's retail price; after which, they were thanked and debriefed.

Results and Discussion. To allow for analyses involving both weight judgments (in grams) and value judgments (in euros), we first standardized the means of these variables by converting them to z scores. To facilitate interpretation, we here report the unstandardized means. We then ran a $3 \times 2 \times 2$ repeated measures analysis of variance on weight and value judgments (information: importance vs. effort vs. neutral; perceptual input: holding vs. looking at the book; judgment type: weight vs. value). This analysis yielded a three-way interaction among information, perceptual input, and judgment type, $F(6, 95) = 3.99, p = .02, \eta^2_p = .08$. No other interaction or main effects were significant (all p values $> .50$). All relevant means are depicted in Table 1.

In a more detailed examination of the three-way interaction, we first looked at participants' weight estimates. We found that among participants who were instructed to hold the book in their hands, those who learned that the book was important perceived it to be heavier ($M = 944$ g, $SD = 461$) compared to those who thought it would require effort ($M = 626$ g, $SD = 436$) and those who received no further information ($M = 591$ g, $SD = 409$), $F(2, 54) = 3.72, p = .03, \eta^2_p = .12$. Least significant differences post hoc analyses revealed that weight perceptions in the importance condition differed significantly from those in the effort conditions and the neutral condition (both p values $< .03$), whereas the latter two did not differ from each other ($p > .81$). Among

participants who were instructed to not touch the book but to only look at it, the type of information that they received had no effects on weight estimates (grand $M = 755$ g, all p values $> .20$).

Another way to interpret the results is to say that among participants who received importance information, those who held the book perceived it to be heavier ($M = 944$ g, $SD = 461$) than did those who solely looked at it ($M = 618$ g, $SD = 378$), $F(1, 34) = 5.09$, $p = .03$. Among participants who received effort information and those who received no further information, holding versus looking at the book did not influence weight estimates, p values $> .20$.

In contrast to our data on weight estimates, our experimental manipulations had no effects on participants' estimates of the book's retail value (grand $M = 50$ euros; all p values $> .32$), which means that even when the book was deemed important, participants did not think it was more expensive than when it was not deemed important.

In sum, Study 2 revealed the predicted differential effect of importance information on physical perceptions of weight. Only participants who felt the weight of the book and who learned that the book was important perceived it to be heavier. As expected, these participants did not think that the book would be more expensive.

General Discussion

The present research investigated whether activation of the concept of importance increases perceptions of weight. In two studies that used different materials and instructions, casually mentioning that a textbook was important made our participants experience the book as being heavier. Combined with previous research (Jostmann et al., 2009), these studies demonstrate that the abstract concept of importance is closely associated with bodily sensations of weight.

The present studies extend previous research by showing that the direction of activation from weight to importance can be reversed. This novel finding—that importance information influences weight perceptions—makes it possible to distinguish between two competing explanations for the mental link between weight and importance. Specifically, the present findings seem to render an explanation from a metaphor-enriched perspective implausible because it is inconsistent with the claim that physical sensations (i.e., weight) always serve as the source domain, whereas abstract conceptualizations (i.e., importance) serve as the target domain (Landau et al., 2010). Instead, the present findings can be explained by an embodied simulation account (Barsalou, 2008). According to this perspective, the abstract concept (i.e., importance) is grounded in related bodily states (i.e., feeling weight). Because abstract knowledge and simulations of bodily states are closely intertwined, their activation co-occurs irrespective of the direction of activation.

One possible limitation of the current research is that our importance instructions might not have activated genuine bodily sensations of heaviness but merely semantic knowledge about the link between importance and weight. However,

because we did not find that importance information influenced weight estimates when participants only looked at the textbook, we deem this possibility unlikely. A purely semantic association should have caused increased weight estimates even when participants could not feel the book's weight, because weight estimations solely based on visual information prevent simulation to occur but leave the possible influence of semantic information intact (Flanagan & Beltzner, 2000; Goodale et al., 1991; cf. Niedenthal, 2007). Contrary to the alternative semantic explanation, only participants who had physical contact with the book perceived it to be heavier.

Another possible limitation concerns low construct validity. Specifically, importance information might have led to increased weight estimates because participants assumed the book to be effortful to read through. Alternatively, importance information might have simply changed perceived task demands and thus influenced any estimation related to impact or importance. However, we ruled out this possibility in our second study by showing that weight estimates were not influenced by the explicit information that reading the book would require much effort. Moreover, importance information affected only weight estimates and left judgments of the book's retail value unchanged. Therefore, we are confident that the present studies unequivocally activated the link between importance and weight.

These issues notwithstanding, the present findings add valuable information to the ongoing debate on how to interpret the ever-growing amount of findings on the interplay between bodily states and abstract information processing (e.g., Barsalou, 2008; Landau et al., 2010). We expect that the issue of whether activation of an abstract concept is able to trigger related bodily sensations will prove helpful in this debate. As noted above, many body-concept connections fit with a metaphor-enriched perspective because their activation roots in the concrete experience (e.g., Casasanto & Boroditsky, 2008; Meier, Robinson, & Clore, 2004). As the present research shows, however, there are notable exceptions (cf. Jostmann et al., 2009; consider also the link between interpersonal affection and warmth; IJzerman & Semin, 2010; Zhong & Leonardelli, 2008). Future research should investigate which principles underlie these differences—for example, by differentiating between culturally learned metaphors and biologically predisposed bodily experiences.

A second aim for future research could be to examine the boundary conditions of the embodied link between importance and weight. A question of particular interest is whether the link is restricted to objects (e.g., books) or extends to social perception. For instance, future research may address the question of whether persons who are perceived as being important are also assumed to be heavier.

On a final note, we emphasize that we do not preclude the possibility that importance and weight can also be metaphorically connected. Heaviness is a fundamental human experience that is reflected in both language and metaphors across cultures as different as ancient Greece and ancient China (Skutsch, 1936; Vankeerberghen, 2006). It stands to reason that people use such weight-related metaphors to structure

importance-related information. Nevertheless, the present research shows us that the connection between importance and weight goes beyond metaphorical mappings. Important matters literally weigh upon us.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

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Bios

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