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"Heavy of Mouth" and "Heavy of Tongue": Weight as a Conceptual Metaphor of Disability

Chani Stroch, Ravit Nussinson, Sari Mentser, and Yoav Bar-Anan

[a]The Open University of Israel; [b]The University of Haifa; [c]Tel-Aviv University

ABSTRACT

We suggest that disability is metaphorically represented in people's minds as heaviness. In three studies we demonstrate the existence of a mental association between physical weight (light vs. heavy) and disability (non-disabled vs. disabled) as well as its bi-directional causal effects (from weight to disability and from disability to weight). In Study 1 (N = 250), participants exhibited the hypothesized association between the dimensions on both a direct and an indirect measure. Study 2 (N = 191) demonstrated that perceived weight affects the perceived severity of a disability, with the weight of a clipboard held by participants affecting perceptions of a target person's stutter or limp. Study 3 (N = 103) testified to the reverse effect: participants who heard a monologue by someone with a pronounced (as opposed to mild) stutter perceived the clipboard they were holding as heavier and estimated its weight in grams as higher. Our findings may suggest that experiences of weight affect both estimates of the prevalence of disabilities in others and in the self as well as level of identification with the disabled. Theoretical implications are discussed as well.

Introduction

"*I am heavy of mouth and heavy of tongue.*" (Moses to God, Exod. 4:10)

"*The ears of the aged become heavy.*" (Babylonian Talmud, Tractate Shabbat, 152a)

A disability is a physical or mental impairment that limits a person's ability to carry out normal day-to-day activities. Disabilities afflict a significant portion of the world's population (12 percent by some reports) and are prevalent in every society (Mont, 2007). Disabilities have always been with humankind, and may indeed be an almost inevitable part of the aging process. Yet, little is known about how disability is mentally represented. As such, it stands to reason that human beings are likely to have developed consistent, shared mental representations of disability.

In various languages, disability is metaphorically described using terms that connote weight. In the Hebrew Bible (Exodus 4:10, quoted above), Moses is called "heavy of mouth and heavy of tongue" (in Hebrew, *k'vad peh u-k'vad lashon*), an expression usually taken to mean that he stuttered. Similarly, in Hebrew, someone who is hard of hearing, visually impaired, or clumsy is, respectively, *k'vad sh'mia, k'vad r'iya*, or *k'vad t'nua* ("heavy" of hearing, sight, or movement). "Heavy of hearing" also describes someone who suffers from hearing loss in Serbian (*tezak na usima*) and Croatian (*teško čuje*). In German and Norwegian, a mentally challenged person is "heavy of understanding" (*schwer von Begriff* and *tung i oppfattelsen*, respectively). Weight-related metaphors are also used to describe someone who is particularly agile, the conceptual opposite of lame or clumsy – giving us *light-footed* in English and equivalent terms in Hebrew (*kal raglayim*), Serbian

CONTACT Ravit Nussinson ravitnu@openu.ac.il Department of Education and Psychology, The Open University of Israel, Raanana 43107, Israel

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(*lakonog*) and Portuguese (*pé ligeiro*). These examples suggest the existence of a conceptual metaphor in which the concrete concept of physical weight or heaviness serves to represent the abstract concept of disability.

There is intuitive logic to the link between disability and weight. The physical weight of objects dramatically influences the manner in which we interact with them. From early on children learn that interaction with some objects, those that feel "heavy," necessitates the investment of increased physical (and sometimes also mental) effort. Indeed, people perceive distances as longer and slopes as steeper when carrying a heavier (compared with lighter) backpack, presumably because of this embedded awareness that interacting with heavier objects requires more effort (Proffitt, 2006). This association between weight and investment of effort is reflected in language in expressions such as "weighing the alternatives" (capturing the investment of mental effort when making a decision) or "weighty matters" (referring to important issues that need deep consideration). In line with this association linguistic studies suggest that both English and Chinese languages associate weight with difficulty (Yu & Huang, 2019).

It is already well-established that weight serves as a metaphor for various abstract concepts, such as importance, seriousness, and severity, presumably because these concepts involve investment of physical or mental effort. A number of studies have investigated how perceptions and judgements are affected by the metaphoric association between physical weight and these abstract concepts – a phenomenon known as the *metaphoric transfer effect* (see Landau, Meier, & Keefer, 2010). For instance, participants who held a heavier clipboard estimated the monetary value of foreign currencies as higher, and judged fair decision-making procedures as more important, than those who held a lighter clipboard (Jostmann, Lakens, & Schubert, 2009; see also Alban & Kelley, 2013; Chandler, Reinhard, & Schwarz, 2012; Zestcott, Stone, & Landau, 2017; but see Rabelo, Keller, Pilati, & Wicherts, 2015). Exemplifying the same association in the reverse direction, participants who were told that a certain book was important perceived it to be heavier than those who were not told anything about its importance (Schneider, Rutjens, Jostmann, & Lakens, 2011; see also Buckingham, 2014; Schneider, Parzuchowski, Wojciszke, Schwarz, & Koole, 2015). Similarly, participants who reviewed resumes on heavier (vs. lighter) clipboards perceived job candidates as displaying more serious interest in the position (Ackerman, Nocera, & Bargh, 2010). In another study, participants who held heavier clipboards perceived both the symptoms of a disease and the side effects of a medicine as more severe than those who held lighter clipboards (Kaspar, 2013). Related findings show that heaviness is associated with negative affect whereas lightness is associated with positive affect, presumably because negative feelings are produced by situations of hardship which require investment of mental or physical effort (Min & Choi, 2016; Zhao, He, & Zhang, 2016).

The disabled are regularly forced to invest substantial physical (and often also mental) effort in order to accomplish simple tasks, and to perform or compensate for mundane functions of the kind that healthy non-disabled people perform easily and seemingly without effort (e.g., hearing, seeing, talking, walking). This increased investment of effort and energy are in most cases easily discerned when one encounters someone with a disability. Thus, exposure to disability activates mental representations of effort. We hypothesize that because the experience of effort forms part of both the concrete concept of physical weight and the more abstract concept of disability, the latter becomes mapped on the former.

The present research empirically examines the hypothesis that disability is metaphorically represented in people's minds as heaviness, through a process of metaphoric transfer such as that seen in relation to the other abstract concepts like importance or severity (Landau et al., 2010). We examine this hypothesis in three studies. In Study 1 we lay the groundwork by testing for the existence of a mental association between physical weight and disability using both a direct and an indirect measure. Studies 2 and 3 explore the two possible effects of the hypothesized conceptual mapping. Specifically, if the concept of disability is mapped on the concept of weight, then carrying a heavier weight should lead people to assess a target person's disability as more severe compared to carrying a lighter weight. Thus, in Study 2 participants judged the severity of a target's stutter or

limp while holding a heavier (1000 g) vs. lighter (150 g) clipboard. We predicted that participants carrying the heavier clipboard would judge the disability of the target person as more severe than participants carrying the lighter one. Finally, following studies which show that activation of metaphorically linked concepts is bi-directional (Lee & Schwarz, 2012), in Study 3 we manipulated the severity of a target disability (stuttering) and asked participants to assess the weight of the clipboard they held. We predicted that participants exposed to severe stuttering would perceive the clipboard as heavier and would estimate its weight as higher than participants exposed to mild stuttering.

Study 1

Method

In Study 1 we employed the Sorting Paired Features (SPF) task (Bar-Anan, Nosek, & Vianello, 2009) as an indirect measure of mental associations, and self-report questionnaires for a direct measure. Informed consent was obtained from participants in all three studies.

Participants

To maximize the odds of obtaining our hypothesized effect, our target sample size for Study 1 was 250, which allowed us power of more than 99% to detect a small effect ($d = 0.3$). Participants were American (English-speaking) volunteers recruited from Project Implicit's participant pool (http://implicit.harvard.edu; Nosek, 2005). They were randomly assigned to this study from a pool of available studies. Four hundred eighty-seven participants agreed to participate, and 256 completed the Sorting Paired Features task (Bar-Anan et al., 2009), our indirect measure (the high dropout rate is typical of Project Implicit because participants are mainly motivated by curiosity and do not receive compensation for their participation). Following Bar-Anan et al. (2009), of the 256 participants who completed the SPF, we excluded 11 participants (4.3% of the sample) who responded either too quickly (RT < 400) or too slowly (RT > 5,000) in more than 10% of the trials. This left 245 participants (173 females, $M_{age} = 33.69$, $SD = 14.10$) in the SPF analyses. A total of 253 (179 females, $M_{age} = 33.57$, $SD = 14.05$) participants responded to all twelve questions in the direct measure questionnaire and were included in its analyses (128 rated photos of heavy and light objects, 125 rated disability- and non-disability-related words; see below). The results are the same if we include only the 244 participants who were not excluded from either the indirect or the direct measures analyses.

Materials and procedure

Indirect measure of the association

We chose the SPF as the indirect measure of the association because – unlike the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), a more common indirect measure of associations – the SPF measures all associations in the same block, and is therefore not sensitive to effects of block order. As such, it is a more suitable measure of the average mental associations in a given sample. In the SPF, participants categorize pairs of stimuli (e.g., the word "Blindness" + a photo of a heavy object) into one of four pairs of categories (Disability + Heavy, Disability + Light, Non-disabled + Heavy, Non-disabled + Light) in three blocks of 40 trials (see Figure 1). Each stimulus pair included one of six words representing disability (blindness, deafness, limping, stuttering, dyslexia, muteness) or its absence (running, climbing, cycling, skiing, hearing, seeing), and one of six photos depicting objects that were clearly heavy (e.g., an anchor) or light (e.g., a single feather). Faster response times for categorizing pairs representing one combination (e.g., Disability + Heavy) compared to another (e.g., Disability + Light) can be interpreted as indicating stronger associations for the former than for the latter.

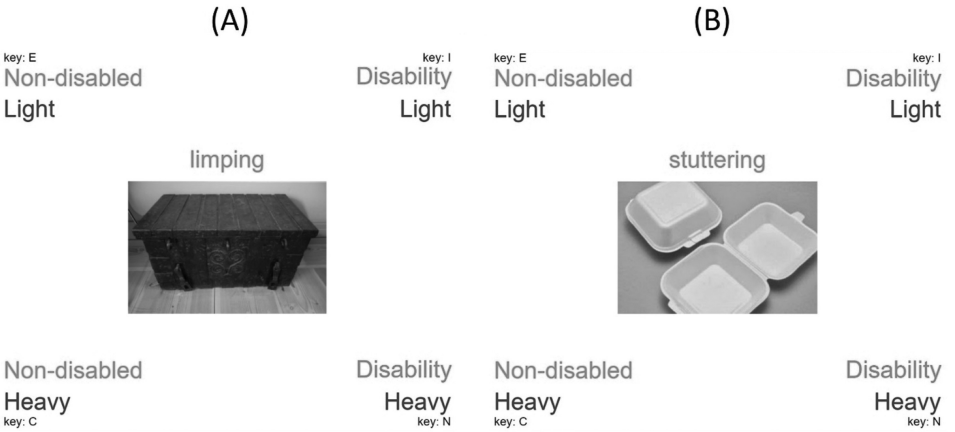

Figure 1. Examples of SPF trials (Study 1): (A) congruent trial; (B) incongruent trial.

Following standard procedure for computing scores for the SPF in the context of social groups (Bar-Anan et al., 2009), we examined whether participants performed better when the target stimulus pair matched the combinations Disability + Heavy and Non-disabled + Light than when the target stimulus pair matched Disability + Light and Non-disabled + Heavy. Specifically, we first computed the difference between the average response latency in trials where the target pairs matched either Disability + Heavy or Non-disabled + Light and that in trials where the match was Disability + Light or Non-disabled + Heavy. This difference was computed for each of the three SPF blocks, then divided by the overall standard deviation of that block to produce that block's SPF *D* score. The average of the three SPF *D* scores was the overall SPF *D* score, used as the indirect measure of the association. Positive SPF *D* scores indicated stronger associations for the combinations Disability + Heavy and Non-disabled + Light than for Disability + Light and Non-disabled + Heavy.

In the SPF, each of the four combinations is located in the corner of a square, such that the categories belonging to one dimension are separated vertically and those belonging to the other dimension are separated horizontally (see Figure 1). We manipulated between participants whether the categories Disability and Non-disabled appeared in the left- and right-hand corners or vice versa. Similarly, we manipulated between participants whether the categories Heavy and Light were positioned in the two top or two bottom corners. The E and C keys were used to indicate the upper and lower left corners, respectively, and the I and N keys the upper and lower right corners. Participants were asked to put their left middle and index fingers on the E and C keys, respectively, and their right middle and index fingers on the I and N keys.

Direct measure of the association

Following the SPF, participants completed one of two self-report questionnaires. Half the participants were given each of the twelve words used for the concepts Disability and Non-disabled (i.e., blindness, deafness, limping, stuttering, dyslexia, muteness, running, climbing, cycling, skiing, hearing, seeing) and were asked to indicate for each word whether they associated that word more with the concept Heavy or the concept Light (e.g., "Do you associate the concept '*blindness*' more with the concept *'Heavy'* or the concept *'Light'*?"). They indicated their answers using a visual analog scale (VAS) that ranged from *Light* through *Equal Association* to *Heavy*. The other half of the participants were given the photos used for the concepts Heavy and Light (see Appendix) and were asked to indicate for each photo whether they associated that photo more with the concept Disability or the concept Non-disabled (e.g., "Do you associate this photo more with the concept *'Non-disabled'* or the concept *'Disability'*?"). They indicated their answers on a similar VAS that ranged from *Non-disabled* through

Equal Association to *Disability*. The two versions of the questionnaire were randomized between participants. Responses were coded with a number from 0 to 100, and recoded such that larger numbers indicated a stronger association with Heavy or Disability than with Light or Non-disabled.

The Ethics Committee of the Department of Psychology at Tel-Aviv University approved the study.

Results

Indirect measure

As hypothesized, the mean SPF score was 0.102 ($SD = 0.433$), significantly larger than zero, $t(244) = 3.68$, $p < .001$, $d = 0.235$, 95% CI [0.108, 0.362]. The results thus point to stronger associations between Heavy and Disability and between Light and Non-disabled than between Heavy and Non-disabled or Light and Disability.

Direct measure

As noted above, responses to the direct measures were coded such that larger numbers indicated a stronger association with Disability (rather than Non-disabled) or Heavy (rather than Light). Thus, our results reflect a relative association with Disability as compared to Non-disabled and with Heavy as compared to Light, rather than an absolute association with each of these concepts separately.

For those questionnaires where the photos of heavy and light objects were rated against the concepts representing disability and its absence, we submitted the average reported associations (detailed in Table 1) to a paired-samples *t*-test comparing associations for the two sets of photos. As hypothesized, participants associated photos of heavy objects more than photos of light objects with the category Disability, $t(127) = 5.67$, $p < .001$, $d = 0.501$. Thus, the results of the direct measure indicate that participants associate heaviness more than lightness with the category Disability (rather than Non-disabled).

For those questionnaires where the ability and disability words were rated against the weight concepts (Heavy and Light), we again submitted the average reported associations (detailed in Table 1) to a paired-samples *t*-test. As hypothesized, participants associated Disability concepts more than Non-disabled concepts with the category Heavy, $t(124) = 4.99$, $p < .001$, $d = 0.438$. Thus, the results of the direct measure also indicate that participants associate disability more than absence of disability with the category Heavy (rather than Light).

Discussion

Supporting our hypothesis, the results suggest that people automatically associate weight with disability. The results further suggest that people are aware of this association: people associate words reflecting disability with the concept "heavy" (rather than "light"), and associate photos of heavier objects with disability.

Study 2

Study 2 examined the effect of experienced weight on perceived disability. We hypothesized that experiencing a physical sense of weight would impact perceptions of disability such that holding a heavier object would make the disability seem more severe. To enable generalization to different incapacities, we investigated two types of disabilities – limping and stuttering.

Table 1. Means and standard deviations of mental associations as reflected in participants' self-reports.

	Associations with Disability ($N = 128$)	
Heavy (photos)	$M = 49.93$	$SD = 18.69$
Light (photos)	$M = 37.37$	$SD = 17.28$
	Associations with Heavy ($N = 125$)	
Disability (words)	$M = 54.18$	$SD = 18.50$
Non-disabled (words)	$M = 42.70$	$SD = 17.32$

Method

Participants and design

To compute the required sample size, we conducted a power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2013). We aimed at a power of 80% to detect a small-to-medium effect (the typical effect size in social psychology; see Richard, Bond, & Stokes-Zoota, 2003) in a two-way ANOVA. Based on this analysis, we recruited 191 participants. All were Israeli adults (125 female, *M*age = 27.53, *SD* = 7.24). Some were recruited via snowball sampling from the first author's social environment; they volunteered to participate in the study with no compensation. The rest were students at various academic institutions in the Tel Aviv area who were tested in the lab and compensated with NIS 12 (about $3). We used a 2 (type of disability: stuttering vs. limping) × 2 (clipboard weight: heavy vs. light) between-subjects design.

Materials and procedure

The experimenter explained that the purpose of the study was to investigate how different body positions influence information processing. Participants were told that they would be asked to listen to (watch) a short audio recording (video clip) and fill in a questionnaire, all in a standing position. The questionnaire was given to them on a clipboard, which they were instructed to grasp with their non-dominant arm and hold in a comfortable position such that its lower part rested on the waist (see Jostmann et al., 2009). The light clipboard weighed 150 g and the heavy clipboard weighed 1000 g.

The audio recording used in the stuttering condition was a 150-sec segment of a live lecture given by a former soldier (see supplemental materials). At some points during the talk the speaker stuttered severely; at other points he stuttered lightly and at some points he did not stutter at all. In the segment, the speaker talks about himself and his army experience. At no point in the segment does he refer to the fact that he stutters. The audio segment continued playing in a loop while participants were completing the questionnaire.

The video used in the limping condition was a 45-sec segment of a film depicting a woman walking down a street (see supplemental materials). While it is evident that the woman in the video limps, she nonetheless is able to move forward relatively fast. This rendered her limping open to be perceived as either mild or severe. Like the audio segment just described, the video continued in a loop while participants completed the questionnaire.

The questionnaire was designed to allow participants to listen to (watch) some of the audio (video) segment before they reached the item asking them to rate the severity of the target's disability. Participants first answered a few demographic questions. They were then asked several questions about what they were hearing or seeing (e.g., how interesting the lecture in the audio was, how well-maintained the environment in the video was) and indicated their current mood. Finally, they were asked to rate the specific disability on a continuous horizontal scale from *stutters a little/limps a little* on the left to *stutters severely/limps severely* on the right. The scale's length varied somewhat between questionnaires (from 100 mm to 108 mm) because of differences in printer settings. Hence, for each response we measured the distance in mm from the left end of the horizontal scale and divided it by the full length of that scale. The resulting quotient served as our severity-of-disability index.

The Ethics Committee of the Department of Education and Psychology at the Open University of Israel approved the study.

Results

Disability severity scores were submitted to a two-way ANOVA with type of disability and clipboard weight serving as the independent variables. The analysis yielded a main effect of disability type, such that the limping (M = .78, SD = .13) was judged more severe than the stuttering (M = .64, SD = .31), $F(1, 187) = 15.48$, $p < .001$, $\eta^2_p = .076$. More importantly, a main effect of clipboard weight emerged,

such that participants in the heavy clipboard condition (M = .74, SD = .23) perceived the disability as more severe than participants in the light clipboard condition (M = .65, SD = .27), $F(1, 187) = 6.35$, p = .013, η^2_p = .033. We did not expect or find an interaction between disability and weight, $F(1, 187) = 1.181$, p = .279, η^2_p = .006. Analyses separately contrasting ratings of stuttering and limping severity in the heavy vs. light condition confirmed that participants holding the heavy clipboard estimated the man's stuttering as more severe (M = .70, SD = .28) than those holding the light clipboard (M = .57, SD = .33), t = 2.14, p = .035. Similarly, limping was judged more severe by participants holding the heavy clipboard (M = .80, SD = .14) than by participants holding the light clipboard (M = .75, SD = .13), t = 1.78, p = .04 (one-tailed). See Figure 2.

To rule out the possibility that disability perceptions were influenced by effects of the manipulation on participants' mood, we carried out a t-test examining between-group differences in mood. The analysis showed no effect of clipboard weight on mood, $t(189) = 0.19$, p = .85.

Discussion

As hypothesized, participants who held a heavier clipboard perceived the disability of a target person as more severe. In other words, the physical experience of weight affected how disabled a person was perceived to be. Study 2 thus provided an evidence that physical weight causally affects perceived disability.

Study 3

Early research examining conceptual metaphors assumed that their effects are uni-directional, such that the concrete domain affects the abstract domain, but not vice versa (Landau et al., 2010). However, recent evidence suggests that the effects of metaphors can be bi-directional (IJzerman & Koole, 2011). For example, not only do fishy smells induce suspicion, but suspicion also heightens sensitivity to low concentrations of fishy smells (Lee & Schwarz, 2012) (for more examples see Crawford, Margolies, Drake, & Murphy, 2006; Giessner & Schubert, 2007; Meier & Robinson, 2004; Nussinson, Elias, Mentser, Bar-Anan, & Gronau, 2019). Lee and Schwarz (2012) proposed that the metaphoric association between a concrete, sensory concept and its related abstract concept results in co-activation of their neural bases, which in turn, results in bi-directional effects of the conceptual metaphor.

It follows that if indeed disability is metaphorically represented as weight, this metaphoric association should give rise to effects of both weight on perceived disability (Study 2) and disability on perceived weight. In Study 3 we hypothesized that participants exposed to heavy stuttering would perceive the clipboard they were holding as heavier, than participants exposed to mild stuttering.

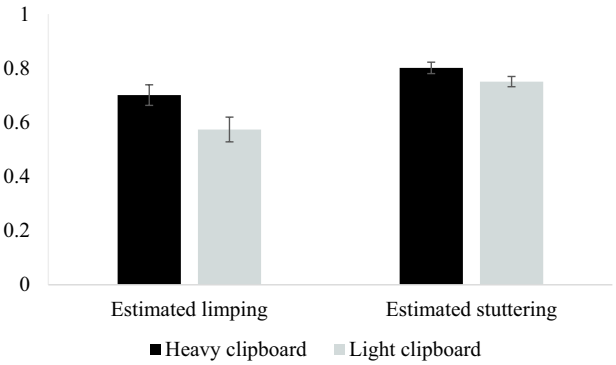

Figure 2. Estimations of disability by experimental condition (Study 2). Whiskers denote standard errors.

Method

Participants and design

As our participant pool was highly restricted at the time of conducting the experiment, we attempted to recruit 50 participants per condition. We carried a sensitivity power analysis with an α of .05 (one-tailed, as our hypothesis is directional) and a power of 80%. The minimum effect size for our hypothesis was a medium effect. One hundred and three Israeli adults (76 female, *M*age = 31.09, *SD* = 11.79) participated in the study. Some were recruited via snowball sampling from the first author's social environment and volunteered to participate in the study with no compensation. The rest were students at various academic institutions in the Tel Aviv area who were tested in the lab and compensated with NIS 15 (about $4). Participants were randomly assigned to the severe-stuttering condition or the mild-stuttering condition.

Materials and procedure

The procedure was similar to that of Study 2 except that for all participants, the questionnaire was attached to a 1000 g clipboard. All participants listened to an audio recording featuring a segment from a monologue by a woman who stuttered. For half the participants, the speaker's stutter was severe, and for the other half it was mild. The two clips were 98 sec and 55 sec respectively (see the supplemental materials). The audio recording continued playing in a loop while participants were completing the questionnaire.

The questionnaire was designed to allow participants to listen to some of the audio segment before they reached the items asking them to assess the weight of the clipboard. Participants first answered a few demographic questions and indicated how interesting and funny the lecture was. Next, they indicated the perceived heaviness of the clipboard by marking a 135 mm horizontal scale from *very light* on the left to *very heavy* on the right. Participants then estimated the weight of the clipboard in grams. Finally, they reported their current mood on another horizontal scale ranging from *very bad* to *very good*. As in the previous study, we measured the distance in mm from the left end of each of horizontal scale and divided it by the full length of the scale to create a perceived heaviness index.

The Ethics Committee of the Department of Education and Psychology at the Open University of Israel approved the study.

Results

We examined a boxplot depicting the distribution of weight estimations and excluded an extreme outlier who estimated the clipboard's weight as 4000 g. We also excluded one participant who provided an estimate of 1, as it was not clear whether the reference was to kilos or grams. After excluding these two the distribution was still highly skewed. We therefore log-transformed all weight estimates.

An independent samples *t*-test comparing weight estimates in the more and less severe stuttering conditions supported the hypothesis: participants in the severe stuttering condition perceived the clipboard as weighing more ($M = 2.78$, $SD = 0.33$) than participants in the mild stuttering condition ($M = 2.58$, $SD = 0.53$), $t(99) = 2.35$, $p = .021$, $d = 0.453$, CI [0.03, 0.38]. A similar analysis on the perceived heaviness scores confirmed that participants in the severe stuttering condition estimated the clipboard as heavier ($M = 0.47$, $SD = 0.22$) than participants in the mild stuttering condition ($M = 0.39$, $SD = 0.23$), $t(99) = 1.87$, $p = .032$ (one tailed), $d = 0.355$, CI [−0.005, 0.17]. We then computed a combined score by summing up *z*-scores of the weight estimates and perceived heaviness. The effect remained virtually unchanged, $t(94.58) = 2.49$, $p = .014$, CI [0.17, 1.48], $d = 0.495$.

As in Study 2, we probed for a possible effect of condition on mood. Again, no such effect emerged, $t(99) = -0.03$, $p = .977$.

Discussion

As hypothesized, participants who heard the clip featuring severe stuttering perceived the clipboard they were holding as heavier, compared to participants who heard the clip featuring mild stuttering. Study 3 thus provided support for the hypothesis that perceived weight is influenced by perceived disability.

General discussion

As predicted, in Study 1 participants demonstrated an association between physical weight and disability, as reflected both in their performance on an SPF task (an indirect measure) and in self-reports (a direct measure). Study 2 demonstrates the existence of metaphoric transfer between the two concepts (Landau et al., 2010). That is, manipulating perceptions related to the source domain (the experience of weight) affected how participants processed information about the target domain (perceived disability). Specifically, participants who held a heavier clipboard perceived the stuttering and the limping of a target person as more severe than those who held a lighter clipboard. Study 3 exemplified the reverse effect, where participants exposed to heavier stuttering perceived the clipboard they were holding as heavier and estimated its weight in grams as higher than participants exposed to lighter stuttering.

As far as we know, our findings are the first to suggest that disability is metaphorically associated with physical weight. They join previous findings which demonstrate that people use physical weight to conceptualize other abstract domains, such as importance, seriousness and severity (Jostmann et al., 2009; Kaspar, 2013; Schneider et al., 2011). Indeed, the effects observed in Study 2, in which participants were asked to rate the severity of a disability (stuttering or limping), and in Study 3, in which we manipulated the severity of a disability (stuttering), may reflect in part a metaphoric mapping of severity on weight, much as Kaspar (2013) found for the severity of medical symptoms. However, the results of Study 1 support the existence of a mental association between physical weight and disability in general, above and beyond any link between weight and severity.

Implications

All studies reported in this paper support the existence of a metaphoric association between physical weight and disability. They join an extensive body of literature which suggests that abstract concepts are metaphorically represented in people's minds in terms of concrete concepts (Lakoff & Johnson, 1980; Landau, 2017; Landau et al., 2010). Furthermore, the results of Study 3 go hand in hand with recent findings suggesting that the effect of conceptual metaphors on information processing may be bi-directional (Lee & Schwarz, 2012).

Previous findings suggest that activation of the source domain (here physical weight) may increase the accessibility of concepts related to the target domain (here disability) (e.g., Mussweiler, 2006; Zhong & Liljenquist, 2006). Our findings thus suggest that information about disabilities may be easier to retrieve and to process when participants experience physical weight. In addition, estimates of frequencies are known to be affected by the ease with which examples are retrieved. If experiences of weight affect the ease with which examples of disability around us (e.g., my son's ADHD) and within us (e.g., my far-sightedness) are retrieved, then they may affect estimates of the prevalence of disabilities both in others and in the self. Furthermore, if people associate heaviness with disability, then they may identify more strongly with the disabled when experiencing heaviness. If this is indeed the case then our findings may provide room for educational interventions. Finally, although (for the most part; see Study 1) our studies focused on physical disabilities, we believe that mental disabilities such as attention deficit disorder and learning disabilities may also be metaphorically conceptualized as heaviness. Future research may want to examine these possibilities.

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Authors' Note

Chani Stroch, Department of Education and Psychology, The Open University of Israel; Ravit Nussinson, Department of Education and Psychology, The Open University of Israel, and Institute of Information Processing and Decision Making, The University of Haifa, Israel; Sari Mentser, Department of Education and Psychology, The Open University of Israel; Yoav Bar-Anan, Tel-Aviv University. Ravit Nussinson has previously published under the name Ravit Levy-Sadot.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Open Practices Statement

The preregistration for Study 1 can be accessed at http://aspredicted.org/blind.php?x=am6h46. Studies 2 and 3 were not formally preregistered. Data associated with this article can be retrieved at https://osf.io/ws5v4/. For the materials used in these studies see Appendices.

References

Ackerman, J. M., Nocera, C. C., & Bargh, J. A. (2010). Incidental haptic sensations influence social judgments and decisions. *Science*, *328*, 1712–1715. doi:10.1126/science.1189993

Alban, M. W., & Kelley, C. M. (2013). Embodiment meets metamemory: Weight as a cue for metacognitive judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*, 1628–1634. doi:10.1037/a0032420

Bar-Anan, Y., Nosek, B. A., & Vianello, M. (2009). The sorting paired features task: A measure of association strengths. *Experimental Psychology*, *56*, 329–343. doi:10.1027/1618-3169.56.5.329

Buckingham, G. (2014). Getting a grip on heaviness perception: A review of weight illusions and their probable causes. *Experimental Brain Research*, *232*, 1623–1629. doi:10.1007/s00221-014-3926-9

Chandler, J. J., Reinhard, D., & Schwarz, N. (2012). To judge a book by its weight you need to know its content: Knowledge moderates the use of embodied cues. *Journal of Experimental Social Psychology*, *48*, 948–952. doi:10.1016/j.jesp.2012.03.003

Crawford, E. L., Margolies, S. M., Drake, J. T., & Murphy, M. E. (2006). Affect biases memory of location: Evidence for the spatial representation of affect. *Cognition and Emotion*, *20*, 1153–1169. doi:10.1080/02699930500347794

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2013). *G* Power version 3.1.7 [computer software]*. Germany: Universität Kiel.

Giessner, S. R., & Schubert, T. W. (2007). High in the hierarchy: How vertical location and judgments of leaders' power are interrelated. *Organizational Behavior and Human Decision Processes*, *104*, 30–44. doi:10.1016/j.obhdp.2006.10.001

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464. doi:10.1037/0022-3514.74.6.1464

IJzerman, H., & Koole, S. L. (2011). From perceptual rags to metaphoric riches—Bodily, social, and cultural constraints on sociocognitive metaphors: Comment on Landau, Meier, and Keefer (2010). *Psychological Bulletin*, *137*, 355–361. doi:10.1037/a0022373

Jostmann, N. B., Lakens, D., & Schubert, T. W. (2009). Weight as an embodiment of importance. *Psychological Science*, *20*, 1169–1174. doi:10.1111/j.1467-9280.2009.02426.x

Kaspar, K. (2013). A weighty matter: Heaviness influences the evaluation of disease severity, drug effectiveness, and side effects. *PloS One*, *8*(11), e78307. doi:10.1371/journal.pone.0078307

Lakoff, G., & Johnson, M. (1980). Conceptual metaphor in everyday language. *The Journal of Philosophy*, *77*, 453–486. doi:10.2307/2025464

Landau, M. J. (2017). *Conceptual metaphor in social psychology: The poetics of everyday life*. New York, NY: Routledge.

Landau, M. J., Meier, B. P., & Keefer, L. A. (2010). A metaphor-enriched social cognition. *Psychological Bulletin*, *136*, 1045–1067. doi:10.1037/a0020970

Lee, S. W., & Schwarz, N. (2012). Bidirectionality, mediation, and moderation of metaphorical effects: The embodiment of social suspicion and fishy smells. *Journal of Personality and Social Psychology*, *103*, 737–749. doi:10.1037/a0029708

Meier, B. P., & Robinson, M. D. (2004). Why the sunny side is up: Associations between affect and vertical position. *Psychological Science*, *15*, 243–247. doi:10.1111/j.0956-7976.2004.00659.x

Min, B., & Choi, I. (2016). Heavy-heartedness biases your weight perception. *The Journal of Social Psychology*, *156*, 513–522. doi:10.1080/00224545.2015.1129305

Mont, D. (2007). *Measuring disability prevalence*. Social Protection, Discussion paper No. 0706 . Washington D.C.: The World Bank.

Mussweiler, T. (2006). Doing is for thinking! Stereotype activation by stereotypic movements. *Psychological Science*, *17*, 17–21. doi:10.1111/psci.2006.17.issue-1

Nosek, B. A. (2005). Moderators of the relationship between implicit and explicit evaluation. *Journal of Experimental Psychology: General*, *134*, 565–584. doi:10.1037/0096-3445.134.4.565

Nussinson, R., Elias, Y., Mentser, S., Bar-Anan, Y., & Gronau, N. (2019). Bi-directional effects of stimulus verticality and its construal level. *Social Psychology*, *50*, 162–173. doi:10.1027/1864-9335/a000371

Proffitt, D. R. (2006). Embodied perception and the economy of action. *Perspectives on Psychological Science*, *1*, 110–122. doi:10.1111/j.1745-6916.2006.00008.x

Rabelo, A. L., Keller, V. N., Pilati, R., & Wicherts, J. M. (2015). No effect of weight on judgments of importance in the moral domain and evidence of publication bias from a meta-analysis. *PloS One*, *10*, e0134808. doi:10.1371/journal.pone.0134808

Richard, F. D., Bond, C. F., Jr, & Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Review of General Psychology*, *7*(4), 331–363. doi:10.1037/1089-2680.7.4.331

Schneider, I. K., Parzuchowski, M., Wojciszke, B., Schwarz, N., & Koole, S. L. (2015). Weighty data: Importance information influences estimated weight of digital information storage devices. *Frontiers in Psychology*, *5*, 1536. doi:10.3389/fpsyg.2014.01536

Schneider, I. K., Rutjens, B. T., Jostmann, N. B., & Lakens, D. (2011). Weighty matters: Importance literally feels heavy. *Social Psychological and Personality Science*, *2*, 474–478. doi:10.1177/1948550610397895

Yu, N., & Huang, J. (2019). Primary metaphors across languages: Difficulty as weight and solidity. *Metaphor and Symbol*, *34*, 111–126. doi:10.1080/10926488.2019.1611725

Zestcott, C. A., Stone, J., & Landau, M. J. (2017). The role of conscious attention in how weight serves as an embodiment of importance. *Personality and Social Psychology Bulletin*, *43*, 1712–1723. doi:10.1177/0146167217727505

Zhao, X., He, X., & Zhang, W. (2016). A heavy heart: The association between weight and emotional words. *Frontiers in Psychology*, *7*, 920. doi:10.3389/fpsyg.2016.00920

Zhong, C. B., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science*, *313*, 1451–1452. doi:10.1126/science.1130726

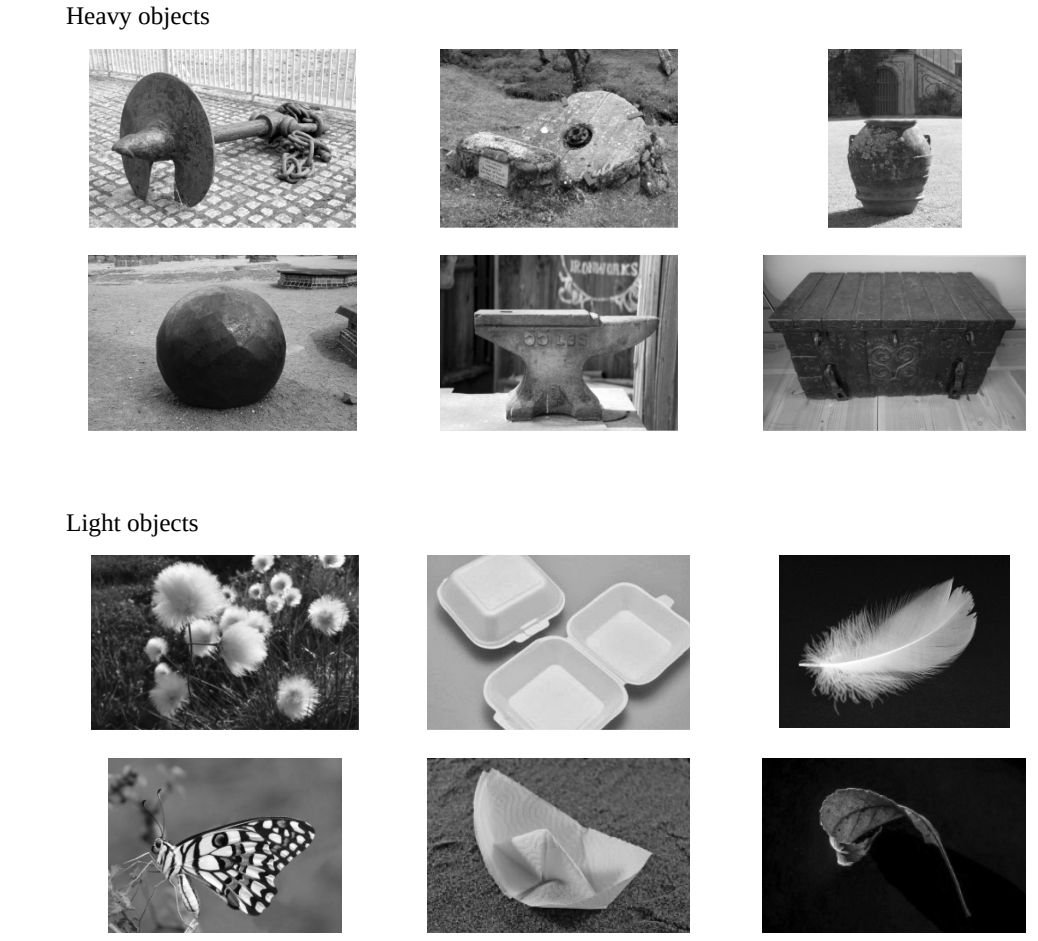

Figure 1. Examples of SPF trials (Study 1): (A) congruent trial; (B) incongruent trial.

Appendix A

Photos used in Study 1.

Appendix B

Links to materials used in Studies 2–3.

(1) Audio recording used in Study 2: https://www.youtube.com/watch?v=0YoYkG8i0Nc (0:34–1:45, then 3:13–3:31, then 3:35–3:56)
(2) Video clip used in Study 2: https://www.youtube.com/watch?v=Cyx5VingKg0
(3) Audio recording used in Study 3 (severe stuttering condition): https://www.youtube.com/watch?v=tYBaDj5Zkz4 (3:59–4:44 and then 8:24–9:15)
(4) Audio recording used in Study 3 (mild stuttering condition): https://www.youtube.com/watch?v=j8izYy6Ub5g