Priming effects for adjectival mixed predicates: Dissociating distributivity from verification

Puzzle. Certain predicates give rise to a systematic ambiguity when they are combined with plural expressions. For instance, (1) below can have a *collective* and a *distributive reading*:

(1) The girls painted a sand castle.
  (a) The girls jointly painted a single sand castle without each separately doing so. (Collective Reading)
  (b) Each of the girls painted a potentially different sand castle. (Distributive Reading)

Sentence (2) exhibits a similar ambiguity; but, while collective and distributive readings are logically independent in (1), this is not the case in (2): the collective reading entails the distributive reading. Changing the polarity of the adjective reverses this entailment pattern (e.g. The bags are heavy).

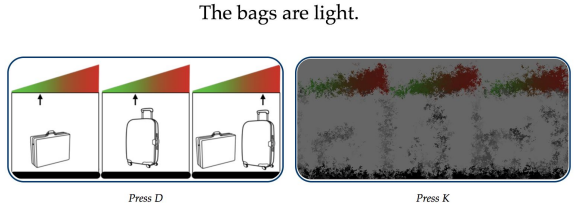
(2) The bags are light.
  (a) The total weight of the bags is low, (and therefore each bag is light). (Collective+Distributive readings)
  (b) Each bag is individually light without the total weight being low. (Distributive reading)

Collective readings are often considered to be the *default* interpretation. In contrast, distributive readings are generally thought to arise through the insertion of a covert distributivity operator *D*, which applies the predicate to each atomic member of the subject (Link 1983; Champollion, to appear). Applying the *D* operator to the VP guarantees the distributivity entailment. Moreover, whenever the predicate is transitive, the *D* operator allows the variables and operators in the VP to *covary* with each member of the subject. This makes the reading compatible with scenarios such as (1b). However, the covariation of objects per subjects is not inherent to distributivity: Not only the collective/distributive ambiguity arises for intransitive predicates (cf. 2, there is no object to covary), but also the distributive reading of sentences such as (1) would still be true in an scenario where no covariation is involved (i.e. the girls painted the same castle).

In the psycholinguistic literature, the question of how plural ambiguous sentences are interpreted in real time has been investigated by comparing the processing of distributive and collective understandings of sentences such as (1) (Frazier et al. 1990; Syrett and Musolino, 2013). In order to isolate distributive interpretations, most studies have used *covariation* scenarios such as (1b). All these approaches have a main drawback: the processing pattern attributed to distributive interpretations confounds verification strategy with actual semantic interpretation. As observed, a strategy based on checking covariation of the object named in the sentence is not inherent to distributivity.

Our goal is to isolate distributivity from covariation. Besides removing the potential confound in previous studies, this would allow us to distinguish semantic interpretation from the strategy required to verify whether a certain reading is true or false. We present a priming study (see Raffray & Pickering, 2010; Maldonado et al. 2017) showing that the collective/distributive contrast is abstractly represented, not only for transitive predicates but also for adjectival predicates, and that this is independent from covariation.

Experimental Design. We run a sentence-picture matching experiment, where we presented a sentence with two different images and participants had to select the image that best corresponds to the sentence. In **target trials,** an ambiguous sentence such as (2) was presented with an overt picture that made the sentence true under only one of its readings, and a blurred picture (cf. Fig 1). The "blur" option could in principle be compatible with either none or both of the readings. Participants were told that they should go for the blur picture only if the overt image did not capture the meaning of the sentence (following the procedure in Huang et al. 2013). There were two types of targets: *collective targets* involved sentences with positive adjectives (e.g. "heavy"), and the overt picture made only the collective reading true; *distributive targets* involved negative adjectives (e.g. "light"), and the overt picture made only the distributive reading true. Participants' responses in targets were thus indicative of the reading they access: Choosing the blur option in collective targets would suggest having a



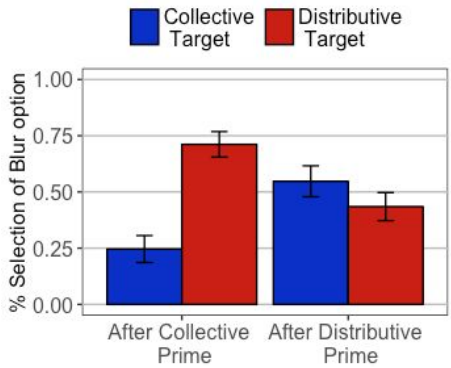
distributive understanding of the sentence, whereas the same choice in distributive targets would be indicative of a collective reading. We were interested in how this preference could be influenced by prime trials that immediately preceded a target. In **prime trials**, the sentence presented the same collective/distributivity ambiguity but the two images were completely visible: one of them made a specific reading true, while the other made the sentence false under all its readings. Participants were forced to choose the former kind of image and, by doing so, they were "forced" to access the corresponding reading. We had two types of primes: in *collective primes* participants were forced to access to collective readings of positive adjectives; in *distributive primes* they were forced to access to distributive readings of negative adjectives.

Target and Prime conditions were fully crossed within subjects. Since sentences could use three different types of predicates (i.e. heavy/light, expensive/cheap, noisy/quiet), we could have matching or mismatching predicates in each experimental pair.

Prediction. After having been forced to access one particular reading in primes, participants were expected to be biased towards the same interpretation in targets, selecting the image accordingly. For example, in *collective targets*, participants should choose more often the blur picture after a *distributive prime* than after a *collective prime* (and the reverse for *distributive target*s). A priming effect would therefore result in an interaction between Target and Prime conditions.

Results. Percentage of "blur" choices in targets are shown in Fig. 2 (N=33, after exclusion). The analyses of the experimental results indicate a significant interaction between Target and Prime conditions (χ^2=50; p<.001).

Fig. 2



Discussion. While these findings suggest that different primes have a different effect in the subsequent target, they do not allow us to determinate whether the priming effect was symmetric (i.e. effects of both collective and distributive primes) or asymmetric, as it has been suggested in previous studies (Maldonado et al, 2017 argued for a priming specifically associated with the presence of the *D* operator).

Follow up: baseline rates to test asymmetry in priming. We ran a second experiment where we included the same experimental pairs as in Experiment 1, but we added a third *baseline prime* before each type of target. Baseline primes shown unambiguous sentences (e.g. "The bag is light.") together with images similar to the ones used in distributive and collective primes.

Results (N=41). (i) The priming effect attested in Experiment 1 is replicated (interaction Prime*Target restricted to targets after collective and distributive primes: χ^2=60; p<.001). (ii) There is indication of two types of priming: Baseline rates differed both from selection choices after collective (χ^2=5; p=.02) and distributive (χ^2=12; p<.001) primes.

Conclusions. Our findings first demonstrate that the collective/distributive contrast in sentences involving mixed adjectival predicates gives rise to priming effects. The existence of distributive priming in absence of covariation reveals an abstract representation of the distributive/collective distinction.

Unlike previous experiments, our results suggest the existence of collective priming. This effect, however, seems to be weaker than the one produced by distributive primes, indicating a potential asymmetry, which would be compatible with priming of a distributivity operator.

Finally, our experiments make a contribution to a general theory of semantic priming, by showing that semantic representations can be primed independently of their strength (i.e. weak readings can prime strong readings).

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