Supplementary Materials: Do language models learn typicality judgments from text?

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1 Code

The code and data materials used to reproduce the analyses reported in the paper can be found in the following link: `https://github.com/kanishkamisra/typicalityprobing`. The code is predominantly written using the `minicons`[1] library.

2 Models Studied

3 Stimuli Generation

In this section we describe in detail the language stimuli used in our two experiments. These stimuli have been summarized in Table 2 in the original paper.

3.1 Categories and Exemplars from Rosch (1975)

We collect our categories and their items/exemplars from the typicality ratings collected by Rosch (1975). In total, we have 565 items spanning across 10 different categories. Table A shows the most and least typical items for each of the 10 categories. We use this dataset as the ground truth resource to construct our stimuli for both our experiments.

3.2 Taxonomic Sentence Verification

Recap Our taxonomic sentence verification experiments test whether the model's attribution of hypernyms to noun concepts—by means of word prediction in context—reflects the graded structure of concepts as observed in humans. To this end, we compare the models' log probability of assigning an item (*robin*) its superordinate category (*bird*) to its typicality rating for the category as produced by humans in the original study.

Construction To construct the stimuli for this experiment, we create simple English templates:

$$\{\texttt{A/An/}\phi\}\ \texttt{[ITEM]}\ \{\texttt{is/are}\}\ \{\texttt{a/an/}\phi\}\ \texttt{[CATEGORY].}$$

where $\{\texttt{.}\}$ denotes an optional word—with options separated by a '/'—and ϕ is a null character. Check out `https://github.com/kanishkamisra/typicalityprobing/python/` for detailed stimuli samples.

[1] `https://github.com/kanishkamisra/minicons`

Table A: Categories and Exemplars extracted from Rosch (1975). The 'Exemplar' column shows 10 most and 10 least typical items for their corresponding category, as rated by native English speakers.

Category	**Exemplar**
toy	*doll, top, jack-in-the-box, toy soldier, yo-yo, block, marbles, rattle, stuffed animal, water pistol, ..., bow and arrow, rope, dishes, cards, mitt, horse, gun, animals, tennis racket, books*
bird	*robin, sparrow, bluejay, bluebird, canary, blackbird, dove, lark, swallow, parakeet, ..., duck, peacock, egret, chicken, turkey, ostrich, titmouse, emu, penguin, bat*
sport	*football, baseball, basketball, tennis, softball, canoeing, handball, rugby, hockey, ice hockey, ..., pool, billiards, hunting, jump rope, camping, chess, dancing, checkers, cards, sunbathing*
vegetable	*pea, carrot, green bean, string bean, spinach, broccoli, asparagus, corn, cauliflower, brussels sprouts, ..., escarole, sauerkraut, pickle, baked bean, pumpkin, seaweed, garlic, dandelion, peanut, rice*
tool	*saw, hammer, ruler, screwdriver, drill, nail, tape measure, sawhorse, sandpaper, sander, ..., plaster, wheelbarrow, axe, slide rule, cement, anvil, hatchet, rag, scissor, crane*
fruit	*orange, apple, banana, peach, pear, apricot, tangerine, plum, grape, nectarine, ..., pawpaw, coconut, avocado, pumpkin, tomato, nut, gourd, olive, pickle, squash*
clothing	*pant, shirt, dress, skirt, blouse, suit, slack, jacket, coat, sweater, ..., handkerchief, purse, hairband, ring, earring, watch, cuff link, necklace, bracelet, cane*
vehicle	*automobile, station wagon, truck, car, bus, taxi, jeep, ambulance, motorcycle, streetcar, ..., rocket, blimp, skate, camel, feet, ski, skateboard, wheelbarrow, surfboard, elevator*
furniture	*chair, sofa, couch, table, easy chair, dresser, rocking chair, coffee table, rocker, love seat, ..., counter, clock, drape, refrigerator, picture, closet, vase, ashtray, fan, telephone*
weapon	*gun, pistol, revolver, machine gun, rifle, switchblade, knife, dagger, shotgun, sword, ..., word, hand, pipe, rope, airplane, foot, car, screwdriver, glass, shoe*

3.3 Category-based Induction

Recap Our category-based induction experiments test whether models reflect typicality effects when making inductive generalizations. That is, are models more likely to generate *"All **birds** can dax"* when given *"**Robins** can dax,"* as opposed to *"**Penguins** can dax"*?

Construction Following Osherson et al. (1990), we use *blank* properties in this experiment – i.e., properties that we estimate to be vaguely unfamiliar to language models (analogous to what Osherson et al. used for humans). To this end, we relied on nonce words such as *dax, slithy, fep, etc.* such that these words do not occur in any model's vocabulary. Since all models in our experiment had the ability to tokenize any word, and not rely on the `<unk>` token—which had been the dominant method prior to the introduction of wordpieces and byte-pair-encodings—we speculate the usage of nonce words to be a reasonable proxy for *blank* properties.

4 Additional Results

4.1 Category-wise results on Taxonomic Sentence Verification Experiments

4.2 Category-wise results on Category-based Induction Experiments

4.3 Confound analyses for Category-based Induction

Taxonomic Sensitivity

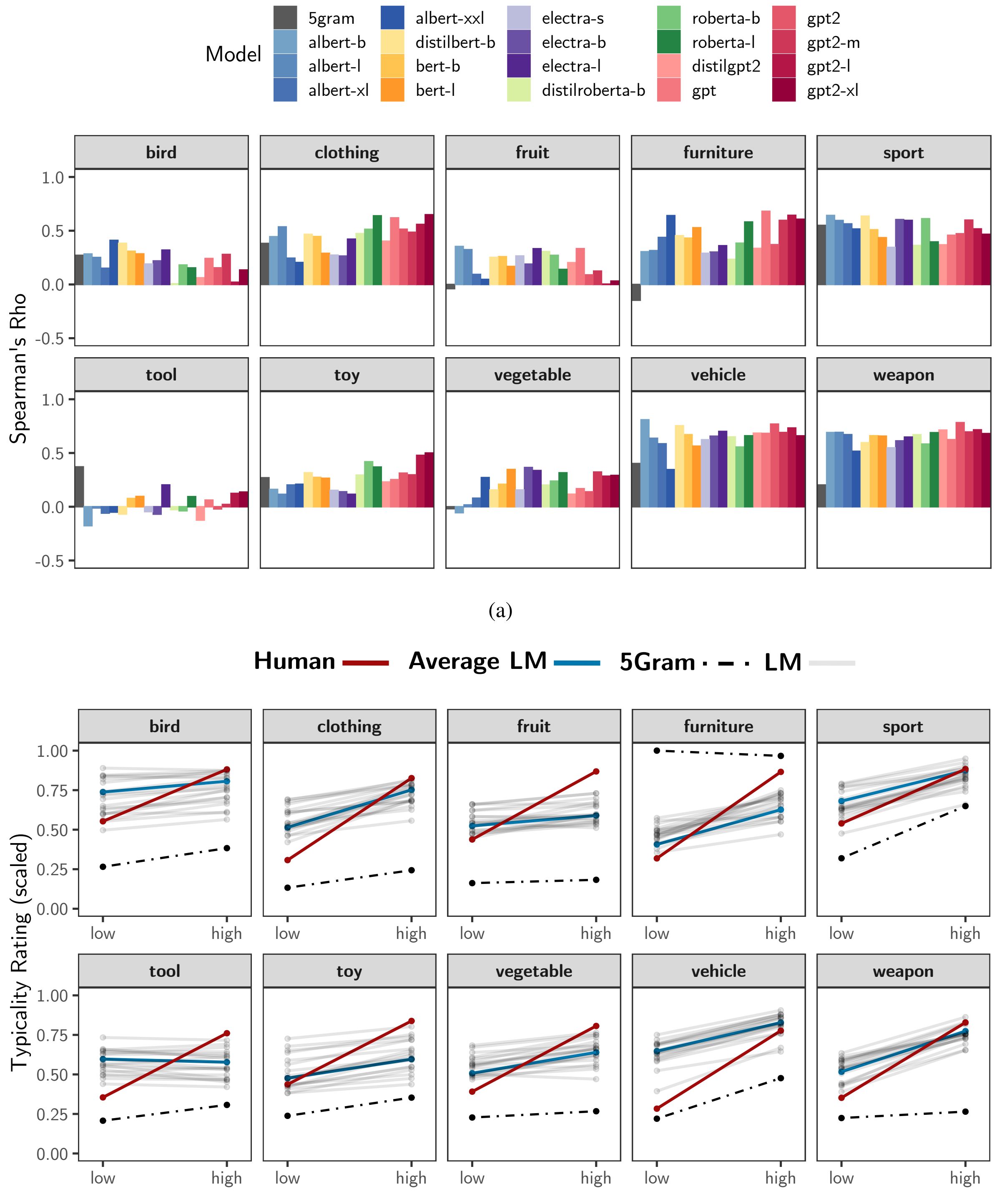
Premise Order Sensitivity

4.4 Typicality Correspondence and Model Parameters

References

Daniel N Osherson, Edward E Smith, Ormond Wilkie, Alejandro Lopez, and Eldar Shafir. 1990. Category-based induction. *Psychological review*, 97(2):185.

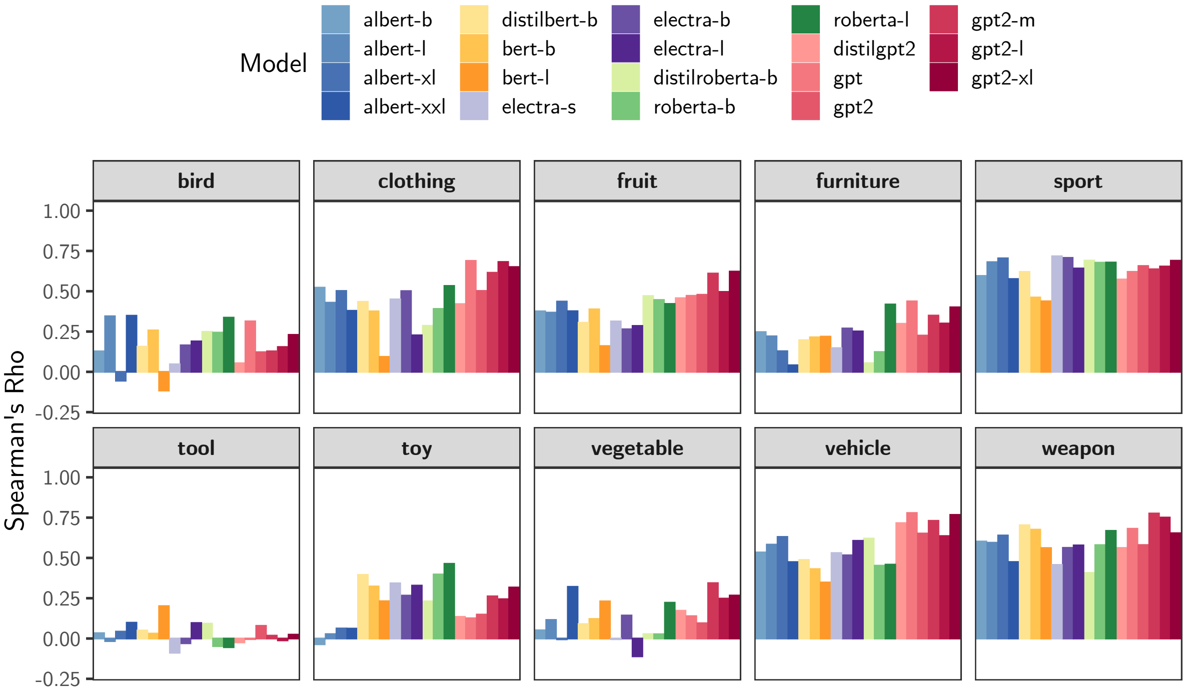
Eleanor Rosch. 1975. Cognitive representations of semantic categories. *Journal of experimental psychology: General*, 104(3):192.



(a)

(b)

Figure 1: Category-wise results from the **Taxonomic Sentence Verification** experiments – (a) Spearman's correlation between language model log-probabilities and human typicality ratings; (b) Average scores (log-probability for language models, and raw typicality ratings for humans) assigned to low and high typicality items.



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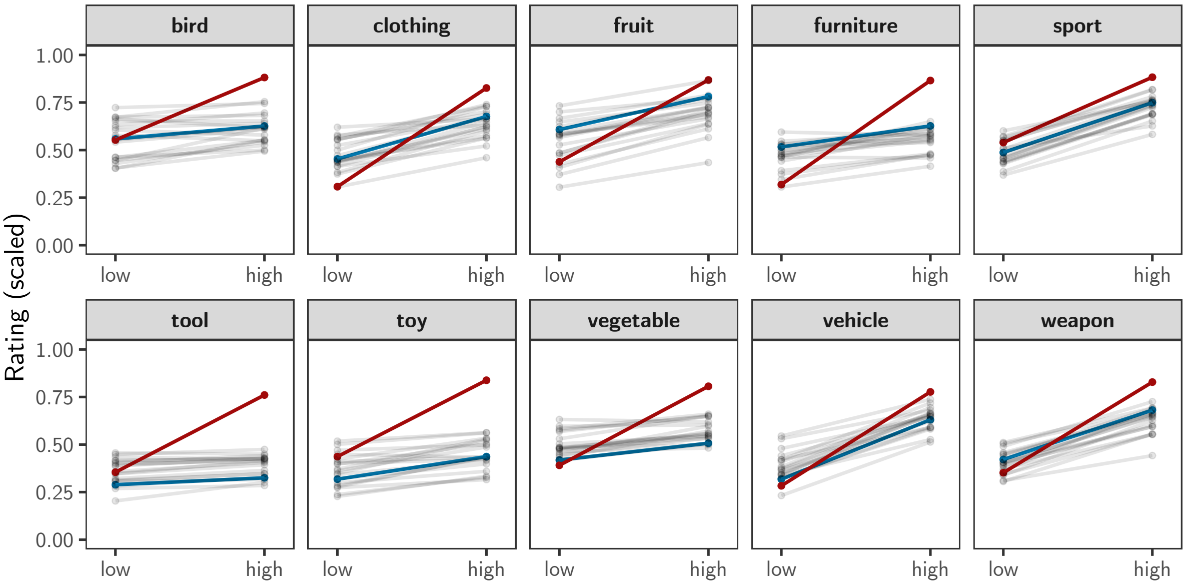

(b)

Figure 2: Category-wise results from the **Category-based Induction** experiments – (a) Spearman's correlation between adjusted AS-scores and human typicality ratings; (b) Average scores (adjusted AS-scores for language models, and raw typicality ratings for humans) assigned to low and high typicality items.

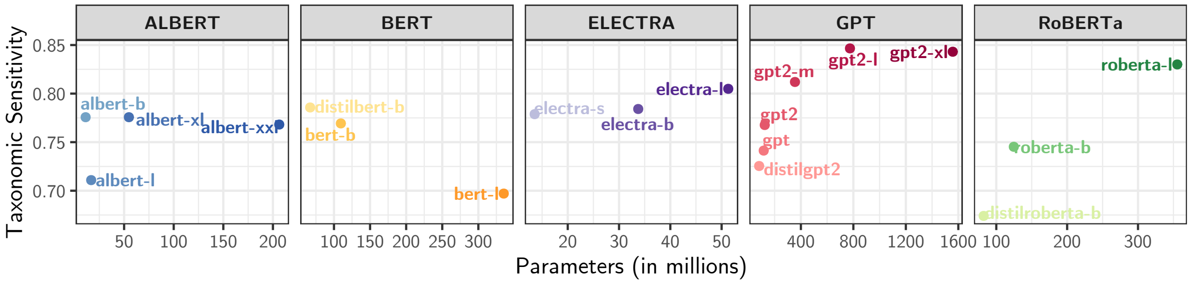

Figure 3: Models' sensitivities to violation of the taxonomic relation between the premise and the conclusion categories.

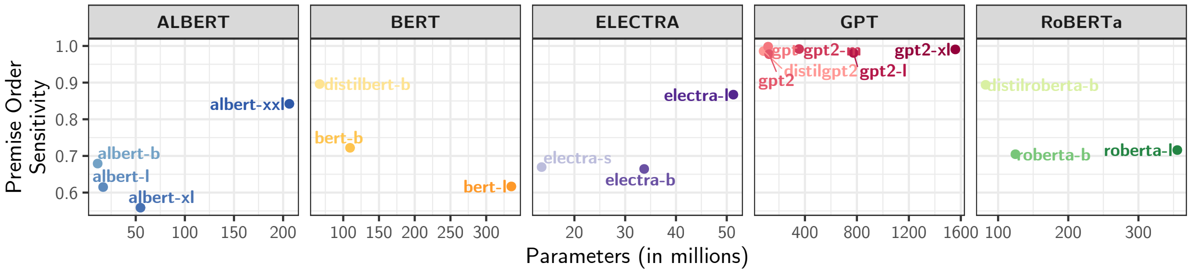

Figure 4: Model's sensitivity to changes in Premise word order.