A Generative Model Draft

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Following definitions in previous notes *Normative Model I*, use a generative process to create causal relations (hypotheses) as follows.

1. Create one causal relation. Start by sampling number of cause sentences (from a gamma distribution, say $\Gamma(1.5, 1)$?); number of effect sentences is 2 by definition (one sentence for R' lightness, and one sentence for R' sidedness).

   Each sentence is created by

   (a) Sample relations, controlled by a relation parameter α:
   $P(\text{pick } =) = P(\text{pick } \neq) = \alpha/2$, $P(\text{pick } >) = P(\text{pick } <) = (1-\alpha)/2$.

   (b) Sample a subject (left-hand side of the picked relation):
   For cause sentences, sample A or R are equally likely, $P(\text{pick } A) = P(\text{pick } R) = 1/2$; effect sentences always take R' as subjects.

   (c) Sample an object (right-hand side of the picked relation):
   Objects can be absolute - an exact lightness or sidedness value, or relative - A's lightness (sidedness) or R's. Relative values, in addition, can combine with the increase or decrease by level 1 option (eg. $L(R') = L(A) + 1$).
   Assume that each type of values are picked equally likely (note: we can also parameterize it if desirable):
   $P(\text{pick } l_i) = \frac{1}{3|L|}$ where l_i is an exact lightness value, and $|L|$ is the total number of lightness values (in current experiment setup);
   $P(\text{pick } s_i) = \frac{1}{3|S|}$ where s_i is an exact sidedness value and $|S|$ is the total number of sidedness values (in current experiment setup);
   $P(\text{pick } A) = P(\text{pick } R) = \frac{1}{6}$ for effect sentences, $P(\text{pick } A) = P(\text{pick } R) = \frac{1}{3}$ for cause sentences (because for a cause sentence the object has to be different from the subject;
   $P(\text{pick } A, +1) = P(\text{pick } A, -1) = P(\text{pick } R, +1) = P(\text{pick } R, -1) = \frac{1}{3\times 4} = \frac{1}{12}$ for effect sentences; and $\frac{1}{6}$ for cause sentences by similar reasons.

2. With probability β sample an extra causal relation that will join the others as an *if-else* clause. β decreases as the number of existing causal relations increases.

The above procedure generates *one* hypothesis, that can potentially contain multiple causal relations by an *if-else* relation.