Relation 1: Cause-Effect

Preamble

Levi (1979) has two CAUSE relations, which differ in directionality: CAUSE1(*X*,*Y*) means *"Y* causes *X*", e.g., "tear/*X* gas/*Y*". CAUSE2(*X*,*Y*) means "*Y* is caused by *X*", e.g., "drug/*X* deaths/*Y"*.

Moldovan et al., (2004) have a relation CAUSE(*X*,*Y*) defined as "an event/state *X* makes another event/state *Y* to take place", e.g., *"*malaria/*Y* mosquito/*X*", *"*earthquake/*X* generates a tsunami/*Y"*.

Nastase & Szpakowicz (2003) have a relation CAUSE(*X*,*Y*) meaning that "*Y* makes *X to occur or exist*; *Y* is necessary and sufficient", e.g., *"*flu/*X* virus/*Y"*. They also have a reverse relation EFFECT(*X*,*Y*) meaning that "*X* makes *Y* to occur or exist; *X* is necessary and sufficient", e.g., *"*exam/*Y* anxiety/*X"*.

Definition

Cause-Effect(*X*, *Y*) is true for a sentence *S* that mentions entities *X* and *Y* if and only if

(1) *S*, *X* and *Y* are in accordance with the general annotation guidelines:

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(2) the situation described in *S* entails that *X* is the cause of *Y*, or that *X* causes/makes/produces/emits/... *Y*.

Definition – Restrictions

(a) X and Y can each be a nominal denoting an occurrence (e.g., event, state, activity), or a noun denoting an entity, either as one of its readings (like "breakfast", which can denote an entity - a piece of bread and some bacon - or an event - which took all morning) or metonymically (like, "the mall", which can stand in for shopping). Physical/tangible entities can be causes but generally not effects; this latter restriction is meant to prevent potential overlaps with Product-Producer.

(b) diseases and their symptoms are considered as specific states/conditions of the body or a body part, even if they are if a physical nature, and thus allowed (e.g. "dermatitis/X causes dandruff/Y").

(c) The cause X should be actively involved in the process of causing the effect Y; this restriction is meant to prevent overlaps with Entity-Origin. For example, "music/Y clock/X" is Cause-Effect, but "music/Y instrument/X" is not: clocks play by themselves, but instruments typically require somebody to play them and thus are only passively involved in the process of causing music to sound. The presence of "causer-like" verbs (cause, bring about) is often good evidence for Cause-Effect. Objects emitting radiation/heat/light... are regarded as Causers of such emissions, not just origins (e.g., "light/Y bulb/X" -- Cause-Effect).

(d) When an effect is caused by a combination of events, each such event is considered a separate cause for the effect.

(e) Indirect causation is considered positive, e.g. Cause-Effect(earthquake, aftershock).

Definition – Notes

(i) The Cause-Effect relation implies a temporal relation as well: Cause precedes Effect. The stronger Cause-Effect relation is preferred if applicable.

Definition – Overlaps

Potentially overlapping relations:

• Product-Producer: distinguished by restriction (a).

• Entity-Origin: distinguished by restriction (b).

The above relations differ from Cause-Effect in that the Effect is an occurrence, not an entity. The effect may be expressed through an entity, but, in the context of the sentence, this entity must stand in for an occurrence.

Positive Examples

"A person infected with a particular <e1>flu</e1> <e2>virus</e2> strain develops an antibody against that virus."

Cause-Effect(e2, e1)

Comment: *flu* is a state, *virus* is the causal agent, thus (a) is satisfied; the *virus* is actively involved in causing *flu* and thus (c) is satisfied.

"Human <e1>growth</e1> <e2>hormone</e2> (HGH) is a substance secreted by the pituitary gland."

Cause-Effect(e2, e1)

Comment: *growth* is a nominal denoting an activity, *hormone* is the causal agent, thus (a) is satisfied; the *hormone* is actively involved in causing *growth* and thus (c) is satisfied. The inverse relation between e1 and e2 is none of the nine.

"Sudden <e1>death</e1> from <e2>inhalation</e2> of petroleum distillates is well recognised in misuses of volatile substances."

Cause-Effect(e2, e1)

Comment: *death* is a state, *inhalation* is a nominal denoting an activity, thus (a) is satisfied; the *inhalation* is actively involved in causing *death* and thus (c) is satisfied. The inverse relation is none of the nine.

"The <e1>news</e1> brought about a <e2>commotion</e2> in the office.

Cause-Effect(e1,e2)

Comment: This is an example mediated by a verb. Verbs will typically be causation-type verbs, or at least imply a causal relationship. Restriction (a) is satisfied since commotion is an occurrence and *news* is a causal agent; the *news* is actively involved in causing *commotion* and thus (c) is satisfied.

"That year, summer students at the VLA made the first discovery of radio <e1>emission</e1> from a brown dwarf <e2>star</e2>."

Cause-Effect(e2, e1)

Comment: The *star* is the cause of the *emission* and is actively involved in it (as in "light bulb").

"That <e1>machine</e1> makes a lot of <e2>noise</e2>."

Cause-Effect(e1, e2)

Comment: *Noise* is an occurrence, and thus restriction (a) is satisfied; *machine* is actively involved in making *noise* and thus (b) is satisfied. Here we assume that the machine is capable of making the noise without somebody having to operate it, i.e. by itself; if it only makes noise when operated by somebody, then (c) would be violated.

"This 8 day <e1>music</e1> <e2>clock</e2> needs winding only once a week."

Cause-Effect(e2, e1)

Comment: *Music* is an occurrence, and thus restriction (a) is satisfied; *clock* is actively involved in making *music* and thus (c) is satisfied. Note that this is different from *music instrument* below.

"At an individual level, mental <e1>illness</e1> is one of the biggest causes of personal <e2>unhappiness</e2> in our society."

Cause-Effect(e1, e2)

Comment: Both entities are states and thus occurrences, which satisfies (a); *illness* is actively involved in causing *unhappiness* and thus (c) is satisfied.

"<e1>War</e1> only causes destructions and <e2>death</e2>."

Cause-Effect(e1, e2)

Comment: Both entities are states and thus occurrences, which satisfies (a); *war* is actively involved in causing *death* and thus (c) is satisfied.

Near-miss Negative Examples

"Baker's yeast <e1>enzymes</e1> convert sugar (glucose, fructose) to <e2>ethanol</e2> and carbon dioxide."

Product-Producer(e2,e1)

Comment: This contradicts (a): *ethanol* is not an occurrence.

"Alcoholic <e1>beverages</e1> that have a lower alcohol content (beer and wine) are produced by <e2>fermentation</e2> of sugar."

Other

Comment: This contradicts (a): *alcoholic beverages* are not an occurrence. Fermentation is an event and thus it cannot be a Producer. Besides fermentation is actively involved in producing alcoholic beverages, so it cannot be an Origin. Thus, we cannot have Cause-Effect, Product-Producer or Entity-Origin.

"All <e1>olive</e1> <e2>oil</e2> —which is, after all, fat—has 120 calories per tablespoon (33 kJ/mL)."

Entity-Origin(e2,e1)

Comment: The sentence violates restriction (c) since *olives* are only passively involved in the production of *oil*.

"One thing SETI has agreed on is that if a <e1>message</e1> from <e2>outer space</e2> is discovered, once it is confirmed by scientists from outside of the organization to authenticate the source, the message will be made known to the public right away."

Entity-Origin(e1,e2)

Comment: The sentence violates restriction (c) since the *outer space* is only passively involved in bringing the *message* into existence.

"Playing a <e1>music<e1> <e2>instrument</e2> opens up a lot of possibilities to enrich your life."

Entity-Origin(e1,e2)

Comment: The *instrument* does not play by itself, and thus restriction (c) is violated. Note that this is different from *music clock* above.

"Upon prior <e1>statement</e1> from the <e2>President</e2> in case of reasons of emergency, national security, or public interest, and solely while such reasons remains, the State may subject the patent to a compulsory license at any time and, in such case, the National Bureau of Industrial Property may grant the requested licenses, regardless of the patent holder's right to compensation..."

Product-Producer(e1,e2)

Comment: A s*tatement* is not an occurrence, and thus restrictions (a) is violated.

"Jensen Passive <e1>television</e1> <e2>antenna</e2> is perfect for the use with HDTV."

Other

Comment: "television antenna" is an instance of the Purpose-Tool relation (Antenna is for TV [signal reception]), which is not in our list of nine relations.

"He stores his <e1>headache</e1> <e2>pills</e2> in these neat rhodium plated cufflinks, for easy access during a long night out."

Other

Comment: pills are meant to oppose headaches in this case, or cause the lack of headaches, so to speak. This might be a relation like Illness-Remedy, but definitely none of the nine we consider.

"The <e1>rumors</e1> were related to the uneasy <e2>atmosphere</e2> that had spread in the office.

Other

Comment: There is some kind of causal connection between e1 and e2, but it is unclear which event caused the other (if any). These cases should not be annotated with Cause-Effect, but with Other.