Causal selection – the linguistic take

Elitzur A. Bar-Asher Siegal, Noa Bassel and York Hagmayer*

Abstract. *Causal Selection* is a widely discussed topic in philosophy and the cognitive sciences, concerned with characterizing the choice of "the cause" among the many individually necessary and jointly sufficient conditions on which any effect depends on. In this paper, we argue for an additional selection process underlying causal statements: *Causative-Construction Selection*, which pertains to the choice of linguistic constructions used to express causal relations. By exploring this phenomenon, we aim to answer the following question: given that a speaker wishes to describe the relation between one of the conditions and the effect, which linguistic constructions are available? We take CC-selection to be more crucial than causal selection, since the latter is in fact restricted by the linguistic options resulting from the former. Based on a series of experiments, we demonstrate that factors taken previously as contributing to causal selection should, in fact, be considered as the parameters that license the various linguistic constructions under given circumstances, based on previous knowledge about the causal structure of the world (the causal model). These factors are therefore part of the meaning of the causative expressions.

Keywords. Causation; Causal selection; Causative-construction selection; lexical semantics; causal reasoning

1. Introduction. **The double selection problem.** The occurrence of any event requires many different conditions to hold (Mill 1884, A System of Logic, Volume I, Chapter 5, §3). More precisely, many conditions are individually necessary and only jointly sufficient in order for a target event to take place, with several sets of jointly sufficient conditions relating to any event kind (Mackie 1965). These conditions may include other events, states and constant background conditions, intentional actions or unintentional behaviors by an agent, and/or properties of the patient.

Take a very simple example, the opening of an automatic door may depend on one sufficient set of conditions including electricity, the door being unlocked, and an agent pressing the door-open button. Another sufficient set may include a door handle, the door being unlocked, and an agent pushing the handle. Imagine a situation in which a person walks up to the door, pushes the button and the door opens. An observer, who wishes to describe what happened, is faced with what we call the double selection problem, involving causal selection on the one hand, and causative-construction selection on the other.

The first problem has been widely discussed in philosophy and the cognitive sciences: the observer has to decide which among the many necessary and - in the particular situation - jointly sufficient conditions was *the cause* of the door opening. Many theoretical accounts have been proposed in the recent years, alongside empirical studies testing how people select the cause from a set of conditions (Cheng & Novick 1991, Hilton 1990 inter alia). Studies show, for example, that

* Authors: Elitzur A. Bar-Asher Siegal, The Hebrew University of Jerusalem (ebas@mail.huji.ac.il), Noa Bassel, The Hebrew University of Jerusalem (noa.bassel@mail.huji.com) and York Hagmayer, University of Göttingen (york.hagmayer@bio.uni-goettingen.de). Research for this paper was supported by the State of Niedersachsen, Germany, "Forschungskooperation Niedersachsen-Israel" for the project "Talking about causation: linguistic and psychological perspectives" given to first and third authors with Nora Boneh. We thank Nora Boneh and Anne Temme for their assistance in early stages of the study.

an action by an agent that violates social norms is more likely to be considered the cause of an effect than an action which is within normative conventions, even in a situation where both actions are necessary for the effect to take place (Hitchcock & Knobe 2009, Reuter et al. 2014, Icard, Kominsky, & Knobe 2017 and Henne et al. 2021 *inter alia*). Meanwhile, foreseeability has been shown to moderate the effect of norm violation in causal selection (cf. Reuter et al. 2014)

The second problem has attracted far less attention in the cognitive sciences: in order to differentiate between causes, an observer has to describe the causal relations through an available linguistic construction, which involves what we call the *causative-construction-selection* (=*CC-selection*). In any causal statement, the speaker selects, along with the cause, a causative construction which appropriately describes the relation behind the observed course of events. In the above example, an observer may state: *the pushing of the button* ***opened*** *the door*, or *pushing the button* ***caused*** *the door to open*, to name just two possibilities. The array of causative constructions available to describe what happened includes connectives like *because* (*of*), *from*, *by*, overt causative verbs like *make* and *cause*, and change-of-state (=CoS) verbs such as *open* and *boil*, and other options available across languages (see Bar-Asher Siegal & Boneh 2020 for a definition of "causative constructions". For typologies of causative constructions see also Shibatani 1976, Comrie 1981, Song 1996 and Dixon 2000). The CC-selection problem can be phrased in different ways, we will treat it as answering the following question: **given that a speaker wishes to describe the relation between one of the conditions and the effect, which linguistic constructions are available?** In our toy example, the question can be phrased as: under what circumstances each of the sentences: *The pushing of the button opened the door* or *Pushing the button caused the door the open* can be expressed? Notably, this question does not assume singularity of causes. That is, with respect to each of the causative constructions, it is possible that more than one condition can be described as *the cause*, and our question aims at discovering the range of linguistic expressions that are available.

CC-selection has largely been ignored in philosophy and psychology, although its relevance has been demonstrated by research inspired by linguistic theories (e.g. Wolff 2003). A parallel question has been raised within theoretical linguistics (cf. Dowty 1979), where various analyses correlate CoS causatives like *Mary opened the door* with direct rather than indirect causation (e.g. by pushing somebody who accidently fell against the door open button) (Fodor 1970, Katz 1970, Shibatani 1976, Wolff 2003 *inter alia*). Further semantic differences between the various causative constructions have been recently raised by Bar-Asher Siegal & Boneh (2020) (for discussion on differences between specific construction see also Neeleman & van der Koot 2012, Maienborn & Herdtfelder 2017, Bar-Asher Siegal & Boneh 2019, Nadathur & Lauer 2020).

We take CC-selection to be more crucial in the choice of a statement than causal selection, due to the fact that causal selection is restricted by the linguistic availabilities resulting from CC-selection. Consider again the door example: determining whether electricity, the person, or the pushing of the button was "the cause" of the door to open, these possibilities have to be stated. Linguistic restrictions therefore affect that choice of the conditions given the causal statements.

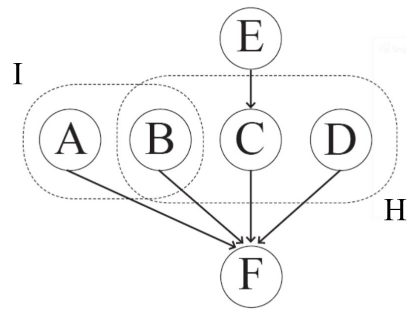
The conceptual relation between causal selection and CC-selection can be observed in experimental studies on causal selection (e.g. Knobe and Fraser 2008): First the participant is confronted with a causal scenario, whose underlying causal structure is known or provided, and in which, (usually) two events occur followed by a target event. The participants are then presented with causal statements involving the observed events, which generally include the phrases *Event A caused the target event* and *Event B caused the target event*, and asked to indicate how much they agree with the given statements. In this common experimental paradigm, the researcher pre-selects the causative constructions for the statements they regard as appropriate descriptions. Hence the researchers made an act of CC-selection, based upon which the participants are asked to make a causal selection.

In this paper, we demonstrate that CC-selection affects causal judgements, showing first which causative constructions are available to observers describing the causal dependency between a condition (a member of a sufficient set of conditions) and an effect (Section 2). We explore the semantics of causative verbs based on structural equation models, and propose a respective formal theory. Second, we present a series of experiments (Section 3) in which we investigate CC-selection, showing that participants systematically rate the acceptability of certain causative constructions higher under specific conditions. We then test how factors that have been shown to affect causal selection (cf. Danks 2017) affect CC-selection, including violation of social norms and foreseeability of the effect by the involved agents. According to this approach, properties taken previously as contributing to causal selection are now considered as the parameters that license the linguistic construction under given circumstances (Section 4), based on previous knowledge about the causal structure of the world (the causal model). These factors, therefore, become part of the meaning/truth-conditions of the causative expressions.

2. A theory of the semantics of causative constructions. In linguistics, the object of investigation into casual statements has traditionally been the structural and interpretative properties of causative constructions. Nonetheless, dealing with causation is not trivial within formal approaches to semantics. The challenge has to do with the fact that formal approaches to the semantics of natural languages are truth-conditional and model-theoretic. In such frameworks, the meaning of a sentence is taken to be the proposition which is true or false relative to some model of the world. It is not trivial, however, to model causal statements, as they do not describe simple state-of-affairs in the world, or even in possible worlds.

Over the last decade, several works have explored the approach developed by Judea Pearl (Pearl 2000) in the context of computer sciences to examine causality through Structural Equation Modeling (SEM), as a way to provide a model for the truth conditions of causal statements (Baglini & Francez 2016, Baglini & Bar-Asher Siegal 2020, Nadathur and Lauer 2020). In SEM, causality is modeled by graphs that fit networks of constructs to data. Here, we rely on Baglini & Bar-Asher Siegal's (2020) formal definition for causal models. For the purposes of the current paper, it is sufficient to note that, in a SEM, dependencies between states of affairs are represented as a set of pairs of propositions and truth values. Considering once more the example of the automatic door, we can define the variables (pairs of propositions and truth values) in A-F in Figure 1 below. The fact that some variables depend on others for their value is represented by structural entailments in G-I. Variables can be classified as belonging to one of two types: *Exogenous variables* do not depend on any other variable (in the model) for their value. The value of the *endogenous variables*, in contrast, are based on the values of variables on which they depend. In our door example above, the exogenous variables are [A., B., D. and E.]. The endogenous variables are [C. and F.]. Dependencies defined within a SEM can be also represented qualitatively with directed graphs (as in Figue 1). Nodes correspond to variables, and arrows indicate the direction of dependency: the value of an originating node dictates the value of nodes it points to. We follow VanderWeele & Robins (2009) and circle sufficient sets.

A Handle: =1 if handle is turned; else =0
B Lock: =1 if door is locked; else =0
C Circuit: =1 if closed; else =0
D Electricity: =1 if running; else =0
E Button: =1 if pressed; else =0
F Door opens: =1 if opens; else =0
G Button =1 ⊨ Circuit =1



Sufficient set 1 (automatic opening)
H Circuit =1 & Electricity =1 & Lock =0 ⊨ Door opens =1
Sufficient set 2 (opening by handle)
I Handle =1 & Lock =0 ⊨ Door opens =1

Figure 1: Structural equations and graphical models of two sufficient sets of conditions for an effect F. See text for explanations

Following Mackie (1965), we treat the nodes in the causal model as *INUS conditions*: a variable or a set of variables which are *Insufficient* but *Necessary* alone, but together *Unnecessary* but *Sufficient*. In our example, then, when the door is unlocked, a closed circuit with electricity supplied constitutes a set which is sufficient but not necessary (since the pair of conditions *Unlocked* and *Handle* together are also sufficient for opening the door). We follow Baglini & Bar-Asher Siegal's (2020) formal system for the definitions of *necessary conditions*, ***a** sufficient set of conditions* and *situations* within the SEM framework. (A situation is defined as a set of pairs of propositions S in a language P and their values.)

In this approach, the SEM encodes speakers' knowledge of the causal structure. Moreover, formal definitions of various types of nodes/conditions (such as INUS), can be used to capture the requirements for licensing linguistic judgments, or in our terms – for defining CC-selection. Following Baglini & Bar-Asher Siegal (2020), we take a CoS verb applied to a certain condition Q representing the cause in the model ("The pushing of the button opened the door"),[1] which is part of a situation S, to yield an acceptable causal statements under the conditions in (1). Similarly, (2) captures the licensing conditions when Q is the subject of an overt causative *cause* ("Pushing the button caused the door the open"):

(1) $\exists Q\exists e\exists t\exists S{:}SUFF(S)^{M,R} = 1 \ \& \ (Q \in S)^{M} \ \& \ S(e) \ \& \ \tau(e) \subseteq t \ \& \ \forall t' < t \forall e' : \tau(e') \subseteq t' \rightarrow [\neg Q(e')]$
(2) $\exists Q\exists e\exists t\exists S{:}SUFF(S)^{M,R} = 1 \ \& \ (Q \in S^{M} \ \& \ Q(e))$

The function SUFF(icient) takes a situation (S) – a set of pairs of propositions and their values – and returns 1 if it is a sufficient set in the model for a specific result (R). The formula amounts to a description of *a completion event*. Thus, in this line of analysis, lexical causatives select the temporally last condition to complete the sufficient set of conditions as its subject (1), while the periphrastic causative "cause" selects any condition in the set (2) (i.e., any INUS condition). Baglini and Bar-Asher Siegal (2020) demonstrate that these formal descriptions capture previous observations regarding "direct causation" in the literature. The next section presents an investigation of the claims represented by (1)-(2), in a variety of experiments, showing that while it holds to a large degree, it must be slightly modified.

[1] In SEM conditions are represented as propositions. We follow a long tradition since Dowty (1979) that the DPs in the actual causal statements are "representatives" of these proposition.

3. Experiments

3.1 AIM AND HYPOTHESES. We report a series of 3 experiments aiming to empirically investigate CC-selection, measuring how the acceptance of a causal statement is affected by the semantics of the causative construction. Based on the theory described in the previous section, we hypothesized that (1) statements with CoS verbs will be more accepted for conditions completing a sufficient set of (preexisting) conditions; (2) sentences with an overt *cause to* construction will only be sensitive to whether their subject is an INUS condition for the effect to take place.

3.2 OVERVIEW. We confronted participants with a common effect structure in which two conditions happened independently of each other, but conjunctively generated the target effect (Figure 2). Hence, the two conditions were INUS conditions in the terms of Mackie (1965).

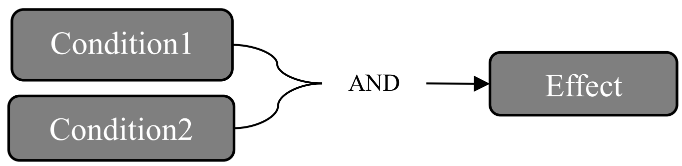


Figure 2: Causal structure underlying the scenarios in all experiments

Participants were presented with various everyday- or fictitious scenarios, where two conditions were generated independently one after the other before the effect took place. We manipulated the temporal order such that both conditions were equally necessary for the effect, but only the condition occurring second completed a sufficient set. Participants were asked to rate causal statements referring to each condition individually. One type of statement used a lexical, CoS causative (e.g., *Peter opened the window*.), the second type a periphrastic, overt causative (*Peter caused the window to open*.). Experiment 1 was designed to show that observers prefer certain causative constructions to describe what happened (i.e. CC-selection). Experiment 2 explored how the violation of social norms affects CC-selection. Experiment 3 did the same with respect to foreseeability.

3.3. EXPERIMENT 1.

DESIGN. The study had a 2(order of causes) x 2(causative construction) x 4(scenario) design. All three factors were manipulated within subjects. The study was run anonymously online using limesurvey (limesurvey.org). According to regulations at the University of Goettingen no clearance by an ethics committee was required.

PARTICIPANTS. We collected data of 35 participants, 32 of which passed the comprehension test. Adult participants were recruited from prolific (prolific.org). English had to be their first language.

MATERIALS AND PROCEDURE. First participants were informed that we are interested in how people use and understand language and that they will be presented with various scenarios and asked several questions examining their understanding of the scenario. Participants were explicitly asked to indicate their informed consent to participate. Then participants were presented with the first of four scenarios (Expose/drawings, Flood/land, Open/door, and Set off/alarm). (3) presents the structure of the Set off/alarm scenario. The participants were asked to rate four statements according to their compatibility with the facts presented in the scenario, as in (4)

(3) *The Kagan family has a motion-sensitive security system, which they switch on when they leave the house. Last Monday, Mary switched the system on, not knowing that her daughter, Emily, was staying at home. When Emily woke up, she passed in front of one of the motion sensors and activated it. The alarm went off*."

(4) (a) *Mary set off the alarm.* (b) *Emily set off the alarm.*
(c) *Mary caused the alarm to go off.* (d) *Emily caused the alarm to go off.*

The rating scale ranged from 1 (least compatible) to 7 (perfectly compatible). After their answer, participants were queried about the order of events to check whether they correctly grasped the given information. Participants continued to the next scenario without receiving any feedback. The order of the scenarios and the order of the presented statements was randomized.

STATISTICAL ANALYSIS. We used a multilevel model to analyze the data, taking into account the within-subjects design. Order, causative construction, scenario, and the interaction of order and causative construction were entered as fixed effects.

RESULTS. Figure 3 displays the mean ratings depending on order and causative construction for the four scenarios. Across all scenarios, ratings of statements with CoS causatives were highly sensitive to order. Ratings were much higher when the condition completed the sufficient set. Ratings for statements involving overt causatives were less sensitive to order. Statements with the first causal condition being the subject were rated higher when an overt causative construction was used than when a CoS causative was. For the Set off/alarm scenario this means that they rated the statement "Mary set off the alarm" as less acceptable than "Mary caused the alarm to go off". There was no difference for statements referring to the second cause, which completed the sufficient set. This pattern was confirmed by the statistical analysis. The multilevel model allowed to predict participants´ ratings, LogLik = -41.9, Chi^2=83.7, p<.0001, R^2(Cox&Snell) = .15. The main effect contrast of order was significant, t(474)=9.45, p<.0001, as was the main effect contrast of causative, t(474)=3.32, p=.001, and their interaction, t(474)=3.66, p=.0003.

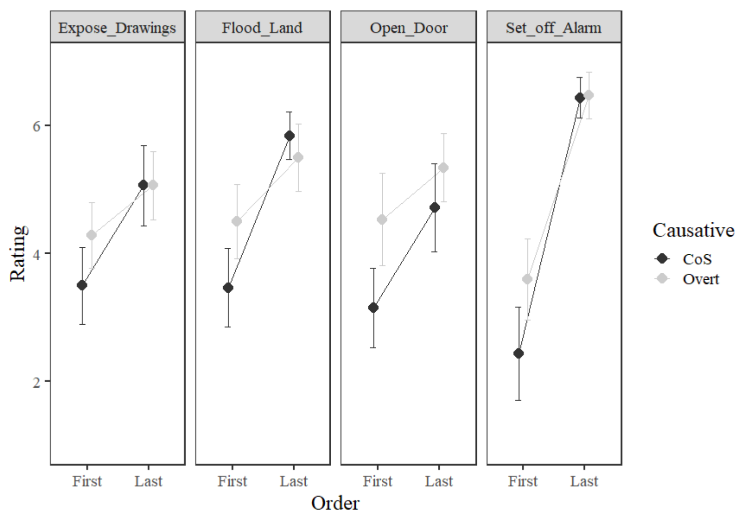


Figure 3: Results of Experiment 1. Mean ratings of causal statements and 95% confidence intervals are shown. Higher ratings indicate higher acceptance.

DISCUSSION. The findings provide evidence for CC-selection: participants rated the acceptance of causative constructions differently depending on which causal condition the statement referred to. When the causal condition completed the sufficient set, overt and CoS causatives were considered appropriate. By contrast, CoS causatives were considered less appropriate than overt causatives for a necessary condition that did not complete the sufficient set. These findings support our first hypothesis: participants were highly sensitive to the completion of a sufficient set when CoS verbs were used. Regarding the second hypothesis, we found that participants were *less* sensitive to a completion of a sufficient set for overt causatives.

3.4 EXPERIMENT 2. In this experiment we investigated the interaction between CC-selection and violation of social norms, which has been shown to strongly affect causal selection (cf. Knobe & Fraser 2008, Icard et al. 2017). We hypothesized that a violation would have a stronger impact on the acceptance of statements when the subject represents the first condition with overt causatives than CoS causatives.

DESIGN. The study had a 2(order of causes) x 2(causative construction) x 3(scenario)[2] x 2(first agent violates norm vs. second agent violates norm) design. While the first three factors were manipulated within participants, the last factor (violation) was manipulated between participants. Again, the study was run anonymously online.

PARTICIPANTS. Seventy-four people participated (37 per violation condition). Five participants were removed from the analysis, because they failed the comprehension test. Recruitment and selection criteria were the same as in Experiment 1.

MATERIALS AND PROCEDURE. Instructions and the procedure were the same as in Experiment 1. Three new scenarios involving two agents were presented (Lock/computer, Set off/alarm, Burst/ tank). The lock/computer scenario is presented in (5), with two possible continuation in (a-b). Participants were asked to rate the statements in (6) on a scale from 1(do not agree at all) to 7 (completely agree). After providing ratings, participants' understanding of the scenarios was tested. The order of the scenarios and the order of the presented statements was randomized.

(5) *The cyber defense company iForce has a secured server which allows only one user to be logged into its system at a time. If a second user tries to log in, the system locks itself. According to schedule the senior developer Beth works on the system every day between 7:00 and 13:00. Her team-mate Frank is scheduled to work on the same system from 13:15 until 19:00.*

(a) First agent violates norms:
…Last week, Beth didn't pay attention to the time and stayed logged in past 13:00. Frank logged in at his regular hour. The system locked.

(b) Second Agent violates Norms:
… Last week, Beth worked her regular hours. Frank felt that he was behind on his tasks and logged into the system at 12:58. The system locked.

(6) (a) *Beth locked the system*, (b) *Frank locked the system*,
(c) *Beth caused the system to lock.* (d) *Frank caused the system to lock.*

STATISTICAL ANALYSIS. We used a multilevel model to analyze the data, taking into account the mixed design. Order, causative, violation, scenario, and the interactions of order, causative, and violation were entered as fixed effects.

RESULTS. The results are depicted in Figure 4. When the second agent violated the norm (lower row in Fig. 4), the first cause received very low ratings. The second cause (completing the sufficient set) received high ratings regardless of the causative construction. By contrast, when the first agent violated the norm (upper row in Fig. 4), ratings were sensitive to order and causative construction.[3] Statements referring to the second cause were rated similarly in the respective scenario

[2] A fourth scenario did not involve agents violating norms and is therefore, not reported.

[3] There is some inter-scenario variation, of which an analysis is beyond the scope of this paper.

given both causative constructions. Statements referring to the first cause, however, were accepted more when an overt causative was used. The latter findings replicate the findings of Experiment 1. Note that we also replicated the findings that overt causative statements referring to agents violating norms are rated higher than overt causative statements referring to agents not violating norms (Hitchcock & Knobe 2009, Reuter et al. 2014, Icard, Kominsky & Knobe 2017 and Henne et al. 2021 inter alia). Importantly, our findings show that there is an interaction of causative construction, order, and norm violation, thus the effect of norm-violation was moderated by the choice of the causative construction. These descriptive findings were corroborated by the statistical analysis. The multilevel model allowed to predict participants' ratings, LogLik = -228.9, Chi^2=457.9, p<.0001, R^2(Cox&Snell) = .42. The following effects were significant: main effect of order (F(1,750)=70.4, p<.0001), main effect of causative (F(1,750)=10.6, p=.001), main effect of violation, (F(1,750)=7.57, p=0.006), interaction of order and causative (F(1,750)=9.55, p=.002), interaction of order and violation (F(1,750)=488.0, p<.0001), and the three-way interaction of order, causative, and violation (F(1,750)=18.9, p<.0001).

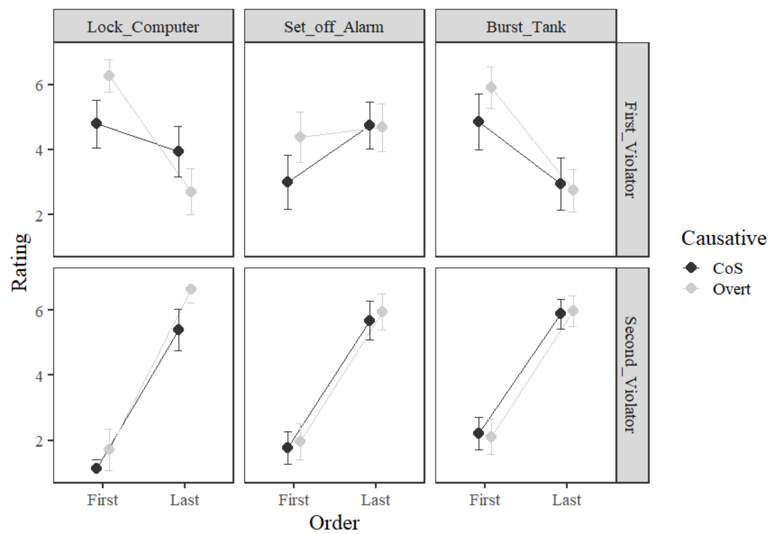


Figure 4: Results of Experiment 2. Mean ratings of causal statements and 95% confidence intervals are shown. Higher ratings indicate higher acceptance.

DISCUSSION. These findings again show the significance of CC-selection: prticipants rated different causative constructions differently with respect to the causal condition (here, an agent) the statement referred to. They also indicated a subtle interaction of norm violation, order, and causative construction. Preferences for a specific construction were strongest when the statement referred to an agent acting first and violating a norm. In this case an overt causative was clearly preferred over a CoS causative. The fact that participants sometimes preferred a CoS causative for the first cause (not completing the sufficient set) over a CoS causative for the second effect (completing the sufficient set) indicates that our hypotheses need to be modified. A violation of norms affected CC-selection beyond the completion of a sufficient set.

3.3 Experiment 3. In Experiment 2, the norm violator could have foreseen the action of the other agent, but the agent conforming to the norm could not. Foreseeability has been shown to moderate the effect of norm violation in causal selection (Reuter et al. 2014). Therefore, the aim of Experiment 3 was to explore the effect of explicit foreseeability on CC-selection. We manipulated the ability of the first agent to foresee the second agent's (later) action.

DESIGN. The study had a 2(order of causes) x 2(causative construction) x 4(scenario) x 2(first agent foresees action of second agent vs. first agent does not foresee action of second agent) mixed design. While the first three factors were manipulated within participants, foreseeability was manipulated between participants.

PARTICIPANTS. Ninety-four people participated (47 per violation condition). Three participants failed the comprehension test and were deleted from the analysis. Recruitment and selection criteria were the same as in Experiment 1.

MATERIALS AND PROCEDURE. Instructions and procedure were the same as in the previous experiments. Four scenarios were presented to participants (Lock/computer, Stop/elevator, Set off/alarm, Open/door). The Lock/computer scenario is given in (7), with two possible continuations in (a-b). Note that there was no explicit social norm that forbade the first agent to act. Participants were asked to rate on a scale from 1 to 7 how much they agreed with the statements in

(7) *The cyber defense company iForce has a secured server "F1", which allows only one user to be logged into its operation system at the same time. If a second user tries to log in, the system locks itself. Frank is the programmer responsible for performing daily checks on the F1 system, every day at 2pm.*

(a) First agent foresees second action:
Beth is Frank's old teammate and knows about his usual work schedule. Last Monday, Beth logged into the system at 1:45pm, knowing that Frank will log in later. Frank logged in from his computer at his regular hour. The operation system locked."

(b) First agent does not foresee second action:
Last Monday, on her first day at work, Frank's new team-mate Beth logged into the system at 1:45pm, not knowing that Frank will log in later. Frank logged in from his computer at his regular hour. The operation system locked.

(8) (a) *Beth locked the system.* (b) *Frank locked the system.*
(b) *Beth caused the system to lock.* (d) *Frank caused the system to lock.*

STATISTICAL ANALYSIS. As before, we used an appropriate multilevel model with order, causative, foreseeability and their interactions and scenario as fixed effects.

RESULTS. Results are visualized in Figure 5. On the left hand side, the results for the individual scenarios are shown, on the right hand side the averages across scenarios. As in the previous two experiments, participants preferred statements with an overt causative over a statement with a CoS causative when the statement referred to the first necessary but not sufficient cause. Across scenarios, there was no clear preference for a particular causative construction for statements referring to the second cause. Note that there was an effect of foreseeability for overt and for the CoS constructions. The differences between ratings for the first and the second agent were smaller, when the first agent could foresee the action of the second agent (see Figure 5 right hand side).
The multilevel model allowed to predict participants' ratings, LogLik = -78.4, Chi^2=156.8, p<.0001, R^2(Cox&Snell) = .10. The following effects were significant: main effect of order (F(1,1355)=72.8, p<.0001), main effect of causative (F(1, 1355)=36.1, p<.0001), main effect of foreseeability (F(1, 1355)=5.89, p=0.015), scenario (F(1, 1355)=6.84, p=0.001), interaction of order and causative (F(1, 1355)=17.5, p<.0001), interaction of order and violation (F(1,750)=488.0, p<.0001), and the interaction of order and foreseeability (F(1, 1355)=16.6, p<.0001). Follow-up analyses of the ratings for CoS constructions showed that there was a significant effect of foreseeability (F(1,631)=4.10, p=.043) and an interaction of order and foreseeability (F(1,631)=4.09,

p=.043). The same analysis for overt causative constructions yielded no main effect of foreseeability (p=.18), but a strong interaction effect of order and foreseeability (F(1,631)=14.2, p=.0002).

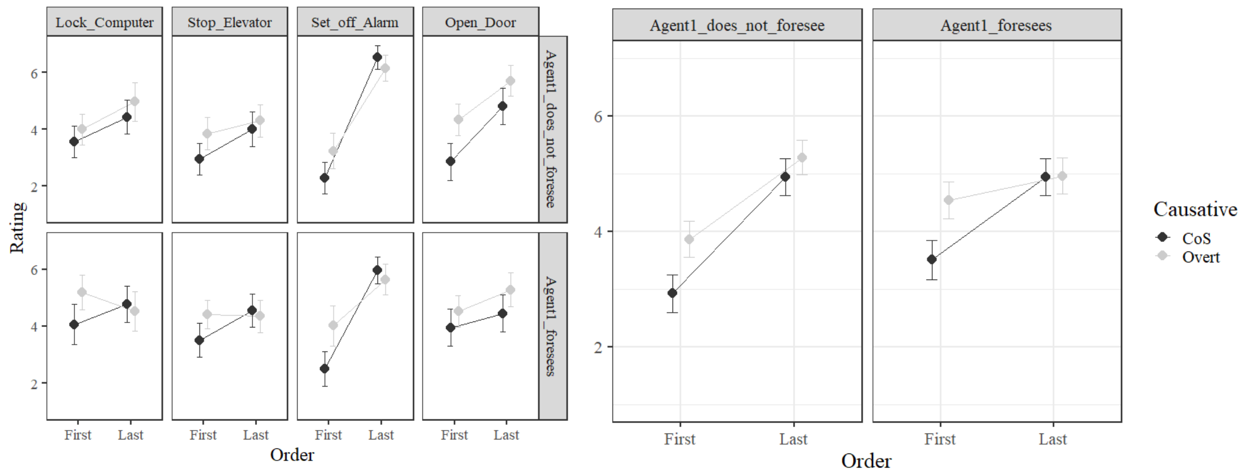


Figure 5: Results of Experiment 3 per scenario (left hand side) and across scenarios (right hand side). Mean ratings of causal statements and 95% confidence intervals are shown. Higher ratings indicate higher acceptance.

DISCUSSION. Like in the previous experiments, we found CC-selection to be crucial in the compatibility ratings of the different statements. When the first agent was the subject of the sentence, participants preferred a statement with an overt causative over a lexical causative regardless of whether the first agent could foresee the action of the second agent. When the statement referred to the second agent, there was no clear preference for a particular causative construction. Foreseeability affected the acceptance with respect to the first agent for overt causatives and CoS verbs, the latter to a lower degree.

There is an important limitation to the above experiments: We manipulated the completion of a sufficient set through temporal order. Therefore, one might argue that the results show that CoS causatives are merely sensitive to order (see Einhorn & Hogarth 1986, N'gbala & Branscombe 1995, for the effect of order on causal judgments). An ongoing trial tests this explanation. However, note that there is a theoretical motivation for why CoS causatives should be sensitive to a completion of the sufficient set (Baglini & Bar-Asher Siegal 2020), and notably, sensitivity to the completion of a sufficient set entails sensitivity to temporal order, at least under certain conditions.

4. The semantics of the overt causative "cause" and CoS verbs. We can now consider properties taken previously as contributing factors to causal selection as parameters in the licensing of linguistic constructions under given circumstances. Accordingly, these factors are taken as part of the meaning/truth conditions of the linguistic expressions.

Our results show that temporal order and thereby the completion of a sufficient set had an effect on both types of constructions, contra to our second hypothesis, and against the common claim relating direct causation with CoS causatives and not overt ones. In other words, while the findings are in line with the "direct causation" analysis of lexical causatives, the effect of temporal order on the overt causative is unexpected. Norm violation and foreseeability showed interactions with construction and order, which means that these factors affect the acceptance of causative constructions differentially. Tables 1 summarizes the interactions of order, norm violation and foreseeability with linguistic construction. It indicates variation between scenarios (always/sometimes) and also relative influence between the two constuctions. The results show that speakers' evaluations of the adequacy of different causal statements vis à vis a particular state of affairs vary systematically, depending on the type of linguistic expression employed to describe them**. This variation indicates that we must treat CC-selection independently, and that causal selection depends on linguistic facts (i.e. the choice of constructions) and not merely on the metaphysical or cognitive characteristics of the relata.**

	Change-of-state verbs	**Relative influence**	**Overt *cause to***
Order (completion of a sufficient set)	Always a factor	>	Always a factor
Violation of Norms	Sometimes a factor	<	Always a factor
Foreseeability	Always a factor	<	Always a factor

Table 1: Interactions of factors and linguistic constructions across Experiments 1-3

Following these results, we suggest to revise the proposal of Baglini & Bar-Asher Siegal (2020) reviewed in Section 2, regarding the constraints on both types of constructions with respect to CC-selection. While being an INUS condition is probably the basic semantic requirement for using the construction with *cause to*, when such a condition is one among other conditions it is not enough. While it is possible that there are various independent factors that license the use of this construction, it is possible to offer a one systematic principle, for the licensing of the *cause to* constructions. According to this proposal, the higher sensitivity to norm-violation (Experiment 2) and the ability of event-participants to foresee the effect (Experiment 3) pertain to the degree of **responsibility** attributed to the condition *wrt* to the effect (see Sytsma et al. 2012 and Samland and Waldmann 2016 for the notions of moral responsibility and blame in the context of causal selection). We further propose that in assigning the role of the cause in the causative construction (i.e., the subject of the sentence), speakers seek to *blame* the specific condition for the occurrence of the effect. Blame can be naturally assigned due to responsibility, but also as a result of a completion of a sufficient set. Accordingly, an event is perceived as more "responsible" or "blameworthy" for an effect, if it is the last to complete the set of sufficient conditions (see Henne et al. 2021, regarding the notion of "recency".) If this proposal is on the right track, all factors are criteria for the same constraint: the condition represented by the subject of the *cause*-construction must be perceived as the one which is more responsible than the other according to at least one parameter. We therefore suggest (9) as a representation of an additional constraint to that in (2) on the choice of condition (Q) among all Conditions (Cs):

(9) $\forall c \in S$ ($C \neq Q$ Responsibility (Q)> Responsibility (C))

With respect to the CoS construction, we see that the requirement that the condition represented by the subject completes the sufficient set is stronger with this construction. However, we must account for two additional facts: in Experiment 2, norm-violation was a factor for accepting this construction, and in Experiment 3 we found that when the first condition could foresee it received a higher rating. In light of this, and especially due to the fact that the factor of completion of a sufficient set is a very strong for the acceptability of this construction we wish to make the following preliminary proposal according to which foreseeability is also related to the notion of completion of the sufficient set. Thus, there are two modes of completion of a sufficient set: **An objective take**: the last event which completes a sufficient set (and then only **time-order** matters**)**; and **a subjective take**: the last condition which the agent didn't know that will be fulfilled (hence **foreseeability** matters**)**. This difference is formally captured between (10), which repeats (1), and (11) in which the model is indexed with a perspective of a certain individual.

(10) $\exists Q\exists e\exists t\exists S{:}suff(S)^{M,R} = 1 \ \&\ (Q \in S)^{M} \ \&\ S(e) \ \&\ \tau(e) \subseteq t \ \&\ \forall t' < t\forall e' : \tau(e') \subseteq t' \rightarrow [\neg Q(e')]$

(11) $\exists Q\exists e\exists t\exists S{:}suff(S)^{M,I,R} = 1 \ \&\ (Q \in S)^{M,I} \ \&\ S(e) \ \&\ \tau(e) \subseteq t \ \&\ \forall t' < t\forall e' : \tau(e') \subseteq t' \rightarrow [\neg Q(e')]$
where I is an individual from whose perspective the causal model is generated

According to this, when the agent forsees that the second condition will take place, his own action was the last condition that he could not know that will be fulfilled. Therefore, his action subjectively completes the sufficient set. In this way we can explain the results from Experiment 3. In Experiment 2, it was soemtime possible for the agent violating the norm to foresee the occurence of the other condition, therefore it might also be a case of a subjective completion of a sufficent set.

5. Conclusions. All 3 experiments demonstrated the significance of CC-selection, by showing that the acceptance of a causal statement was affected by the choice of the causative construction. Consequently, we took the factors affecting the acceptance of the various constructions to be parameters that license the linguistic construction under given circumstances. We propose that they are components in the meaning of the causative expressions. An important ramification from these results is that future studies in cognitive sciences on causal selection must control for linguistic construction used to express causative relations, thus accounting also for CC-selection.

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