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Order of Mention in Causal Sequences: Talking about Cause and Effect in Narratives and Warning Signs

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ABSTRACT

Causal sequences can be segmented into cause and effect. However, some argue causal relations in discourse are by default in *effect–cause* order. Others claim *cause–effect* order is easier to process and the default way of expressing causality, due to iconicity. We conducted experiments testing participants' production choices in two different contexts—narratives and safety/warning signs—to see whether genres/discourse types differ in their preferred cause–effect order. We find that while narratives (which involve temporally anchored events) elicit iconic cause–effect order, safety signs (with generic statements rather than specific temporally anchored events) show a bias toward effect–cause. The present work highlights the importance of differences in text type and communicative purpose and suggests that there is no single answer regarding the primacy/salience of cause versus effect.

Introduction

The notion of causality is a fundamental property of human cognition. Causality plays a central role in daily life, and humans are very good at recognizing and comprehending causal relationships. This allows us to build expectations about what will happen next, to reason about past and future events, to understand the connections between our actions and those of others, and to engage in goal-directed behavior (e.g., Wolff, 2007). Causal relations have been argued to be fundamental to how humans conceptualize events (e.g., Sanders, 2005; Sanders & Sweetser, 2009; Wolfe, Magliano, & Larsen, 2005). Causal relations also play a central role in how narratives are represented in memory (see Van Den Broek, 1990 for an overview). For example, statements that are part of causal chains are judged to be more important, recalled more frequently, and included in summaries more often than sentences that do not contribute to the causal flow of the narrative (e.g., Black & Bern, 1981; Trabasso & van Den Broek, 1985; Sanders & Noordman, 2000).

Causal sequences can be segmented into two components, *cause* and *effect*. In episodic/eventive contexts, the causal event typically temporally precedes its effect/consequence. For example, in a situation where Annie pushing Peter causes him to fall over, the pushing event temporally precedes the falling-over event. Language offers multiple ways of conveying such a sequence, some of which are shown in (1). The options can vary in terms of the order in which the cause and the effect are mentioned and whether and how connectives such as "so" or "because" are used (see also Sanders & Stukker, 2012 for a recent discussion of causal connectives):

(1a) Annie pushed Peter. He fell over. [cause–effect]
(1b) Annie pushed Peter, so he fell over. [cause–effect]

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(1c) Peter fell over because Annie pushed him. [effect–cause]
(1d) Because Annie pushed him, Peter fell over. [cause–effect]

Thus, language can express cause–effect sequences with cause–effect clause order that is *isomorphic with* ("matches") the actual order of events in the world (ex.1a,b,d), but also gives us the option of using effect–cause clause order (ex.1c), which *is not isomorphic* with actual event order. These orders can be described as *iconic* (cause–effect; also called "forward causal") and *noniconic* (effect–cause; also called "backward causal" or explanation relations).

The existence of two options brings up questions about how speakers choose between them when producing utterances, and, relatedly, whether one is generally more frequently produced than the other. As will become clear below, these issues are still open. Although everyone agrees that causal relations influence language processing, the question of whether effect–cause or cause–effect is easier to produce—or comprehend—is not settled. This taps into fundamental questions regarding language production that reach beyond causality, because an understanding of why something is mentioned first and why something else is mentioned later is important for understanding human language use more generally. A plethora of production studies shows that variation in the order-of-mention of the elements of a sentence allows us to gain insights into key aspects of language production (e.g., Ferreira & Slevc, 2007). Building on these insights, the two experiments presented in this article use *production tasks* to investigate speakers' choices of whether to use cause–effect or effect–cause order in two very different contexts, narratives and warning/safety signs, to shed light on which order is preferred and whether this depends on the nature of the information being conveyed. Prior work largely used tasks involving comprehension and memory, so use of a production task can be regarded as a complementary approach that allows us to tap into the conceptual accessibility of causes and effects.

In the following sections I first review divergent results from prior work. Although some researchers claim that isomorphic cause–effect order is easiest to process, others found that causal relations in discourse are by default presented in noniconic effect–cause order, and yet others found that the degree of causal relatedness between the two elements in the cause–effect sequence modulates the preferred order. I then motivate the use of a production methodology (used in the experiments presented in this article) as a complementary method to gain insights into the conceptual accessibility of causes and effects and discus the importance of looking at different genres/text types to see if they differ in their preferred cause–effect order.

Isomorphism and cause–effect order

Many researchers have suggested that even beyond causal relations, isomorphism is preferred in language use—in other words, elements in narrative text are depicted in chronological order (the *iconicity assumption*, see e.g., Fleischman, 1990; Hopper, 1979; Ohtsuka & Brewer, 1992; Zwaan & Radvansky, 1998). For example, Enkvist (1981) discusses the principle of "experiential iconicism," according to which "elements of language are ordered to make a text isomorphic with the universe it describes" (1981, p. 98). Similarly, according to Brewer (1985), "the order of events in the discourse will map the order of underlying events" (1985, p. 187). In the case of causality, cause–effect order is regarded as more iconic than effect–cause order, because the former reflects the natural chronological order of events (see e.g., Spooren & Sanders, 2008 for discussion).

Indeed, prior comprehension experiments suggest that when events are mentioned in chronological (iconic) order, people are more accurate at answering comprehension questions and language processing is faster than when events are described out of chronological order (e.g., Mandler, 1986; Ohtsuka & Brewer, 1992; Rinck & Weber, 2003; see also Noordman, 2001 for related work). Language acquisition work also suggests that that children prefer cause–effect order (e.g., Kuhn & Phelps, 1976; Brown & French, 1976; see also Spooren & Sanders, 2008 for related discussion).

Experimental evidence showing that iconic cause–effect order is easier to process than noniconic effect–cause order comes from Briner, Virtue, and Kurby (2012). Using a lexical-decision paradigm, they tested both cause–effect and effect–cause orders (2a, 2b). (They also tested control sentences without causal links.) The items they used consisted of short, two-sentence "textoids" (to use Art Graesser's term), not extended narratives. Briner et al. measured how fast people recognize words (e.g., "bake" for ex.(2)) related to the causal event, presented after the sequence of two sentences. Briner et al. found that lexical decision times were faster in the cause–effect conditions than in the effect–cause conditions. Briner et al. (2012) interpret this as evidence showing that presenting events out of chronological order makes processing harder—in other words, that iconicity facilitates processing. (As expected, they also found that lexical decision times for cause-related words in *both* cause–effect and effect–cause sequences were faster than in their noncausal [control] counterparts, indicating that causal inferences are activated during comprehension.)

(2a) *Forward causal*: Saul placed the roast in the oven. Two hours later, his kitchen smelled good.
(2b) *Backward causal*: Saul's kitchen smelled good. Two hours earlier, he'd placed a roast in the oven.

Briner et al. (2012)'s work resembles much of the other research on causality in narratives in that the sentences describe specific events in the past that have already happened. However, what about *generic causal statements* that do not refer to a particular event and also apply to events that have not yet happened (e.g., "People set their alarms so that they wake up in time" or "Because vitamins are healthy, many people strive to eat more vegetables") or conditional sentences that refer to possible events that have not yet happened (e.g., "if you eat more vegetables, you will increase your vitamin uptake")? It has been suggested that cause–effect order is the default even in nonepisodic/noneventive contexts such as causal conditionals (e.g., Dancygier, 1999; see also Sweetser, 1990). In her discussion of causal relations in conditionals and related constructions, Dancygier (1999, pp. 80–81) mentions the importance of iconic ordering but does not offer an experimental test or quantitative analysis of ordering preferences.

In related work on causality, Sanders (1997), Spooren and Sanders (2008), Sanders and Spooren (2009), and others make a distinction between content relations, involving relations between events or "states of affairs" in the world (also called *semantic relations*, see Knott, Sanders, & Oberlander, 2001 for a review), and noncontent relations, such as epistemic and speech-act relations (also called *pragmatic relations*). A sequence such as "The lights in the neighbors' living room are out. So they are not at home." (Knott et al., 2001, p. 202) exemplifies an epistemic relation (involving reasoning/making an inference based on evidence[1]). A sequence such as "Does anybody need to go to the restroom? Because we are leaving in a minute" (Sanders & Spooren, 2009, p. 203) exemplifies a speech-act relation, because the "because" clause provides an explanation for why the speaker produced a certain speech act (question about need for the restroom). In an elicited-production and conversation-based study with children, Spooren and Sanders (2008) found that content relations (involving events) tend to occur with iconic cause–effect order, but epistemic and speech-act relations tend to occur with noniconic effect–cause order. This finding is significant, because it shows that cause–effect ordering should not be treated as an overarching default and that this depends on the semantics/pragmatics of the causal relation. In the next section we consider additional evidence against the idea that causal relations have a default cause–effect order.

1. As noted by Knott et al. (2001), in these kinds of relations we "understand the second part as a conclusion from evidence in the first, and not because there is a causal relation between two states of affairs in the world: it is not because the lights are out that the neighbors are not at home" (p. 202).

Nonisomorphic effect–cause order

In contrast to the sizable body of work suggesting that isomorphic cause–effect order is easiest to process, there are also divergent findings indicating that causal relations in discourse are by default presented in noniconic ***effect–cause*** order (e.g., Moeschler, 2014; Diessel & Hetterle, 2011; see also Spooren & Sanders, 2008) and that effect–cause order is easier to process (Moeschler, Chevallier, Castelain, van der Henst, & Tapiero, 2006). For example, Diessel and Hetterle (2011) observed a preference for *effect–cause* order in a cross-linguistic typological study of more than 60 languages. More specifically, they found more languages in which embedded clauses expressing the cause (e.g., "because Annie pushed him", see ex.(1)) must or tend to *follow* the main clause (which typically expresses the effect/consequence, e.g., "Peter fell over", ex.(1)) than languages where causal clauses precede the main clause (see also Diessel, 2001). Thus, from a typological perspective, *effect–cause* order seems to be more common than *cause–effect* order.

This observation is also corroborated by psycholinguistic work: A comprehension experiment in French by Moeschler et al. (2006), using short two-clause textoids not unlike those of Briner et al. (2012), suggests that *effect–cause* order is easier to process than *cause–effect* order. Participants rated the plausibility of sentences while measuring clause-by-clause reading times for cause–effect and effect–cause sequences (ex. 3–4). The level of relatedness/strength of the causal connection between the clauses was manipulated (compare ex. 3 and 4) based on a norming study. Like Briner et al. (2012), Moeschler et al. (2006) tested episodic/eventive contexts, mostly in the past tense.

(3) *High level of causal relatedness*
Cause–effect: Le vase de cristal est tombé, il s'est cassé. (The crystal vase fell, it broke.)
Effect–cause: Le vase de cristal est tombé, quelqu'un l'a fait tomber. (The crystal vase fell, someone made it fall.)
(4) *Lower level of causal relatedness*
Cause–effect: La barque a heurté le rocher, elle a coulé. (The boat hit the rock, it sank.)
Effect–cause: La barque a heurté le rocher, il y avait du courant. (The boat hit the rock, there was a current.)

Moeschler et al. (2006) found that in items with lower levels of causal relatedness, reading times show order effects: Compared with utterances in a neutral context, the second clause of a cause–effect sequence is read more slowly than the second clause of an effect–cause sequence. Being the second clause of an effect–cause sequence results in a greater processing speed-up than being the second clause of a cause–effect sequence (compared with being read in isolation). Moeschler et al. conclude that effect–cause order is easier to process than cause–effect order, at least in items with lower levels of causal relatedness. Overall, they find no evidence in favor of cause–effect order.

Level of causal relatedness

Moeschler et al. (2006) found that the level of causal relatedness modulates effects of clause order. Earlier work on memory representation of causal relations in narrative also found effects of the level of causal relatedness (e.g., Keenan et al., 1984; Myers, Shinjo, & Duffy, 1987; Wolfe et al., 2005). For example, Myers et al. (1987) used a cued-recall task to see how well participants could recall parts of cause–effect sequences differing in causal relatedness (ex. 5–6). Participants read a list of sentence pairs in cause–effect order (e.g., "Joey's big brother punched him again and again. The next day his body was covered in bruises.") and were then cued with cause sentences or effect sentences and asked to recall the other sentence in each pair. Similar to Briner et al. (2012) and Moeschler et al. (2006), Myers et al. also used short two-sentence textoids, not extended narratives. The level of causal relatedness between the sentences was manipulated by changing the cause sentence (ex. 5a–d)). The recall results show that regardless of whether the cause or effect was used as the cue, recall performance was (1) worst for sentence pairs that were weakly causally related, (2) best for sentence pairs that had an intermediate level of causal relation, and (3) at an intermediate level for sentence pairs that were highly causally related. (Levels of causal relatedness were determined by a norming study.) Thus, there is an inverted-U-shaped relation between level of causal relatedness and ease of recall.

(5a) Joey's big brother punched him again and again. [highest level of causal relatedness]
(5b) Joey began fighting with his older brother.
(5c) Joey got angry at his brother in a game.
(5d) Joey went to play baseball with his brother. [lowest level of causal relatedness]
(6) The next day his body was covered in bruises.

Why would moderately related causal sequences differ from highly related and weakly related sequences? Building on Keenan et al. (1984), Myers et al. (1987) discuss the possibility that processing of moderately related sequences triggers the formation of a causal inference between the two sentences—thereby requiring more in-depth processing which improves recall—in contrast to highly related sequences where the causal relation is so obvious that (virtually) no inferencing/reasoning is needed and to weakly related sequences where the causal relation may be so weak that comprehenders cannot generate a causal inference. See also Zwaan and Radvansky (1998) for additional discussion.

How does this reasoning relate to Moeschler et al.'s (2006) finding that less-connected sentence pairs show sensitivity to the cause–effect/effect–cause distinction (effect–cause order seems to be easier to process than cause–effect order) while highly connected pairs do not? It may be that we are dealing with a ceiling effect with the highly connected pairs, such that an order effect cannot be detected or—relatedly—that only sentences that require a certain level of inferencing show ordering effects. Perhaps sentences with a high level of causal relatedness, which require no additional inferencing on the part of the comprehender, are equally easy to comprehend in cause–effect and effect–cause order. The experiments reported in this article do not aim to test these issues directly, as the focus here is on cause–effect ordering in language *production*, but it is worth noting that effects of the level of causal relatedness on comprehension can be plausibly explained. For the purposes of this article, it will be important to ensure that we do not accidentally fail to detect effects of cause–effect ordering due to causal relations being too strong/obvious.

Taking stock: is there a preferred order?

As shown above, the conclusions of Moeschler et al. (2006) diverge from those of Briner et al. (2012): Moeschler et al.'s findings suggest that making a causal inference is easier in effect–cause order than cause–effect order, whereas Briner et al.'s results suggest an advantage for cause–effect order over effect–cause order. However, because these studies used different methods, it is difficult to compare them directly. Furthermore, based on Spooren and Sanders (2008), it appears that cause–effect ordering preferences are different for two causally linked events and for speech-act and epistemic relations. The situation is further complicated by other work that failed to find significant differences between cause–effect and effect–cause order (e.g., Singer, Halldorson, Lear, & Andrusiak, 1992).

In sum, prior work on comprehension and recall of causal sequences has yielded mixed results, both in terms of whether iconic cause–effect order is the default/preferred order or not and in terms of how/whether noniconic effect–cause order is preferred only with epistemic and speech-act based relations or with all kinds of causal relations (e.g., Moeschler et al., 2006; Spooren & Sanders, 2008). As a result, the question of whether cause–effect order or effect–cause order is easier to process is not yet clear, nor is it clear whether different kinds of communicative contexts would show the same ordering preferences.

Aims of the present work

The current experiments aim to investigate causal ordering by looking at speakers' *production* preferences. We chose to focus on production (rather than comprehension or recall), because people's production choices allow us to gain insights into which component of the causal sequence is more conceptually accessible/salient in people's minds: A large literature on language production research in psycholinguistics (see e.g., Ferreira, 2010 for an overview) has repeatedly shown that speakers tend to mention first things that are more conceptually accessible and to delay mention of less accessible things. Conceptual accessibility can be defined as "the ease with which the mental representation of some potential referent can be activated in or retrieved from memory" (Bock & Warren, 1985, p. 50; see also Bock, 1987; Levelt, 1989).

Although the notion of accessibility has mostly been used on the level of sentences when describing the order in which people mention specific referents, conceptually the same idea can also be applied to subparts of causal chains, that is, causes and effects/consequences. Thus, by looking at the order in which people mention causes and effects, we can gain insights into which component is more accessible/activated—and thus easier to retrieve—in their mental representation of the event. The present experiments investigate (in a controlled laboratory setting) whether people tend to mention causes before events or events before causes. Although these production methods have not been standardly used in the investigation of cause–effect order, they are well established and well understood in other areas of language processing (thanks to a growing body of work on language production) and offer a promising new tool for investigating the contested issues of cause–effect ordering preferences.

Furthermore, the experiments reported here test whether different contexts/genres differ in their ordering preferences. Experiment 1 investigated past-tense narrative-style sequences, whereas Experiment 2 investigated safety/warning signs that do not make reference to specific events in the past. Consider a sign in a library that says "Be quiet" on one line and "People are studying" on the next line. Linguistically, this could be described as "Please be quiet, because people are studying" or "People are studying, so please be quiet". Here, we are not describing specific past events that already happened, and there is no specific temporal ordering being described, but logically speaking the need to be quiet is an *effect*/consequence of people studying (the *cause*).

This raises the question of what ordering preferences can be observed with cause–effect sequences in this context, which differs from narratives both in terms of the semantics (not past tense or episodic events) and its communicative function. Investigating how people communicate the content of warning/safety signs (Experiment 2) offers a naturalistic way of testing whether the ordering patterns observed with production of past-tense narrative events (Experiment 1) extend to a different context—without a chronological order and with a different communicative function.

In sum, comparing participants' production patterns in Experiments 1 and 2 will shed light on the depth/generality of causal ordering preferences, and provide information about whether the human language processing system consistently treats one subcomponent of causal sequences as more accessible or whether this is a genre-dependent/context-dependent pattern. The present article does not aim to identify which specific properties of the texts are responsible for the difference but to accomplish the initial step of testing whether differences exist between different genres/text types in terms of their preferred cause–effect order. Prior work on the order of mention of cause and effect did not systematically consider potential effects of two clearly different text types. Thus, to preempt the results somewhat, the key contribution of the present article is to provide empirical evidence showing that there is no default cause–effect/effect–cause ordering preference that applies across all genres, thereby providing the groundwork for future research to investigate the differences in more detail.

Experiment 1: narratives

Experiment 1 used a production task to investigate whether people first mention cause or effect when describing a sequence of causally connected events and whether this depends on the level of causal relatedness of the events. Prior work on language production shows that more accessible things tend to be mentioned before less accessible things, so the order in which people mention cause and effect provide information about how people mentally represent cause–effect sequences, in particular which component is more accessible/salient. This will allow us to assess whether iconic or noniconic order is preferred. Furthermore, manipulating the strength of the causal connection between the two events addresses potential concerns regarding ceiling events or lack of inferential processing, which have posed challenges for prior work as discussed above.

In this experiment all critical items involve specific events in the past tense, that is, events with a particular temporal/chronological order. This allows us to test whether people exhibit a preference to describe causally linked sequences in the canonical, chronological cause–effect order. Using a production task provides a measure of how accessible/salient causes and effects are in people's mental representations of cause–effect sequences, building the widely accepted finding from language production research that people mention more accessible things before less accessible things (see e.g., Ferreira, 2010 for an overview).

Methods

Participants

Twenty-four adult native English speakers from the University of Southern California participated. All reported normal or corrected-to-normal vision and hearing.

Materials and design

On each trial, participants first saw two sentences on the computer screen. On critical trials, the sentences were cause–effect pairs as exemplified in ex (7): One sentence described an event (e.g., Cathy being carried to a hospital) that was an effect/consequence of the event described in the other sentence (e.g., Cathy fainting at work). All critical sentences were in the past tense and involved humans. The study included 12 targets and 39 fillers. The stimuli were adapted[2] from Myers et al. (1987), who had normed them for strength of causal relatedness. Thus, in line with much prior work, my stimuli consisted of short two-sentence textoids that could be viewed as fragments taken from a longer narrative. The current experiment does not test longer stretches of narrative discourse, although that is an important direction for future work.

The design manipulated (1) the level of causal relatedness between the sentences: whether the two sentences were highly causally related or moderately causally related (as normed by Myers et al., 1987), and (2) the layout on the screen: whether the cause was shown on the top half of the screen and the effect on the bottom half or whether the effect was shown on the top half and the cause on the bottom half of the screen (2 × 2 design). Both of these were manipulated within items, in a Latin-square design. This yielded four conditions (ex. (7)). In the causal relatedness manipulation, the cause was kept constant and the effect was varied, following Myers et al. (1987). Furthermore, Myers et al. (1987) made sure that the different effect sentences were comparable in length and complexity of meaning ("idea units", as defined by Kintsch & Van Dijk, 1978).

(7a) [cause–effect|high]
Cathy felt very dizzy and fainted at work.
Cathy was carried unconscious to a hospital.

2.Some minor wording changes were made, for example, changing MIT to Caltech to be more regionally appropriate to southern California (where the study was conducted). In addition, pronouns were changed to full nouns or names to avoid biasing people toward a certain order.

(7b) [effect–cause|high]
Cathy was carried unconscious to a hospital.
Cathy felt very dizzy and fainted at work.
(7c) [cause–effect|moderate]
Cathy worked very hard and become exhausted.
Cathy was carried unconscious to a hospital.
(7d) [effect–cause|moderate]
Cathy was carried unconscious to a hospital.
Cathy worked very hard and become exhausted.

All the highly causally related pairs used in Experiment 1 were rated at least 6 on a 7-point scale of causal relatedness (Myers et al., 1987, 7 = highly causally related), and all of the moderately causally related pairs were rated between 4 and 5.1 on the 7-point scale. The study also used 39 fillers. These did not include any cause–effect/effect–cause items and instead were pairs of sentences with other kinds of relations. For example, some were pairs of two parallel/similar sentences that had no intrinsic order (e.g., Cary drank some orange juice//Antonia sipped some milk) and others were pairs of two distinct events that were not causally related (e.g., The doctor examined a patient's ear.// The office assistant cleaned some paperwork off the desk. OR The hikers were enjoying the beautiful scenery.//The park ranger made sure all signs and maps were up-to-date.)

Procedure

The procedure is summarized in Figure 1. The experiment was implemented using ExperimentBuilder software (SR Research). Participants did two interleaved tasks: a sentence recall task and a letter recall task. On each trial, participants first saw the two sentences on the screen for 4000 ms. (Piloting confirmed that this was enough time to read the sentences.)

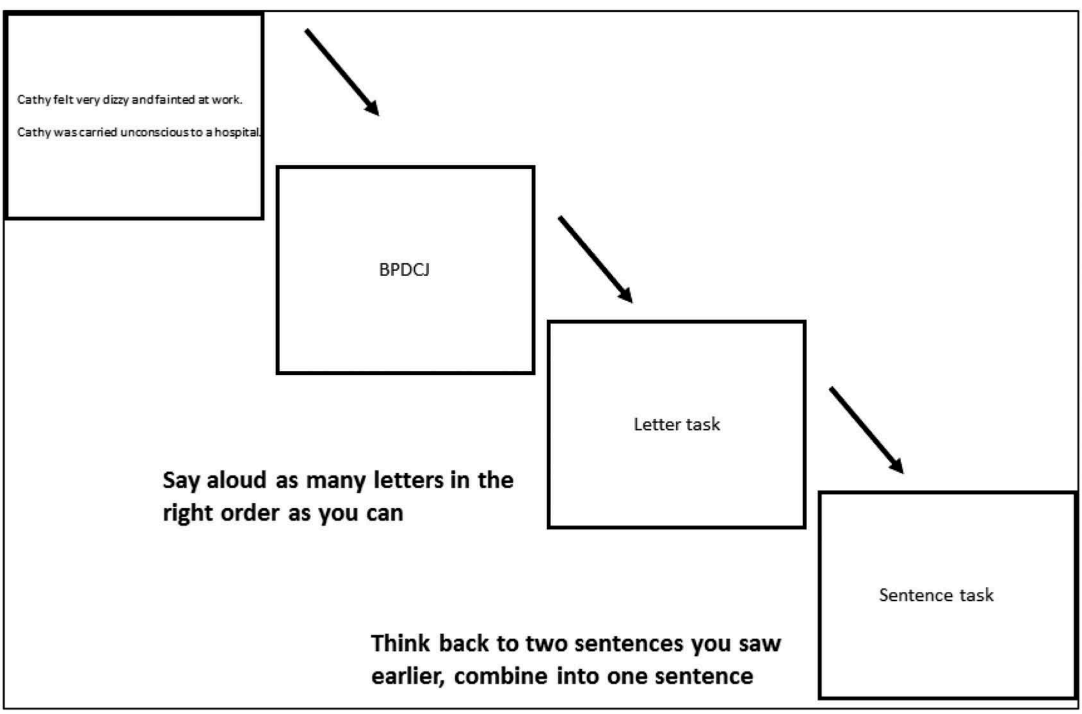

Figure 1. Experiment 1 procedure.

After seeing each pair of sentences, participants completed a brief unrelated distractor task, intended to prevent subvocal rehearsal and verbatim repetition of the sentences. They saw a five-letter string (e.g., BPDCJ, MFHGT, FSGPJ) on the screen for 1000 ms. The strings contained only consonants and were generated following Jones, Fox, and Jacewicz (2012): Only "easily recognizable and frequently occurring capital letters: B, C, D, F, G, H, J, K, L, M, P, R, S, and T" were used (Jones et al., 2012, p. 1867). After the letters disappeared, participants saw a gray screen for 2,500 ms, followed by a screen with the words "Letter Task". They were instructed that upon seeing this screen, they should recall (by speaking aloud) the letters in order as best they could. (Participants did well on this distractor task. The average accuracy of letter recall—i.e., the correct letter in the correct position of the string—on target trials was 92.3% [*SD* 9.87%]. This confirms that participants were indeed paying attention to the distractor task, as intended.)

After the distractor task, participants saw the words "Sentence Task" on the screen, which meant that they should say the two sentences aloud (without seeing them again) and to combine them into one sentence. Examples presented before the start of the main experiment illustrated that combining the sentences could be done by adding some kind of connective and adjusting wording if necessary (e.g., using pronouns). Participants were not *explicitly* told to add connectives or to use pronouns to avoid biasing people toward particular strategies. Samples of what participants said are in (8). The combination task encourages deeper processing and discourages verbatim repetition. Participants completed the letter task and sentence task at their own pace (i.e., there was no time pressure when recalling the letters or producing the sentence). Thus, this study does not aim to tap into real-time/online aspects of processing and instead focuses on speakers' ultimate choice of which order to produce.

(8a) *(i) Shown on screen: (effect–cause condition)*
Cathy was carried unconscious to a hospital.
Cathy worked very hard and become exhausted.
(ii) Participant said: Because Cathy worked very hard and was exhausted she was carried unconscious to the hospital.
(8b) *(i) Shown on screen: (cause–effect condition)*
Tony's friend suddenly pushed him into a pond.
Tony walked home, soaking wet, to change his clothes.
(ii) Participant said: Tony's friend suddenly pushed him into a pond so he had to walk home soaking wet.

Data analysis

Participants' utterances were transcribed and fully double-coded by two coders for whether the participants mentioned the cause or the effect first. To ensure that the results are not potentially distorted by participants failing to fully encode or retrieve the cause or the effect from memory, all trials on which the cause and/or the effect was not accurately produced were excluded. Thus, any preferences we observe for cause–effect or effect–cause order cannot be attributed to problems in encoding or recalling either component. The exclusion criteria were intentionally designed to be strict to avoid this. More specifically, responses were excluded from subsequent analysis if participants failed to mention either the cause or effect sentence (e.g., if they replaced one with an entirely different event, ex. 9a) or omitted one of the two events entirely, ex. 9b). Trials were also excluded if participants' responses clearly indicated that they had not conceptualized the two sentences on the initial screen as involving a cause–effect relation (ex. 9c). Such data points were excluded from subsequent analysis because they could not be analyzed for whether the cause or effect was mentioned first. All these exclusions resulted in 20.1% of the data being excluded (no significant differences in the distribution between conditions). This percentage of exclusions is not unexpected, given the memory load imposed by the letter recall task, the fact that people did not see the sentences again when they had to produce their response, and he fact that all targets involved two clauses (rather than just one clause, which is often the case in other production studies).[3] Thus, the final dataset only included utterances that included both the cause and the effect, and that could be analyzed as exhibiting cause–effect or effect–cause order.

(9a) *(i) Shown on screen (effect–cause condition,//indicates a line break in the actual display)*:
Cathy was carried unconscious to a hospital. //Cathy worked very hard and become exhausted.
(ii) Participant said: Catherine was carried unconscious to the hospital but her mother was fine.
(9b) *(i) Shown on screen (cause–effect condition)*:
Cathy worked very hard and become exhausted.//Cathy was carried unconscious to a hospital.
(ii) Participant said: Kate was very tired after working.
(9c) *(i) Shown on screen (cause–effect condition)*:
Sharon's car was totally wrecked last week.//Sharon went to the bank hoping to get a loan.
(ii) Participant said: Carolyn's car was completely totalled but she hoped to get a loan from the bank.

Predictions

Based on language production work showing that more accessible things tend to be mentioned before less accessible things, I assume that people will tend to mention first the event that is most easily accessible in their mind. Thus, people's linguistic production choices can provide information about how people mentally represent cause–effect sequences, in particular which component is more accessible/salient. If causes are more accessible/salient than consequences, cause–effect order should be more frequent. This what iconicity based approaches would lead us expect. Conversely, if the

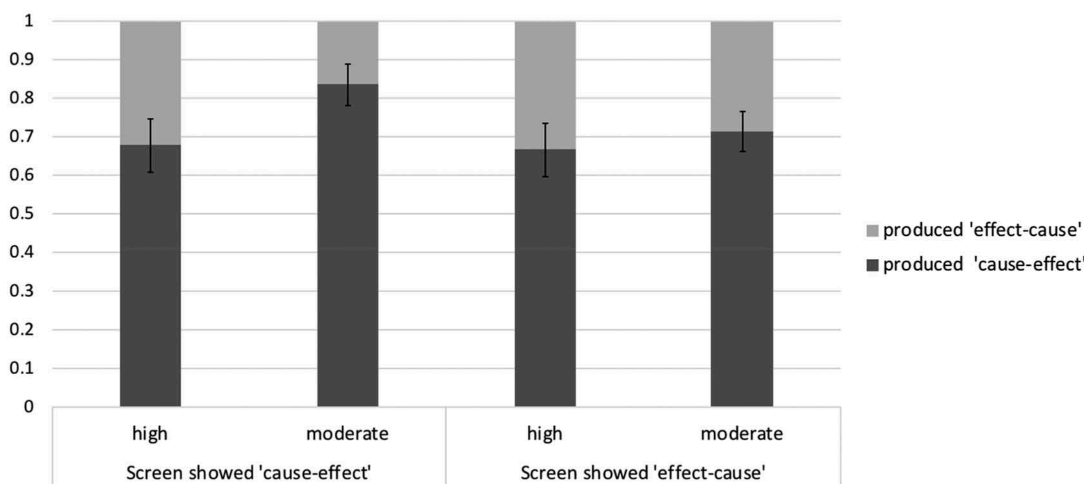

Figure 2. Mean proportions of cause–effect and effect–cause responses in Experiment 1. Error bars show ±1 *SE*.

3.If participants changed the names in the sentences (e.g., item had mentioned Sharon but participant talked about Samantha) or paraphrased the sentences or used close synonyms, these utterances were included in the final dataset.
(i) Shown on screen: Cathy was carried unconscious to a hospital. / Cathy felt very dizzy and fainted at work.
(ii) What participant said: Lisa felt woozy at work and fainted and was then carried to the hospital unconscious.

noniconic order is actually the default option in language and effects are more salient than causes, effect–cause order is expected to be more frequent.

As regards potential effects of the causal relatedness manipulation, I hypothesized that in the highly related condition, the causal relation between the two sentences would be very clear to participants—in other words, no additional inferencing/reasoning is needed for people to recognize that the two events/situations are causally linked. However, for the moderately related condition, participants presumably need to engage in some inferencing or reasoning to process the relation between the two sentences, that is, to recognize they are causally connected. Consequently, the expectation is that the moderately related condition will trigger deeper processing than the highly related condition and might thus be a better means of tapping into the mental representation and subsequent linguistic encoding of cause–effect sequences.

Results

The results are shown in Figure 2. Descriptively speaking, it is clear that participants produced more cause–effect responses than effect–cause responses in all four conditions, regardless of whether the sentences were presented on the screen in cause–effect or effect–cause order. However, the preference for cause–effect order appears to be smaller when the sentences were highly causally related, as compared with moderately causally related (especially when the screen showed the sentences in cause–effect order), suggesting that the level of causal relatedness plays a role. Let us now test if these patterns are statistically significant:

To see if these patterns are statistically significant, I used mixed-effects regression models (lmer, R Core Team, http://www.R-project.org/). Mixed-effects models are better suited for this kind of categorical data than analyses of variance (e.g., Jaeger, 2008who notes that categorical outcomes violate ANOVA's assumptions, and empirically shows that using ANOVA on proportions of categorical variables can lead to spurious outcomes). Indeed, mixed-effect models have emerged as the current standard in psycholinguistics and many other linguistic subfields (e.g., Baayen, Davidson, & Bates, 2008; Barr, Levy, Scheepers, & Tily, 2013; Gries, 2015). For a detailed introduction, see Baayen (2008).

I first tested whether the rate of cause–effect responses in each condition differs from chance. Chance is 0.5, because only cause–effect and effect–cause responses were included in the final dataset. A logistic mixed effects model (with lmer) with only an intercept (as well as random effects) was fitted to the data in each condition. We find that the proportion of cause–effect responses is significantly higher than chance in all conditions except for [effect–cause|high], where it is nevertheless close to marginal ([cause–effect|moderate]: intercept = 1.659, z = 3.91, $p < .001$, [cause–effect|high]: intercept = 0.762, z = 2.35, $p < .02$, [effect–cause|moderate]: intercept = 7.27, z = 2.96, $p < .005$, [effect–cause|high]: intercept = 0.844, z = 1.631, $p = .103$). In sum, all conditions elicit more cause–effect responses than expected by chance, except for the condition where the spatial layout is effect–cause and the sentences are highly causally related.

I also tested for main effects and interactions of sentence order and causal relatedness. The mixed-effect models used the maximal random effect structure justified by the repeated measures 2 × 2 design (cause–effect/effect–cause × high/moderately related), with random slopes and intercepts for subjects and items. (If the maximal model did not converge, the model was simplified, beginning with removal of a random slope for the interaction, until it converged.)

The proportion of cause–effect responses (the inverse of the proportion of effect–cause responses) shows a main effect of relatedness ($\beta = -0.712$, $SE = 0.339$, z = −2.101, $p < .05$, 95% CI [−1.377, −0.0477]), no main effect of the on-screen presentation order ($\beta = 0.298$, $SE = 0.419$, z = 0.711, $p > .4$, 95% CI [−0.023, 1.119]) and (perhaps surprisingly) no significant interaction between these two ($\beta = -0.554$, $SE = 0.674$, z = −0.822, $p > .4$, 95% CI [−1.875, 0.767]). Numerically at least, the effect of relatedness is especially clear when the sentences are presented in cause–effect order.

Discussion

Participants' utterances in Experiment 1 reveal a strong preference for iconic cause–effect order, the only exception being the [effect–cause|high] condition, where the preference is numerically present but does not reach significance. The lack of a clear cause–effect preference in this one condition can be presumably attributed to the spatial order of the sentences on the screen favoring the other order, combined with the fact that in prior work highly related causal pairs showed less clear effects of ordering preferences (Moeschler et al., 2006). As a whole, Experiment 1 provides strong support for the hypothesis that causes are more accessible/salient than effects, in line with iconic cause–effect order.

The results are also compatible with the idea that the level of causal relatedness plays a role, in line with the conclusions of Myers et al. (1987). It is worth noting that there is no main effect of presentation order: Even when people saw things on the screen in effect–cause order, they tended to recall them in cause–effect order. This highlights the strength of the cause–effect preference.

Experiment 2: warning signs

The results of Experiment 1 go against claims that effect–cause order is the preferred way of describing causal relations in language (e.g., Moeschler et al., 2006) and instead support the iconicity assumption, that is, that cause–effect order is the preferred structure for causal sequences in language (e.g., Briner et al., 2012). More specifically, Experiment 1 provides evidence for cause–effect order from a production study that allowed participants to freely mention either the cause or the effect first, complementing prior work that mostly used memory-based and lexical decision-based methods to probe how people processed items with cause–effect and effect–cause order.

However, these results leave open the question of the generality of the preference for cause–effect order. In particular, does it extend beyond narrative contexts in which both the cause and the effect are in the past and have already happened? In narratives in the past tense, the cause chronologically/temporally precedes the consequence. For example, in "Sharon decided to buy a foreign sports car, so she went to the bank hoping to get a loan", the decision-making (cause) occurs before the bank visit (effect), but both have taken place—that is, neither is presented as a hypothetical or future event, for example. Both are presented as specific past events that have already happened.

To test whether the cause–effect bias observed in Experiment 1 persists in nonepisodic, non–past tense contexts, Experiment 2 investigated how cause and effect are ordered in a production task using a different kind of context, namely safety/warning signs (see examples in Figure 3). I chose to use safety/warning signs because in terms of their logical/causal structure, they commonly include

Figure 3. Examples of signs used in Experiment 2. The signs in the top row are examples of *effect–cause* order (i.e., the explanation for doing/not doing a specific action is given on the second line), whereas the ones on the bottom row are examples of *cause–effect* order (i.e., the explanation is given on the first line).

two causally related components: One component consists of an action that we are being instructed/commanded to do/not to do (e.g., “do not enter” or “wear safety shoes”) and the other component provides the reason/cause for why we should or should not do this (e.g., due to the presence of a shock hazard). One component is the *cause* (e.g., there exists a shock hazard) of the other component, the *consequence/effect* (e.g., therefore, you should not enter).

Crucially, however, when we describe the meaning of a sign, we are *not* talking about two concrete past events involving specific people that have already taken place in a certain chronological order, in contrast to Experiment 1. For example, if someone is asked to convey the meaning of the sign in Figure 3, they might say “There is a shock hazard, and so you should not enter” or “Do not enter because you could get shocked.” Thus, we are usually dealing with an *on-going* situation/state (e.g., there exists a shock hazard, or corrosive chemical are present, and so on) which has consequences in the form of things that *people in general* (generic reference) should or should not do (e.g., do not enter, do wear gloves, and so on)—the need to do or to not do something is not restricted to a specific point in time or a specific person. As a result, use of warning/safety signs in Experiment 2 allows us to test whether the cause–effect preference we observed in Experiment 1 extends to a nonepisodic, nontemporal, generic context.

In addition, warning/safety signs have different communicative functions than narratives. In particular, the most important and most urgent part of such a sign is the command/imperative (e.g., “do not enter”), and indeed sometimes warning/safety signs only include this part and omit the reason/cause for why the command should be obeyed. Because of this we might in fact expect people to prioritize mention of the effect over the cause, perhaps preferring effect–cause order.

Thus, investigating how people communicate the content of warning/safety signs offers a naturalistic way of testing whether it is possible to overcome the cause–effect bias that we saw in the narrative-based production task in Experiment 1, which has also been observed in a large body of prior memory-based and comprehension-based research. The two genres/text types tested in Experiments 1 and 2 were intentionally chosen to differ from each other along multiple dimensions, as one key aim of this article is to look for initial evidence of whether two clearly different genres differ in their preferred cause–effect order. These issues can contribute to our understanding of the generality of causal ordering preferences and how the human language processing system conceptualizes subcomponents of causal sequences.

Methods

Participants

Twenty adult native English speakers from the University of Southern California participated. All reported normal/corrected-to-normal vision and hearing. None had participated in Experiment 1.

Materials and design

On both critical and filler trials, participants saw a picture of a safety sign/warning sign on the computer screen. On critical trials, the signs involved a cause–effect sequence as exemplified in Figure 3: One line identified an action that people needed to do or not do (e.g., wear safety shoes, do not enter, no smoking) and the other line provided the explanation for doing/not doing this action (e.g., corrosive chemicals, flammable gas). The design manipulated the order of these two lines, that is, whether the cause appeared above the effect or the effect above the cause. This was manipulated between subjects.

Experiment 2 did not manipulate the degree of causal relatedness, unlike Experiment 1, because it was judged too difficult to do this with warning/safety signs in a reliable manner without compromising the meaningfulness/realism of the signs. This study included 26 target signs (12 with a “danger” heading, 12 with a “warning” heading, 2 with a “fire” icon) and 32 fillers.

The signs were made using St. Claire’s Safety Sign Builder 2.0, a free web-based sign maker program (http://www.stclaire.com/safety_sign_builder/ssb-panel.php). The basic layout of the sign maker program follows the guidelines of OSHA (Occupational Safety and Health Administration)

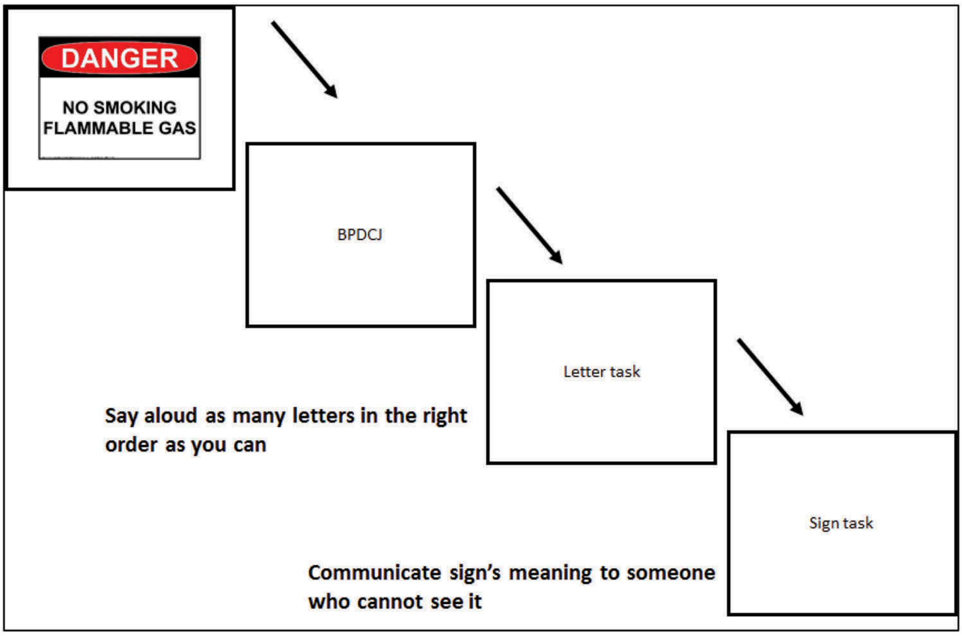

Figure 4. Experiment 2 procedure.

and ANSI (American National Standard Institute). The content and style of the signs used in this study is in line with actual signs in the United States to ensure that the signs are realistic for the participant population of this study.

The experiment also included 32 filler signs. Like targets, some fillers had headings saying "warning" or "danger". Other fillers had "notice" or "caution" headings (also used in real U.S. signs). Fillers used various linguistic constructions and were a mix of signs where the information mentioned on the top and bottom line could be mentioned in either order (e.g., "be alert//drive defensively") and signs where the information in the top row linguistically preceded the information in the bottom row (e.g., "do not operate//unless properly trained").

Procedure

The procedure is summarized in Figure 4. Similar to Experiment 1, participants did two interleaved tasks: a sign recall task and a letter recall task. The timing of the different components was the same as Experiment 1. Participants first saw a sign on the screen and then completed the letter recall task. Participants then saw the words "Sign Task" on the screen, which meant they were asked to communicate the information on the sign (without seeing the sign again) as if talking to a friend who cannot see the sign. Example utterances are in (10). Example trials presented before the start of the main experiment illustrated that paraphrasing and creation of different kinds of full sentences was allowed (since signs only show sentence fragments). As in Experiment 1, participants completed the letter task and sign task at their own pace.

On-line/real-time processing was not investigated in this study.

(10) Examples of what people said for the signs shown on the left half of Figure 3:
(10a) It is important not to smoke here because there are flammable gasses.
(10b) There are flammable materials, so you cannot smoke.
(10c) You should avoid entering the area due to the shock hazard.
(10d) There is a shock hazard, so it's probably not a good idea to enter.

Data analysis

Participants' utterances were transcribed and fully double-coded by two coders for whether the participants mentioned the cause (reason/explanation) or the effect (consequence/what to do or not to do) first. As in Experiment 1, the final dataset only included trials where participants mentioned both the cause and the effect to avoid introducing any memory-based distortions into the results. Thus, a trial was excluded from subsequent analyses if the utterance (1) failed to mention one or both of the components of the sign (cause or effect) and replaced one or both with an entirely different component, ex. (11a), or (2) omitted one of the two components entirely, ex. (11b). This was done because such sentences could not be analyzed in terms of cause–effect versus effect–cause order and because they indicated that participants may have failed to fully encode and/or retrieve part of the sign from memory. This resulted in 13.1% of the data being excluded. (There are more errors/exclusions when the information on the sign is presented in cause–effect than effect–cause order, which makes sense given the strong preference for effect–cause order that we find with signs; see below.) Given the memory load, this level of exclusion is not unexpected.[4] The fact that this proportion is less than Experiment 1 is not surprising, since Experiment 1 involved longer sentences than Experiment 2 (signs often only have 2–3 words per line) and the sentences used in Experiment 1 also contained more detailed information about specific people at specific places and times.

(11a) *(i) Shown on sign*: ear protection required//loud noise area
(ii) Participant said: There's some loud noise here so you should stay away.
(11b) *(i) Shown on sign*: loud noise hazard//wear ear protection
(ii) Participant said: You should wear ear protection.

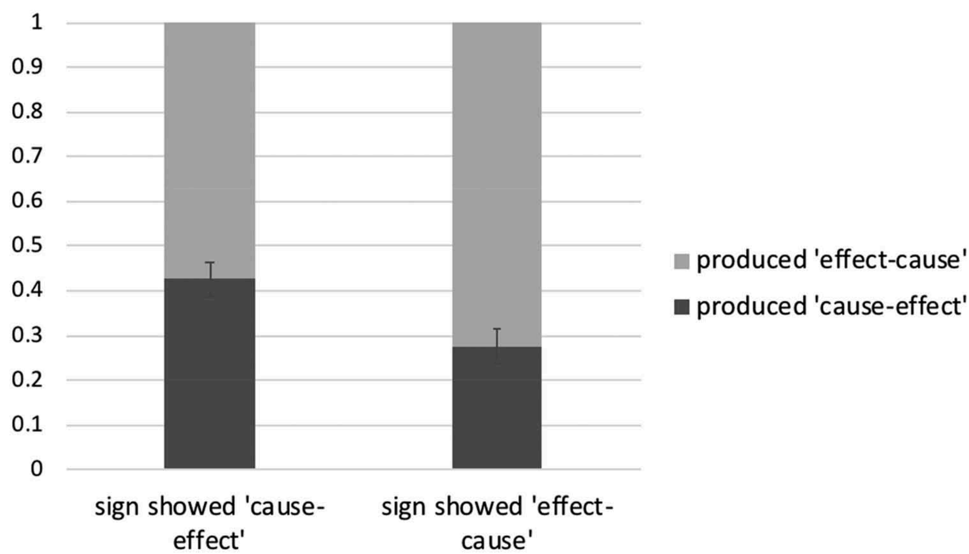

Figure 5. Mean proportions of cause–effect and effect–cause responses in Experiment 2. Error bars show ±1 *SE*.

4.Due to the memory-based nature of the task and the brief wording of the sings, if participants paraphrased the sentences or used synonyms, these utterances were included in the final dataset. Examples are given below:
(a) *(i) Shown on sign*: do not enter // shock hazard
(ii) What participant said: You should stay away because there's a shock hazard.
(b) *(i) Shown on sign*: corrosive chemicals // face shield required
(ii) What participant said: Because of corrosive chemicals, please wear a face mask.

Possible outcomes

If causes are more accessible/salient in people's mental representations of causal sequences even in non-narrative contexts whose temporal and communicative properties differ from Experiment 1, a preference for cause–effect order is predicted for Experiment 2. However, if the cause–effect ordering in Experiment 1 is related to the past-tense nature and chronological ordering of the events being described, then we may or may not observe the same preference in Experiment 2. In sum, Experiment 2 allows us to test whether a different context (without a chronological order and with a different communicative function) allows the cause–effect preference to be overridden.

Results and Discussion

The results are shown in Figure 5. Descriptively speaking, participants produced more effect–cause responses than cause–effect responses in both conditions, regardless of the order of sentences on the sign.

The results differ strikingly from Experiment 1. There is no sign of a cause–effect preference in Experiment 2: Regardless of whether participants saw a sign with cause–effect or effect–cause order, they produced numerically more effect–cause utterances, which echoes what Moeschler et al. (2006) found in French, with different kinds of sentences and a different task. However, the effect–cause preference seems to be stronger when it matches the order of the sign.

To assess whether these patterns are statistically significant, I used mixed-effects models (lmer, R). I first tested whether the rate of cause–effect responses in each condition differs significantly from chance (0.5) by fitting a logistic mixed effects model with only an intercept (as well as random effects) to the data in each condition. We find that when the text on the signs was shown in effect–cause order, the rate of cause-effect descriptions is significantly below chance (intercept = –0.998, SE = 0.1696, z = −5.882, p < .001), and when the text was in cause–effect order, the rate of cause-effect continuations was still marginally below chance (intercept = –0.306, SE = 0.1629, z = −1.876, p = .0607). Thus, both conditions tend to elicit *more effect–cause responses* than expected by chance, and, numerically speaking, this preference is especially clear when it matches the order of the words/clauses on the sign itself. A direct comparison of the rate of cause–effect responses in the two conditions reveals no significant difference (β = –0.612, SE = 0.756, z = –0.81, p > .4, 95% CI [–2.094, 0.869]).

The finding that warning/safety signs elicit a higher-than-chance rate of effect–cause responses contrasts strikingly with Experiment 1, which investigated the ordering patterns in past tense narrative causal sequences. Experiment 2 shows that cause–effect order is no longer preferred when we switch to a different context with different communicative goals, in this case one where the purpose is to warn someone of what to do/not to do, in a context that is not anchored to a specific point in time or to a specific person. Before discussing these results in more detail, the next section directly tests whether the results of Experiments 1 and 2 differ significantly from each other.

Comparison of Experiments 1 and 2

To assess whether the difference between the two studies in statistically significant, I fit a mixed-effects regression model to the rate of cause–effect responses with "experiment" and "presentation order" (whether an item has cause–effect or effect–cause order on the screen) as fixed effects. (I also included random intercepts for subjects and items, as well as random slopes for "presentation order" whenever possible.) I conducted one analysis including both highly related and moderately related items from Experiment 1 and another analysis with only the highly related items from Experiment 1 (because arguably the highly related sentence pairs from Experiment 1 are most similar to the signs which have two highly related components.)

The results confirm that Experiment 1 elicited significantly more cause–effect responses than Experiment 2. When the proportion of cause–effect responses from Experiment 2 is compared only with items in the highly related conditions in Experiment 1, we find no effect of presentation order (β = –0.403, SE = 0.436, z = 0.925, p > .3, 95% CI [−0.451, 1.258]), a significant effect of experiment (β = 1.723, SE = 0.49, z = 3.515, p < .001, 95% CI [0.762, 2.683]), and no interaction (β = –0.629, SE = 0.877, z = –0.718, p > .4, 95% CI [−2.349, 1.089]). Narrative stimuli elicited cause–effect order significantly more often (and effect–cause order significantly less often) than warning/safety sign stimuli. When both highly related and moderately related from items from Experiment 1 were compared with Experiment 2, we find a marginal effect of presentation order (β = 0.641, SE = 0.369, z = 1.737, p = .0824, 95% CI [−0.082, 1.363]), a significant effect of experiment (β = 2.026, SE = 0.468, z = 4.327, p < .0001, 95% CI [1.108, 2.943]), and no interaction (β = –0.096, SE = 0.767, z = –0.130, p > .8, 95% CI [−1.560, 1.366]). Thus, regardless of whether we focus only on the highly related or on both the highly and moderately related conditions of Experiment 1, the rate of cause–effect responses is significantly higher in Experiment 1 than Experiment 2. The marginal effect of presentation order shows that when items showed cause above effect, the proportion of cause–effect responses is marginally higher than when items showed effect above cause—that is, we see a marginal (and unsurprising) preference to follow the order on the screen.

The asymmetry observed between Experiments 1 and 2 fits very well with prior work by Spooren and Sanders (2008). Recall that Spooren and Sanders (2008) found that "content" relations (involving events) tend to occur with iconic cause–effect order—in line with what was found in Experiment 1—whereas "noncontent" relations involving epistemic and speech-act relations tend to occur with non-iconic effect–cause order. The stimuli used in Experiment 2 could be analyzed as involving speech act relations. For example, "Flammable gas. No smoking" could be worded as "Flammable gas is present. That is my motivation for ordering you not to smoke". The finding that warning/safety signs elicit a higher-than-chance rate of effect–cause responses thus fits well with Spooren and Sanders (2008) claim that iconic orders tend to occur with content relations and noniconic orders with speech act relations.

General discussion

The two experiments reported in this article investigate the linguistic encoding of causal sequences, in particular whether speakers are more likely to mention the cause or the effect first, to gain insights into how people conceptualize causal sequences. The experiments tested participants' production choices in two different contexts: narratives (Experiment 1) and safety/warning signs (Experiment 2). The results show that while narratives (which involve temporally anchored events) show a preference for iconic cause–effect order, safety signs (with generic statements rather than specific temporally anchored events) tend to elicit effect–cause order.

In light of prior work on language production showing that people tend to mention first things that are more conceptually accessible while delaying mention of less conceptually accessible things, the studies reported here used a production task to shed light on the mixed results from prior work on cause–effect ordering. Conceptual accessibility can be defined as "the ease with which the mental representation of some potential referent can be activated in or retrieved from memory" (Bock & Warren, 1985, p. 50). Thus, looking at the order in which people mention causes and effects allows us to gain insights into which component is more accessible/activated—and thus easier to retrieve—in their mental representation of the event.

Prior comprehension-based work led to divergent results regarding the questions of whether iconic cause–effect order is the default/preferred order or not (e.g., Briner et al., 2012; Moeschler et al., 2006) and, relatedly, whether noniconic effect–cause order is preferred only with certain kinds of causal relations epistemic and speech-act based relations or with all kinds of causal relations (e.g., Moeschler et al., 2006; Spooren & Sanders, 2008). As a result, the question of whether cause–effect order or effect–cause order is easier to process was not yet clear, nor was it clear whether different kinds of communicative contexts would show the same ordering preferences.

Experiment 1 found that in a production task with episodic, past-tense events involving specific people, participants generally tend to mention *cause before effect*, suggesting that causes are more conceptually accessible than effects. In addition, the level of causal relatedness also appears to play a role: When the causal relation between two events is very strong—meaning that the causal relation can be recognized immediately, without any kind of inferential processing (see Zwaan & Radvansky, 1998; Myers et al., 1987; for discussion)—the preference for cause–effect order seems weaker. Numerically, this is especially clear when the sentences are presented to participants spatially in cause-effect order" (in other words, change 'effect-cause' to 'cause-effect'). This suggests that engaging in deeper processing and reasoning about a causal relation may be at least partly responsible for the higher conceptual accessibility of the cause.

In contrast, the results of Experiment 2 reveal that once we turn to a context with a different chronological structure and different communicative goals, we no longer find evidence for a cause–effect ordering preference: People's descriptions of the warning/safety signs show a preference for effect–cause order, going in the opposite direction to Experiment 1. The results suggest that in Experiment 2 the effect (consequence) is more conceptually accessible than the cause. This goes against claims that iconic cause–effect order is an across-the-board default (see also Moeschler et al., 2006, who found a processing advantage for effect–cause in French). Indeed, this is the main claim being made in the current article: Iconic cause–effect order is not an across-the-board pattern that holds in all genres/domains.

Unlike Experiment 1, Experiment 2 did not manipulate the level of causal relatedness, as this would have been too difficult to implement in the safety/warning signs in a natural way, although it is an interesting direction for future work. However, the absence of the causal relatedness manipulation in Experiment 2 is not a problem for the claims being made in this article. Specifically, the comparisons between Experiments 1 and 2—which show that the two experiments differ significantly in terms of the relative cause–effect ordering they elicit—are not invalidated by the additional variable present in Experiment 1, because the relatedness manipulation did not reverse the ordering preferences in any of the conditions in Experiment 1.

As a whole, this new evidence in favor of the idea that there is no across-the-board preferred ordering for the production of cause–effect sequences is a necessary foundation for future work, which can then investigate in more depth *why* different genres and discourse types exhibit the ordering preferences that they do and what this means for the iconicity assumption. These questions were not the aim of the present article, which focused on the initial step of establishing the existence of genre-based differences in ordering preferences.

Let us consider what the present findings mean for the iconicity assumption, according to which cause–effect is the preferred order for conveying causal sequences. It could be that the iconicity assumption is a default preference that can be overridden in the presence of other cues or in certain contexts, such as the generic, nonepisodic nature of warning/safety signs. Relatedly, it could be that the iconicity assumption is a default that humans apply to episodic sequences with a clear temporal order but not to generic contexts like warning/safety signs. Thus, in situations like Experiment 1 that use "decontextualized" textoids, it may be that participants prefer the iconicity default because of the relatively impoverished nature of the context and/or because of the episodic nature of the events, especially in the case of moderately connected sequences that presumably require more in-depth processing of the temporal and causal relations. These are important questions for future work.

Another future direction concerns other text genres: It could be that in other contexts—like news text, which have a specific kind of narrative structure and often present the crucial event at the very onset—there are other cues that, if present, can override the iconicity assumption. In general, an important direction for future work is a detailed, systematic investigation that aims to identify which genres and text types/discourse types are most likely to exhibit iconic (vs. noniconic) cause–effect ordering.

Importantly, the possibility that iconic cause–effect order is a defeasible default, or a default that is only used with temporal sequences, is not in any way a problem for the key observation made in the present article, namely that iconic cause–effect order is not an across-the-board pattern that holds in all genres/domains. Indeed, these possibilities would fit very well with the basic idea that there is no single default and that multiple factors can influence the order in which comprehenders mention the cause and the effect.

In sum, the present work highlights the importance of differences in text type and communicative purpose and suggest that there is no single answer regarding the primacy/salience of cause versus effect. An important question for future work will be a more detailed investigation of how differences in communicative intent interact with differences in temporal/semantic properties to modulate the choice of cause–effect and effect–cause order.

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