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RESEARCH REPORT

The effect of filled pauses on the processing of the surface form and the establishment of causal connections during the comprehension of spoken expository discourse

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Abstract The purpose of this study was to examine the effect of filled pauses (*uh*) on the verification of words and the establishment of causal connections during the comprehension of spoken expository discourse. With this aim, we asked Spanish-speaking students to listen to excerpts of interviews with writers, and to perform a word-verification task and a question-answering task on causal connectivity. There were two versions of the excerpts: *filled pause present* and *filled pause absent*. Results indicated that filled pauses increased verification times for words that preceded them, but did not make a difference on response times to questions on causal connectivity. The results suggest that, as signals of delay, filled pauses create a break with surface information, but they do not have the same effect on the establishment of meaningful connections.

Keywords Filled pauses · Causal inferences · Discourse comprehension

Introduction

Spoken discourse comprehension involves processing the content of the statements, just as written discourse comprehension does. Yet, speech comprehension involves the processing of information that is *not* present in written discourse, such as filled pauses. Clark (1996) has referred to this as two tracks of communication in spoken discourse: one track involving communication of the topic or content of discourse and the other track involving provision of collateral signals about speakers' performance, which include filled pauses. Because they indicate delays due to production difficulties (Clark 1996; Clark and Wasow 1998; Fox Tree 2001; Fraundorf and Watson 2011), filled pauses communicate useful information to the listener. The purpose of this study is to investigate their effect on the verification of previous words and on the generation of causal inferences (reinstatements) during the comprehension of spoken expository discourse.

Comprehension of filled pauses

Filled pauses can be produced within a statement or at the end of a statement (Fraundorf and Watson 2014, 2011). It has been argued that their presence indicates that the speaker is actively searching for information, or is deciding how to continue (Brennan and Williams 1995; Christenfeld et al. 1991; Fox Tree 2001, 2002; Levelt 1989; Smith and Clark 1993. For other related roles of filled pauses, see Schegloff 2010). As signals of delay, filled pauses have been suggested to focus listeners' attention on immediately upcoming speech, in anticipation of a continuation (Clark 1996; Fox Tree 2001; Fraundorf and Watson 2011). This heightening of listeners' attention to the speech stream is thought to influence online processing, such that it

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facilitates the integration of subsequent information (Fox Tree 2001; Fraundorf and Watson 2011). Consistent with this idea, Fox Tree (2001) found that listeners that were presented with spoken excerpts of conversations were able to identify words for which they were monitoring (they were asked to press a button when they heard them) faster when the word was produced after a filled pause ("He also sold her on a couple of uh *furniture* items") compared to when no filled pause had been present ("He also sold her on a couple of *furniture* items"). Likewise, Brennan and Schober (2001) observed faster recognition times for spoken words that occurred after mid-word interruptions that included filled pauses such as "Move to the yel-uh, *purple* square" in comparison with interruptions that did not "Move to the yel-*purple* square" (see Barr and Seyfeddinipur 2010, for similar results with a referential task). Filled pauses also have been found to have an effect on memory for spoken discourse: Fraundorf and Watson (2011) observed that their presence improved the recall of statements that were produced after them, such as "She finds a golden key on a table" in: "In this story, Alice is in a cave somewhere in Wonderland. Uh, she finds a golden key on a table" in comparison with versions in which they had been edited out "In this story, Alice is in a cave somewhere in Wonderland. She finds a golden key on a table."

Taken together, these studies provide evidence for the facilitative role of filled pauses in the lexical processing of subsequent speech. It is conceivable, however, that they also affect the understanding of information that *preceded* them in the discourse. Given that they signal delay and focus listeners' attention on subsequent utterances, filled pauses could have a decreasing effect on the activation of previous words. In addition, it is possible that this decrease in the availability of preceding information makes it harder for the comprehender to establish causal connections between this information and prior statements. This could happen because activating information on speaker's performance that suggests that he or she is having production difficulty could create a break with the processing of information that is central to the discourse representation, given that the listener would focus on waiting for the speaker to continue talking. By creating this discontinuity or break with preceding content, filled pauses would represent non-semantic shifts. Exploration of such non-semantic shifts would add to studies (for example, those based on the event-indexing model: Zwaan 1996; Zwaan et al. 1995; Zwaan and Radvansky 1998) which have focused on the role that semantic signals of discontinuity, such as time or space boundaries, play in comprehension (Rapp and Gerrig 2002; Rapp and Taylor 2004; Rinck and Weber 2003). Examining the potential effects of filled pauses is important, because processing the surface information of statements and establishing connections among them are necessary for the construction of a coherent representation of discourse as a whole.

The construction of discourse coherence

The construction of a coherent discourse representation involves processing at different levels: *surface, textbase* and *situation model* (Graesser et al. 1997; Kintsch 1998; van Dijk and Kintsch 1983; Zwaan and Radvansky 1998). The surface level refers to the explicit statements that are part of the discourse (i.e., the exact wording). The text base includes idea units to which the discourse refers, but not every word that is part of it. The situation model involves information presented explicitly as well as inferences that the reader/listener has generated to semantically connect statements or to connect text statements to his or her background knowledge. For coherence, a particularly important type of inferences concerns those that are generated when the comprehender reactivates information presented previously (before the immediately previous statement), in order to attain sufficient causal justification for the statement that he or she currently is processing (van den Broek 1990). For example, in this excerpt of *The Invention of Solitude,* by Paul Auster (1982):

> The news of my father's death came to me three weeks ago. It was Sunday morning and I was in the kitchen preparing breakfast for my small son, Daniel. Upstairs my wife was still in bed, warm under the quilts, luxuriating in a few extra hours of sleep. Winter in the country: a world of silence, wood smoke, whiteness. My mind was filled with thoughts about the piece I had been writing the night before, and I was looking ahead to the afternoon when I would be able to get back to work. Then the phone rang. I knew instantly that there was trouble. No one calls at eight o'clock on a Sunday morning unless it is to give news that cannot wait.

For readers of this segment, the statement "No one calls at eight o'clock on a Sunday morning unless it is to give news that cannot wait." would prompt reactivation of "The news of my father's death came to me 3 weeks ago." through the generation of a *reinstatement inference*. This reinstatement inference is likely because it establishes a causal connection: in this segment, someone called *at eight o'clock on a Sunday morning to give news that could not wait* BECAUSE he or she needed to give *the news of the narrator's father's death.* Thus, such *reinstatements* of discourse contents help the reader or listener to explain or understand the causes or consequences for the statement that they currently are processing. Prior studies have found that causally connected statements are indeed reinstated

when they provide causal explanation for the current statement (Pérez et al. 2014; van den Broek et al. 1996). For example, students tend to reinstate prior statements that help them causally explain current events when they are asked to think aloud as they read (Bohn-Gettler and Rapp 2011; van den Broek and Lorch 1993). When students are interrupted during reading to perform a speeded recognition task of earlier textual information, they respond faster when the probe word was part of a prior causally connected statement than when it was not (Dopkins et al. 1993; Trabasso and Suh 1993). Such reactivation of prior statements has been observed to occur regardless of how distant the to-be-reinstated statements are in the surface structure of the discourse (O'Brien and Myers 1987; van den Broek and Lorch 1993). This suggests that causally related statements are directly connected in the mental representation of the comprehender, even when apart in the discourse itself (van den Broek and Lorch 1993). The generation of reinstatement inferences has also been investigated mostly in the context of the comprehension of written discourse (e.g., Bohn-Gettler and Rapp 2011; Cevasco and van den Broek 2008, 2013; Speer and Blodgett 2006; Zwaan and Rapp 2006). The aim of this study was to be the first one to examine the interplay between the generation of reinstatements and the presence of filled pauses during the comprehension of expository spoken discourse. The examination of expository spoken discourse materials is important, because this type of discourse is central to learning settings (Britton et al. 1990; McDaniel and Einstein 1989; Singer and O'Connell 2003; Zwaan and Rapp 2006). As with reinstatements, studies on the comprehension of spontaneous spoken expository discourse have been less common than studies based on planned written discourse (e.g., Cevasco and van den Broek 2013; Ferreira and Anes 1994; Speer and Blodgett 2006; Zwaan and Rapp 2006) and have tended to include presentation of materials in English (Barr and Seyfeddinipur 2010; Fox Tree 2002; Fraundorf and Watson 2011).

Based on these prior results, one would expect that by focusing the listener on processing upcoming speech, the presence of filled pauses would create a discontinuity or coherence break with preceding discourse content, making prior information less available than if had not been produced. This may affect the comprehension of discourse in various ways. One possibility is that such reduction in availability occurs both for the explicit words that preceded the filled pause (surface level of processing) and for the inferences that were generated right before it was produced (situation level). In other words, hearing a signal that the speaker is having trouble producing speech could decrease the accessibility of prior discourse content (at surface and situation levels), because it would focus listeners on expecting the production of upcoming statements, in order to integrate them. For example, imagine listeners being presented with the following spoken segment extracted from the Audiolibrary of Argentine Writers Corpus (Wroblewski and Vegiersky 2003):

> Author:
> Writing involves physical sensations that the writer learns to identify. This is not usually taught or discussed when you take writing classes. Writers are always taught to consider what they think about a text, when writing is about experiencing emotions with the body above everything else.
> It's not that critical or interpretative analyses should be ruled out, but they should not be the center or main focus of the writing process, uh

For listeners of this segment, the statement "but they should not be the center or main focus of the writing process" may prompt reactivation of "Writing is about experiencing emotions with the body above everything else." through the generation of a *reinstatement inference*. This reinstatement inference is likely because it establishes a causal connection: in this segment, *critical or interpretative analyses should not be the center or main focus of the writing process,* BECAUSE *writing should be about experiencing emotions with the body above everything else.* Note that the speaker produced a filled pause at the end of the segment. According to the hypotheses outlined above, the presence of the pause may make both the explicit words that preceded it (words from "but they should not be the center or main focus of the writing process" such as "focus") and the statements that were reinstated before the pause (e.g., "Writing is about experiencing emotions with the body above everything else.") less available than if the pause had been absent. Alternatively, it is possible that hearing the filled pause creates a discontinuity with the explicit words that preceded it, but not with information generated via reinstatement inferences. This may happen because keeping prior causally connected statements available is more relevant for the integration of upcoming statements than keeping prior explicit words available. Given that comprehenders seek to maintain causal coherence as they process discourse (McMaster et al. 2014; van den Broek 1990, 1994, 2010; Zwaan and Rapp 2006), they will attempt to establish causal connections between the statement that is produced after the filled pause and the immediately preceding statement (in this case "*but it should not be the center or main focus of the writing process*"). If this direct causal connection is established, then an indirect causal connection will also be established between the new statement and the causally connected statement that was reinstated before the filled pause was produced (in this example "Writing is about experiencing emotions with the body above everything else."). These

indirect causal connections are established through *transitivity:* if a causal connection is established between statement A and statement B, and statement B is connected to a new statement C, then a causal connection will also established between statement A and statement C (Trabasso et al. 1989). The establishment of these multiple connections contributes to the integration of distant statements, and to the construction of a mental representation of discourse as a network of causes and consequences (Goldman and Varnhagen 1986; Graesser and Clark 1985; O'Brien and Myers 1987; Trabasso and Sperry 1985; van den Broek and Espin 2010; van Silfhout et al. 2015). As a result, listeners and readers may make an effort to keep reinstated statements available after hearing a filled pause for connecting them to upcoming statements and building a situation model, but not to keep available every explicit word that preceded its production.

This study

In order to examine these set of predictions, a group of Spanish-speaking college students were asked to listen to excerpts from expository spoken discourse (excerpts from the above-mentioned corpus) that either contained or did not contain filled pauses produced at the end, and to perform a word-verification task and a question-answering task on causal connectivity. The word-verification task required for students to indicate whether a word that appeared on the screen after the excerpt concluded had been part of the last sentence they had heard or not. The question-answering task required participants to indicate whether a sentence that appeared on the screen after the excerpt ended helped them to explain or understand the last sentence they had heard or not. The target sentence had been part of the excerpt, and it was causally connected to the last sentence participants heard. By combining these two tasks, we hoped to gain insight into the role of filled pauses in both the processing of the surface form of discourse and the representation of coherence relations among statements. We predicted that if hearing a filled pause creates a discontinuity with the surface information of the statement that preceded its production, listeners would take longer and would be less accurate to verify words that were part of this statement when they are presented after a filled pause than when the filled pause was absent. If, in addition, hearing a filled pause creates a discontinuity in the generation of causal inferences, listeners would take longer and be less accurate to respond that sentences that represent reinstatements help them explain or understand the statement that precedes the filled pause (that is, that they provide causal justification for this statement) after they had heard a filled pause than when no filled pause was present.

Methods

Participants

Thirty-two students from the University of Buenos Aires participated in the study for course credit. Their mean age was 22. They were all native Spanish speakers.

Materials

Materials were taken from interviews in Spanish to Argentine writers that were available on the Audiolibrary of Argentine Writers Corpus (Wroblewski and Vegiersky 2003). These excerpts involved a writer responding to an interviewer's question about the meaning of writing to them. These responses revolved around the speakers' definitions of writing, and always involved a writer talking about the creative process and providing insights and suggestions for writing based on their expertise. Each individual excerpt involved only one speaker talking (the writer).

Sixteen segments of speech were selected to be presented to the participants. Their mean duration was 30 s (SD 10). Every segment was transcribed and parsed into statements. Following Trabasso and Sperry (1985), a statement was defined as a unit that contains sufficient state or action information to be identified as a cause or a consequence of another statement. The mean number of statements per segment was seven (SD 2). The last statement of each excerpt contained a spontaneously produced "*uh*" at the end. The statement that preceded the filled pause was expected to promote the generation of a reinstatement inference (that is, to prompt the reactivation of a previous statement that described its causes and enabling conditions). Filled pauses tend to be produced at the end of statements, because this location represents a discourse boundary, where the speaker delays to plan the next statement (Fraundorf and Watson 2011, 2014). We presented excerpts that ended with a filled pause, because it allowed us to test the availability of previous content (part of the surface form or reactivated through the generation of an inference) immediately after listeners processed a signal of performance that focused them on anticipating upcoming speech. Causal connections between the statement that contained the filled pause and previous statements were identified following the procedures proposed by Trabasso and Sperry (1985). To judge whether two statements were causally connected, the criterion of necessity in the circumstances was used (Mackie 1980). This criterion is tested through the counterfactual argument "If not A, then not B." That is, if an event described in statement A had

not happened, then an event described in statement B would not have happened. If this is true, then it is concluded that event A is a cause of, or a condition for, B. In addition to this, a cause needs to be temporally prior to the consequence and active when the consequence occurs. In order to identify locations that required reinstatements, and the content of these inferences, two judges applied the described criteria. They agreed on 90 % of the relations ($\kappa = .85$). Differences were resolved through discussion. There were other spontaneous filled pauses produced in the excerpts, but they were not part of the last statement that participants heard. Each segment started with an idea and finished with completed thought.

There were 16 critical stimuli. For each critical stimulus, a second version was created where the critical *uh* was digitally excised. Sixteen words that had been part of the statement preceding the filled pause were selected for the word-verification task. These words were 2–4 syllables long and included verbs and nouns (for example *anthologists, style* and *young*). They occurred between 2 and 5 words before the filled pause. In each critical stimulus, a statement from earlier portions of the interview that provided causal explanation for the statement that preceded the filled pause was selected as the target sentence. Sample excerpts of interviews with the target sentences and words presented to the students can be found in "Appendix." In addition, 16 filler excerpts were presented. These were similar in length and topics and were produced by the same speakers as in the experimental segments. Words and sentences that were presented after them had not been part of the segments that participants had listened to, so the response that they needed to provide was *no*. In other words, each participant listened to 32 excerpts in total (16 critical and 16 filler).

Procedures

Each participant was randomly assigned to listen to the *filled pause present* or *filled pause absent* version of each excerpt. In total, each participant heard half of the excerpts in the filled pauses absent condition and half in the filled pauses present condition present condition.

Participants received spoken instructions and then were seated in front of the computer. They were asked to keep their index fingers on the "Y" and "N" buttons as they listened. Two practice trials helped them understand the instructions. Participants listened to the excerpts on the computer. Once each excerpt was over, participants were presented with the target word. Their task was to decide whether they had heard it in the last sentence or not by pressing the "Y" or "N" keys. After they had responded to the word, a sentence appeared on the screen. Participants' task was to decide whether this sentence helped them explain or understand the last sentence they had heard or not by pressing the "Y" or "N" keys. Once they had completed these tasks, they pressed the spacebar to move on to the following segment. The experiment lasted around 30 min.

Results

Word-verification task

Mean correct word-verification times were submitted to a one-way ANOVA, with *filled pause presence* (present vs. absent) as the independent variable. Analyses were conducted by subjects (F_1) and by items (F_2). Outliers were excluded from the analyses. These were more than 2.5 SD above or below of the condition mean. They represented 1.7 % of the data. This analysis indicated that there was an effect of filled pause presence on word-verification times, F_1 (1,461) = 12.249, $p = .001$, $\eta^2 = .026$, F_2 (1,30) = 4.229, $p = .049$, $\eta^2 = .124$. Participants verified words more slowly following a filled pause than when no filled pause was present. Table 1 displays the means and standard deviations for each condition.

A second analysis of variance was conducted to test the effect of *filled pause presence* (present vs. absent) on accuracy. This analysis indicated that there was no such effect F_1 (1,484) = .967, $p = .326$, $\eta^2 = .002$, F_2 (1,30) = .357, $p = .555$, $\eta^2 = .012$. Words that participants were asked to verify when the filled pause was absent did not receive more correct responses than those same words when the filled pause was present (see Table 1).

Question-answering task

Mean correct response times were submitted to a one-way ANOVA with *filled pause presence* (present vs. absent) as the independent variable. Analyses were conducted by subjects (F_1) and by items (F_2). Outliers were excluded from the analyses. These were more than 2.5 SD above or below of the condition mean. They represented 2.7 % of the data. Responses to statements that represented reinstatements were not slower after a filled pause was present than when no filled pause was present, F_1 (1,428) = .124,

Table 1 Mean verification times (in ms) and proportions of correct responses to target words by filled pause presence (standard deviations in parentheses)

Filled pause presence	Reaction times	Accuracy
Present	1513.80(637.80)	.93(.24)
Absent	1335.57(440.45)	.95(.19)

Table 2 Mean reaction times (in ms) and proportions of correct responses to target sentences as a function of the presence/absence of filled pauses (standard deviations in parentheses)

Filled pause presence	Reaction times (ms)	Accuracy
Present	2574.89(1108.59)	.90(.29)
Absent	2613.68(1170.66)	.94(.23)

$p = .725$, $\eta^2 = .000$, F_2 (1,31) = .024, $p = .877$, $\eta^2 = .001$. Table 2 displays the means and standard deviations for each condition.

A second analysis of variance was conducted to test the effect of *filled pause presence* (present vs. absent) on accuracy of responses. This analysis indicated that there was no such effect F_1 (1,464) = 3.017, $p = .083$, $\eta^2 = .006$, F_2 (1,31) = 2.226, $p = .146$, $\eta^2 = .069$. That is, responses to statements that represented reinstatements were not less accurate after a filled pause was present than when no filled pause was present (see Table 2).

Discussion

This study examined the effect of filled pauses on subsequent verification of previous words and on the generation of causal inferences during expository spoken discourse comprehension. The results indicate that the presence of filled pauses increased verification times for words that preceded the pauses but did not affect response times to questions about causally connected statements that were reactivated before the filled pauses were produced.

These results suggest that filled pauses create a shift or discontinuity with the explicit information of the statement that precedes them, but do not seem to create a discontinuity with the availability of statements that were reactivated through the generation of causal inferences. It appears that, given that filled pauses heighten listeners' attention to the integration of upcoming speech (Fox Tree 2001; Fraundorf and Watson 2011), they create a break with information that does not make a relevant contribution to this process, such as the surface form of preceding discourse, but not with information that has the potential to contribute to the creation of a meaningful representation of the discourse. The decrease in the activation of information that is not central to comprehension would contribute to allocating cognitive resources to the incorporation or integration of upcoming relevant information. In contrast, the activation of causally connected statements seems unaffected by filled pause presence, suggesting that these statements remain available because they contribute to the establishment of new causal connections. This result converges with those of previous studies that have found that establishing multiple causal connections among statements is important for the construction of an integrated representation of discourse (Espin et al. 2007; Goldman and Varnhagen 1986; Kendeou et al. 2014; O'Brien and Myers 1987; Radvansky et al. 2014).

These findings are also consistent with those of previous studies that have found an effect for filled pauses on word recognition. These investigations have tended to focus on the role of filled pauses on the activation of subsequent information (Brennan and Schober 2001; Fox Tree, 2001), showing that by heightening listeners' attention to the speech stream, filled pauses facilitate the processing and recognition of upcoming words. The current study extends this prior research by examining the effect of filled pauses on the activation of previous speech and by testing whether this effect is the same for the surface level of the preceding statement and for information that was reactivated through the generation of inferences. The consideration of the effect at each level is important because explicit surface information and information activated through the generation of inferences serve different roles in discourse comprehension (Sparks and Rapp 2010; van Dijk and Kintsch 1983; Zwaan and Rapp 2006) and previous studies on filled pauses have tended to focus on the processing of the surface form of speech (Fraundorf and Watson 2011).

The current study also extends prior research in that it investigates the effect of filled pauses on the comprehension of expository discourse. Previous studies on filled pauses have tended to use instructions or conversations as discourse materials (Arnold et al. 2003; Barr and Seyfeddinipur 2010; Fox Tree 2001, 2002), which do not resemble the expository spoken discourse that is produced, for example, during the delivery of lectures. In turn, studies on spontaneous spoken expository discourse comprehension have been less common than those based on planned written materials, which do not include signals of production difficulty (Fox Tree 2001; Fox Tree and Schrock 1999). The materials used in the current study concerned excerpts of interviews, which share features with lectures. For example, they involved only one speaker presenting specific information to the audience and, unlike conversations, did not involve turn-taking. Also, like lectures but unlike informal conversations, they were based on the presentation of expository discourse with the goal of explaining (Britton and Black 1985; Flowerdew and Tauroza 1995; Goldman and Bisanz 2002). Thus, although interviews tend to share similarities with conversations (Schiffrin 1994), the excerpts that we selected were closer to a teacher presenting information on a specific subject to the students than to speakers taking part in a conversation. Thus, consideration of our results can contribute to our understanding of how students comprehend expository discourse while taking classes.

In this study, we tested comprehension through a word-verification task that was presented immediately after participants had listened to the filled pause at the end of each excerpt. One possible concern is that this sounded odd or unnaturalistic to the students, given that there was no speech afterward. This could have distracted them and increased verification times. Although speakers do not tend to end conversations and lectures with an *uh,* in the excerpts that we presented they produced filled pauses after completed thoughts. We chose to test comprehension at this point, because our aim was to explore the effect of processing a signal that activates information about how the speaker is performing at producing speech, on the activation of prior discourse content. This allowed us to investigate the effect of listeners focusing on waiting for the speaker to resolve production difficulty and continue producing speech, on the (re)activation of the discourse representation that they constructed that far. Yet, it is important for future research to test comprehension after speakers do produce speech following a filled pause, to determine whether the current findings generalize to that situation. Another possible alternative hypothesis is that it was not the presence of the filled pause that resulted in increased reaction times to the word-verification task, but the time it takes to process them. That is, statements that contained filled pauses were longer than those that did not, which could have led to decreased activation of the preceding words. This is unlikely, because prior studies have already compared the comprehension of statements containing filled pauses to that of statements containing silent pauses of the same duration (Brennan and Williams 1995) or coughs or sniffles of the same duration (Barr and Seyfeddinipur 2010; Fraundorf and Watson 2011), finding that the latter interruptions did not have the same effect as filled pauses did.

We examined the effect of filled pauses on the generation of causal inferences during listening through the usage of a question-answering task, finding no significant differences between the *filled pause present* and *absent* conditions. It is possible that this represents a null effect and that the task was not sensitive enough to find differences between the conditions. For example, it is possible that this task was too subjective or indirect (students could have responded "no" because they interpreted that the prior statement was already easy to understand). Results from prior studies argue against this possibility, as they have shown that students reliably identify causal connections spontaneously and that they do so when theoretical models would predict they do (Trabasso and Sperry 1985). Another possibility is that the time that elapsed between hearing the excerpts and performing the word-monitoring task made it difficult for participants to decide on the existence of a connection between the reinstated statement and the last statement that they had heard. Yet, prior studies have suggested that after processing each new statement comprehenders spontaneously initiate a reinstatement search that proceeds backward until those statements to which they are causally connected are reactivated (O'Brien and Myers 1987; van den Broek 1990). This reactivation is expected to strengthen the trace of these prior statements (van den Broek et al. 2005). Considering this, it is unlikely participants would find it difficult to respond that reinstated statements helped them comprehend the last statement that they had heard, because the causal connection between them should have already been established in their mental representation by the time they performed the question-answering task. To completely rule out this possibility, however, further research should examine possible effects of filled pauses by using different tasks (e.g., a sentence-recognition task, a sentence-verification task) and by using question-answering tasks that do not involve delay. Likewise, it would be useful to generalize beyond the particular materials that we presented (for example by presenting excerpts of lectures).

This study examined comprehension through offline tasks that focused on the verification of words and question answering. It would be interesting for future research to determine the off-line representation of the discourse through the use of other tasks, such as cued recall or summarization. Based on the current findings, one would expect that words that preceded filled pauses in the presented discourse are less often recalled when filled pauses were present than when they were absent and that statements that were reactivated through the generation of inferences are recalled as often in both cases. Yet, it is possible that memory for spoken discourse depends more on the semantic representation of the connections among statements and that this representation is not much influenced by the surface level of processing. There are, of course, other factors besides filled pauses that influence recall of words, such as their frequency, plausibility, concreteness and accentedness. Indeed, prior studies have suggested that words that occur more frequently in the language are more recalled than those with low frequency (Hall 1954; Mandler 1980) and that concrete words are more easily recalled than abstract words (Walker and Hulme 1999). In turn, accented words are usually produced with a higher pitch and with a longer duration than words that are not accented, which can make them stand out (Ladd 1996; Wagner and Watson 2010). It would be interesting for future research to examine the interplay between the salience or distinctiveness of words and the presence of filled pauses on comprehension. Yet, given that the items analysis on the results of the word-verification task showed that there were significant differences between the conditions, it can be proposed that there is an effect of

filled pause presence, despite potential between-item variation in these lexical factors.

To summarize, the findings from this study contribute to our understanding of how listeners understand disfluent speech, how causal relations are established during the comprehension of spoken discourse, and how non-semantic cues contribute to discourse segmentation. Filled pauses are not simply pauses without consequence. Rather, they influence the availability of information in ways that influence processing by the listener. According to our results, filled pauses decrease the activation of words that preceded them, but they do not seem to have a similar effect on the generation of causal inferences. It is often assumed that conclusions reached with written discourse can be applied to spoken discourse (Ferreira and Anes 1994), but these findings suggest that signals that are part of spontaneous spoken discourse affect the flow of activations of concepts in ways that would be absent in the comprehension of edited written discourse. In other words, the comprehension of spontaneous spoken discourse involves managing signals of production difficulty that affect how the content is processed, pointing to the existence of processes that are specific to this modality of presentation.

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Appendix

Example Excerpts of Interviews Parsed in Statements with Target Sentences and Target Words in the Filled Pause Presence Versions (Translated from Spanish)

1

Author 1:

Journalistic writing differs completely from writing novels.

Journalistic writers are always moved by momentary passions,

Today it can be a religious cause,

tomorrow the robbery of a bank,

the day after tomorrow the assassination of a historic figure,

Filled Pause Present Version:

and in the end they are always anthologists of short stories, uh.

Filled Pause Absent Version:

and in the end they are always anthologists of short stories.

TARGET WORD

anthologists

TARGET STATEMENT

Journalistic writers are moved by momentary passions

2.

Author 2:

Writing involves physical sensations that the writer learns to identify.

This is not usually taught or discussed when you take writing classes.

Writers are always taught to consider what they think about a text,

when writing is about experiencing emotions with the body above everything else.

It's not that critical or interpretative analyses should be ruled out,

Filled Pause Present Version:

but they should not be the center or main focus of the writing process, uh.

Filled Pause Absent Version:

but they should not be the center or main focus of the writing process.

TARGET WORD:

focus

TARGET STATEMENT:

Writing is about experiencing emotions with the body above everything else.

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