Active dependency formation in islands: How grammatical resumption affects sentence processing

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ACTIVE DEPENDENCY FORMATION IN ISLANDS:
HOW GRAMMATICAL RESUMPTION AFFECTS SENTENCE PROCESSING

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Previous studies concluded that despite the parser's eagerness to resolve filler-gap dependencies, in island configurations it prefers to posit late grammatical gaps over early ungrammatical ones. This study investigates the possibility of resolving filler-gap dependencies inside Hebrew islands. We investigated the acceptability of resumptive pronouns (RPs) in two islands and the sensitivity of on-line dependency formation to the status of those RPs. Results revealed a filled-gap effect inside the island that allows RPs but not inside the one that prohibits them. This suggests that active dependency formation can proceed inside islands, and that when processing dependencies with islands, the Hebrew parser prefers an early RP over a later gap.*

Keywords: filler-gap dependencies, self-paced reading, Hebrew, islands, resumptive pronouns, filled-gap effect, sentence processing

1. Introduction. Over the years, numerous psycholinguistic studies have examined the on-line formation of long-distance dependencies, also referred to as filler-gap dependencies. Long-distance dependencies, which are predominantly manifested in wh-questions (1) and relative clauses (2), are characterized by an association between a constituent that appears to be displaced (the filler, in bold in 1–2) and its canonical site (the gap, the underscore in 1–2). This type of dependency can span multiple clause boundaries and is thus, in principle, unbounded.

(1) **Which student** was the teacher waiting for __ ?

(2) The doctor **who** the secretary was trying to call __ had lost his suitcase.

Since the gap site is usually phonetically null, incremental processing may encounter a temporal ambiguity regarding the structure of the sentence (i.e. whether the filler should be interpreted at a certain site or whether lexical material will be provided for this position). This, among other sources of interest, has incited many psycholinguistic studies targeting the strategy used by the parser to resolve such dependencies.

One of the basic findings of these studies is that once a filler is identified, the human parser attempts to posit a gap as soon as possible, namely at the first verb that subcategorizes for an appropriate argument (Frazier 1987, Frazier & Flores d'Arcais 1989, Garnsey et al. 1989, Pickering & Traxler 2001, Stowe 1986, Sussman & Sedivy 2003, Traxler & Pickering 1996, Wagers & Phillips 2009) or even before (Lee 2004, Omaki et al. 2015). However, it has also been suggested that the parser refrains from postulating gaps in positions that are banned by the grammar, namely in so-called islands (Bourdages 1992, Pickering et al. 1994, Stowe 1986, Traxler & Pickering 1996; see Phillips 2006 for a review). Islands (Ross 1967) are constraints on filler-gap dependencies: some grammatical structures are prohibited from containing a gap position corresponding to an external filler. For example, in 3, the bracketed relative clause is an extraction island, such that the wh-question in 4 is ungrammatical.

(3) The detective followed the man [who bought an axe].

(4) *What did the detective follow the man [who bought __]?

Studies of this process of active dependency formation and its island sensitivity have mainly been conducted in English and have generally assumed that if the parser enters an island environment while holding an open filler-gap dependency, then it has only two hypothetical options: (i) predicting a gap inside the island, which would result in ungrammaticality, or (ii) putting the active search for a gap 'on hold' and predicting a gap only when outside the island. While, as mentioned above, the second option is the one that was in fact found to be adopted by the parser, this option is probably costly in some respect, given the fact that in island-less sentences the parser prefers an early resolution of the dependency.

Interestingly, however, there might be a third option available for the parser as it enters an island while holding a filler: predicting a resumptive pronoun inside the island. RESUMPTIVE PRONOUNS (RPs) are instances of regular personal pronouns that appear at the end of a long-distance dependency, where a gap usually occurs. The acceptability of these pronouns varies crosslinguistically, with some languages, such as Hebrew, allowing alternation between gaps and RPs (in some or all sentential positions), and others, such as English, assigning RPs a degraded status. In general, it is thought that in the former type of languages, RPs can 'rescue' island dependencies (see §1.2). However, it is not clear that RPs improve the acceptability of islands in English and other languages of the latter type (Alexopoulou & Keller 2007, Polinsky et al. 2013). It might therefore be that prediction of an RP was not found in previous studies of long-distance dependencies with islands since the languages investigated are ones in which island structures cannot be salvaged by resumption. In languages that allow resumption, however, positing an RP inside an island may provide the parser with an early and grammatical resolution of the dependency.

In this study, we aimed to investigate to what extent the grammatical properties of a language—in our case, the fact that the grammar of Hebrew allows RPs in some islands but not in others—have implications for the on-line processing strategies adopted by the parser as it encounters a filler-gap dependency. Specifically, we tested whether the Hebrew parser differs from its English counterpart during on-line dependency formation inside islands, in that it attempts to resolve dependencies in island contexts that allow RPs.

1.1. PARSING FILLER-GAP DEPENDENCIES AND ISLANDS. In one of the earliest studies on the processing of filler-gap dependencies, Stowe (1986), following Crain and Fodor (1985), demonstrated the parser's tendency to interpret a filler as early as possible using the self-paced reading technique. The study showed that reading times on the embedded object position (the word *us* in 5–6) were higher in sentences with an open dependency (an embedded WH-question, as in 5) than in sentences without one (an embedded *if*-clause, as in 6).

(5) My brother wanted to know who Ruth will bring **us** home to __ at Christmas.
(6) My brother wanted to know if Ruth will bring **us** home to Mom at Christmas.

Stowe interpreted the difference as stemming from a reanalysis that is required if in the WH-condition the parser first places a gap right after the embedded verb (*bring*) and needs to change this initial analysis when encountering a phonetically realized direct object. The increased reading time associated with this reanalysis can be termed the FILLED-GAP EFFECT. The experiment shows that although the parser could, in principle, wait for unequivocal evidence for the existence of a gap (i.e. a missing argument), in practice it actively searches and predicts gap sites in advance. In later studies this AC-TIVE FILLER strategy (to borrow Frazier's (1987) term) was shown to operate in differ-

ent languages, using a variety of experimental methods (Aoshima et al. 2004, Frazier & Clifton 1989, Frazier & Flores d'Arcais 1989, Garnsey et al. 1989, Love & Swinney 1996, Nakano et al. 2002, Phillips et al. 2005, Sussman & Sedivy 2003, Traxler & Pickering 1996). It should also be mentioned that this was suggested to be a predictive process. That is, the parser not only assumes a gap was already present in its input, but also expects to resolve the dependency in the early stages of the sentence's processing, thus predicting lexical material, such as a transitive verb (Omaki et al. 2015).

A productive line of inquiry with regard to this mechanism for active dependency formation investigated its sensitivity to island constraints (Ross 1967). As explained above, although there appears to be no grammatical limit on the distance that can separate a filler from its associated gap, certain kinds of configurations, called extraction islands, do not allow gap positions. These configurations, which include, among others, subject phrases, NP-modifying clauses, and coordinate structures, have been the focus of many studies over the years. Stowe (1986) tested the island sensitivity of the active filler strategy using subject island structures, which rule out gaps embedded in a subject phrase. The experiment manipulated the dependency structures such that the potential gap site (i.e. a subcategorizing verb/preposition) was placed either inside or outside of a subject island (the island is bracketed in 7, with the potential gap site occurring after the preposition *about*). Results showed that there was no increase in reading times of the noun phrase (NP) occupying the potential gap site inside the island (*Greg's* in 7), relative to the reading times of this NP in a corresponding *if*-clause (8).

(7) The teacher asked what [the silly story about **Greg's** older brother] was supposed to mean __ .

(8) The teacher asked if [the silly story about **Greg's** older brother] was supposed to mean anything.

This suggests that no reanalysis was required when encountering the filled gap in the island. Hence, Stowe argued that the parser refrained from postulating a gap in this site, in line with the grammatical restriction on gaps in island positions.

Over the years, similar (null) effects were found in other island structures. The most frequently used island is the COMPLEX NP (CNP); the COMPLEX NP CONSTRAINT rules out gaps in clauses (either relative clauses (RCs) or sentential complements) embedded under an NP (Ross 1967). This island was shown to constrain the on-line parsing of filler-gap dependencies in English (McElree & Griffith 1998, Omaki & Schulz 2011, Traxler & Pickering 1996), French (Bourdages 1992), and Japanese (Yoshida 2006). For example, Traxler and Pickering (1996) obtained a plausibility effect (i.e. longer reading times for an implausible vs. a plausible filler) on the main verb of a relative clause (*wrote* in 9), showing that the filler was considered a complement to the verb at this point. However, no such plausibility effect was found on the verb when it was embedded in an RC island, namely in a relative clause (bracketed in 10) modifying the subject of the main relative clause. This suggests again that resolution of the dependency was not considered at this point, due to island constraints.[1]

(9) We like the {book/city} that the author **wrote** unceasingly and with great dedication about while waiting for a contract.

[1] A possible claim against this conclusion would be that gaps were not predicted in these island structures since their position would be more deeply embedded than that of a gap outside and after the island, and therefore they might not be considered as more proximate to the filler. However, it has been argued that what counts as 'as soon as possible' in dependency formation is computed by the parser based on linear proximity rather than hierarchical depth, based on the finding that in languages with different word orders, speakers show different interpretation preferences for a gap site in ambiguous WH-questions (Omaki et al. 2014).

(10) We like the {book/city} that the author [who **wrote** unceasingly and with great dedication] saw while waiting for a contract.

Another interesting construction in this context is COORDINATE STRUCTURES (CSs), which give rise to the COORDINATE STRUCTURE CONSTRAINT (Ross 1967). This constraint rules out gaps inside CSs (11), except in cases of across-the-board extraction, namely, when both coordinated phrases contain a gap (12).

(11) *The boy who you [laughed at Mary and embarrassed __] cried.

(12) The boy who you [laughed at __ and embarrassed __] cried.

In a self-paced reading experiment, Pickering, Barton, and Shillcock (1994) showed that in WH-dependencies like 13 there is a filled-gap effect on the first potential gap site (at the first verb's object, that is, *the cupboard*) but not on the second potential gap site (at the second verb's object, that is, *the mirror*).

(13) I know what you hit **the cupboard** [and broke **the mirror**] with __ today.

Pickering and his colleagues suggest that during the on-line parsing of this dependency, the first conjunct is not initially analyzed as part of a CS, since the conjunction marker (*and*) only occurs after it is parsed. Therefore, while the first conjunct exhibits the (non-island) filled-gap effect, the null effect on the second conjunct suggests that the parser is faithful to the CS constraint.

The parser's conformity to the CS constraint has also been exhibited from a different angle, using the structures it allows rather than those it prohibits. Wagers and Phillips (2009) created contexts in which the first conjunct in a CS embedded in a filler-gap dependency contains a gap, thus obligating a gap in the second conjunct in order for the dependency to be grammatical. The study revealed a plausibility effect on the second verb (*sprayed*, in 14).

(14) The {adhesive coating/computer program} that the talented engineer designed __ for his boss [and methodically **sprayed** the special test surfaces with __] in his new laboratory could make the company lots of money.

This finding indicates that the parser actively posits a gap in the second conjunct of a VP coordination that contains a gap in the first conjunct, in accordance with the CS grammatical constraint.

1.2. RESUMPTIVE PRONOUNS. As explained above, resumptive pronouns are pronouns that occur as the tail of a long-distance dependency, where a gap usually occurs. Different languages allow different degrees of freedom in the usage of RPs. Whereas these pronouns are considered grammatically illicit in some languages (so called INTRUSIVE-RESUMPTION languages), including English (e.g. 15), other languages (GRAMMATICIZED-RESUMPTION languages) may allow or even obligate RPs in all or some positions.[2] In Hebrew, for example, RPs are banned from the highest subject position and obligatory in indirect object position, and they manifest an alternation with gaps in the direct object position (16), with a slight preference for gaps (Farby et al. 2010, Meltzer-Asscher et al. 2015).

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[2] Another distinction between grammaticized and intrusive resumption concerns the availability of a bound-variable interpretation (Chao & Sells 1983). While RPs in intrusive-resumption languages cannot refer to an antecedent that requires a bound-variable reading (e.g. *every NP*), RPs in grammaticized-resumption languages can. For example, the English sentence in (i) cannot include an RP, since intrusive pronouns cannot be bound by quantifiers, while in (ii) a gap and an RP are interchangeable.

(i) I'd like to review every book that Mary couldn't remember if she read __ / *it before.
(ii) I'd like to review the book that Mary couldn't remember if she read __ / it before.

(15) The boy who the girl kissed (*him) ran away.
(16) Ha-yeled še-ha-yalda niška (oto) barax.
     the-boy   that-the-girl kissed (him) escaped
        'The boy who the girl kissed ran away.'

Interestingly, the grammatical status of RPs is thought to vary with the existence of islands. The precise characterization of the interaction between resumption and island constraints is a complex and widely discussed subject. Traditionally, RPs were thought to improve the grammaticality of island constructions crosslinguistically, that is, in both intrusive- and grammaticized-resumption languages (e.g. Erteschik-Shir 1992, Ross 1967). Hence, RPs were often given a different analysis from gaps—namely, while gaps were analyzed as resulting from WH-movement, RPs were analyzed as pronouns that are bound in situ. Adopting this assumption, some linguists have claimed that the use of RPs reflects a cognitive phenomenon, perhaps indicating low accessibility of the filler (Ariel 1999, Erteschik-Shir 1992), while others have suggested that RPs are a grammatical tool, used as a last resort when movement is grammatically impossible (Shlonsky 1992).

In Hebrew, it was indeed shown that, in line with observations from theoretical linguistics (Borer 1984), RPs are judged as better than gaps inside CNPs with RCs (17) (Farby et al. 2010). In English and other intrusive-resumption languages, however, the situation regarding RPs in islands seems to be more complex. While in recent years several studies have shown that the native speakers of these languages do not rate islands with RPs as more acceptable than ones containing gaps (18) (Alexopoulou & Keller 2007, Omaki & Nakao 2010, Polinsky et al. 2013), other studies have suggested that RPs can, in some cases, repair island violations (Han et al. 2012, Keffala 2013, McDaniel & Cowart 1999) or have some facilitatory effects on sentence comprehension (Beltrama 2013, Hofmeister & Norcliffe 2013).

(17) Dina maskima lifgoš   et   ha-calemet   še-ha-xaver   še-pagaš ota
     Dina agrees   to.meet ACC the-photographer that-the-friend that-met her
           be-xeyfa nasa   le-šam   be-mikre.
           in-Haifa traveled to-there in-chance
        'Dina agrees to meet the photographer that the friend who met her in Haifa
         went there by chance.'   (Farby et al. 2010)
(18) *This is the man that the policeman who arrested him saved the President's
      life.   (Polinsky et al. 2013)

Nevertheless, the conclusion seems to be that resumption in island contexts is not considered a grammatical option by the English parser, at least in the islands previously tested, since RPs do not generally improve the acceptability of those islands. Hebrew, by contrast, seems to allow grammaticized resumption more freely. This raises the possibility that positing an RP inside an island might be attempted by the Hebrew parser during the processing of filler-gap dependencies. The current study set out to test this hypothesis.

1.3. THE PRESENT STUDY. This study aims to investigate whether the on-line parsing of Hebrew long-distance dependencies is influenced by the grammatical possibility of resumption. As explained above, it was previously shown that when the parser is confronted with an island during the processing of a long-distance dependency in English, it prefers to obey the grammatical constraints of the language and not posit a gap inside the island, rather than resolving the dependency earlier (namely, inside the island) but ungrammatically. However, given that RPs are grammatical inside certain islands in

Hebrew, we wanted to test whether during the processing of long-distance dependencies with islands, the Hebrew parser prefers predicting an RP inside the island as a grammatical option for an early resolution of the dependency over waiting for a later resolution outside the island. In order to test this, we conducted two experiments. Experiment 1 establishes a contrast in the sensitivity of RPs to two different island structures in Hebrew: the CNP (with an RC) and the CS islands. Experiment 2 uses these island types in order to test whether the on-line operation of the active filler strategy reflects the off-line island (in)sensitivity of RPs.

2. EXPERIMENT 1. In order to test the acceptability of resumption in different Hebrew islands, we conducted an acceptability-judgment experiment. The experiment investigated two island structures: CNPs with an RC modifying the head noun, and CS islands. While the first is considered a canonical example both for the island insensitivity of RPs and for the island sensitivity of the active filler strategy, we suspected that in the latter case RPs are ungrammatical, even in Hebrew.

The grammatical status of coordination of phrases that include a lexical NP in one conjunct and an RP in the other is not widely discussed in theoretical linguistics, with only a few relevant judgments found. Borer (1984) uses an example of resumption in a coordinated object in order to suggest that resumption does not obey the CS constraint (19).

(19) Raiti   et   ha-yeled še-rina   ohevet oto ve-et   ha-xavera šelo.
     saw.1SG ACC the-boy that-Rina loves   him and-ACC the-friend of.him
         'I saw the boy that Rina loves him and his girlfriend.'   (Borer 1984)

However, on closer examination her example turns out to exemplify across-the-board binding, since the second conjunct also contains a (coreferential) pronoun (*šelo* 'his'). Thus, it merely suggests that RPs are grammatical in CSs when both conjuncts contain RPs (similar to the status of gaps in this context) and does not bear on the grammatical status of CSs with a lexical NP in one conjunct and an RP in the other (in which a gap would be excluded).

Other than that, the discussion regarding the sensitivity of resumption to the CS constraint has mainly focused on the coordination of RPs and gaps. CSs with a gap in one conjunct and an RP in the other (e.g. 20) are generally judged as grammatical (Sells 1984).

(20) kol   professor še-dani   roce lehazmin aval lo maarix   oto maspik
     every professor that-Danny wants to.invite but   not appreciate him enough
         'every professor who Danny wants to invite but doesn't appreciate
          enough'   (Sells 1984)

This type of evidence was considered problematic for accounts of resumption as a nonmovement strategy (see §1.2), since the coordination of a trace of a WH-movement in one conjunct with a pronoun bound in situ in the other should be overruled by the requirement for across-the-board movement (Zaenen et al. 1981). However, Sells (1984) interprets the grammaticality of these structures as an indication that the principle of across-the-board movement is not in fact a condition on movement, but a condition on parallel operator-binding. Thus, sentences like 20 are grammatical since both the RP and the gap are bound by an operator. Although Sells does not discuss this directly, his hypothesis also predicts that coordination of an RP with a lexical NP would be ungrammatical, since the lexical NP is not operator-bound while the RP is.

In this experiment, we aimed to test the grammatical status of such coordination structures and to compare them to resumption in the CNP island. We hypothesized that resumption in those CS positions would be ungrammatical and thus would not differ from CS gaps, while resumption in CNP structures would be significantly better than gaps in CNPs.

2.1. Methods.

Participants. Thirty-two native Hebrew speakers (thirteen males and nineteen females), with a mean age of twenty-six (range: twenty-two to forty-three) participated in the study. Participants were from the Tel-Aviv University community and included undergraduate linguistics students (without relevant linguistic background) and students from other departments, who volunteered for the study. Twenty-eight of the participants were monolingual and four were bilingual.

Materials. The experiment tested the acceptability of resumption in complex NP structures, including a relative clause (CNP) and coordinate structure (CS), both embedded inside relative clause dependencies. The two island types were crossed with two dependency-resolution types: gaps and RPs. We constructed twenty sets of experimental items, each including four conditions that manipulated the dependency's tail (RP vs. gap) and the type of island configuration (CNP vs. CS) (see Table 1).[3] The items included RPs/gaps just in direct object position, the only position in which RPs are grammatically optional in (nonisland) long-distance dependencies in Hebrew. The main relative clause in all sentences was right-branching in order to prevent doubly center-embedded structures in the CNP condition. In addition, the subject of the main clause was differentiated from the filler in agreement features, such that only the filler could be considered a possible antecedent for the pronoun. The CS condition included a coordination of VPs, using a lexical NP as the object of the first conjunct and an RP as the object of the second conjunct. This was done in order to resemble the items in experiment 2, as is explained in §3 below. The CNP condition was constructed using a relative clause embedded under the subject of the main relative clause.[4] This type of island can be also referred to as an RC island; however, we label it 'CNP' here in order to distinguish the island manipulation from another structural manipulation in experiment 2.

Items were distributed into four lists in a Latin-square design, and participants were evenly assigned to lists. In addition, forty filler items were constructed, which contained long and short grammatical and ungrammatical sentences. Ungrammatical fillers included sentences with subcategorization violations, agreement mismatches, and preposition stranding and RPs in wh-questions (both impossible in Hebrew). Each list appeared in four possible pseudo-randomized orders, such that there were no more than three consecutive experimental items and no two consecutive items from the same experimental condition.

Procedure. Participants were given a written questionnaire and were instructed to rate the acceptability of the sentences on a seven-point scale, with 1 indicating that the sentence is not natural at all and 7 indicating a very natural sentence. No time pressure was placed on participants, who completed the questionnaire in about fifteen minutes.

2.2. Results. Experimental items were rated an average of 1.641 ($SD = 1.12$). The average rating for the grammatical filler items was 6.162 ($SD = 1.33$), and that for the ungrammatical filler items was 2.572 ($SD = 1.92$). Mean acceptability ratings of the experimental conditions are shown in Table 2. Ratings were z-transformed by converting

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[3] The full list of experimental sets and fillers is available upon request from the corresponding author (AM-A).

[4] It can be observed that our CNP island thus instantiates another island structure, namely the so-called subject island (Ross 1967). Though this island exhibits substantial crosslinguistic variability, it is generally thought to exist in Hebrew (e.g. Landau 2006), although this can only be observed unambiguously with clausal subjects since extraction out of NPs, even simple ones, is impossible in Hebrew regardless of the position of the NP (e.g. whether it is in subject or object position). For the current purposes, we continue to refer to this structure as a CNP island.

CONDITION	EXAMPLE
CS-RP	Ha-šotrim hekiru et ha-iša še-ha-xašudim daxafu et ha-melcar ve-takfu ota the-cops knew ACC the-woman that-the-suspects pushed ACC the-waiter and-attacked her be-mis'ada yukratit. in-restaurant upscale 'The cops knew the woman that the suspects pushed the waiter and attacked her in an upscale restaurant.'
CS-GAP	Ha-šotrim hekiru et ha-iša še-ha-xašudim daxafu et ha-melcar ve-takfu the-cops knew ACC the-woman that-the-suspects pushed ACC the-waiter and-attacked __ be-mi'sada yukratit. __ in-restaurant upscale 'The cops knew the woman that the suspects pushed the waiter and attacked __ in an upscale restaurant.'
CNP-RP	Ha-šotrim hekiru et ha-iša še-ha-xašudim še-takfu ota daxafu et ha-melcar the-cops knew ACC the-woman that-the-suspects that-attacked her pushed ACC the-waiter be-mis'ada yukratit. in-restaurant upscale 'The cops knew the woman that the suspects who attacked her pushed the waiter in an upscale restaurant.'
CNP-GAP	Ha-šotrim hekiru et ha-iša še-ha-xašudim še-takfu __ daxafu et ha-melcar the-cops knew ACC the-woman that-the-suspects that-attacked __ pushed ACC the-waiter be-mis'ada yukratit. in-restaurant upscale 'The cops knew the woman that the suspects who attacked __ pushed the waiter in an upscale restaurant.'

TABLE 1. Example sentences for experiment 1.

each participant's ratings to a standardized scale. Z-transformed ratings, representing the number of standard deviations the raw rating was from the participant's mean, were suggested to eliminate some scale biases between participants (Schütze & Sprouse 2014). Mean z-scores of the experimental conditions are shown in Figure 1.

	COORDINATE STRUCTURE	COMPLEX NP
RESUMPTIVE PRONOUN	1.80 (1.03)	2.77 (1.55)
GAP	1.57 (0.67)	1.57 (0.61)

TABLE 2. Raw means and standard deviations of acceptability ratings on a scale of 1–7 (experiment 1).
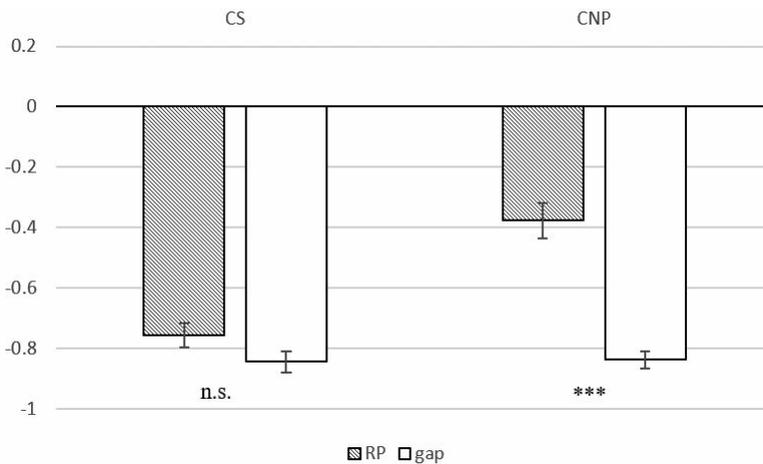

FIGURE 1. Mean z-transformed ratings of experimental conditions (experiment 1). Error bars represent ±1 SE.

Statistical analyses were carried out on the *z*-transformed data, in the R environment (R Core Team 2015) using the lme4 package (Bates et al. 2014). A linear mixed-effects model was fitted, with resolution type (RP vs. gap) and island type (CNP vs. CS) as fixed-effect predictors, and subject and item as random-effect predictors. Following Barr and colleagues (2013), we constructed a maximal random-effect structure, including subject and item random intercepts and random slopes for both fixed effects and their interaction. The analysis revealed a main effect for dependency's tail, such that RPs were rated higher than gaps (estimate = 0.46, $SE = 0.12$, $t = 4$, $p < 0.001$), and, crucially, a significant interaction between resolution type and island type (estimate = -0.37, $SE = 0.11$, $t = -3.46$, $p = 0.002$). Pairwise comparisons, reported with Bonferroni correction for multiple comparisons, revealed a significant difference for CNPs between the RP condition and the gap condition (estimate = -0.46, $SE = 0.12$, $t = -4$, $p = 0.001$), such that RPs were rated higher than gaps. For the CS, however, no such difference was found (estimate = -0.09, $SE = 0.08$, $t = -1.16$, $p = 1$). In addition, the ratings of the sentences in the CS-RP condition were significantly lower than those in the CNP-RP condition (estimate = -0.47, $SE = 0.12$, $t = 3.64$, $p = 0.004$), but not significantly higher than those in the CNP-gap condition (estimate = -0.08, $SE = 0.08$, $t = -0.98$, $p = 1$).

2.3. Discussion. Experiment 1 replicated previous findings regarding the ameliorating effect of resumption on the acceptability of CNPs in Hebrew (Farby et al. 2010), with CNPs with RPs exhibiting a higher mean rating than CNPs with gaps. For coordinated structures, however, there was no significant difference in acceptability ratings between sentences with RPs and gaps. In addition, the ratings of RPs in the coordination structures tested in this experiment were similar to those of CNPs with gaps, and these RPs were largely considered ungrammatical.[5] The acceptability judgments obtained in this experiment thus suggest that RPs are a grammatical option in CNPs but not in CSs of the type tested in this experiment, namely VP coordinations with a lexical NP as the object of the first conjunct and an RP as the object of the second. These results suggest that RPs may be used as a grammatical mechanism during the parsing of long-distance dependencies including CNP islands, but not CS islands.

3. Experiment 2. In this experiment, we used the graded island sensitivity of resumption found in experiment 1 to test the island sensitivity of the Hebrew parser and its interaction with the availability of resumption. We hypothesized that if the parser can 'predict' an RP in Hebrew islands, active dependency formation will be attempted inside the CNP island (where an RP is grammatically possible) but not inside the CS island (where an RP is grammatically impossible). In order to test this hypothesis, we conducted a self-paced reading experiment, using a filled-gap design (cf. Stowe 1986) that manipulated the potential gap/RP site such that it could occur inside either a CNP or a CS island, or outside these islands. Filled-gap effects, namely higher reading times upon encountering a complement to the verb in the condition with an incomplete dependency than in a baseline condition, are expected in both nonisland positions, but not inside the CS island, as exhibited previously for English. Critically, and in contrast to classic results from English, we expect this experiment to reveal a filled-gap effect, or rather a 'filled-RP' effect, inside the CNP island, due to an unrealized prediction for an RP.

[5] A referee notes that it is possible that the ratings for the CS-gap and the CS-RP conditions were not significantly different due to a floor effect. Indeed, it is possible that with different filler items or with a wider rating scale, the CS-gap condition would have obtained an even lower rating. However, the fact that the RP condition was rated so poorly suggests it cannot be considered a grammatical resort for that island structure, an interpretation that is also supported by the processing data in experiment 2.

3.1. METHODS.

PARTICIPANTS. Thirty-eight native Hebrew speakers (eighteen females, twenty males) with a mean age of twenty-five (range: eighteen to twenty-nine), who did not participate in experiment 1, volunteered for this experiment. Thirty of them were monolingual and eight were bilingual.

MATERIALS. Materials were generally based on the items of experiment 1, with some adjustments and variations. There were twenty sets of experimental items, with four sentence conditions in each set, manipulating the existence of a dependency (relative clause (RC) vs. sentential complement (SC)) and island type (CS vs. CNP).[6] The RC conditions were designed such that the CS/CNP islands included potential gap/RP positions (namely subcategorizing verbs), but this position was actually filled with a lexical NP. These NPs were considered to be critical regions for the experiment. For the sentences to be well formed, an RP resolving the dependency was realized later on in the sentence, in an adjunct. RPs were found to be judged as significantly better than gaps in adjunct islands in a different acceptability-judgment test we conducted, similar to the effect previously discussed regarding the CNP island.[7] Thus, we consider the resolution of the dependency in our materials acceptable. See Table 3 for an example of an experimental set, with the relevant island structures bracketed and the critical words (i.e. words appearing in the potential gap/RP positions) in bold. It should be mentioned that in order to make the very complex experimental sentences as natural as possible, in some sets (but not in others) there was additional material intervening between the regions discussed here (for example, adjectives modifying the objects); this did not, however, change the structure of the sentence.

For the CS sentences we used a coordination of VPs rather than NPs. Since the Hebrew conjunction marker (*ve* 'and') is orthographically coupled with the following word, only extraction of an element from a conjunct, and not extraction of a complete conjunct, allows the parser to 'realize' that it has entered an island before the critical word arrives. This configuration also allowed for better parallelism between the CS condition and the CNP condition, which also had to contain two VPs (one embedded inside the CNP island and one in the main clause of the larger relative clause).

Note that in these structures, the critical words in the CNP and CS conditions differ not only in the type of island they appear in, but also in their linear position in the sentence (appearing after the first or the second verb, respectively). In order to avoid this confound, another pair of NPs was considered to be critical for this experiment: the object of the second verb in the CNP sentences and the object of the first verb in the CS sentences (see words in bold outside the bracketed islands in Table 3). As a result, every sentence included two critical words: one inside the island structure (hereafter CNP-in and CS-in) and one outside the island structure (CNP-out and CS-out).

Each item was followed by a yes/no comprehension question. Comprehension questions for experimental items always contained only lexical material from the item (i.e.

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[6] The full list of experimental sets and fillers is available upon request from the corresponding author (AM-A).

[7] This experiment included forty-eight participants and eighteen experimental sets of six conditions. We manipulated the tail of the dependency (RP vs. gap) and the type of the adjunct (finite temporal clause, nonfinite goal clause, and an 'instead'-phrase). Relevant for the construction of the materials in the current experiment was the comparison between gaps and RPs inside a finite temporal clause (e.g. *the doctors talked to the nurse that the manager welcomed the patients after he praised* {*her*/__}). This contrast yielded a significant difference (estimate = 0.15, *SE* = 0.05, *t* = 3.22, *p* = 0.01), such that RPs were rated significantly higher than gaps (RP: raw rating = 3.02, *z*-score = −0.22; gap: raw rating = 2.31, *z*-score = −0.37).

CONDITION	EXAMPLE
CNP-RC	Ha-šotrim mekirim et ha-iša še-ha-xašud [še-takaf **et ha-melcar**] the-cops know ACC the-woman that-the-suspect [that-attacked ACC the-waiter] kilel **et ha-tabax** axrey še-hu daxaf ota be-mis'ada yokratit be-Tel Aviv. cursed ACC **the-cook** after that-he pushed her in-restaurant upscale in-Tel Aviv 'The cops know the woman who the suspect [who attacked **the waiter**] cursed **the cook** after he had pushed her in an upscale restaurant in Tel Aviv.'
CS-RC	Ha-šotrim mekirim et ha-iša še-ha-xašud takaf **et ha-melcar** the-cops know ACC the-woman that-the-suspect attacked ACC **the-waiter** [ve-kilel **et ha-tabax**] axrey še-hu daxaf ota be-mis'ada yokratit be-Tel Aviv. [and-cursed ACC **the-cook**] after that-he pushed her in-restaurant upscale in-Tel Aviv 'The cops know the woman who the suspect attacked **the waiter** and [cursed **the cook**] after he had pushed her in an upscale restaurant in Tel Aviv.'
CNP-SC	Ha-šotrim imtu et ha-divuax še-ha-xašud [še-takaf **et ha-melcar**] kilel the-cops verified ACC the-report that-the-suspect [that-attacked ACC **the-waiter**] cursed **et ha-tabax** axrey še-hu daxaf et ha-iša be-mis'ada yokratit be-Tel Aviv. ACC **the-cook** after that-he pushed ACC the-woman in-restaurant upscale in-Tel Aviv 'The cops verified the report that the suspect [who attacked **the waiter**] cursed **the cook** after he pushed the woman in an upscale restaurant in Tel Aviv.'
CS-SC	Ha-šotrim imtu et ha-divuax še-ha-xašud takaf **et ha-melcar** the-cops verified ACC the-report that-the-suspect attacked ACC **the-waiter** [ve-kilel **et ha-tabax**] axrey še-hu daxaf et ha-iša be-mis'ada [and-cursed ACC **the-cook**] after that-he pushed ACC the-woman in-restaurant yokratit be-Tel Aviv. upscale in-Tel Aviv 'The cops verified the report that the suspect attacked **the waiter** [and cursed **the cook**] after he pushed the woman in an upscale restaurant in Tel Aviv.'

TABLE 3. Example sentences for experiment 2.

they could not be answered based on familiarity only) and targeted either the relative clause (the critical clause of the experiment) or the adjunct clause presented subsequently. Materials were assigned to four lists in a Latin-square design. Each list included forty filler items in addition to the experimental items. Fillers were long grammatical sentences (similar in length to the experimental items) and included eighteen occurrences of object relatives, nine of them containing resumption (in nonisland contexts). The order of the items was randomized for each participant.

PROCEDURE. The experiment was programmed using Linger (Rohde 2003). Items were presented in a self-paced reading paradigm (noncumulative), such that the previous and following words of the sentence were masked by dashes. In Hebrew, RPs are cliticized to the accusative case marking or to a preposition, in contrast to lexical NPs. Therefore, the presence of a bare case marker or preposition would imply that the following word is a lexical NP rather than an RP. Accordingly, prepositions and case markers were presented with their following NP. Participants were examined individually in a quiet environment. They were instructed to make sure that they understood the sentences in order to answer the comprehension questions correctly, but not to linger during the reading of a sentence. In addition, participants received feedback when they gave wrong responses to the comprehension questions. Before they began the experiment participants underwent a practice block of five items.

3.2. RESULTS. Seven participants were excluded from the analysis due to very low accuracy level in the comprehension questions (providing a correct response to 55% of the experimental items or less). Three additional participants were removed for exhibiting reading times higher than three standard deviations above the group's average

and/or for using atypical reading strategies. Consequently, the final analysis was carried out on data from twenty-eight participants.[8]

Mean accuracy rate on the comprehension questions was 84% overall, and 72.9% on experimental items. Reading times that were higher than 2.5 standard deviations above the individual's average reading time (in experimental items) were trimmed (affecting 0.85% of the data). Reading times (RTs) were then log-transformed and analyzed in a mixed-effects linear model using the R environment and the lme4 package (Bates et al. 2014). Fixed effects followed the design of the experiment and included island type, dependency type, and sentential position (inside or outside the island). Since our materials included two critical regions per sentence and sets slightly differed in word number, we also included RT of the previous word (log-transformed) and the word's linear position in the sentence as fixed-effect predictors, in order to control for effects of word position and possible RT differences at precritical regions. We included random effects for subjects and items. We initially ran a maximal model including subject and item random intercepts and random slopes for all fixed effects and their interactions. Due to convergence failure, slopes for interactions were removed, for both subjects and items.

The model showed a main effect for dependency type (estimate = −0.11, SE = 0.03, t = −4.02, p < 0.001), indicating that on average, critical words were read more slowly in sentences with relative clauses than those with sentential complements. There was also a main effect for island type (estimate = −0.14, SE = 0.03, t = −4.9, p < 0.001), such that, on average, critical words in the CNP sentences had longer RTs than those in the CS sentences, and an in/out position main effect (estimate = −0.08, SE = 0.03, t = −2.76, p = 0.006), suggesting that, on average, critical regions inside islands were read more slowly than those outside islands. In addition, significant two-way interactions of island type and in/out (estimate = 0.023, SE = 0.04, t = 6.39, p < 0.001) and of island type with dependency type (estimate = 0.11, SE = 0.04, t = 2.99, p = 0.003) were found. Crucially, a three-way interaction was found to be significant (estimate = −0.15, SE = 0.05, t = −2.92, p = 0.003). RTs for critical as well as noncritical words are shown in Figure 2.
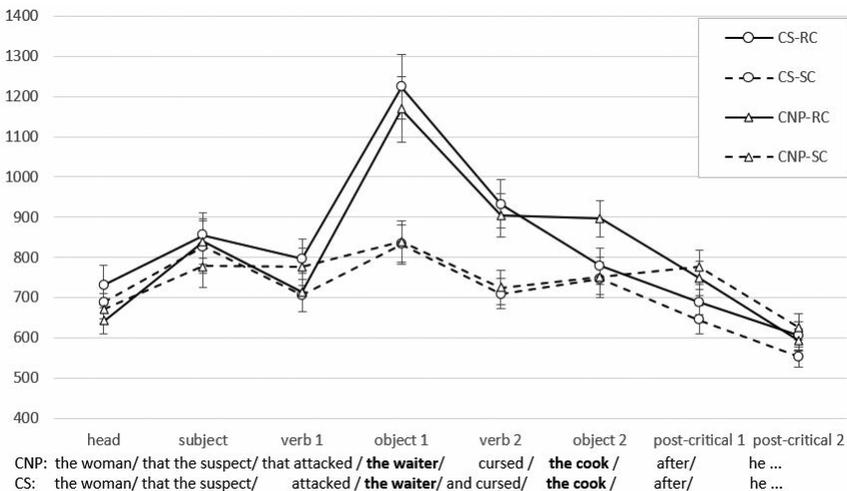

FIGURE 2. Mean RTs (in ms) of the different conditions (experiment 2). Error bars represent ±1 SE.

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[8] The low comprehension scores, alongside informal feedback from the participants, indicated that some of the participants may have judged the experimental filler-gap dependencies as unacceptable, possibly because of their complexity and the need for two reanalyses.

Mean RTs of critical regions of the experimental conditions are shown in Figure 3. Pairwise comparisons were conducted in order to detect filled-gap effects, comparing the RC version and the SC version for each of the four critical regions (two island-internal positions and two island-external positions). Contrasts are reported here with Bonferroni correction for four comparisons. Significant differences were found on both positions outside the islands, such that the NP filling the potential gap position elicited longer RTs in the RC than in the SC condition, indicating a filled-gap effect (CS-out position: estimate = 0.12, SE = 0.03, t = 4.27, p < 0.001; CNP-out position: estimate = 0.08, SE = 0.03, t = 2.79, p = 0.03). A significant difference was also found in the CNP-in position, such that RTs were longer for the NP in the RC condition than in the SC condition, again indicating a filled-gap effect (estimate = 0.11, SE = 0.03, t = 4.02, p < 0.001). However, no significant difference was found for the CS-in position (estimate = 0.004, SE = 0.03, t = 0.16, p = 1).
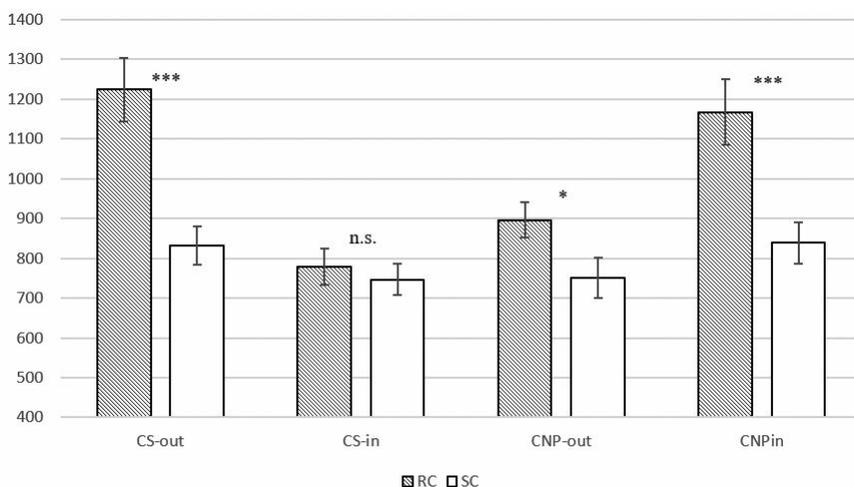

FIGURE 3. Mean RTs (in ms) of critical words (experiment 2). Error bars represent ±1 SE.

Noncritical regions (including the relative head, the embedded subject, and the first and second verbs) and two postcritical positions (the first and second words after the second critical region) were also analyzed. It should be mentioned that since not all of the sets were uniform in terms of word number (due to variation in usage of adjectives etc.), the analysis here includes only the regions that appeared in all of the sets. Analysis was carried out using the same model specification as above, removing only the in/out position factor. This predictor was removed since each model fitted only one word per sentence, rendering this factor redundant since it would portray the same information as the island type factor. Planned comparisons were conducted between the RC and SC versions for each island condition. Comparisons were performed separately for the different noncritical positions, with a Bonferroni correction for two comparisons. A significant difference was found on the second verb (verb 2 in Fig. 2) of the CS island sentences (estimate = 0.08, SE = 0.03, t = 2.43, p = 0.04), such that this position was read more slowly in relative clauses than in sentential complements. A similar difference was found in CNP sentences (estimate = 0.09, SE = 0.03, t = 2.77, p = 0.02). No significant differences were found for the other positions analyzed.

3.3. DISCUSSION. In this experiment, we tested whether the grammatical status of RPs inside different islands in Hebrew has implications for processing. In particular, we

asked whether the Hebrew parser will adopt a different strategy in processing filler-gap dependencies involving a CS, from which RPs are banned, than in processing those involving a CNP, where RPs are accepted more freely, as shown in experiment 1. We hypothesized that the parser would consider the possibility of an RP upon processing a transitive verb in the CNP island, and that we would thus observe a filled-gap effect, namely increased RTs, once a lexical NP is encountered in this position. In contrast, in the CS island, since RPs (just like gaps) do not provide a grammatical resolution of the dependency, the parser will not predict an RP (or a gap), and there will be no evidence for reanalysis, or a filled-gap effect, in the complement position.

The results obtained in the experiment corroborate our hypotheses. First, as shown in previous experiments (e.g. Pickering et al. 1994, Stowe 1986, Traxler & Pickering 1996), we found a filled-gap effect in island-external positions (whether this position was the first or the second possible gap position in the sentence), indicating that the parser posited a gap, or possibly an RP, in these positions, which led to a need for reanalysis once the lexical NP in object position was encountered. However, in the potential gap positions found inside the islands, we observed a difference between the two island configurations. While a filled-gap effect was found inside the CNP island, no such effect was found inside the CS island. We propose that this pattern of results reflects the difference in grammaticality of RPs inside the two islands. While RPs can salvage CNP islands in Hebrew, they cannot do so for CSs. We further propose that just as the parser is 'aware' of grammatical constraints in the language, thus avoiding positing gaps inside islands, where the resulting structure would be ungrammatical, so it takes into account the grammatical (im)possibility of resolving the dependency with an RP inside the island.

One additional effect was revealed in the analysis and requires some further explanation. The second verb position (verb 2) showed a significant difference between the RC and the SC versions of both sentence types (CNP and CS). This difference seems to result from a spillover effect, stemming from the strong filled-gap effects on the object of the first verb in both cases (CNP-in and CS-out). However, this effect is not likely to underlie the effect in the second critical area, since the effect on the verb is similar for both sentence types, while the filled-gap effect on its object differs between the conditions (i.e. is exhibited in the CNP but not in the CS condition). In addition, we included in our model the RT of the previous word as a predictor, and hence the statistical effects described here extend beyond the variance explained by the neighboring word.

4. General discussion. Studies on filler-gap dependencies in English and other languages have shown that while the parser actively seeks to resolve an open dependency by positing a gap as soon as possible (Garnsey et al. 1989, Lee 2004, Omaki et al. 2015, Stowe 1986, Sussman & Sedivy 2003, Traxler & Pickering 1996), it does so in compliance with the grammar of the language. In particular, the parser does not seem to posit gaps where this operation would result in an ungrammatical representation, namely inside islands (Bourdages 1992, Pickering et al. 1994, Stowe 1986, Traxler & Pickering 1996). In these environments, the parser prefers a late, grammatical resolution of the dependency over an early and ungrammatical one.

In the current study, we explored the possibility that in certain cases, the parser may exhibit an alternative strategy, namely actively predicting a resumptive pronoun inside an island, where such a pronoun is grammatically licit. In experiment 1, we established a difference in the grammatical status of RPs inside two islands in Hebrew: it was shown that speakers judge RPs in CNP islands with a relative clause as significantly more grammatical than RPs inside CSs (which were judged to be as unacceptable as gaps inside CSs and CNPs). Experiment 2 tested whether this grammatical difference is

reflected in on-line processing strategies. Our results showed that whereas the parser is not 'surprised' to encounter a lexical NP in a potential gap (i.e. verb's complement) position inside a CS, such an NP causes a filled-gap effect inside a CNP island, namely an increase in RT presumably indicating a need for reanalysis. We propose that this parsing pattern is related to resumption; specifically, since Hebrew speakers use a grammaticized-resumption strategy in certain long-distance dependencies, they are able to actively predict an RP in these structures, where a gap resolution is unavailable. The filled-gap effect found inside the Hebrew CNPs contrasts not only with the lack of such effect in CSs, but also with the well-established case of processing of English islands, where null effects were obtained inside islands, including CNPs with relative clauses. This difference in processing strategies between the languages is predicted if resumption is not perceived as a grammatical option for resolving dependencies (with or without islands) in English (Alexopoulou & Keller 2007, Polinsky et al. 2013), while it is perceived as such in Hebrew.

It should be acknowledged, however, that the current experiment does not indicate directly the prediction of an RP. Our results suggest active dependency formation inside the CNP island, with no definite indication of which resolution is predicted for the dependency. It is possible, in principle, that the parser is expecting a gap in this island. However, we find it reasonable to assume that the fact that active dependency formation was available only inside the island that is ameliorated by resumption suggests that the predicted resolution of the dependency inside the island is an RP. This could be further investigated in future studies, for example, by testing for the existence of a reanalysis effect on an RP placed inside the island. Such a filled-gap effect might suggest a gap postulation rather than an RP prediction.

It can further be noted that the parser's preference for prediction of an early RP inside the island over waiting for a gap position outside the island can be considered somewhat surprising, given the low acceptability ratings this structure obtained in the first experiment. Although CNP island RPs were significantly better than gaps in this position, overall their ratings did not suggest full grammaticality. There are two possible interpretations of this finding. It might be the case that the parser is willing to pursue an acceptable, though not fully grammatical, analysis in order to satisfy other principles. In the current case, these principles may be the ones suggested over the years to induce the active filler strategy, including reducing the working-memory load associated with keeping the filler active (Frazier 1987, Wanner & Maratsos 1978), maximizing the incremental interpretation of the input (Altmann 1999), and promoting thematic assignment (Pritchett 1992, Weinberg 1993). According to this account, the predictive process manifested in the active filler strategy is shaped not only by the overall grammaticality of the final sentence but also by short-term processing goals.[9]

Alternatively, it could be suggested that the low acceptability judgments obtained for RPs inside CNPs in this study do not represent the full grammatical potential of RPs in comparison with other possible resolutions of a long and complex dependency. The acceptability-judgment experiment did not include, for example, a condition representing the option of a late nonisland gap, which is by hypothesis fully grammatical, but undoubtedly hard to process, and may elicit low acceptability ratings too. Given our current results, we cannot determine whether such a condition would indeed be considered sig-

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[9] It is also possible in principle that after an RP is predicted inside the island, another coreferential element (RP or possibly a gap) is predicted outside it. The parser may prefer an RP over no resolution at the first stage, inside the island (as it is yet unknown whether one would be presented outside the island), and then predict another tail for the dependency (which might be preferred grammatically over only an island RP) as a way of allowing a rapid licensing of the dependency.

nificantly better than the CNP-RP sentences included in our survey. Therefore, we cannot exclude the possibility that RP dependencies are in fact fully grammatical, on a par with postisland gaps, but are rated poorly due to processing difficulties that arise from other properties of our materials, like the structure's complexity and the presence of several definite animate NPs inducing interference (Gordon et al. 2001, Lewis et al. 2006).

Our results offer some further implications for the crosslinguistic status of the active filler hypothesis. First, hypothetically, the existence of grammaticized RPs in Hebrew could have resulted in a different, more major shift in the strategy for dependency formation in this language. RPs are phonetically realized elements that can be used by the parser as a concrete indication for the resolution of a dependency. These elements also are usually located directly adjacent to the verb. This contrasts with gaps, whose presence may not be confidently assumed until other (possibly late) indirect evidence suggests a missing argument. Since RPs eliminate the temporal ambiguity that characterizes structures with gaps, their availability in the language's grammar could, in principle, bias the parser toward waiting for unequivocal evidence for the tail of the dependency. Namely, if the parser is willing to construct a filler-RP dependency rather than a filler-gap dependency, the need for actively positing the integration site might be obviated. Therefore, the fact that some of the dependencies in Hebrew exhibit RPs might have rendered the active filler strategy less preferable, as it would presumably be easier for the parser to identify the filler's integration site when it is overtly marked.

However, we did not find evidence that the Hebrew parser is inactive, or that it is a 'last resort' parser. On the contrary, our results show that the active filler strategy is operative in Hebrew and, moreover, that it is operative in contexts where an RP is predicted. In addition, the results also suggest that the active filler strategy can be persistent enough to predict a gap even after one reanalysis. This may provide evidence for the importance of stability of the parsing method across environments and for the crosslinguistic eagerness of the parser to resolve the dependency, regardless of the existence of grammaticized RPs in the language. But the results do exhibit a contrast between the parsing of islands in Hebrew vs. English, thus showing that the active filler parsing strategy is not uniform across languages, but obeys the specific grammatical characteristics of a language.

Our results are also relevant for the discussion of the nature of RPs. As mentioned in the introduction, there have been some proposals in the literature that RPs facilitate processing of difficult structures as they aid in the retrieval of a filler that is no longer accessible. For example, Ariel (1999) claims that RPs are markers of low cognitive accessibility. Ariel suggests that relative clauses in which the filler is highly accessible at the integration site select gaps, and that relative clauses whose heads maintain only a low degree of accessibility exhibit RPs. Another accessibility-failure approach is presented in Erteschik-Shir 1992. Erteschik-Shir argues that both pronouns and fillers generally initiate search operations, and that the search operation initiated by the filler cannot operate in island structures. The author proposes that if the pronoun's search order is directed after the filler's order is no longer operative, the pronoun can access the filler's information in working memory and thus be used as a gap. Therefore, this successful search results in acceptability of resumption in islands, according to Erteschik-Shir, for both English- and Hebrew-type languages.[10]

The active filler strategy was initially suggested to be induced by the cost of maintaining the filler in working memory (Frazier 1987). A similar approach was formulated

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[10] For resumption in nonisland Hebrew structures, Erteschik-Shir suggests that these RPs have a special pragmatic function in that they are limited to restrictive contexts that allow the pronoun to access the filler although the search operation of the filler itself is still operative.

more recently by Wagers and Phillips (2014), who argued that some properties of the filler (the fact that it signals an unresolved dependency and its syntactic category) are actively maintained, such that they are available in short timescales and can immediately affect parsing choices (in contrast to other lexical properties). Under this view of the active filler strategy, the suggestions about the role of RPs as initiating and guiding retrieval of the filler are compatible with the suspension of the active dependency formation inside English islands. Namely, inaccessibility of these filler properties inside the island prevents the parser from engaging in active dependency formation, and therefore proper parsing requires a retrieval cue, realized as the RP.

However, our results illustrate that this is not the case for Hebrew, as the active filler strategy is operative inside the CNP structure. We interpret this as indication that the filler is accessible, as least to the degree that it enables active dependency formation. The ability of the parser to carry forward a prediction about the resolution of the dependency in this environment, as it does in nonisland contexts, implies that some stable level of accessibility of the filler is maintained, even in these complex sentence structures. This can be taken as evidence against the assumption that resumption is used to facilitate retrieval of an inaccessible filler, at least in the case of Hebrew islands. This can be further tested by assessing whether the cues provided by the verb suffice for proper retrieval and integration of the properties that were suggested (Wagers & Phillips 2014) to be released from working memory. To conclude, the current study implies that resumption in Hebrew is not an artifact of parsing difficulties, but rather a grammatical phenomenon. This is also compatible with the lack of an increase in acceptability of resumption in Hebrew with the addition of embedding levels (Farby et al. 2010) and with Shlonsky's (1992) suggestion that the difference between intrusive-resumption languages, like English, and grammaticized-resumption languages, like Hebrew, is based on a parametric difference.

Finally, our results have implications with regard to the nature of island constraints. The basic finding from English—that the parser is sensitive to island constraints—is compatible with two types of accounts for island phenomena: grammar-based approaches, which would argue that the parser aligns with the grammar and does not create a dependency where the grammar does not allow this (Lewis & Phillips 2015, Phillips 2013); and resource-based approaches, which suggest that parsing is aborted in these structures due to overload of working memory (or other processing resources), which also leads to ungrammaticality of the sentences (Hofmeister & Sag 2010, Kluender 1998, Kluender & Kutas 1993). Our results, which exhibit the availability of the active filler strategy inside island structures, suggest that no parsing breakdown occurs in the processing of these structures, and that material regarding the dependency is kept in working memory and is able to direct the processing of the sentence. This suggests that the parser is not inherently limited by islands. Parsing strategies obey grammatical constraints, but these constraints cannot be fully reduced to considerations of processing complexity. A similar line of thought was also suggested by Yoshida and colleagues (2014), who showed that the active search initiated in the processing of a different kind of long-distance dependency, cataphora, is not constrained by islands. Thus, Yoshida and his colleagues similarly conclude that their results pose a challenge for attempts to derive island constraints from limitations on on-line parsing.

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