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Processing covert dependencies: Turkish wh-in-situ

Duygu Demiray & Matt Wagers *

Abstract. This study presents a reading and production experiment on Turkish wh-in-situ constructions. These constructions establish a relationship between a wh element and its scope position without displacing the element from its original argument position; thus, they are referred to as covert dependencies. The results suggest that covert dependencies are resolved actively, similar to filler-gap dependencies that have reliable cues that signal the existence of a dependency. This preference for resolving dependencies at the first grammatically available position is paralleled in production results. However, an unexpected pattern is observed in the production study, where declarative sentences are preferred over questions even though the length of the dependencies between these constructions are the same. This brings the question of whether there is a bias for statements over questions independent of dependency length optimization. A follow-up to Experiment II that includes context scenarios and controls for the frequency of different verb types can clarify the source of this bias.

Keywords. language science; psycholinguistics; Turkish language processing; Turkish; Turkic languages; wh-in-situ; dependency processing; covert dependencies; sentence processing; production

1. Introduction. Dependencies track relationships between linguistic elements, such as arguments and their verbs, or a relativized noun and its original argument position. Tracking these relationships is crucial for interpreting sentences. The principles that are employed by the parser during the course of dependency resolution are shaped both by linguistic information and domain general principles, namely prediction and working memory. A large body of work on dependency resolution has focused on overt movement dependencies, such as wh-dependencies in English. This work focuses on the resolution of wh-in-situ dependencies in Turkish, also referred to as covert dependencies. In-situ dependencies form an interesting point of comparison to overt movement dependencies since there is no displacement of an argument, but an abstract dependency marking the scope position of the wh-element. This work is interested in whether covert dependencies use the same underlying mechanisms as overt dependencies.

Existing work has shown that dependencies are resolved incrementally and at the earliest grammatically available position (Frazier & d'Arcais 1989; Omaki et al. 2014). Bottom-up information is used to predict upcoming structure and to resolve the dependency *eagerly*, showing a pressure for closing the dependency in as short an amount of time as possible after the search process begins (Traxler & Pickering 1996; Garnsey et al. 1989). Syntactic principles guide dependency resolution across different dependency types, which can be seen from sensitivity to island domains (Stowe 1986; Omaki et al. 2015) and c-command configurations in anaphora resolution (Aoshima et al. 2009). In the resolution of argument-verb dependencies, distractors that are rep-

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resented using similar features to the argument are found to cause interference effects, again with sensitivity to their syntactic position (Wagers 2008; Franck et al. 2002; Nicol et al. 2016). This body of work has demonstrated that grammatical information is used immediately in the course of dependency resolution, how linguistic information is represented and maintained in memory, and how predictive processes operate to resolve dependencies.

So far, a considerable body of work has focused on overt movement dependencies. In overt movement dependencies, an argument appears in a different position from its canonical argument position. Thus, in order for the argument-verb dependency to be resolved, the displaced element (i.e., *filler*) should be identified and a search process for its original position (i.e., *gap*) should take place. For example, wh elements in English are fronted consistently and thus do not appear in their canonical argument position. Stowe (1986) compares sentences like Example (1a), which has a wh element, with sentences like Example (1b), which is a declarative baseline, in a self-paced reading (SPR) experiment.

It is generally assumed that the wh filler is identified immediately because wh elements are almost always displaced from their argument position. Thus, the search process should begin upon encountering this wh filler. The first potential resolution site for the dependency, the so-called *gap location*, immediately follows the embedded verb *bring*. However, there is an element occupying this position, eliciting a *filled gap effect*. When the reading times for this region are compared between wh-sentences and a non-wh baseline, the reading times in Example (1a) are significantly longer. There is converging evidence for this effect from plausibility mismatch paradigms.

(1) a. My brother wanted to know *who* Ruth will bring **us** home to ___ at Christmas.
b. My brother wanted to know if Ruth will bring **us** home to Mom at Christmas.

Traxler & Pickering (1996) manipulate the semantic fit between instrumental modifiers and verbs and measure reading times on the verb in Example (2). Semantic mismatch between these two elements results in a slowdown in reading times. These results show that a gap is predicted at least immediately after encountering a verb that can potentially host the argument, at the earliest grammatically available position.

(2) (Traxler & Pickering 1996:459)
That's the **garage/pistol** with which the heartless killer **shot** the man yesterday afternoon.

However, under a fully incremental account of the processing of unbounded dependencies, it would be expected that a gap is predicted *immediately* upon encountering the filler. In these experiments, it is not clear whether the gap is predicted before or after encountering a verb. If a gap is predicted before the verb, this would imply that some information about the verb, such as transitivity, should also be predicted upon encountering a filler. Head-final languages raise questions about verb-prediction, too, since all of the arguments are presented before the verb in these languages, and it becomes an important problem whether the parser waits for bottom-up evidence, or predicts a verb based on the arguments that are present in the input (Konieczny 2000; Omaki et al. 2015).

Omaki et al. (2015) test pre-verbal object gap creation in English, using island domains inside which gaps are not predicted (Example (3)).

(3) a. The city [that the author **wrote** regularly about ___] was named for an explorer.
b. The city [that the author [who **wrote** regularly about .....]] was named for an explorer.
c. The city [that the author **chatted** regularly about ___] was named for an explorer.
d. The city [that the author [who chatted regularly about .....]] was named for an explorer.

Pre-object gap creation predicts difficulty in the intransitive non-island condition compared to the intransitive island condition. Furthermore, it does not predict the difficulty in the corresponding transitive conditions. In other words, an interaction between transitivity and islandhood is expected, where only intransitive non-island conditions have a reading time slowdown at the critical embedded verb region. In two experiments using SPR and eye tracking, they show that an interaction is present in the expected direction, suggesting that the gap location is predicted prior to when information about the verb is present.

Previous work on the resolution of filler-gap dependencies shows that the parser predicts the gap location immediately after identifying a filler. In other words, filler-gap dependencies are resolved *actively*. The active filler hypothesis is motivated in several ways. It can be a strategy to minimize memory load associated with maintaining an "open dependency" in memory. It can also be a principle involving maximal interpretation at any possible point, where an argument should be linked with a verb at the earliest possible point (Aoshima et al. 2004).

1.1. COVERT DEPENDENCIES. Covert dependencies involve an in-situ wh element and its scope position. In syntax, overt wh-movement and wh-in-situ are analyzed in similar ways. Analyses of wh-in-situ posit movement of the wh element to SPEC CP at LF, or binding with an operator situated at SPEC CP (Huang 2009; Aoun & Li 1993). These structures form an interesting point of comparison to overt dependencies because they do not involve the same cues that signal an overt dependency.

In certain languages, like Mandarin Chinese (henceforth Chinese) and Turkish (in Example (4)), there are no cues marking these dependencies except for intonation, making it difficult to track the dependency during reading. This is even more strongly the case in experimental settings like SPR where words are presented one at a time. This brings the question of whether covert dependencies can be resolved actively like overt dependencies.

(4) a. Gizem Selin-in nere-ye git-tiğ-i-ni söyle-di?
Gizem Selin-NOM where-DAT go-NMLZ-3SG-ACC say-PST
'Where did Gizem say that Selin went?'
b. Gizem Selin-in nere-ye git-tiğ-i-ni söyle-di.
Gizem Selin-NOM where-DAT go-NMLZ-3SG-ACC say-PST
'Gizem said where Selin went.'

There is no displaced element, which means that this is not an argument-verb dependency, and there is no gap to search for. However, since wh scope is similarly an interpretive procedure requiring resolution, a dependency should still be present. The tail of the dependency is not a gap in this case, but a structural position with no correspondent in the surface structure. Previous work investigating the processing of wh-in-situ provide evidence in favor of incremental dependency resolution.

Xiang et al. (2014) conduct a speed-accuracy tradeoff (SAT) study in Chinese wh-in-situ constructions. In a 2x2x2 design manipulating sentence type (declarative x wh.), dependency length (long x short), and plausibility (plausible x implausible), they show that (i) processing wh sentences involves extra processing cost, and (ii) this processing cost increases as a function of length.

(5) a. Shizhengfu yancheng-le/#kuojian-le nàxie guanyuan
city-council punish/#expand those officials
'The city council punished/#expanded those officials.'

b. Shizhang mingling shizhengfu yancheng-le/#kuojian-le nàxie guanyuan
mayor order city-council punish/#expand those officials
'The mayor ordered the city council to punish/#expand those officials.'

c. Shizhengfu yancheng-le/#kuojian-le nǎxie guanyuan
city-council punish/#expand which officials
'The city council punished/#expanded which officials?'

d. Shizhang mingling shizhengfu yancheng-le/#kuojian-le nǎxie guanyuan
mayor order city-council punish/#expand which officials
'The mayor ordered the city council to punish/#expand which officials?'

The SAT paradigm is useful because it provides a way of dissociating how speed and accuracy are affected during the course of long-distance dependency resolution (Foraker & McElree 2011). These measures are affected differently by different memory access mechanisms. If the representations are accessed *serially*, meaning that each candidate verb for the object is accessed one by one, then speed is affected. If potential candidates are accessed *directly* or *simultaneously*, then accuracy is affected (McElree 2006). Foraker & McElree (2011) find that representations are accessed simultaneously in filler-gap dependencies.

Participants are required to judge the accuracy of the items (5) at different three different points in time after the sentence is presented while accuracy changes as a function of speed. The results show lower accuracy in wh items, providing evidence that wh sentences involve a dependency not present in declarative sentences. Moreover, an interaction is present where longer dependencies have the lowest accuracy. Speed of recall is not affected by the rate at which information accrues, suggesting that memory access mechanisms governing overt and covert dependencies are the same.

Head-initial languages where the verb is presented first are useful for investigating memory access. In the case of Chinese, the verbs provide surface cues for scope resolution sites. Their plausibility is manipulated to render different scope options. However, in order to test for the analogue of the filled-gap effect, a forward-looking dependency is necessary. In other words, the wh-word should occur before information about the scope resolution site is available. Head-final

languages provide configurations where information about the verb is not revealed until all the other information is encountered. This is not only true for covert dependencies, but almost any type of head-final dependency. Regardless of this property, dependencies are resolved fully incrementally, in other words, the parser does not wait for the verb to posit a gap position (Omaki et al. 2014, 2015).
Miyamoto & Takahashi (2002) conduct a study on Japanese wh-in-situ constructions where an embedded and main verb follows an embedded wh object (6).

(6) a. Kakarichoo-ga *dono-senmu-ga* atarasii-pasokon-o **tukatteiru-to** itta-no?
supervisor-NOM which-director-NOM new-computer-ACC using-is-that said-QP
'Which director did the supervisor say is using the new computer?'

b. Kakarichoo-ga *dono-senmu-ga* atarasii-pasokon-o **tukatteiru-ka** itta-no?
supervisor-NOM which-director-NOM new-computer-ACC using-is-QP said-QP
'Did the supervisor ask which director is using the new computer?'

The nominative-marked sentence initial NP signals that the clause is biclausal and that there is another potential dependency resolution site. Even when participants are aware of this, they still predict an embedded verb with a question particle, shown by slower reading times in item (6a) compared to item (6b). This result suggests that scope dependencies are also resolved eagerly, and invoke an analogue of the filled gap effect, which Miyamoto & Takahashi (2002) call the *type mismatch effect*.

2. Current work. This work investigates the processing of wh-in-situ dependencies in Turkish using the type mismatch effect. Syntactically, wh-in-situ is analyzed as a binding relationship in Turkish, similar to Chinese and Japanese. A Q-operator is responsible for typing the clause interrogative. It starts out at a C-head local to the wh element and can move via cyclic movement to take non-local scope (Arslan 1999).
In Turkish, different from Japanese, there is not a fixed cue signaling the scope dependency. For example, both the selectional restrictions of the main verb or the type of embedding nominalizer can restrict the scope of an in-situ wh element.

(7) a. Adam araba-yı nere-ye sür-düğ-ü-nü biliyor.
Man car-ACC where-DAT drive-NOM-3SG-ACC knows
'The man knows where he is driving the car.'

b. Adam araba-yı nere-ye sür-düğ-ü-nü sanıyor?
Man car-ACC where-DAT drive-NOM-3SG-ACC think
'Where does the man think he is driving the car?'

In example (7b), the verb *sanmak* (to think) forces matrix scope. On the other hand, the verb *bilmek* (to know) forces embedded scope. There are also verbs that allow for both matrix and embedded scope interpretations of wh elements.
Different nominalized embedded clauses also restrict scope in different ways. As can be seen above, the nominalizer *-dIk* does not restrict wh-scope. In other words, the operator in the embed-

ded clause can move to the matrix CP when the properties of the main verb support this movement. On the other hand, the nominalizer *-mA* cannot host a Q-operator. This is argued to be either because *-mA* does not have a C-layer (Kornfilt 2003), or featurally cannot have a wh-typed CP (Predolac 2017).

(8) *-mA* nominalizer
Adam araba-yı nere-ye sür-me-yi düşünüyor?
Man car-ACC where-DAT drive-NOM-ACC thinks
'Where does the man think of driving the car?'

These properties provide the most abstract configuration to test forward-looking covert dependencies, and can be informative about when scope is predicted, and which structural commitments are made by the parser for eager dependency resolution.
The remainder of this section will present an SPR experiment and a fragment completion task in Turkish, with a focus on wh-in-situ constructions. The primary aim of these experiments is to contribute to the growing literature on the resolution of covert dependencies, and to conduct, to our knowledge, the first experiment on the resolution of wh-in-situ dependencies in Turkish. Theoretically, this work aims to enrich the literature on linguistic dependency resolution by focusing on wh-in-situ constructions, which involve the prediction and maintenance of different kinds of representations.

2.1. EXPERIMENT I. Active dependency resolution predicts a preference for local scope in the resolution of wh-in-situ dependencies. This self-paced reading experiment investigates whether Turkish speakers have a preference for local over non-local wh-scope. Results show that non-local dependencies incur a significant slowdown in wh-sentences, compared to dependencies that are resolved locally.

2.1.1. PARTICIPANTS. Participants were 36 native speakers of Turkish recruited online. All participants consented to participate in the experiment and were compensated $12/hour for their participation. The experiment took 40 minutes on average.

2.1.2. MATERIALS AND DESIGN. 36 sets of target items and 54 fillers were presented in a 2x2 design crossing sentence type (wh. x declarative) with local scope (allowed x disallowed). Items were distributed across four Latin square lists. All target items are biclausal structures with different nominalized embedded clauses, with a wh element inside the embedded clause. *-mA* and *-dIk* nominalizers are used as cues for different scope configurations. An example itemset is presented in (9) with the critical region (CR) marked with **bold**.

(9) a. Ece Özge-nin *hangi* *makale-yi* sunum-a eklemek için bir gecede
Ece Özge-GEN which article-ACC presentation-DAT add to a night
oku-ma-sı-na şaşırdı?
read-MA-3SG-DAT surprised

b. Ece Özge-nin *hangi* *makale-yi* sunum-a eklemek için bir gecede
Ece Özge-GEN which article-ACC presentation-DAT add to a night
oku-duğ-u-na şaşırdı?
read-MA-3SG-DAT surprised
'Which article was Ece surprised that Özge read in a night to add to the presentation?'

c. Ece Özge-nin makale-yi sunum-a eklemek için bir gecede
Ece Özge-GEN article-ACC presentation-DAT add to a night
oku-ma-sı-na şaşırdı.
read-MA-3SG-DAT surprised

d. Ece Özge-nin makale-yi sunum-a eklemek için bir gecede
Ece Özge-GEN article-ACC presentation-DAT add to a night
oku-duğ-u-na şaşırdı.
read-MA-3SG-DAT surprised
'Ece was surprised that Özge read the article in a single night to add to the presentation.'

-mA and *-dIk* clauses render different meanings when they are selected for by the same verb. Namely, *-dIk* clauses have a factive meaning, whereas *-mA* clauses have a subjunctive meaning (Göksel & Kerslake 2004).

(10) a. Adam araba-yı nere-ye sür-düğ-ü-nü biliyor.
Man car-ACC where-DAT drive-NOM-3SG-ACC knows
'The man knows he is driving the car to Kadıköy.'

b. Adam araba-yı nerey-e sür-me-yi biliyor?
Man car-ACC where-DAT drive-NOM-ACC knows
'Where does the man know how to drive?'

This leaves a limited number of verbs that can select for both *-mA* and *-dIk* nominalizers without a difference in meaning. Emotive factive predicates will be used in the experimental stimuli, since they render the same meaning regardless of the embedding nominalizer that is used.
The ambiguity in the local scope allowing conditions is temporary; all target items unambiguously resolve to matrix scope upon reading the sentence-final main verb. This is counterbalanced with fillers to prevent participants from forming a bias for matrix scope. The fillers consist of wh-constructions with an embedded scope reading, non-wh constructions, and monocausal constructions.

2.1.3. PROCEDURE. The experiment is conducted online on PCIbex (Drummond 2013). Items were presented word by word using a non-cumulative self-paced reading paradigm. Participants pressed a key to move from one word to the next, and their keypresses were timed. Following each experimental item, participants had to complete an argument-verb matching task, where the embedded or main verb was presented on the screen with either the matrix or embedded subject. One of these arguments always functioned as a foil depending on which verb is presented on the screen.

2.1.4. PREDICTIONS. Predicting the dependency resolution site ahead of time requires some structural commitments on the comprehenders part. If the parser prefers embedded wh-scope, this should trigger reanalysis in (9a) upon encountering the embedded verb. No such reanalysis is predicted in (9b). We predict an interaction where wh-sentences with LS: disallowed have slower reading times on the critical embedded verb.

2.1.5. ANALYSIS. A Bayesian mixed effects model was run on the accuracy and reading time data with subjects and items as random effects using the R package *brms* (Bürkner 2021). Center sum coding was used with the contrasts shown on Table 1. RT's faster than a 100 ms and slower than 5000 ms were removed prior to analysis. The reading time analysis is run on the nominalized embedded verb (CR), and the main verb at the end of the sentence (spillover region).

Contrasts	**sentence_type**	**clause_ type**
-0.25	decl.	LS:allowed
+0.25	wh.	LS:disallowed

Table 1. Contrast coding

2.1.6. RESULTS. The reading time results show a credibly non-zero interaction between sentence type and local scope (Estimate: 0.31, 95% CrI: [0.17 0.84]) at the spillover region. When sentence type is wh and local scope is disallowed, reading times are significantly longer (see Table 3). No effects were observed at the critical region. There was no significant difference between conditions for the model run on the accuracy data.

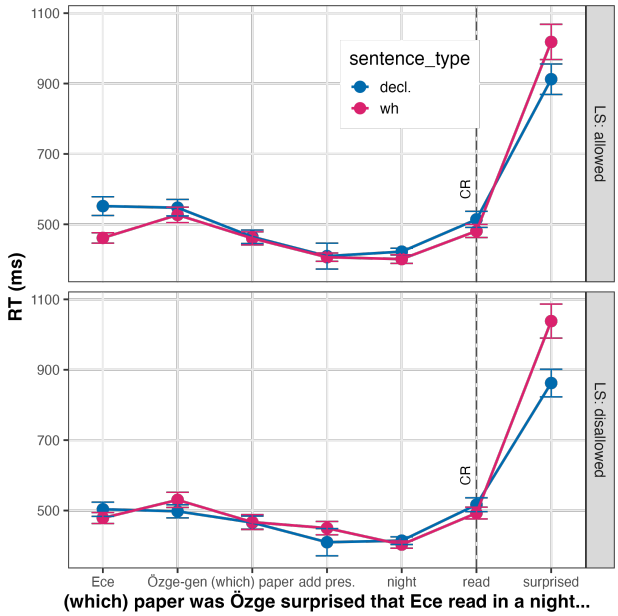

Figure 1. Word by word reading times (RTs) in Experiment I. Critical region is marked with dashed lines. Error bars show standard error. LS short for local scope.

Parameter	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat
Intercept	6.16	0.07	6.03	6.29	1.01
sentence_type1	-0.11	0.05	-0.20	-0.01	1.00
clause_type1	0.04	0.05	-0.05	0.14	1.00
sentence_type1:clause_type1	-0.08	0.18	-0.44	0.28	1.00

Table 2. Reading time regression coefficients at the critical region (CR)

Parameter	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat
Intercept	6.75	0.12	6.52	6.98	1.01
wh	0.10	0.06	-0.02	0.22	1.00
clause_type1	0.00	0.06	-0.12	0.12	1.00
sentence_type1:clause_type1	0.31	0.24	0.17	0.84	1.00

Table 3. Post-CR RT regression coefficients

2.1.7. DISCUSSION. The effects are delayed by one region and there is no effect approaching significance in the CR (Table 2). Even though this is common in SPR, it makes it difficult to make inferences about the time course of dependency resolution. The strongest version of active gap filling would predict local scope to be predicted immediately upon encountering the wh-element. There is no evidence, based on these results, that wh-scope is predicted *prior to* when information from the embedded verb becomes available. Thus, it is not certain whether the parser makes a structural commitment about clause structure in order to host scope.

The preference for local scope may reflect a strategy to minimizing memory load. However, the difficulty in processing non-local scope dependencies may also reflect higher surprisal values upon encountering non-local scope (Levy 2008). Under surprisal theory, incremental processing difficulty is a function of the negative log probability of a word in context (Hale 2001). This theory of processing assumes a probabilistic parser that assigns probabilities to upcoming sequences based on the already seen input, and processing difficulty arises from reassigning these probability values. Thus, surprisal theory predicts a relationship between production and processing, where structures that are produced more frequently should be easier to process.

Even though surprisal does not necessarily rule out the role of structural, interpretive, or domain-general memory constraints, it has come to the foreground as a domain-general theory unifying a diverse set of phenomena. In order to understand the role of predictive processes, a production experiment is conducted as a follow-up.

2.2. EXPERIMENT II. A fragment completion task on wh-constructions investigating whether there is a preference for local scope in production. Results show a very strong preference for local scope, but this preference may be motivated by pragmatics. Results, their interpretation, and future steps are outlined in discussion.

2.2.1. PARTICIPANTS. Participants were 24 native speakers of Turkish recruited online. All participants consented to participate in the experiment and were compensated $12/hour for their participation. The experiment took an hour to complete.

2.2.2. MATERIALS AND DESIGN. 10 item sets with 6 conditions and 30 filler fragments were constructed (11).

The short (11a), short adverbial (11b), declarative, and wh conditions (11c) were added to the experiment to see at which point participants disambiguated the number of clauses a sentence contained.

(11) a. Ece Özge-nin...
Ece Özge-GEN...
b. Ece Özge-nin sunum-a eklemek için...
Ece Özge-GEN presentation-DAT add to...
c. Ece Özge-nin sunum-a eklemek için (*hangi*) *makale-yi*...
Ece Özge-GEN presentation-DAT add to (which) article-ACC...
d. Ece Özge-nin sunum-a eklemek için (hangi) makale-yi
Ece Özge-GEN presentation-DAT add to (which) article-ACC
oku-ma-sı-na/oku-duğ-u-na ...
read-NOM-3SG-DAT...

2.2.3. PROCEDURE. The experiment was conducted online on PCIbex (Drummond 2013). Each fragment was presented on the screen individually, and a textbox was provided for participants to type in their continuations. Participants clicked on a button after filling in the textbox to move to the next item. Completions without a punctuation mark at the end and shorter than 5 characters incurred an error, which prevented the participant from moving to the next item.

2.2.4. PREDICTIONS. Surprisal theory predicts a relationship between processing difficulty and frequency where less frequent structures are more difficult to process. In other words, *-dIk* clauses with local scope should be more frequent, and continuations inducing non-local scope should be dispreferred less in *-mA x -dIk* fragments. It should be noted that there was no main effect of sentence type in Experiment I. Thus, there is no reason to expect the *-mA* nominalizer to be dispreferred in the absence of a wh element, and this will not be part of the analysis.

2.2.5. ANALYSIS. The data was annotated for the number of clauses (monoclausal, biclausal, triclausal), sentence type (wh, declarative), nominalizer type (*-mA, -dIk, -AcAK*), and scope (local, non-local, matrix). The label *non-local* is used to annotate triclausal sentences where wh scope is in the second clause (12). The results section shows that the *-mA* condition incurred non-local completions.

(12) Sevil Ayşen-in ortalığı birbirine kat-arak hangi söylenti-yi yay-ma-sı-na
Sevil Ayşen-GEN make a mess-CVB which rumor-ACC spread-MA-3SG-ACC
izin ver-diğ-i-ni bil-mi-yor.
let do-DIK-3SG-ACC know–NEG-IPFV
"Sevil doesn't know which rumor Ayşen allowed them to spread and make a mess."

Unacceptable completions made up 22% of the trials and were removed prior to analysis. A Bayesian mixed effects model with subjects and items as random effects was run using the R package *brms* Bürkner (2021). The analysis is run on the wh-condition only. The nominalizers

-mA and *-dIk* are used as levels of the nominalizer type factor, and scope is a binary factor represented by 0 and 1 for non-local and local scope, respectively.

condition	scope preference	percentage
DIK	LOCAL	100
DIK	NON-LOCAL	0
DIK	MATRIX	0
MA	LOCAL	5
MA	MATRIX	52
MA	NON-LOCAL	43

Table 4. Experiment II continuations

2.2.6. RESULTS. There is a significant effect of nominalizer type on scope (CrI: -0.95, 95% CrI: [-1.04 -0.86]), where local scope continuations are always preferred with a *-dIk* nominalizer. *-mA* nominalizer, on the other hand, shows much greater variability in continuations, and uncover an overall preference for non-matrix scope rather than local scope. These structures do not have local scope, and are almost equal in number to matrix scope completions in *-mA* clauses (Table 4).

2.3. DISCUSSION. The results of Experiment II show that there is a parallel between production and processing, and thus put these results in line with the predictions of surprisal theory. A dependency length minimization strategy like this can be considered economical on two respects. On the one hand, it reduces ambiguity of the local input string by preferring an interpretation over other possible interpretations. On the other hand, it reduces working memory load by terminating the dependency at the earliest possible point (Futrell et al. 2020).
However, the preference for local vs. matrix scope cannot be reduced to processing ease or surprisal alone since there is an interpretive difference between these two configurations. As can be seen in (12), repeated in (13), participants form triclausal structures, adding a *-dIk* nominalizer on top of the *-mA* fragment, and place the scope in this intermediary position.

(13) Sevil Ayşen-in ortalığı birbirine kat-arak hangi söylenti-yi yay-ma-sı-na
Sevil Ayşen-GEN make a mess-CVB which rumor-ACC spread-MA-3SG-ACC
izin ver-diğ-i-ni bil-mi-yor.
let do-DIK-3SG-ACC know–NEG-IPFV
"Sevil doesn't know which rumor Ayşen allowed them to spread and make a mess."

Importantly, these non-local completions place scope in the same position as matrix scope in a biclausal construction, in other words, dependency length is not shorter in these constructions. Previous work by Bakay (2020) shows that sentential complements in Turkish incur less processing difficulty compared to center-embeddings with relative clauses. Still, an additional layer of embedding introduces additional complexity, and participants prefer to add a sentential complement over forming a question. As one reviewer puts it, the pressure to avoid questions seems to outweigh the pressure to avoid complexity.

This may be a by-product of the experimental design, where participants were provided with no context scenario preceding the fragments, effectively removing any context that might prompt a question. Furthermore, there weren't any instructions, beyond putting the necessary punctuation, which would encourage participants to form questions. There may be a pragmatically motivated preference where questions are only used if there is an existing discourse.
Alternatively, these results may have to do with the relative frequency of the constructions *-mA* fragments were expected to elicit. These constructions can only be completed using emotive factive predicates because a limited number of verbs select for the *-mA* nominalizer to begin with. This is different from *-dIk* fragments where the nominalizer can be selected for by any verb. Thus, participants may be adding an additional clause to resolve the matrix verb dependency more easily.
Without a follow-up, what motivates the results seen on Table 4 is not clear. This pattern cannot be straightforwardly explained by surprisal, memory principles, or maximum interpretation.

3. Conclusion. These two experiments provide evidence for local dependency resolution in Turkish wh-in-situ dependencies, and explore the potential mechanisms that give rise to this preference. We additionally observe a parallel between the processing and production of wh-in-situ dependencies. In production, as well as in comprehension, local dependencies are overwhelmingly preferred.
Overall, we interpret these results as providing initial evidence for the active gap filling hypothesis (Frazier & d'Arcais 1989), showing that overt and covert dependencies are resolved using similar parsing mechanisms. Overt dependencies involve displacement of an element from its canonical argument position, the identification of which triggers a search for a gap position. This search process is predictive, where bottom-up information is used to predict upcoming structures in line with grammatical principles. Wh-in-situ dependencies, also referred to as *covert* dependencies, do not involve a displacement of an argument. However, the existence of a wh element triggers a search process regardless, since the scope dependency is not marked on the surface structure. The search for a scope position is marked in different ways in different languages, which is a point of departure from filler-gap dependencies. Regardless, the resolution of covert dependencies are subject to memory-driven locality effects in backward-looking dependencies (Xiang et al. 2014), and prediction of the scope dependency at the earliest grammatically available position in forward-looking dependencies (Miyamoto & Takahashi 2002).
Our results are also in line with the predictions of surprisal theory. Experiment II results show that participants do not prefer to associate *-mA* clauses with local scope, which should not be surprising since it is not grammatically available. Thus, if wh scope is eagerly predicted to be on the embedded clause during processing, *-mA* clauses should cause processing difficulty. This is seen in the reading time results of Experiment I. Secondly, *-dIk* clauses are *always* completed with local scope in Experiment II. Thus, there is a strong preference for local scope in production. This preference should lead to overall higher frequency for local scope in wh constructions, which would in turn make them easier to process. This is the complements the reading time results; *-dIk* clauses do not incur processing difficulty because they *do not contradict* with the existing local scope prediction.
However, there is also a general tendency towards non-matrix scope instead of local scope, which is not predicted by any of these views, since this preference does not result in minimized dependency length. This is surprising given that, in Experiment II, the *-dIk* clauses have the wh-

dependency resolved at the linearly earliest possible point. But, the additional layer of embedding in the *-mA* clauses increases the dependency length between the main verb and the complement clauses, as well as introducing an additional clause. This would not be predicted by DLT-type theories of local dependency resolution (Gibson et al. 2000; Futrell et al. 2020). These results are more similar to anti-locality effects observed in head-final languages, where the prediction for the main verb becomes sharper with additional input (Konieczny 2000). This is particularly relevant for the completion study because fragments which have the *-mA* nominalizer can only have emotive factive predicates as the main verb. Adding another layer of embedding, despite introducing some additional complexity, allows for participants to complete the sentence with many different verbs that have higher frequency.

These results could also be driven by an avoidance towards questions as opposed to statements. This was interpreted as a by-product of the design, since no context is presented during the course of the fragment completion task. Further work is required to confirm whether this is indeed the case, or if there is an actual bias for non-matrix scope in production and processing. A replication study that uses more variable fragments and manipulation of prior context to bias towards questions or declarative statements can clarify the results of Experiment II.

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