1. Introduction

It is well known that in many languages, subject relative clauses (SRs), such as “the student that saw the professor”, are generally easier to comprehend than object relative clauses (ORs), such as “the student that the professor saw”, irrespective of typological differences (e.g., Chinese: Lin, 2006; Dutch: Mak, Vonk, & Schriefers, 2006; English: Staub, 2010; French: Cohen & Mehler, 1996; German: Schriefers, Friederici, & Kühn, 1995; Hungary: MacWhinney & Pleh, 1988; Japanese: Ishizuka, 2005; Korean: Kwon, Lee, Gordon, Kluender, & Polinsky, 2010; Spanish: Betancort, Carreiras, & Sturt, 2009; Turkish: Kahraman, 2010). To explain the processing ease of SRs over ORs, various hypotheses have been put forward. Some of these hypotheses attach greater importance to structural factors, such as distance between the relative clause head (RC-head) and its gap position – including dependency locality theory (DLT) (Gibson, 1998) and structural distance hypothesis (SDH) (O’Grady, 1997) – , whereas other hypotheses attach greater importance to probabilistic factors - including frequency (Reali & Christiansen, 2007; Gennari & MacDonald, 2009) and expectation (Hale, 2006).

As an extension of probabilistic framework, recently Roland, Mauner, O’Meara, and Yun (2012) proposed discourse function hypothesis (DFH). Among the above-mentioned hypotheses, DFH seems very powerful because it also takes contextual factors into consideration. According to Roland et al. (2012), SRs and ORs are used for different purposes in the discourse, and ORs are more context-dependent than SRs. Since previous studies generally examined the processing of SRs and ORs in context-free test environments, ORs might have been more difficult to process than SRs due to lack of appropriate context, which violates the discourse requirements of ORs. Furthermore, Roland et al. (2012) showed that when an appropriate context is provided, processing difficulty of ORs is reduced in English.

Yet, the validity of DFH has been examined in a very limited number of languages. To provide more robust evidence to support DFH, it particularly needs to be examined in typologically divergent languages. In this regard, Sato, Kahraman, and Sakai (2010) attempted to test the effect of context on processing SRs and ORs in Japanese as a head-final language, but they failed to support the validity of DFH. However, Japanese RCs are structurally ambiguous between a matrix clause and an embedded clause at the RC-verb position; therefore, the structural ambiguity might have somehow weakened the impact of appropriate context on RC processing in Japanese. To draw clear-cut conclusions concerning the impact of context on RC processing in head-final languages, the structural
ambiguity needs to be eliminated. For this purpose, Turkish RCs provides an appropriate test case because use of RC markers resolves structural ambiguity at the RC-verb position. Moreover, Kahraman (2010) has shown that SRs are easier to process than are ORs in Turkish; however, in that study, no context was provided. Therefore, the observed processing asymmetry between SRs and ORs might be due to lack of appropriate context (Roland et al., 2012). To examine this possibility, the impact of context on RC processing needs to be examined in Turkish as well.

In this regard, the present study – using Turkish SRs and ORs – aims to examine the impact of context on RC processing and reassess the validity of discourse function hypotheses by ruling out structural ambiguity in the head-final languages. To accomplish this, neutral and appropriate contexts were used prior to SRs and ORs. A self-paced reading experiment was conducted with 35 Turkish native speakers. The results showed that SRs were read faster than ORs in both contexts, indicating that ORs are still harder to process than SRs, even after the appropriate context. This suggests that the ORs’ processing difficulty in the head-final languages (such as Turkish and Japanese) does not stem from lack of appropriate context, and the weakness of the impact of context on RC processing is not likely due to structural ambiguity in the head-final languages. In the next section, previous studies related to the present study will be briefly explained.

2. Previous Studies

2.1 Discourse Function Hypothesis (DFH)
Based on the study of Fox and Thompson (1990), Roland et al. (2012) pointed out that SRs and ORs may be used for different purposes in the discourse. To explore how SRs and ORs are used in the discourse, Roland et al. (2012) conducted a corpus analysis. They found that an OR, such as “the artist that the sculpture admired…” is more likely to appear after the context “the sculpture collected paintings.” On the other hand, an SR, such as “the artist that admired the sculpture…” is more likely to appear after a context such as “there was an exhibition” rather than the context “the sculpture collected paintings.” These results suggest that SRs and ORs are used in different contexts for different purposes.

Following these findings, Roland et al. (2012) argued that ORs are used for grounding modified nouns to the ongoing discourse, and embedded NP within ORs is generally the topic of the discourse. Thus, the embedded NP within ORs is an old discourse referent. On the other hand, SRs are used for supplying additional information about the modified noun, and the embedded NP within SRs is generally a new discourse referent. These findings suggest that ORs are used in more specific situations as compared to SRs. In other words, ORs are more likely to be context-dependent than are SRs. Roland et al. (2012) pointed out that the processing difficulty of ORs observed in previous studies may be due to lack of appropriate context because ORs are more unnatural than SRs in context-free environments; further, previous studies generally did not provide any context prior to RCs. Moreover, they argued that if the discourse requirements of ORs are satisfied and any unnaturalness is eliminated, the processing difficulty of ORs might be reduced. To test this assumption, Roland et al. (2012) manipulated the contexts before RCs and compared the reading times of SRs and ORs, as follows:
There is always something happening in Elmwood Village.

The sculpture collected paintings.

The artist that admired the sculpture exhibited portraits at the gallery.

The artist that the sculpture admired exhibited portraits at the gallery.2

In Context (1), no particular noun within RCs is mentioned. Therefore, this context is neutral in terms of the newness of discourse referent. In Context (2), on the other hand, the embedded NP within RCs – namely the sculpture – is the topic of the discourse, and it is an old referent. According to Roland et al. (2012), the embedded noun within ORs is generally an old discourse referent; ORs, as in (4), are more likely to appear after a context, as in Context (2). In a self-paced reading experiment, Roland et al. (2012) presented SRs and ORs after such Contexts as (1) and (2). The results showed that SRs were read faster than ORs after Context (1). On the other hand, the reading times of SRs and ORs did not significantly differ when Context 2 was presented before RCs. These results suggest that SRs are easier to process than are ORs in a neutral context in which the embedded NP is not mentioned and is a new discourse referent. On the other hand, in a context in which the embedded NP is the topic of the discourse, there was no processing difficulty between SRs and ORs. This indicates that when the embedded NP is the topic of the previous context and an old discourse referent, the processing difficulty of ORs is reduced in English. Based on these results, Roland and colleagues argued that the processing difficulty of ORs stems from lack of appropriate context, and when the discourse requirements of ORs are satisfied by appropriate context, they are no more difficult to process than are SRs in English.

Needless to say, a language is generally produced and comprehended in a context. Since DFH takes contextual factors into account, it is a powerful hypothesis. If we assume that the discourse function of RCs and the impact of the context on RC processing are universal, the context’s effect should also be observable in other languages. However, to date, the impact of the context on RC processing has been examined in a limited number of languages (Mak, Vonk, & Schriefers, 2008; Roland et al., 2012). To understand more deeply how context affects RC processing, it needs to be investigated in typologically different languages as well. For this purpose, Sato et al. (2010) conducted a study in Japanese. The details of this study will be explained below.

2.2 Examination of DFH in Japanese

To explore how the context affects the RC processing in the head-final languages, Sato et al. (2010) conducted a corpus analysis and a self-paced reading experiment in Japanese. In the corpus study, Sato and colleagues investigated the newness of the discourse referent within RC. To do this, Sato et al. checked the sentences preceding SRs and ORs. The results showed that the 70% of the embedded NPs within SRs are new discourse referents, whereas 80% of the embedded NPs within ORs are old discourse referents. This result indicates that
the embedded NP within SRs is not explicitly mentioned in the previous context. On the other hand, the embedded NP within ORs is explicitly mentioned in the previous context in Japanese, as in English (Roland et al., 2012). This suggests that the contexts prior to RCs are very similar in English and Japanese, and the discourse functions of RCs would be universal. Furthermore, to examine the impact of the context on RCs processing, Sato et al. prepared contexts before RCs and conducted a self-paced reading experiment.

**Neutral Context:**
(5) Jiken-no genba-de sousa-ga okonawareta.
Incident-GEN place-LOC investigation-NOM was carried out.
‘An investigation was carried out at the place of incident.’

**Topic Context:**
(6) Keiji-ga jiken-no sousa-ni atatta.
Detective-NOM incident-GEN investigation-DAT assigned
A detective was assigned to the investigation of incident.’

**SRs:**
(7) Keiji-o yonda tantousha-wa genba-o annaissshita.
Detective-ACC called officer-TOP place-ACC introduced
‘The officer who called the detective introduced the place of incident.’

**ORs:**
(8) Keiji-ga yonda tantousha-wa genba-o annaisshita.
Detective-NOM called officer-TOP place-ACC introduced
‘The officer who the detective called introduced the place of incident.’

The results of self-paced reading experiment showed that the head-noun (*tantousha-wa*) of SRs was read faster than that of ORs after reading the sentences as in (5) and (6). This demonstrates that SRs were easier to process than ORs in both contexts, suggesting that DFH cannot account for the processing difficulty of ORs in Japanese.

In Japanese, neither relative pronouns nor particular RC-markers are used. At the RC-verb position (*yonda*), Japanese RCs are structurally ambiguous between a matrix clause and an embedded clause because the RC-verb is indistinguishable from the matrix verb. In other words, ‘keiji-ga yonda’ or ‘keiji-o yonda’ in above examples can be interpreted as a matrix clause with pro, or as a part of an embedded clause. This sort of ambiguity might have somehow weakened the impact of the context on the RC processing in Japanese. Since the parser cannot detect the existence of an RC until the RC-head, it might have not decided how to integrate the embedded NP within RCs to ongoing discourse. Therefore, this uncertainty might have hindered the power of appropriate context on RC processing; consequently, SRs would have been processed more easily than ORs in Japanese.

To draw a clear conclusion regarding the impact of the preceding context on the RC processing in the head-final languages, structural ambiguity needs to be ruled out. Therefore, Turkish RCs provides an ideal opportunity because use of RC-markers *An* and *DIK* resolve structural ambiguity at the RC verb position, as explained in the next section.
2.3 RC Processing in Turkish

Typologically, Turkish and Japanese RCs are very similar. RC precedes its head, and the word orders of RCs are identical in both languages. Moreover, overt case markers are attached to the embedded NP within RC. The fundamental difference between Turkish and Japanese is the use of RC-markers. In Turkish, suffixes An and DIK are attached to the RC-verb. The former is generally used to relativize the subject noun, whereas the latter is used to relativize the non-subject nouns (e.g. Kornfilt, 1997). Unlike Japanese, the structural ambiguity may be resolved at the RC-verb due to the use of An and DIK in Turkish (see examples in Section 3).

To explore the online processing of SRs and ORs, Kahraman (2010) conducted a series of sentence-fragment completion experiments and self-paced reading experiments in Turkish. The results of sentence-fragment completion experiments showed that when participants read the RC-verb without seeing the RC-head, they produced SRs and ORs almost at the rate of 100%. This suggests that the structural ambiguity is indeed resolved at the RC-verb position in Turkish. Furthermore, the results of self-paced reading experiments showed that the SR-verb was read faster than the OR-verb, indicating that SRs are easier to process than ORs in Turkish. This also suggests that the processing asymmetry between SRs and ORs are observed at the position where structural ambiguity is resolved in the head-final languages. However, Kahraman (2010) did not provide any context before RCs; therefore, the processing difficulty of ORs might be due to lack of appropriate context.¹

By the use of context before RCs, we can first examine whether the processing difficulty of ORs over SRs stems from the lack of appropriate context in Turkish. By doing so, then, we can also examine the impact of the context on RC processing more purely in the head-final languages because the structural ambiguity is ruled out in Turkish, and we can provide a further evidence for the DFH. Therefore, the present study has two aims: The first aim is to examine the impact of the context on the processing of SRs and ORs in Turkish. The second aim is to reappraise the validity of DFH by eliminating the structural ambiguity in the head-final languages.

3. Experiment

The aim of the experiment is to test whether the processing difficulty of ORs is eliminated in Turkish when an appropriate context is provided. To do this, two types of contexts and SRs and ORs were prepared, as shown below.⁴

Neutral context:

(9) Üniversite yolsuzluk yüzünden incelemeye alındı.
University corruption due to investigation taken.
‘The university was investigated due to the corruption.’

SRs:

(10) Dekan-ı suçla-yan rektör okul-u düşün-üyor-du.
Dean-ACC blame-SR rector school-ACC think-PROG-PAST
‘The rector who blamed the dean was thinking of the school.’
ORs:
Dean-GEN watch-NSR-3s rector school-ACC think-PROG-PAST
‘The rector who the dean blamed was thinking of the school.’

Topic context:
(12) Dekan  fakülte-deki işleri-ne fazla önem vermez-di.
Dean  faculty-at work-DAT much care-NEG-PAST
‘The dean did not care much about his works at the faculty.’

SRs:
(13) O-nu  suçla-yan rektör okul-u düşüniyor-du.
He-ACC blame-SR rector school-ACC think-PROG-PAST
‘The rector that he blamed was thinking of the school.’

ORs:
He-GEN watch-NSR-3s rector school-ACC think-PROG-PAST
‘The rector that he blamed was thinking of the school.’

In the Neutral context, no NP within RCs is overtly mentioned. In the Topic context, on the other hand, the embedded NP within RCs is the topic of the context and overtly mentioned in the preceding sentence. In the SRs, a sentence starts with an accusative-NP, followed by an RC-verb marked with \( An \), an adjective, and RC-head, respectively. In ORs, a sentence starts with a genitive-NP, and an RC-verb marked with \( DİK \) follows it. The rest of the ORs are identical to the ones in the SRs. If the main source of the processing difficulty of ORs is lack of appropriate context, the processing asymmetry between SRs and ORs may be eliminated in the Topic context because this context satisfies the discourse requirements of ORs (Roland et al., 2012).

To test this prediction, 24 sets of SRs and ORs were used with preceding contexts, as shown above. In addition to these sentences, 48 filler sentences were prepared with preceding contexts. Prior to the experiment, semantic naturalness of RCs was tested in a norming study, and biased sentences were excluded from the test sentences. Twenty-four sets of the test sentences were divided into four lists by a Latin Square design. Thirty-five native speakers of Turkish participated in the experiment. They were all university students at Çanakkale Onsekiz Mart University (mean age: 23.6, SD = 3.84). Sentences were presented on a computer monitor using Linger 2.94 (developed by Douglas Rohde) in a word-by-word, non-cumulative, self-paced reading task. To check whether the sentences were comprehended appropriately, participants answered a yes–no question after each sentence. Before the experiment, six practice sentences were given to the participants.

3.1 Results
Statistical analyses for reading times were conducted on the sentences wherein yes–no questions were answered correctly by the participants. In the Neutral context condition, the accuracy rate of SRs was 93% and ORs was 90%. In the Topic context condition, the
The analysis of variance (ANOVA) was conducted on residual reading times because word lengths were not equal at the RC-verb position. The results of ANOVA for repeated measures showed that the main effect of the context-type was significant at the first noun where the accusative-NP and genitive-NP appear [$F_1 (1,34) = 20.42, p < .001; F_2 (1,23) = 26.31, p < .001$]. This demonstrates that the first nouns of RCs in the Neutral context were read faster than those in the Topic context. The delay in the Topic context may be due to the process of linking the pronoun with the topic of the ongoing discourse. At this region, the main effect of the RC-type was significant only by subject analysis [$F_1 (1,34) = 4.58, p < .05; F_2 (1,23) = 2.49, p = .12$]. This shows that genitive-NPs were read faster than the accusative-NPs. This may be due to a scrambling effect because the subject noun was missing from its original position. At this region, there was no significant interaction between the context-type and RC-type.

At the RC-verb position, the main effect of the context-type was statistically significant [$F_1 (1,34) = 25.24, p < .001; F_2 (1,23) = 41.02, p < .001$], but the main effect of RC-type and interaction were not statistically significant. This shows that the RC-verbs in the Topic context were read faster than those in the Neutral context. At the next region where an adjective appears before the RC-head, the main effect of the RC-type was statistically significant [$F_1 (1,34) = 14.48, p < .001; F_2 (1,23) = 8.80, p < .001$], but the main effect of context-type and interaction were not statistically significant. Moreover, planned pair-wise comparisons showed that SRs were read faster than ORs in both contexts ($p < .05$). This shows that SRs were easier to process than ORs at the adjective. At the RC-head position, the main effect of the context-type was statistically significant [$F_1 (1,34) = 8.42, p < .01; F_2 (1,23) = 5.96, p < .05$], but the main effect of RC-type and interaction were not statistically significant. At the next region, similarly, the main effect of the context-type was statistically significant [$F_1 (1,34) = 4.27, p < .05; F_2 (1,23) = 4.73, p < .05$], but the main effect of RC-type and interaction were not statistically significant. This shows that the RC-heads and the next words in the Topic context were read faster than those in the Neutral context. For the following words, including the matrix verb, there was neither a significant main effect nor interaction.
4. Discussion and Conclusions

Overall results showed that sentence-initial proper nouns in the Neutral context were read faster than the pronouns in the Topic context. This may be due to the burden of the linking process of the pronoun with the topic of the previous context. On the other hand, at the RC-verb, RC-head, and the next word, RCs were read faster in the Topic context compared to those in the Neutral context. This suggests that the context-type has an impact on RC processing, and RCs were easier to process after the Topic context in Turkish.

However, the processing difficulty of ORs did not change due to the context-type. In particular, the reading time difference at the adjective between the RC-verb and RC-head showed that SRs were read faster than ORs in both contexts. This suggests that ORs were harder to process than SRs, even after the Topic context. Therefore, the present results cannot be accounted by DFH because it predicts that processing difficulty of ORs should be reduced in the Topic context (Roland et al., 2012). On the other hand, the present results are in line with the results of Kahraman (2010). 5 Taken together, it can be said that the processing difficulty of ORs does not stem from the lack of the context itself in Turkish.

The present findings are also in line with the L1 acquisition studies (e.g. Hermon, Kornfilt, & Öztürk, 2012; Özge, Marinis, & Zeyrek, 2009), L2 studies (Aydn, 2007), and aphasia studies (Yarbay, Aygen, & Bastiaanse, 2009) of Turkish RCs. Most of these studies argued that the difficulty of ORs can be explained by the structural distance between the gap and the RC-head (O’Grady, 1997) but cannot be explained by the linear distance (DLT) (Gibson, 1998). In this present study and that of Kahraman (2010), the processing asymmetry between SRs and ORs was consistently observed before the RC-head. Therefore, these results cannot be explained simply by the distance between the gap and the RC-head because structural distance hypothesis (SDH) assumes that the processing asymmetry should be observed at the RC-head. However, there is another version of SDH that assumes the embedding depth of the gap to be the main source of the processing difficulty of ORs (Ishizuka, 2005). The present results can be explained by the embedding depth of the gap because the gap is always embedded more deeply in ORs than in SRs. This also suggests that the difficulty of ORs found in previous studies in Turkish might be due to the depth of embedding of the gap rather than the distance between the gap and RC-head. However, this possibility needs to be examined more extensively in future studies by manipulating the depth of embedding of the gap.

The results of the present study are also consistent with the findings of Sato et al. (2010) in Japanese. Sato and colleagues reported that ORs are still harder to process than SRs, even after the topic context. In the previous sections, it was argued that the structural ambiguity of RCs might have somehow weakened the impact of context in Japanese, and SR might have been processed more easily than ORs after the Topic context. In Turkish, RCs are not structurally ambiguous, as explained in Section 2.3. Nevertheless, a similar processing pattern was observed in Turkish and Japanese. This suggests that the weakness of impact of the context on RC processing is not due to structural ambiguity in the head-final languages. If this were the case, ORs would have been no more difficult to process in the Topic context. One natural question is, then, why does the existence of context have no observable impact on the processing difficulty of ORs in the head-final languages? One possible answer would be that the existence of context itself does not determine the
processing difficulty of ORs; the reduction of processing difficulty of ORs in English might simply be due to repetition of the same nouns in the previous context and RCs, as argued by Sato et al. (2010). The second possibility could be as follows: In the present study, it was assumed that the discourse function of RCs would be universal, but there might also be some language-specific functions of RCs in the head-final languages. Since these language-specific functions of RCs were not fully satisfied in Turkish and Japanese, SRs might have been processed more easily than ORs. At this stage, however, it is impossible to test the second possibility because the use of Turkish RCs was not directly analyzed through a corpus study. In a future study, we need to conduct a corpus study to explore more extensively how RCs are used in Turkish and Japanese; if it is necessary, we would also re-examine the effect of context on the RC processing.

Overall, the aim of the present study was twofold: The first aim was to examine the impact of context on the processing of SRs and ORs in Turkish. The results of a self-paced reading experiment showed that SRs are easier to process than ORs in the Neutral and Topic contexts. This suggests that the processing difficulty of ORs does not stem from the lack of appropriate context itself in Turkish. The second aim was to reassess the discourse function hypothesis in the head-final languages by eliminating the structural ambiguity seen in Japanese. The results of the current study showed the same tendency with Japanese, irrespective of the existence of structural ambiguity. This suggests that the weakness of the impact of appropriate context on RC processing is not due to the structural ambiguity in the head-final languages, and the discourse function of RCs is not the decisive factor of the RC processing in languages such as Turkish and Japanese.

Notes

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1 Sato et al. (2010) cites the earlier version of Roland et al. (2012).
2 Due to space limitations, original examples were simplified in Roland et al. (2012).
3 Özge, Marinis, and Zeyrek (2010) used a context before presenting SRs and ORs; they found that ORs were easier to process than SRs in Turkish. However, the aim of this paper is not to examine the impact of the context itself on RC processing, and the test sentences were adjusted to the level of children.
4 Due to space limitations, original examples in the experiment were simplified. The original RCs consist of 7 words as follow: Dekanı / Onu suçlayan eski rektör okulun geleceğini düşünüyordu (The old rector who blamed the dean / him was thinking of the future of the school), and Dekanın / Onun suçladığı eski rektör okulun geleceğini düşünüyordu (The old rector that the dean / he blamed was thinking of the future of the school). Moreover, in the Topic context, to avoid repeated name penalty and unnaturalness, the third person pronoun was used within RC instead of proper nouns.
5 In Kahraman (2010), the processing asymmetry was observed at the RC-verb. In the present study, the processing asymmetry was observed at the adjective soon after the RC-verb. This may be due to a spillover effect because the existence of the preceding contexts made RC processing faster.

References


