Perspective on Korean Anaphors: Comparing Inanimate *cachey* vs. Animate *caki-casin*

Dorothy Ahn and Isabelle Charnavel

1. Introduction

While anaphors are usually analyzed as requiring local binders (Condition A, see Chomsky 1986, a.o.), some instances of anaphors in many languages do not need local, c-commanding antecedents. This raises the issue of how to empirically distinguish between instances of anaphors subject to Condition A and instances of anaphors exempt from it: the boundary between the two cases is hard to draw given that this requires simultaneously knowing how to define Condition A and how to formulate the conditions for being exempt from it.

Many studies suggest that the conditions for exemption from Condition A are related to perspective, or so-called logophoricity (Clements 1975, Kuno 1987, Sells 1987, Pollard and Sag 1992, Huang and Liu 2001, Charnavel 2014, a.o.). Specifically, the antecedents of anaphors that are exempt from Condition A refer to individuals whose perspective is reported in the sentence. However, exactly how and why this correlation holds remains unclear.

The goal of this paper is to study such perspectival effects on Korean anaphors focusing on the inanimate anaphor *cachey* and the animate anaphor *caki-casin*, which has recently been argued to be an anaphor that can be exempt from Condition A (Kim and Yoon 2009). We use grammaticality judgment scores collected in a systematically controlled experiment to compare the behavior of the two anaphors.

In order to define Condition A independently of potential perspectival effects, we first examine the distribution of inanimate *cachey* to determine the binding domain in Korean (i.e. we use the inanimacy strategy introduced in Charnavel and Sportiche 2016). Then, we compare it with the distribution of the animate anaphor *caki-casin* by crucially contrasting cases where the antecedent is a logophoric center with cases where it is not. The results of our experimental studies show that exempt *caki-casin* is significantly more acceptable in logophoric conditions – specifically in attitude and empathy contexts – confirming that logophoricity plays a crucial role in licensing exempt anaphors.

2. Delimiting Condition A in Korean: inanimate *cachey*

2.1. Theoretical background: Inanimacy and Condition A

Before investigating the effect of perspective in licensing Korean exempt anaphors, we must first determine the scope of Condition A in Korean independently. We do this by making use of the inanimacy strategy proposed in Charnavel and Sportiche 2016. While it is now widely accepted that anaphors can be exempt from Condition A when logophoric (see references above), there is no consensus on the exact definition of logophoricity or perspective. However, one thing that crucially holds is that inanimates cannot be perspective holders since they lack a mental state. Therefore,
Inanimate anaphors cannot be exempt: inanimacy is a sufficient condition for being a plain (i.e. non-exempt) anaphor. Investigating the distribution of an inanimate anaphor thus allows us to identify the scope of Condition A without the confound of logophoricity.

Drawing on this idea, we examined the distribution of the understudied inanimate anaphor cachey to define the relevant notion of locality for Condition A in Korean. Given the different definitions proposed for Condition A in the literature, this involved testing configurations where we varied the relative positions of the anaphor and the antecedent in several relevant ways explained below and detailed in the next subsection.

First, all definitions of Condition A ultimately assume that the anaphor must be bound, i.e. c-commanded, by its antecedent. Accordingly, we checked whether the antecedent has to c-command cachey. Furthermore, all formulations of Condition A suppose that the antecedent should appear in a domain that is local relative to the anaphor. But the definition of that domain is subject to variation.

According to Chomsky’s (1986) definition of Condition A, an anaphor must be bound by its antecedent within the smallest XP containing it and a subject distinct from it. This means that locality basically amounts to the absence of a subject intervening between the antecedent and the anaphor; this is sometimes (see Kim and Yoon 2009) referred to as the Specified Subject Condition (SSC, inspired by, but different from, the condition described in Chomsky 1973). We tested for the (im)possibility of SSC violation by comparing configurations where the anaphor and the antecedent are within the same clause and configurations where the anaphor is in a subordinate clause and is separated from the antecedent sitting in the matrix clause by the subject of the subordinate clause.

According to predicate-based theories (Pollard and Sag 1992, Reinhart and Reuland 1993, a.o.), on the other hand, locality boils down to coargumenthood: the antecedent of an anaphor must not only be within its smallest XP, but must also be its coargument. We tested this hypothesis comparing cases where the anaphor anteceded by a subject is the object of the clause (i.e. coargument of the subject) and cases where it is (within) an adjunct or within the object (i.e. non-coargument of the subject).

Other studies add an absolute locality requirement to such relative ones: the antecedent must not only be within the same XP as the anaphor with no subject intervening (or alternatively, be its coargument), but also within the smallest tensed clause containing the anaphor: tensed TP is an absolute boundary that cannot separate the anaphor and its antecedent. This is sometimes (see Kim and Yoon 2009) referred to as the Tensed-S Condition (TSC, inspired by, but different from, the condition described in Chomsky 1973). Charnavel and Sportiche (2016) show that TSC cannot be violated for French anaphors, which leads them to formulate Condition A in terms of Phase Theory. Kim and Yoon (2009) assume that TSC violation is possible for Korean cachey based on Huang and Liu’s (2001) observation about Mandarin plain anaphors. However, the results of their study (which we will further discuss in Section 3.1) lead Kim and Yoon (2009) to question this assumption. We tested the (im)possibility of TSC violation for cachey using configurations that involve an anaphor in a complement clause anteceded by the matrix subject, and comparing cases where the anaphor is (within) the subject of the subordinate clause and cases where it is (within) its object.

We present our studies below. The upshot is that cachey is subject to the c-command requirement, the SSC, and the TSC, but not to coargumenthood: in short, cachey conforms to Charnavel and Sportiche’s (2016) definition of Condition A, according to which a plain anaphor and its binder must be in the smallest XP containing both without an intervening subject and no larger than a tensed TP.

2.2. Experimental study: Distribution of cachey

Thirty-nine native Korean speakers were asked to perform grammaticality judgment tasks online (on Qualtrics) on 54 randomly ordered sentence items based on a 6-point Likert scale. All sentences contained the anaphor cachey and its antecedent in various positions for the reasons explained above. The items were divided into three main groups which we call A, B, and C. Group A contained sentences where cachey had a clausemate, c-commanding antecedent; subgroups distinguished

1 In addition to the anaphoric use, cachey has an intensifier use like English itself. While emphatic cachey can be attached to animate DPs, its anaphoric use is strictly restricted to inanimate referents.
between *cachey* in coargumental positions and *cachey* in non-coargumental positions, as illustrated in (1a) and (1b) below:

(1)  

a. Group A (clausemateness + c-command) with no coargumenthood

[i senpak]-un *cachey*-uy chwucinlyek-ulo wumcikil swu-iss-ta.
this ship-TOP self-GEN momentum-INST move able-DECL

‘[This ship], can move using its, momentum.’          [5.67/6]

b. Group A (clausemateness + c-command) with coargumenthood

cikwu-nun *cachey*-lul tollin-ta.
earth-TOP cachey-ACC spin-DECL

‘[The earth], spins (on) itself.’                   [4.29/6]

In Group B, the antecedent of *cachey* was within the same clause as *cachey* but not c-commanding it.

(2)  

Group B (clausemateness + no c-command)

*[i kwail]-uy cayipayca-nun *cachey*-uy khentisyen-ul cacwu hwakihan-ta.
this fruit-GEN grower-TOP self-GEN condition-ACC often check-DECL

‘[This fruit],’s grower often checks its, condition.’        [1.97/6]

Finally, Group C contained bi-clausal sentences with *cachey* in the embedded clause and its (c-commanding) antecedent in the matrix clause. This group crucially included cases where the anaphor is (within) the subject of the embedded clause and cases where it is (within) the object of the embedded clause as shown in (3a) and (3b), respectively.

(3)  

a. Group C (TSC-violation + c-command) with no SSC violation:

*[i sosel]-un [cachey]-uy ceca]-ka thulawuma-lul kaccoissta-nun
this novel-TOP self-GEN author-NOM trauma-ACC have-RC
kes-ul pouyecwun-ta.
fact-ACC show-DECL.

‘[This novel], shows that its, author suffers from a trauma.’     [2.95/6]

b. Group C (TSC-violation + c-command) with SSC violation:

*[kwaile]-un [tongmwalul-i *cachey*-uy kwayuk-ul meknunta]-nun
fruit-TOP animals-NOM self-GEN pulp-ACC eat-RC

cangcemu-luckoissesta.
advdantage-ACC have

‘The fruit, has the advantage that animals eat its, own pulp.’      [2.66/6]

The average ratings of the sentences in Groups A, B, and C are shown in Table 1 below:

<table>
<thead>
<tr>
<th>Condition</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>coargument</td>
<td>non-coargument</td>
<td>no SSC violation</td>
</tr>
<tr>
<td>Ratings</td>
<td>4.43</td>
<td>4.97</td>
<td>2.452</td>
</tr>
</tbody>
</table>

Group A was rated significantly higher than group B (p<0.0001) and group C (p<0.0001), confirming that c-command and locality are required for the antecedent of *cachey*. Furthermore, there was no significant difference between subgroups within group A and within group C. This suggests that coargumenthood is not relevant for *cachey* binding, but subject intervention is, and that the tensed clause is an absolute boundary between *cachey* and its antecedent, thus corroborating Kim and Yoon’s (2009) findings about the exempt status of Korean anaphors violating TSC. In sum, we can apply to

---

2 The slightly archaic nature of *cachey* may explain why scores never attain the maximal value (i.e. 6). But as standard, we here focus on contrasts, which are more informative than absolute scores.
Korean anaphors Charnavel and Sportiche’s (2016) formulation of Condition A, which defines locality in terms of c-command, absence of subject intervention, and absence of tensed clause boundary.

3. Perspective-based exemption from Condition A in Korean: animate caki-casin

With the baseline of Condition A set for Korean with the inanimate anaphor cachey, we go on to investigate the distribution of the animate anaphor caki-casin. The goals of our second experimental study were two-fold: first, we wanted to verify that caki-casin can indeed be an exempt anaphor as argued by Kim and Yoon (2009) against traditional assumptions; the second goal was to inquire into the precise role of logophoricity in exempting caki-casin from Condition A.

3.1. Kim and Yoon’s (2009) study

While traditional analyses assume that the complex anaphor caki-casin is a strictly local anaphor as opposed to the simplex anaphors caki and casin, Kim and Yoon’s (2009) study reveals that caki-casin can be long-distance bound under logophoric conditions.3

This interesting result is however undermined by some issues in the study. First, Kim and Yoon (2009) treat TSC-violation cases, i.e. configurations where caki-casin is separated by its antecedent by a tensed clause boundary, as local binding. As exemplified in (4a) and (4b), they compare cases where the anaphor is (within) the subject of its tensed clause (no SSC violation) and cases where it is (within) its object (SSC violation), based on the assumption that the former are cases of local binding. They examine the two cases by collecting grammaticality judgment scores of such sentences and by probing into strict and sloppy readings of immediately following sentences containing VP-ellipsis (such as the bracketed sentence in 4b), based on the assumption that the availability of strict readings diagnoses exemption from Condition A (Cole et al. 2006, a.o.).

(4) a. Only TSC violation:

Jieun,ka Sanghoon-eykey [ipen hakkcy-nun caki-casin, ka kkok
Jieun-NOM Sanghoon-DAT this semester-LOC-TOP self-NOM for/sure
1st.place-ACC do-ASP-DECL-COMP said-DECL-COMP I-TOP know-COMP be-DECL
‘I know that Jieun said to Sanghoon that self, would be at the top of her class this semester.’

b. Both TSC and SSC violation:

Heera,-nun [tongcahangho-ka [caki-casin,-i taumcwwu-ey kylhonhanta-nun
Heera-TOP alumno-assoc-NOM self-NOM next.week get.married-RC
ssil]-ul palphyohayssta]-ko malhayssta. [Aera-to kulekey malhay-ss-ta,]
fact-ACC announced-COMP said Aera-too so say-PAST-DECL
‘Heera said that the alumni association announced the fact that self, would get married next week. [Aera said so too.]’

But their results show that cases like (4a) are in fact also instances of exemption, which means that their study does not contain any control case of local binding. The inanimacy strategy that we instead adopt allows us to avoid this problem by comparing the distribution of the necessarily non-exempt cachey to that of caki-casin: if caki-casin is licensed in any of the conditions in which cachey is not available (groups B and C), that demonstrates that caki-casin is exempt in those conditions.

Kim and Yoon’s (2009) test based on strict readings is moreover problematic for two reasons. First, instead of testing for the availability of strict readings, they use a preferential sentence interpretation task. Second, Hestvik’s (1995) observation that strict readings are available for locally bound anaphors in the case of subordination as in (5) is not taken into account, which questions the validity of the diagnostic, all the more since they do not test strict/sloppy readings under local binding.

3 Given that casin can serve as an intensifier, caki-casin could in principle also be analyzed as the intensified version of caki. The two uses of caki-casin can however be distinguished by prosodic and interpretive clues. We here focus on the anaphoric use of caki-casin and leave the comparison between the two uses for future research.
3.2. Our experimental study: Distribution of caki-casin

Our experimental study about caki-casin, in which 38 Korean speakers participated to judge 69 sentence items, used the same methodology as our study on cachey. We adopted the same three main structural distinctions, except that in groups B and C, we added another variable, namely logophoricity.

Thus, group A sentences had clausemate, c-commanding antecedents, just as in the cachey study:

(6) Jeehye-nun caki-casin-ul pohohalye hass-ta.
    Jeehye-TOP self-ACC protect try-DECL
    ‘Jeehye tried to protect herself, ’

The other two groups also involved the same structural conditions as in the previous study: group B sentences contained clausemate, non c-commanding antecedents, and group C included c-commanding non-clausemate antecedents. Because both groups B and C were shown to be cases of Condition A violation in the cachey study, we tested for each of them whether the rating of the sentences goes up when the antecedent is a logophoric center, i.e. when the sentence is portrayed in the antecedent’s perspective. This would mean that logophoricity licenses exemption from Condition A.

As attested by the literature on logophoricity (Clements 1975, Sells 1987, Kuno 1987, a.o.), there are various ways of defining a logophoric center or perspective holder of a sentence: for instance, it can be the source of the information described by the sentence, or it can be a participant from whose point of view the event is described. To precisely determine which notion is relevant for exemption of caki-casin, we followed Charnavel’s (2014) methodology, which proposes a specific test for identifying each relevant type of logophoric center (Attitude Holder, Empathy Locus, and Deictic Center). Specifically, we hypothesized that caki-casin can be exempt from Condition A when antecedited by attitude holders or empathy loci, and we diagnosed attitude contexts using the Epithet test and empathy contexts designing the new Sibling test. We discuss attitude contexts first.

3.3. Attitude contexts

Our first hypothesis about the exemption of caki-casin due to logophoricity is shown in (7):

(7) Hypothesis 1: caki-casin can be exempt from Condition A in attitude contexts when antecedited by the attitude holder of that context.

In other words, we hypothesized that attitude holders are a type of logophoric centers that can exempt caki-casin from Condition A when occurring in the relevant attitude context. The notion of attitude holder is independently well-defined in the literature, given that attitude contexts are characterized by specific properties such as the availability of de dicto, de re and de se readings or substitution failures with co-refering terms, among others.

To identify anaphors meeting the conditions described in Hypothesis 1, we used Charnavel’s (2014) Epithet test, which is based on Dubinsky and Hamilton’s (1998) observation that an epithet cannot be antecedded by an individual from whose perspective its attributive content is evaluated.

(8) Epithet test for attitude-based exemption (Charnavel 2014): given that an epithet occurring in an attitude context cannot refer to the attitude holder of that context, replace the exempt anaphor with an epithet and check whether the sentence is unacceptable.
In order to experimentally test Hypothesis 1, we introduced attitude contexts in Group C sentences (the condition with c-commanding, non-clausemate antecedents) that contained anaphors passing the epithet test. Specifically, we constructed sentences that have attitude verbs such as think and say as matrix verbs, and in which replacing the anaphor with an epithet yields ungrammaticality. This is illustrated in (9) where caki-casin can refer to Cina, but not to the epithet ku papo (‘the idiot’).

(9) Cina-nun kwucwunha-n wuntong-i {caki-casin/*[ku papo],}-ul ul Cina-TOP regular-RC exercise-NOM self the idiot -ACC
pakkwuko ista-ko sayngkakhan-ta.
change be-COMP think-DECL
‘Cina thinks that regular exercise is changing {her/*[the idiot]}.’ [5.47/6]

The results confirmed our hypothesis as shown in Table 2. First, while there was no significant difference (p=0.416) between the ratings of cachey and that of caki-casin in Group A (the local condition), there was a significant contrast (p<0.0001) between the ratings of caki-casin in Group A and in Group C (the logophoric long-distance condition). Moreover, the logophoric long-distance condition for caki-casin had scores significantly higher (p<0.0001) than the long-distance condition for cachey. In sum, caki-casin can be exempt from Condition A in attitude contexts when anteceded by the attitude holder of that context.

<table>
<thead>
<tr>
<th>Condition</th>
<th>A (clausemate + c-command)</th>
<th>C (non-clausemate + c-command)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cachey</td>
<td>4.675</td>
<td>3.25</td>
</tr>
<tr>
<td>caki-casin</td>
<td>4.771</td>
<td>4.726</td>
</tr>
</tbody>
</table>

3.4. Empathy contexts

Furthermore, we hypothesized that a second type of logophoric center can exempt caki-casin from Condition A as described in (10):

(10) Hypothesis 2: caki-casin can be exempt from Condition A in non-attitude contexts when anteceded by an empathy locus.

The linguistic relevance of the notion of empathy has been mainly demonstrated by Kuno (1987), who defines an empathy locus as the event participant with whom the speaker empathizes, i.e. identifies: the event expressed by the sentence is described from that participant’s point of view. Kuno and Kaburaki (1977) use the Japanese giving verbs yaru and kureru as an illustration, which describe the event of giving from the perspective of the giver and the receiver, respectively. While Korean also has a parallel pair of giving verbs, the distinction is restricted to the honorific register (Ahn 2016). For that reason, we instead used a novel sibling test introduced in Ahn (2016) to identify empathy contexts. Korean lexicalizes empathy information in the terms used for older siblings. Specifically, the Korean terms for older siblings identify the gender of the empathy locus, creating a four-way contrast

---

4 Because we wanted to keep the structural conditions as close as possible to the cachey study (in which group C only included bi-clausal sentences with complement clauses, all sentences of Group C involved attitude contexts: we found out that complement clauses of verbs with animate subjects are necessarily attitudinal. In particular, even if an adjunct phrase is added to imply that the complement clause does not express the content of the matrix subject’s thoughts as in (i), caki-casin still passes the epithet test, which shows that it is in an attitude context.

(i) Mincwun-un {cakicasin-*[ku papo,ka]} yenayhanta-nun kes-ul phyoceng-ul thonghay amshiyassta MC-TOP self-NOM the idiot-NOM in.relationship-RC fact-ACC facial.expression-ACC through suggested ‘MC, suggested through his facial expression that {he/*[the idiot]} was in a relationship.’

5 In the experimental study, only sentences with caki-casin were tested, sentences with epithets were tested offline.
shown in (11) (vs. two-way contrast in English). Thus, sibling terms can be used as a test to check whether an anaphor is in an empathy context as explained in (12).

(11) sibling  
| older brother  | male  | hyeng  |
| older brother  | female| opa    |
| older sister   | male  | nwuna  |
| older sister   | female| enni   |

(12) Sibling test for empathy-based exemption (Ahn 2016): given that sibling terms encode the gender of the empathy locus, replace the exempt anaphor with the relevant sibling term (with respect to the gender of the antecedent) and check if it can refer to the antecedent’s sibling.

The test is applied in sentences (13a) and (13b) involving unbound caki-casin, which is replaced with nwuna (older sister, empathy locus male).

(13)  
1a. Kangwu,uy sayngkak-un {caki-casin,ul/nwuna-lul} wihem-ey ppattulyessta. 
Kangwu-GEN thoughts-TOP self-ACC sister-ACC danger-DAT make.fall 
‘Kangwu’s thoughts put {himself/ his, sister} in danger.’ [5.06/6] 
1b. *Kangwu,uy cacenke-nun {caki-casin,ul/nwuna-lul} wihem-ey ppattulyessta. 
Kangwu-GEN bike-TOP self-ACC sister-ACC danger-DAT make.fall 
‘Kangwu’s bike put {himself/ his, sister} in danger.’ [3.11/6] 

In (13a), nwuna can refer to Kangwu’s older sister and caki-casin is acceptable; in (13b) however, nwuna cannot refer to Kangwu’s sister (it can only refer to the speaker’s sister if the speaker is male) and caki-casin is not acceptable. This means that Kangwu, the antecedent of caki-casin, is an empathy locus in (13a), but not in (13b), so that it can exempt caki-casin from Condition A only in (13a). This difference results from the contrast between the two head nouns sayngkak ‘thoughts’ and cacenke ‘bike’: only the former causes the event to be portrayed from the subject’s perspective.

Furthermore, applying the epithet test to both sentences as in (14) shows that the anaphor is not in an attitude context: thus, perspective based on empathy has to be distinguished from attitude report.

(14) Kangwu,uy {sayngkak-un/cacenke-nun} [ku papo],-lul wihem-ey ppattulyessta. 
Kangwu-GEN thoughts-TOP/bike-TOP the idiot-ACC danger-DAT make.fall 
‘Kangwu’s {thoughts/bike} put [the idiot], in danger.’

To test Hypothesis 2, we introduced empathy contexts in Group B sentences⁶ that contained anaphors passing the sibling test (but not the epithet test).⁷ Specifically, we constructed sentences with mental nouns like ‘thoughts’ that make the antecedent an empathy locus (cf. 13a), and contrasted them with sentences with non-mental nouns like ‘bike’ (cf. 13b) that do not.

---

⁶ We tested for the effect of empathy in group B for the same reason as we did not test non-attitude contexts in group C (see footnote 4), i.e. because we wanted to keep the structural conditions as close as possible to the cachey study (in which bi-clausal sentences of group C only included complement clauses), and because animate matrix subjects of complement clauses are always attitude holders. But both empathy contexts and non-attitude contexts could in principle be tested in Group C (c-commanding, non-clausalmate antecedent) using relative clauses for instance. Conversely, attitude contexts could be tested in group B using sentences such as (ii) where the nature of the head noun (e.g. ‘letter’, which has a content) can make the VP an attitude context.

(ii) John,uy pyenci-nun {caki-casin/*ku papo},-uy hengtong-ul pangeohass-ta. 
John-GEN letter-TOP self the idiot -GEN behavior-ACC defended 
‘John's letter defended {his/*the idiot} behavior.’

⁷ As in the attitude cases (footnote 5), the epithet and sibling tests were performed offline.

⁸ Another way we used to ensure that the subject antecedent is not an empathy locus was to make another element the empathy locus, using verbs such as ‘scare’ that make the object the empathy locus.
The results confirmed our hypothesis as shown in Table 3. While there is no significant difference (p=0.152) between the scores of the Group B sentences containing cachey and those of the group B sentences containing caki-casin in the non-empathy condition, the caki-casin sentences were rated significantly higher (p<0.0001) in the empathy condition. In sum, we show that caki-casin can be exempt from Condition A in non-attitude contexts when anteceded by an empathy locus.

### Table 3

<table>
<thead>
<tr>
<th>Condition</th>
<th>A (clausemateness + c-command)</th>
<th>B (clausemateness + non c-command)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cachey</td>
<td>4.675</td>
<td>2.452</td>
</tr>
<tr>
<td>caki-casin</td>
<td>4.771</td>
<td>[- empathy] 2.724</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[+ empathy] 3.694</td>
</tr>
</tbody>
</table>

### 4. Conclusion

Our two studies quantify the significant effect of logophoricity in licensing anaphors in Korean. Empirically, we have added a new anaphor, inanimate cachey, to the inventory of Korean anaphors obeying Condition A, and we have showed that caki-casin can be exempt from Condition A when logophorically interpreted, thus reinforcing Kim and Yoon’s (2009) claim with a different set of methodologies. Theoretically, our data support the Chomskian-type formulation of Condition A as modified in Charnavel and Sportiche (2016), which restricts the binding domain of a plain anaphor to its smallest tensed TP with no subject intervening; we also confirm Charnavel’s (2014) claim that logophoricity is a crucial condition for exempting anaphors from Condition A, with attitude holder and empathy locus being two relevant types of logophoric centers. Methodologically, we have strengthened the validity of the inanimacy strategy (Charnavel and Sportiche 2016) and the epithet test (Charnavel 2014), and presented a new test for identifying empathy loci in Korean (Ahn 2016).

### References


