Non-uniform plural inferences as scalar implicature[1]

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Abstract. Persian possesses a type of full root reduplication called *m-reduplication* that, when applied to a noun, results in a non-homogeneous plural interpretation; a reduplicated nominal is understood to refer to one or more objects in the denotation of the predicate denoted by the bare noun, as well as one or more objects that are similar in some respect to the bare noun. Although previous work has characterized m-reduplication as denoting a non-homogeneous plurality, evidence from non-upward-entailing environments and pragmatic contexts establishing speaker ignorance demonstrates that the non-homogeneous plural inference associated with reduplication is not entailed, but merely implicated. I provide an analysis of m-reduplication as involving *higher-order scalar implicature* (Spector, 2007), and further explain variation in the interpretation of m-reduplication in non-upward-entailing contexts. Finally, I unify the analysis of m-reduplication with that of the non-exhaustive expressions *-toka* and *-tari* in Japanese, providing a more satisfactory analysis of the latter than was present in previous work (Smith and Kobayashi, 2018).

Keywords: m-reduplication, Persian, higher-order scalar implicature, Japanese.

1. Introduction

Many languages, including Turkish, Persian, and Hindi, possess a type of full root reduplication called *m-reduplication*, that, when applied to a noun, results in a non-homogeneous plural interpretation; a reduplicated nominal is understood to refer to one or more objects in the denotation of the predicate denoted by the bare noun, as well as one or more objects that are similar in some respect to the bare noun. Focusing on examples from Persian, (1) is felicitous if Ali read gathered a bunch of objects, at least one of which is a flower, but others of which may be simply similar to flowers in the context, such as leaves or sticks.

(1) Ali   gol   mol   jam' kard
     Ali   flower RED   collect do.PST[2]
     'Ali gathered flowers and the like.'

Previous work on m-reduplication mostly focuses on its morphophonology (Alderete et al., 1999; Ghaniabadi et al., 2006, a.o.), examining alternations in the first consonant of the reduplicant, which surfaces as [m] by default but as [p] when the first consonant of the base

[2] This paper makes use of the following abbreviations: ACC: accusative case; CL: classifier; IMP: imperferctive aspect; NEG: negation; NOM: nominative case; PRS: present tense; PST: past tense; RED: reduplication; SG: singular; SUBJ: subjunctive mood

is also [m]. Given the phonological nature of this work, the non-homogeneous plural meaning is simply taken for granted.

In one of the few works on the semantics of m-reduplication, Armoskaite and Kutlu (2013) examine m-reduplication in Turkish, characterizing it as a *similative plural*, where the plurality is understood to be non-uniform in the sense discussed by Nakanishi and Tomioka (2004) in the context of the Japanese associative plural *-tati*. In other words, the plurality denoted by m-reduplication contains objects in the set denoted by the non-reduplicated nominal, as well as objects that are similar, but not identical, to those objects. At first glance, this appears to be a good characterization of m-reduplication, and matches the intuitions native speakers have about (1) in Persian. However, the majority of Armoskaite & Kutlu's work is devoted to the range of categories to which m-reduplication may apply in Turkish, and otherwise takes the non-homogeneous plural inference for granted.

The goal of this work is to understand the *nature* of this non-homogeneous plural inference: is the existence of such a plurality *entailed* by m-reduplication, or is it merely *implicated*? In section 2 of this paper, I present an argument for the latter state of affairs: m-reduplicated nominals do *not* entail the existence of a non-homogeneous plurality. In particular, in non-upwaed-entailing semantic environments, as well as contexts establishing speaker ignorance, reduplication clearly includes uniform plurals, as well as singletons, in its denotation. I then propose an analysis of the non-homogeneous plural inference as derived via *higher-order scalar implicature* (Spector 2007): the inference arises via competition with an exhaustified version of the bare nominal. I also take into account variation in the interpretation of m-reduplication in non-upward-entailing and ignorance contexts, proposing different underlying meanings for the two groups of speakers examined while maintaining an implicature-based analysis for both. Finally, I show how the analysis extends naturally to the Japanese similative expressions *-toka* and *-tari*, which show the same sensitivity to monotonicity and interspeaker variation, and further demonstrate how the current analysis improves on previous analyses of these items (Smith and Kobayashi, 2017; 2018).

2. Non-upward-entailing environments

Although m-reduplication receives a non-uniform plural reading in upward-entailing environments like (1) above, there are a variety of contexts in which this reading is no longer found. These environments share the property of being non-upward-entailing: they are either downward-entailing or, in the case of questions, non-monotonic. I now turn to each of these environments in turn.

2.1. Negation

Negated sentences with m-reduplication provide the first clue that m-reduplicated sentences do not denote a non-uniform plurality. We find that (2), for instance, is true if Rostam did not read any number of books or, for some speakers, *anything similar to one*[3]
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[3] Where speakers vary in their judgments, I will put additional aspects of the interpretation permitted by speakers with a less restrictive interpretation of m-reduplication in parentheses.

(2) Rostam ketâb metâb na-   xund
     Rostam book RED   NEG- read.PST
     'Rostam didn't read books (or anything like that.)'

If *ketâb-metâb* denoted a plurality consisting of a book *and* at least one other book-like things, we would expect (2) to be interpreted as having the weaker interpretation that Rostam didn't read both a book and something similar.

2.2. The antecedent of a conditional

In the antecedent of a conditional, we again find that m-reduplication lacks the non-homogeneous plural reading attested in upward-entailing contexts.

(3) age   ketâb metâb mi-   xun -i,   be   man be-   gu!
     if   book RED   IMP- read.PRS-2.SG to   1.SG SUBJ- say.PRS
     'If you read books (or something like that), tell me!'

In (3), the addressee may felicitously tell the speaker even if she has read only a single book, any number of books and nothing else, or, for some speakers, just some number of book-like things that are not themselves books, such as one or more magazines, in addition to a combination of books and book-like things. No speakers require that the addressee only tell the speaker if she reads at least one book in addition to a book-like thing.

2.3. Imperatives

In imperatives, m-reduplication once again fails to exhibit a non-homogeneous plural requirement. In (4), for instance, we observe that the speaker's request will be satisfied if the addressee eats at least one apple, or, for some speakers, just some apple-like fruit, such as an orange.

(4) sib   mib   bo-   xor!
     apple RED   SUBJ - eat.PRS
     'Eat an apple (or something like that)!'

In this case, too, if the non-homogeneous plural inference were part of the basic meaning of m-reduplication, we would expect to find that the addressee would need to eat both an apple *and* some apple-like fruit in order to comply with the imperative in (4), but no speaker judges this to be the case.

2.4. Polar questions

The final environment we will consider is polar questions. As with the other environments discussed above, m-reduplicated nominals are not interpreted as imposing a non-

homogeneous plural requirement on the denotation of the nominal, as the following question answer pair demonstrates.

(5)   a. sib   mib   xord   -i?
         apple   RED   eat.PST -2. SG
         'Did you eat an apple (or something like that)?'

      b. âre,   ye/do   tâ   sib   xord   -am
         yes,   one/two   CL   apple   eat.PST -1.SG
         'Yes, I ate one/two apples.'

For some speakers, the following answer in (6) is also felicitous.

(6)   âre, ye/do   tâ   porteghal   xord   -am
      yes, one/two   CL   orange   eat.PST -1.SG
      'Yes, I ate one/two oranges.'

As with the other cases, we would expect to find the answers in (5b) and (6) to be infelicitous if the question in (5a) were interpreted to be asking whether the addressee consumed at least one apple and at least one apple-like thing.

2.5. Interim summary

Thus far, I have used non-upward-entailing semantic environments to demonstrate that m-reduplication does not entail the existence of a non-homogeneous plurality. This is very reminiscent of the behavior of English bare plurals, which exhibit a multiplicity inference in upward-entailing contexts, but which clearly possess singletons in their denotation when considered in the above contexts (Krifka, 2003; Spector, 2007; Zweig, 2009, a.o.). In the next section, I will provide further evidence for the lack of a non-homogeneous plural entailment with m-reduplication by using more pragmatic, rather than strictly semantic, considerations.

3. Speaker ignorance

Even in upward-entailing environments, it is possible to manipulate the pragmatic contexts in such a way that the non-homogeneous inference no longer arises. These are cases involving *speaker ignorance*. For example, consider the the speaker's statement in the context provided in (7). In keeping with the convention in previous examples, I include in parentheses aspects of the interpretation relevant to speakers with a less restrictive reading for m-reduplication.

(7)   Context: you see Roya carrying a small lunchbox, in which she usually keeps an apple
      for an afternoon snack, but sometimes brings some other kind of fruit. You don't know
      exactly how many things she has in the box (and are not entirely sure what kind of fruit
      it is).
      Sentence: Royâ sib   mib   dâr   -e
                Roya apple   RED   have.PRS   -3.SG
                'Roya has an apple (or something).'

Here, the speaker is not committed to Roya having more than one apple, nor are they committed to her having anything but apples. What's more, some speakers are not even committed to Roya specifically having an apple in the first place; for these speakers, she may just have some number of other kinds of fruits, such as oranges.

We find a parallel with the behavior of English bare plurals here as well. deSwart and Farkas (2010) note that bare plurals can be used in contexts in which some number of entities is known to exist, but for which there is not enough evidence to establish how many entities there are. In these cases involving ignorance, a plural may be used when the speaker does not know whether or not there is more than one object, just like in the m-reduplication case in (7).

(8)   Inclusive reading of bare plurals with ignorance (deSwart and Farkas, 2010, 30)
        a. [Speaker walks into basement, and notices mouse droppings]
            Arghh, we have mice!
        b. [Speaker walks into unknown house, and notices toys littering the floor]
            There are children in this house.

All of this goes to show that the non-homogeneous plural inference observed in Persian m-reduplication is much like the multiplicity inference associated with English bare plurals: it is sensitive to the monotonicity of the semantic environment it is in, and also vanishes in more global pragmatic contexts establishing speaker ignorance, even in semantic environments in which the inference would otherwise be expected to arise. In the following section, I pursue an analysis further connecting m-reduplication to English bare plurals involving implicature.

4. Non-homogeneous plural inferences as higher-order scalar implicature

I propose that the non-homogeneous plural inference of m-reduplication be treated as an instance of scalar implicature. In particular, I propose that this involves *higher-order scalar implicature*, as proposed by Spector (2007) for deriving the multiplicity inference of English bare plurals. The basic idea behind a higher-order scalar implicature is that the implicature arises via the negation of an *already exhaustified* alternative. Due to the variation noted throughout the data discussed above, I provide two distinct but related analyses: the first will concern the more restrictive speakers, who do not permit m-reduplication to refer simply to the objects that are similar but not of the same variety as those denoted by the bare nominal, and the second will address the interpretation that less restrictive speakers obtain, in which m-reduplicated nominals may refer to those similar objects.

4.1. More restrictive speakers

For the more restrictive speakers, I analyze the unenriched meaning of m-reduplication as semantically identical to the unreduplicated bare nominal. Example (9a) demonstrates this analysis for reduplication as applied to the expression *book*, while (9b) provides a translation for *Mohsen read book-RED*.

(9)   a. ⟦book-RED⟧ = ⟦book⟧ = λX.*Book(X)

       b. ⟦Mohsen read book-RED⟧ = ∃X[*Book(X) & *Read(X)(m)]

This captures the interpretation of m-reduplicated nominals in non-upward-entailing and ignorance contexts for more restrictive speakers, where an m-reduplicated nominal may refer simply to one or more books, but not to one or more objects similar to books.

Next, we need to derive the alternatives to an m-reduplicated nominal. By virtue of being more morphologically complex than the bare nominal (Katzir, 2007), reduplicated nominals have their bare nominal counterpart as an alternative. This is particularly appropriate for Persian, as bare nominals receive a number-neutral interpretation, and this will ultimately allow us to exclude cases where the subject, for instance, read only one or more books.

On top of this, I propose that sentences with m-reduplicated nominals specifically have as their alternative an *exhaustified* version of the sentence with the bare nominal. This will essentially amount to a focused version of the ssentence with a bare nominal, where the alternatives are contextually defined and excluded. This is similar to Spector's treatment of bare plurals, as well as to Sudo's (2014) analysis of disjunctions with conjunctive inferences in Japanese, where the required inferences are generated via competition with already exhaustified alternatives.

I formalize the notion of exhaustification in terms of Fox's (2007) *Exh* operator, defined in (10). IE stands for *innocently excludable*, and refers to the set of alternatives to a proposition p that may be negated without contradicting what is asserted by p.

(10)   Exh(A)(p) = p & ∀q ∈ IE(A)(p): ¬q

In words, Exh takes a proposition and a set of alternatives to that proposition, asserts the proposition and then negates all of the innocently excludable propositions in the set of alternatives to p.

Assuming a set of contextually relevant alternatives to (9a),[4] applying exhaustification to a sentence with the bare nominal, in this case book, results in (11a), with the innocently excludable alternatives given in (11b).

(11)   a. ⟦Exh(Mohsen read book)⟧ = ∃X[*Book(X) & *Read(X)(m)] & ∀p ∈ IE(A)(p): ¬p

       b. IE(A)(p) = {Mohsen read magazine, Mohsen read comic book, …}

(11a) is interpreted to mean 'Mohsen read one or more books and he read nothing else that is contextually relevant.' Applying Exh to the sentence with m-reduplication then negates the alternative in (11a), resulting in (12).

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[4] Possibly restricted by a similarity requirement.

(12) ⟦Exh(Mohsen read book-RED)⟧ = ∃X[*Book(X) & *Read(X)(m)] &
¬[∃X[*Book(x) & *Read(x)(m)] & ∀p ∈ IE(A)(p) :¬p]

By deMorgan's Law, this reduces to the expression in (13).

(13) ∃X[*Book(X) & *Read(X)(m)] & (¬∃X[*Book(X) & *Read(X)(m)]
v ¬∀p ∈ IE(A)(p): ¬p]

By disjunctive syllogism, we may eliminate the first disjunct within the second conjunct resulting from the application of Exh. Finally, by applying the equivalence between ¬∀p[¬p] and ∃p[p], we derive (14).

(14) ∃X[*Book(X) & *Read(X)(m)] & ∃p ∈ IE(A)(p): p

This results in an interpretation where Mohsen read one or more books, and at least one of the contextually relevant alternatives is true. This is exactly the non-homogeneous plural inference we are looking for.

4.2 Less restrictive speakers

Recall that there are some speakers who permit less restrictive interpretations of m-reduplication in non-upward-entailing and ignorance contexts. Such speakers accept, for instance, cases where *ketâb metâb* 'book-RED' could refer to a single magazine, in addition to the interpretation where it refers to one or more books as interpreted by the more restrictive speakers.

One possibility is that these speakers have a different unenriched denotation for m-reduplication, such as the disjunctive one provided in (15).[5]

(15) ⟦RED⟧ = λP. λX. P(X) v ∃Q[Q ~ P & Q(X)]

A translation for (9b) using this denotation of m-reduplication is provided in (16). Here, Mohsen is interpreted as either reading a book or something similar, but not identical to, a book.

(16) ⟦Mohsen read book-RED⟧ =∃X[*Book(X) v ∃Q[Q ~ Book & *Q(X)] & *Read(X)(m)]

Although the non-homogeneous plural interpretation is more difficult to derive in this case, one possibility for deriving it is to follow Bowler's (2014) approach to conjunctive inferences associated with disjunction in Warlpiri and treat each disjunct as an alternative, while explicitly excluding a conjunctive alternative. Each disjunct will be exhaustified, yielding the set of alternatives in (17).

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[5] The interpretation of the similarity relation ~ will have to be non-reflexive in order to ensure that Q is not identical to P.

(17)   {P & ¬Q, Q & ¬P, P v Q}

Negating the innocently excludable alternatives, here (P & ¬Q) and (Q & ¬P) will result in the following in (18).

(18)   (P v Q & ¬(P & ¬Q) & ¬{Q & ¬P)) = P & Q

This delivers a conjunctive inference, leading to an interpretation where, for instance, Mohsen reads both at least one book and at least one thing similar to a book. This is also the non-homogeneous plural reading we're interested in.

This raises the question of how to derive the required alternatives in the first place. One route would follow Sauerland et al.'s (2015) approach to the Japanese alternating conjunctive/disjunctive coordinator *ya* and simply associate the (exhaustified version of) each disjunct in the logical form of the sentence with RED. This raises an additional issue: one of these disjuncts does not correspond to any lexical item in the language, and is thus an *abstract* alternative. Such abstract alternatives may be independently motivated, as argued by Charlow (2016) and Buccola et al. (2018). This is thus not necessarily a problem for the current analysis. I will leave further investigation of this issue to future research.

5. Beyond Persian m-reduplication: Japanese *-toka* and *-tari*

Smith and Kobayashi (2017; 2018) investigated the Japanese morphemes *-toka* and *-tari*, which modify nominals and verb phrases, respectively. These bear a strong resemblance to m-reduplication in Persian, in that they are associated with a non-exhaustive inference in upward-entailing environments that disappears in non-upward-entailing contexts. The interpretation of these expressions in upward-entailing environments is given in (19) and (20), and an example of a downward-entailing environment eliminating the non-exhaustive inference is given in (21).

(19)   Taro   -toka   -ga   ki   -ta
        Taro   -toka   -NOM   come   -PST
        'Taro and someone else came.'

(20)   Taro   -ga   heya   -o   sooji si   -tari   si   -ta
        Taro   -NOM room -ACC   clean do   -tari   do   -PST
        'Taro cleaned his room and did other such things.'

(21)   Taro -toka (Hanako -toka)   -ga   ki -tara, Yosuke-wa ocha -o   das   -u
        Taro -toka Hanako -toka   -NOM come -if Yosuke -TOP tea   -ACC serve -PRS
        'If Taro, Hanako, or someone like that comes, Yosuke will serve tea.'

Smith and Kobayashi's analysis makes use of a Hamblin-style alternative semantics (Hamblin 1973; Kratzer and Shimoyama 2002), according to which the alternatives generated by *-toka* and *-tari* are universally quantified in upward-entailing contexts but, essentially, existentially quantified in other contexts. This is similar to Davidson's (2013) analysis of general coordination in ASL.

This analysis runs into a few problems, however. First, use of the universal propositional quantifier leads to overly strong truth conditions in upward-entailing contexts; an expression with *-toka* or *-tari* in an upward-entailing environment is predicted to be true only when *all* of the contextually relevant alternatives are true. However, in reality, such sentences are judged true in upward-entailing contexts when *at least one* other alternative is true. Second, this analysis predicts very weak truth conditions for the cases when *-toka/-tari* appears in a downward-entailing environment; the prediction is that it should be possible for them to refer to an unmentioned alternative similar to the overtly mentioned expression in these contexts. While Ryoichiro Kobayashi is able to get this interpretation, other Japanese speakers disagree with this judgment.

One solution to these problems is to adopt an analysis for *-toka/-tari* that is basically identical to the one I have developed for Persian m-reduplication in this paper.[6] On this analysis, something like *Taro-toka* is interpreted as being identical to simply *Taro*, as (22) shows.

(22) $\llbracket$Taro-toka$\rrbracket = \llbracket$Taro$\rrbracket = t$

A sentence containing a *-toka/-tari* phrase will then be interpreted as identical to the sentence without the particle, as in (23).

(23) $\llbracket$Taro-toka-ga kita$\rrbracket = $ Came(t)

We can then follow the same logic from section 4.1; sentences with *-toka* are associated with an exhaustified version of the sentence containing the bare nominal. This exhaustified alternative is shown in (24).

(24) $\llbracket$Exh(Taro-ga kita)$\rrbracket = $ Came(t) & $\forall p \in$ IE(A)(p) :$\neg$p IE(A) = {Hanako came, Jiro came, …}

We can then exhaustify the sentence with *-toka*, using the same applications of deMorgan's Law, disjunctive syllogism, and the equivalence between $\neg\forall p[\neg p]$ and $\exists p[p]$ we took advantage of before to generate the non-homogeneous plural inference of Persian m-reduplication.

(25) $\llbracket$Exh(Taro-toka-ga kita)$\rrbracket$ = Came(t) & $\neg$[Came(t) & $\forall p \in$ IE(A)(p): $\neg$p]
$\qquad\qquad$ = Came(t) & ($\neg$Came(t) v $\neg\forall p \in$ IE(A)(p): $\neg$p)
$\qquad\qquad$ = Came(t) & $\exists p \in$ IE(A)(p): p

This analysis solves the problems faced by Smith & Kobayashi's previous analysis. First, instead of universal quantification over the alternatives, we derive existential quantification over the alternatives, which correctly accounts for speaker's judgments in upward-entailing contexts. Second, in non-upward-entailing contexts, we no longer expect to derive the previous excessively weak reading of these expressions. Instead, we predict that the non-exhaustive reading goes away, resulting in cases where, for instance, only Taro came, rather than just someone similar to him in the context. While this matches the interpretation other

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[6] I illustrate the analysis with *-toka*, but the same considerations hold for sentences with *-tari*.

Japanese speakers get, it is still possible to derive Ryoichiro Kobayashi's judgment for Smith and Kobayashi (2018) by proposing a disjunctive interpretation for *-toka/-tari* prior to exhaustification. It is therefore possible that there is interspeaker variation in the judgments about *-toka/-tari* in non-upward-entailing environments that mirrors the variation found in the judgments of Persian speakers about m-reduplication in the same environments.

6. Conclusion

In this paper, I examined the semantic properties of m-reduplication in Persian, and demonstrated that the non-homogeneous plural inference, taken for granted in other works, is not entailed by m-reduplication, but is rather implicated. I developed an analysis according to which this inference is generated via higher-order scalar implicature, taking into account interspeaker variation by proposing distinct underlying representations for the two populations of speakers. I then extended this analysis to the expressions *-toka* and *-tari* in Japanese, and showed that the analysis not only provides a unified framework for dealing with m-reduplication and these Japanese expressions, but also provides a more satisfactory account of the data discussed in Smith and Kobayashi (2017; 2018).

There is still much work to be done. First, the analysis of less restrictive speakers is a bit stipulative, and would do with more careful thinking. See Smith (in prep) for a more up to date analysis that reconciles the analyses of m-reduplication for more and less restrictive speakers, and puts the analysis of the judgments of less restrictive speakers on firmer footing. Second, it would be interesting to examine the behavior of m-reduplication in other languages in which it appears, such as Turkish and Hindi, to see if the judgments pattern the same as they do for Persian speakers. Third, it would be of interest to situate the behavior of these kinds of expressions in the context of other types of plurals crosslinguistically. While I have drawn an explicit comparison between the behavior of Persian m-reduplication and Japanese non-exhaustive particles to that of English bare plurals, it would be interesting to compare the behavior of these similative expressions to that of associative plurals, such as Japanese *tati* (Nakanishi and Tomioka, 2004, a.o.).

Finally, it has been brought to my attention that a connection with the semantics of plural personal pronouns may shed light on some of these issues.[7] Plural personal pronouns have an associative semantics: *we*, for instance, is typically interpreted to refer to the speaker and their associates. However, there are contexts, typically non-upward-entailing, in which singleton reference is possible, just like in the cases of m-reduplication and *-toka/-tari*. Example (26) demonstrates this possibility.

(26) Context: Sneaking into a museum to steal a priceless diamong. There are security cameras everywhere.

       If we get spotted by a security camera, we'll go to jail.

Here, the interpretation is such that the group will go to jail if just one member of the group associated with the speaker is spotted by a security member, rather than the expected reading

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where everyone in the group associated with the speaker needs to be spotted by a security camera. It is possible that an analysis along the lines of that pursued here could shed light on the issues raised by this case, and I leave an attempt to make such a connection to future research

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