

REFERENTIAL CHOICE IN MULTIMODAL COMMUNICATION¹

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This article deals with an application of referential markup to a large multimodal resource “Russian Pear Chats and Stories”, annotated for vocal, oculomotor, manual and cephalic channels. Despite a large number of works on referential choice, it has never been investigated within the framework of multimodal communication. For this purpose, a special annotation scheme in the ELAN environment is proposed, allowing one to annotate different types of referential units and to conduct a simultaneous tracking of referential expressions (full NPs, pronouns, demonstratives, zeroes, etc) with accompanying verbal and non-verbal units. The analysis of three recordings (overall duration equals to 141 minute), where the new referential annotation was introduced in addition to the existing multimodal markup, reveals a range of understudied peculiarities of the referential choice. It was found that the role of the Commentator in the conversation entails a significantly larger amount of constructions with a zero subject pronoun, compared to the monologue discourse of the Narrator and the Reteller. The analysis of referential expressions and accompanying pointing gestures complied with more general data previously obtained on the English material and showed that nouns are significantly more often accompanied by a pointing stroke than personal pronouns, while demonstratives occupy an intermediate position between nouns and personal pronouns as units potentially accompanied by a gesture.

Keywords: referential choice, referential expression, full NP, personal pronoun, demonstrative pronoun, pointing gesture, multimodality

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1. Introduction. Multimodal communication as a subject of study and the resource “Russian Pear Chats and Stories”

Human communication is a simultaneous interaction of verbal and non-verbal components, or channels. Their joint analysis has only recently become possible within the multimodal (multichannel) approach [Kress 2002]; [Kibrik 2010]; [Knight 2011]. Its development went along with the creation of multimodal resources compiled in vast repositories of media files annotated for various channels of communication [Kibrik, Podlesskaya 2009]; [Brône, Oben 2015]; [Kibrik 2018a].

This article lies within the framework of multimodal studies and is based on one of the largest resources in terms of annotated channels, “Russian Pear Chats and Stories” (for details, see the website www.multidiscourse.ru). It consists of 24 sessions of natural communication in groups of four participants discussing the Pear Film [Chafe 1980]. Each of the four participants has a fixed role: the Narrator (N), the Commentator (C), the Reteller (R) and the Listener (L). At the preliminary stage, N and C watch the film, then N tells the plot of the film for R. No interruption is allowed until N completes the story. This is followed by a conversation stage, in which C adds details to the first story of N and R asks questions that help him/her understand the plot better. After that, R retells the plot of the film to L, who joins the rest of the participants only at the last final stage. For details, see [Kibrik 2018b].

The main mark-up of the “Russian Pear Chats and Stories” corpus is carried out with ELAN software (<https://tla.mpi.nl/tools/tla-tools/elan>) and includes the annotation of vocal, oculomotor, manual and cephalic channels. In addition, on a subcorpus of three sessions (04), (22), (23), a referential annotation is performed. This paper is particularly devoted to this aspect. At present, there are many works which discuss potential factors of referential choice [Arnold 2001]; [Kaiser, Truswell 2008]; [Kibrik et al. 2016], but this is the first time it is explored in the context of multimodal communication. In this regard, a brief review of the phenomenon of referential choice and its aspects studied in this framework will be given in Section 2; Section 3 will focus on basic principles of the applied annotation. Section 4 will provide summary results of different referential units’ behavior throughout the corpus. Finally, Section 5 will examine one application of referential annotation in the multichannel approach—the analysis of referential choice and accompanying pointing gestures.

2. Referential choice: types of annotated referential expressions

Referential choice is the choice of a language expression which refers to any definite object or phenomenon. The same referent can be marked with a full NP, a personal pronoun, a reflexive, a zero form, etc. Among all language expressions with a specific definite reference, two basic types of units can be distinguished: anaphoric and deictic.

Anaphoric units are language expressions that are impossible to interpret unambiguously without referring to previously known contextual information. The majority of works on referential choice are dedicated to this type of reference (see [Kibrik 1996]; [Kaiser 2013]; [Kibrik et al. 2016]; [Sauermann, Gagarina 2017] *inter alia*). The list of anaphoric language expressions is large and includes:

- third person pronouns:
- (1) (h) (q) (a) [**on**] XX sobiraet /–gruši,
‘[**He**] is picking pears’
- demonstrative pronouns:
- (2) Nu potomu čto/[**tot**] nemnožko byl v\šoke;
‘Well as [**that one**²] was a bit shocked’
- definite pronouns:
- (3) /volosy [**u vsex**] dostatočno dlinnyje;
‘The hair [**of everybody**] is quite long’
- indefinite pronouns:
- (4) nu-u n’= || [**kto-to**] /vyše,
[**kto-to**] \nižew
‘Well [**some**] are taller, [**some**] are shorter’
- zeroes:
- (5) a potom [**Ø_{pro}**] spuskajets’a po /lestnice
‘and then [**he**] goes down the stairs’

All these units belong to a wider category of reduced reference [Kibrik 2011]. This category is opposed to full reference, i.e. constituents with a noun or numeral head, which act as antecedents for subsequent anaphoric units:

- (6) (a) (m) velosiped [**mal’čiku**]_i /velik
(h) [on]_i jedet ne v /sedle,
‘The bike is too large [**for the boy**], [he] does not ride the saddle’
- (7) Bylo [**dve /napolnennyx**],
[**odna**] byla \pustaja.
‘[**Two**] were full, [**one**] was empty.’

In this study, both reduced anaphoric expressions and their full antecedents are annotated within a wider category of anaphoric reference.

Another type of reference is deixis. Unlike anaphora, where the referent’s interpretation relies on previous context, deictic referents are identified through visual attention. The linguistic expressions most commonly used for of deictic reference include first and second person pronouns (both overt and zero forms), demonstrative pronouns and demonstrative adverbs. In this study the list of annotated deictic expressions is limited to first- and second-person subject pronouns. In a number of languages, including Russian, one may choose not to express these pronouns explicitly (see Example 9) and the choice between overt and zero subject forms is a complex issue which depends on a range of heterogeneous factors.

² Here and throughout italics is used in English translations for Russian zero forms.

- (8) (/Možno [ja] rasskažu^h?
'Can [I] tell?')
- (9) [Ø_{pro}] \Voobščę ne pomn'u etogo!
'[I] absolutely do not remember it'

Although the dominant referential pattern in Russian is the one in which a subject pronoun is explicitly expressed, its omission is also quite common and ranges from one-fourth to one-third of all occurrences [Kibrik 1996]; [Grenoble 2001]. Factors that influence the presence or absence of Russian subject pronouns have been investigated (see, for example, [Seo 2001; Zdorenko 2010]), but at present they remain neither definitively classified nor fully understood.

Most studies of the referential choice focus on anaphoric devices and do not include deixis. This is partly due to the fact that in the case of deictic subject reference, the referent of the linguistic expression is depends upon a predetermined binary opposition permitted only in languages which allow subject omission, a process significantly different from the selection of anaphoric expressions. Nevertheless, since the corpus “Russian Pear Chats and Stories” implies further use for general linguistic research, both types of reference are included in the current markup. It is assumed that the corresponding annotations will help to establish additional prosodic and kinetic factors associated with referential choice.

In recent years, researchers have developed numerous resources that investigate coreference in anaphoric relationships, e.g. ARRAU [Poesio, Artstein 2008], GREC [Belz et al. 2010], WSJ MoRA Corpus [Kibrik 2016 et al.]; RuCor [Toldova et al. 2014]. The markup of these corpora is based on special procedures considering the distance between the anaphor and the antecedent, as well as their discourse, grammatical and syntactic properties [Kibrik et al. 2016], provided by automatic extraction tools (see, for example, MMAX [Müller, Strube 2007], RuCor Annotation tool [Toldova et al. 2016]). Unlike previously cited works, this article focuses on the relations between different types of referential expressions and various kinetic channels of communication. This issue has been partially investigated with regard to Germanic and Turkic languages [Gullberg 2006]; [Debreslioska et al. 2013]; [Azar, Özürek 2015], but this is the first time Russian corpus data is brought into the picture. Since the annotation of all communication channels in “Russian Pear Chats and Stories” was performed in ELAN and the current task involves further analysis of non-verbal channels on a par with with accompanying referential units, referential annotation at the current stage was also carried out in ELAN. Accordingly, certain solutions were modified to incorporate embedded and zero units, since by default ELAN does not allow such kinds of annotations. The following solutions will be presented below.

3. Principles of referential annotation

The entire referential annotation of the “Russian Pear Chats and Stories” corpus is divided into two markups dealing with anaphoric and deictic expressions, respectively. Within the annotation, anaphoric and deictic units form two main independent

tiers (refAnaphora/refDeixis) which both depend on the Words³ tier (part of the vocal annotation). Each of these two tiers is a parent for several tiers where a range of referential parameters is annotated (see below). For the third person zero pronoun, the following explicitly expressed word in the Words tier is annotated as a parent item. Sometimes referential expressions form embedded constituents: several syntactically related (either with coordination or subordination) anaphoric expressions form a compound expression with a definite reference:

(10) {sw} /po-mojemu eto bylo [[/dva mal'čika]_i i [devočka]_j]_k
 'I think there were [[two boys]_i and [a girl]_j]_k'

(11) /Potom v kadre pojavl'ajets' [[[(h) (a) \mal'čik [na velosipede]_i]_j
 'Then in the shot [a boy [on a bike]_i]_j appears

Since ELAN does not allow creating a tier with different levels of annotation, all referential expressions that do not contain embedded constituents (=discrete annotations of the refAnaphora tier) depend on the refAnSpread tier. Each of the annotations of the refAnSpread tier represents a group of one or several syntactically related expressions refAnaphora by default. At present, based on the recordings #4, #22, and #23 of the "Russian Pear Chats and Stories" corpus, the maximum number of embedded constituents was equal to three items. For this reason, in the annotation scheme the refAnSpread tier is by default a parent to the three child tiers, refAnaphora1, refAnaphora2 and refAnaphora3, respectively. When no embedded referential are found, only the first refAnaphora1 tier is annotated.

At present, the referential annotation does not allow automatic extraction of coreference units. The elaboration of an appropriate tool for this purpose is left for future research. However, other parameters potentially affecting the referential choice are taken into account. In the current version of the referential markup, the following parameters are annotated, each of them forming a separate layer that depends either on the refDeixis or on the refAnaphoraN⁴ tier, according to the type of the referential expression:

- 1) For deictic expressions:
 - a. Explicitness (*refDeiExpr* tier): explicitly expressed/not expressed (Overt/Zero). For a first or second zero pronoun, the following explicitly expressed word in the *Words* tier serves as a parent element.
 - b. Person (*refDeiPerson* tier): first/second person (1/2)
 - c. Number (*refDeiNumber* tier): singular/plural (SG/PL)
 - d. Grammatical role (*refDeiSynt* tier): subject/direct object/indirect object/other (Subj/DirObj/IndirObj/Other)
- 2) For anaphoric expressions (*refAnaphora1-3*):
 - a. Type of reference (*refAnType* tier): Full/ Reduced

³ On the intermediate tier refAnSpread for anaphoric expressions, which is located between Words and refAnaphoraN tiers in the hierarchy, see below.

⁴ N equals to 1, 2 or 3, due to the number of embedded units.

- b. Type of referential expression (*refAnExpression* tier; depends on the *refAnType* tier): NP with a noun/numeral head (NomP/NumP) for full reference VS third person pronoun/ demonstrative pronoun/ definitive pronoun/indefinite pronoun/zero for reduced reference (Pron3/Dem/Def/Indef/Zero). In the case of a preceding preposition, a corresponding expression with a Prep-tag is to be chosen.
- c. Gender (*refAnGender* tier): male/female/neutral/mixed/other (M/F/N/Mixed/Other). ‘Mixed’ is used for a compound expression which refers to several different entities (as shown in Example 10). ‘Other’ is used when it is impossible to define the gender of paired elements, such as *nožnicy* ‘scissors’, *br’uki* ‘pants’, etc.
- d. Number of the referent (*refAnNumber* tier): singular/plural (SG/PL)
- e. Syntactic expression (*refAnSynt* tier): subject/direct object/indirect object/other (Subj/DirObj/IndirObj/Other).

Apart from this, each *refAnaphoraN* and *refDeixis* tier has an dependent tier with comments where the type of relation for compound elements (Coordination / Subordination), a preceding definite (With Def) or indefinite pronoun (With Undef), or relative clause (With REL) can be marked, along with emphasis (Emphasis) or contrastiveness (Contrast).

An example of referential annotation is presented below in **Figure 1**:

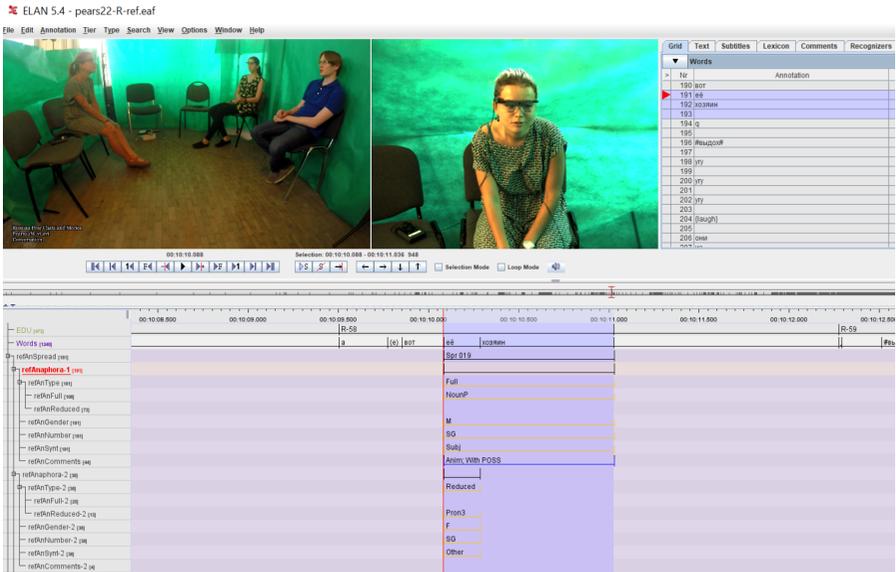


Fig. 1. Referential annotation of the compound unit
[[*jeje*] *xoz'ain*] ‘[[[her] owner]’

4. The distribution of referential units in the corpus

According to the demo subcorpus of 3 sessions (9 videos—22N, 22C, 22R; 4N, 4C, 4R; 23N, 23C, 23R, total duration equals to 141 minute), among the most frequent anaphoric referential expressions full NPs with a noun or numeral head (FullNP) account the highest proportion (52%). They are followed by personal pronouns (Pron, 34%) and zero forms (Zero, 13%). Demonstrative pronouns are extremely rare (Dem, 1%):

Table 1. The distribution of different anaphoric expressions in the “Russian Pear Chats and Stories” corpus

	4N	4C	4R	22N	22C	22R	23N	23C	23R	Total
FullNP	161	103	187	144	92	154	121	123	133	1,218 (52%)
Pron	119	61	152	86	63	88	112	72	58	811 (34%)
Dem	2	1	2	0	2	2	2	5	2	18 (1%)
Zero	54	27	68	27	19	32	18	38	25	308 (13%)

This ratio is consistent with other results on Russian oral discourse (see, for example, [Grenoble 2001]). From a statistical perspective, no clear relationship between the percentage of referential expressions and the speaker’s role (N/C/R) was revealed at this stage. However, a number of features (in particular, a rather high percentage of pronouns in 23N, compared to other speakers, see **diagram 1**) draws attention and may be the subject of further research.

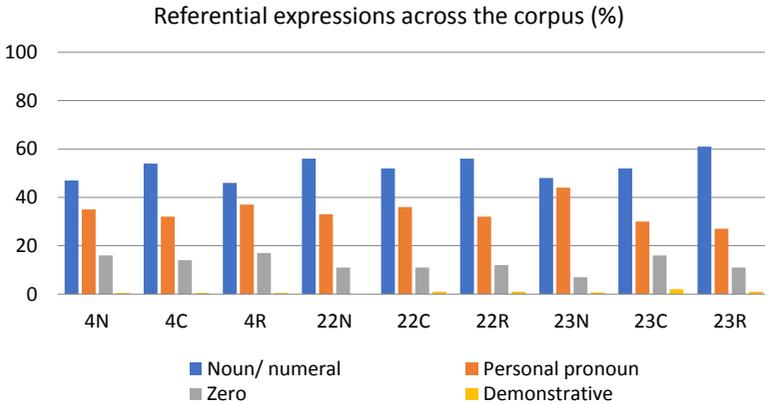


Diagram 1. The distribution of different anaphoric expressions according to the speaker’s role (N/C/R)

The analysis of deictic subject reference revealed the expected advantage of the pattern with an explicitly expressed pronoun (67%) over the zero one, see **Table 2**.

Table 2. Deictic subject reference in the “Russian Pear Chats and Stories” corpus

	4N	4C	4R	22N	22C	22R	23N	23C	23R	Total
Overt	18	4	11	20	7	7	9	4	5	85 (67%)
Zero	8	6	3	5	7	2	6	3	2	42 (33%)

It was also found that commentators used a significantly larger percentage of constructions with a zero subject pronoun, compared to other participants:

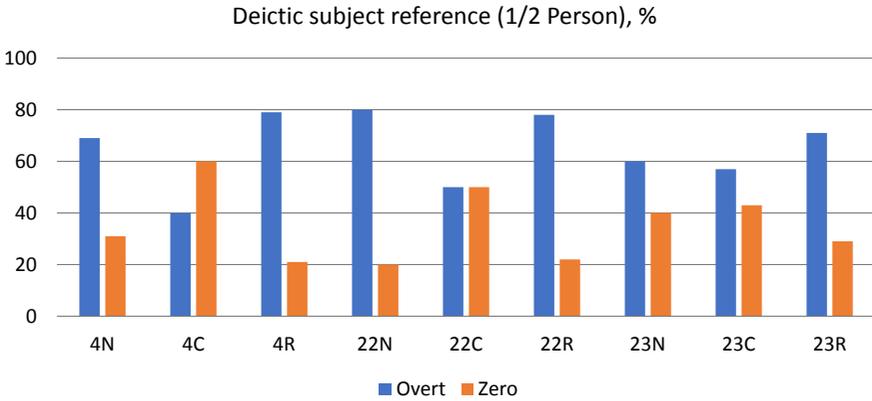


Diagram 2. The distribution of personal deictic pronouns according to the speaker’s role (N/C/R)

Statistical analysis (Fisher’s exact test, p-value <0.05) confirmed that C dropped pronouns significantly more often than N and R. Apparently, the role of the Commentator, who participated only in a spontaneous conversation process and never produced a more structured monologue, was associated with more conditions for the discourse subject ellipsis (for more details on this phenomenon, see [Zdorenko 2010]). In this regard, the empirical remark that in Russian “the absence of the first person subject pronoun is related to the neutralization of the speaker’s role” [Fougeron, Breillard 2004: 159] can be proven: compared to N and R, C focused to the least extent on himself/herself. This additionally contributed to a greater percentage of patterns with a zero subject pronoun.

5. Application of referential annotation: referential expressions in interaction with the manual channel

Studies conducted on several European languages indicate that new and cognitively less accessible referents are more likely to be expressed by full NPs with a noun head [Chafe 1994] and accompanied by a gesture [Levy, Fowler 2000]. In contrast, pronouns and zeros are associated with the most cognitively accessible information that does not imply additional expression on a non-verbal level. Our research was aimed at testing this hypothesis on Russian-language data, focusing particularly on pointing gestures.

On a semantic level, this type of gesture connects most closely to specific definite linguistic entities, and therefore to referential expressions [Kibrik 2011: 41]. At present, studies on relations between reference and gestures exist ([Gullberg 2006; Debreslioska et al. 2013]), yet there are rather few works on particular types of gestures and accompanying referential expressions, and all of them are based on languages others than Russian ([Sluis, Krahmer 2007] on Dutch, [Azar, Özyürek 2015] on Turkish).

In the course of our analysis, all pointing gestures were extracted from the previously conducted manual annotation of the corpus [Litvinenko et al. 2016]. Afterward, strokes—the most semantically significant phases of the gestures—were aligned with referential expressions that overlapped with them in time, according to the principle of “minimal overlapping” [Fedorova et al. 2015]. Many gestures accompanied the verbs of movement and did not correspond to explicitly expressed referential expressions. Although these gestures underwent no further analysis, the summary **table 3** incorporates them as well.

Statistical analysis of the data obtained showed that in most cases pointing strokes were aligned with full NPs with a noun and numeral head (χ -square, p-value < 0.01). Next are demonstrative pronouns, which overlap with a pointing stroke more often than personal pronouns (χ -square, p-value = 0.05). This conclusion is consistent with similar observations on other languages but specifies the behavior of pronouns and demonstratives.

It was also found that the “prototypical” object, accompanied by a pointing gesture, is a singular noun (see **Table 4**). No correlation between the presence of a pointing gesture, on the one hand, and the referent’s gender and grammatical role, on the other hand, has been detected.

Table 3. Types of different referential expressions (nouns/numerals; personal pronouns and demonstratives, including demonstrative pronouns within full noun phrases with a noun head), aligning with strokes of pointing gestures

	4N	4C	4R	22N	22C	22R	23N	23C	23R	Total
Pointing gestures	78	14	30	52	30	40	54	19	39	356
NounP/ NumP	37 (45%)	3 (14%)	14 (47%)	20 (38%)	12 (37%)	15 (38%)	21 (39%)	8 (42%)	22 (56%)	153 (44%)
Pron	4 (5%)	2 (14%)	7 (23%)	3 (6%)	7 (23%)	4 (10%)	7 (13%)	2 (10%)	8 (21%)	44 (14%)
Dem_all	2 (2%)	0 (0%)	2 (7%)	0 (0%)	2 (7%)	1 (3%)	0 (0%)	1 (5%)	2 (5%)	11 (3%)

Table 4. Singular and plural referential expressions aligned with pointing gestures’ strokes (%)

	TOTAL	Aligned with pointing strokes	%	p-value (χ -square)
Full NP SG	871	121	14%	0.05
Full NP PL	380	37	9%	

This data can serve as an aid to the analysis of human communication. In particular, obtained correlations can help determine the most probable referential expression in case of a sound loss.

6. Conclusion

The article has demonstrated the application of referential markup to a large multimodal corpus. A specially designed annotation scheme was presented, allowing for a simultaneous analysis of referential expressions and accompanying non-verbal means of communication. It was shown that the addition of a new referential component could contribute to studies of both referential choice and the interaction of different communication channels. Namely, it was found that the role of the Commentator in the process of spontaneous dialogue entails a significantly larger percentage of constructions with zero subject pronouns, compared to the monologue discourse of the Narrator and the Reteller. The analysis of referential expressions and accompanying pointing gestures confirmed data which were previously obtained on the English material [Levy, Fowler 2000] and showed that in most cases pointing strokes were accompanied by full NPs with a noun or numeral head and almost never accompanied by personal pronouns. Demonstratives took an intermediate place in this hierarchy.

Further research on the relationship between referential expressions and speakers' nonverbal behavior (e.g., eye and head movements) will likely contribute to establishing other unnoticed peculiarities of human communication.

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