

# Paraphrasing Portuguese Adverbs ending in *–mente*

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**Abstract.** In this paper, we depart from the lexical-syntactic-semantic properties that were used to classify the most frequent *–mente* ‘*–ly*’ ending adverbs in Portuguese, and explore the generation of different paraphrasing patterns, both regular or very general structures, such as those for manner and view point adverbs, as well as other, less productive (and sometimes idiomatic) structures. The goal is to provide a comprehensive set of paraphrasing strategies, which can be used in several natural language applications, like text simplification or even machine translation.

**Keywords:** adverbs, ending in *–mente* ‘*–ly*’, paraphrase, word sense disambiguation, lexicon-grammar, Portuguese

## 1 Introduction

Adverbial constructions are a important part of the content of any text, and show a complex syntax, which can be seen as a challenge to many Natural Language Processing (*NLP*) applications. Their formal (syntactic) properties include: (i) the adverbs’ *scope* (either a single constituent or an entire sentence; (ii) (basic) position; (iii) quantification; (iv) the part-of-speech (*PoS*) they modify; (v) the type of paraphrase(s) they can allow. It is this later type of property that will be the focus of this paper. Also, we adopt the concept of *paraphrasing* in the Harrisian [11] and Lexicon-Grammar [6,8] perspectives, that is, whenever there is a *transformational* equivalence relation between sentences, which requires that the same meaningful lexical material (even if in a different form) is involved. Mere synonymy is, therefore, excluded. Paraphrase is, thus, a theoretically motivated tool for linguistic description, though, to the best of our knowledge, issues arising from systematically exploiting paraphrastic mechanisms on Portuguese adverbial constructions in running (concatenated) texts had not been described before.

In this exploratory paper, we depart from the lexical-syntactic-semantic properties [14] that were used to classify the most frequent adverbs ending in *–mente* ‘*–ly*’ in Portuguese [5]. We posit that the lexical-syntactic classification is key to produce adequate paraphrases for these adverbs and we test the generation of different paraphrasing patterns on real examples randomly selected from corpus.

On the other hand, we aim at obtaining a comprehensive set of paraphrasing strategies, along with some constraints on their application, which can be used as guidelines for systematic description of adverbial constructions, and may be used in several NLP applications, such as text simplification or even machine translation.

Word sense disambiguation (WSD) is construed as a prior step to the paraphrasing task. A previous machine-learning approach to WSD of the most frequent, derived adverbs ending in *-mente* ‘-ly’ from Brazilian Portuguese [5] reported an overall accuracy of 81%. Therefore, only (or mostly) paraphrases of unambiguous (monosemic) adverbs will be considered here.

## 2 State of the art

Though many authors have produced insightful descriptions on adverbs’ syntax and semantics [2,3,4,12], these studies consist mostly of sparse observations, and some clarification of distinctive semantic and (more rarely) syntactical (i.e. formal) properties. Furthermore, taxonomies and classification schemata, when produced, often show overlapping criteria. It is, thus, safe to say that, to the best of our knowledge, no systematic and comprehensive description of this PoS has been produced for any natural language, except perhaps for French compound adverbs [7] and particularly for French derived adverbs ending in *-ment* ‘-ly’ [14] .

In this paper, we adopt the Lexicon-Grammar [8] approach to language description and the classification of adverbs originally proposed by [14], and later adapted to the description of Portuguese adverbs, namely, to the most frequently occurring adverbs ending in *-mente* ‘-ly’ from the Brazilian Portuguese [5]; and to the compound adverbs of European Portuguese [15]. In this theoretical framework, adverbial constructions are organized into 9 classes: 3 main types of sentence-modifying adverbs (classes Px) and 6 main types of proposition-internal modifying adverbs (classes Mx). For lack of space, a detailed description of the syntax and semantics of these constructions can not be present here. Please refer to the works above.

## 3 Methods

From the CETEM*Público* corpus [17], we first extracted all the lemmas of the adverbs ending in *-mente* ‘-ly’ (4,384). From the 974 adverbial constructions already described in the STRING system [13] lexicon, only 28 (> 3%) did not occur in the corpus. Using the information encoded in that lexicon, we remark that 110 (11.3%) of the adverbs found in the corpus are ambiguous, with 2 or more word senses (and the correspondingly distinct syntactic behaviour). For example, *pontualmente* ‘occasionally/punctually’, can function as a sentence-internal, time-related, aspectual (frequency) modifier (class MT), as in *Pontualmente, o*

*Pedro faz isso* ‘Occasionally, Pedro does that’; or as a sentence-internal, subject-oriented manner adverb (class MS), as in *O Pedro chegou à reunião pontualmente* ‘Pedro arrived at the meeting punctually’.

Next, for each syntactic-semantic class, the main paraphrasing strategies were described, using finite-state transducers with the Unitex 3.1. corpus processing tool [16]. The linguistic description was based on the concordances of adverbs from each class that were retrieved from the corpus (excluding those that were to be used in the evaluation). For the evaluation, 10 randomly selected concordances of the 2 most frequent adverbs of each syntactic-semantic class (ideally, only non-ambiguous words) were extracted from the corpus. The quality of the paraphrased sentences (*i.e.* their semantic equivalence *and* acceptability) was independently assessed by 2 native-speaker annotators, and any divergence discussed and sorted out. As the purpose of the paper is essentially exploratory, no inter-annotator agreement assessment is provided here.

## 4 Paraphrases

In this section, we highlight some of the most common paraphrasing structures found for adverbs ending in *-mente* in European Portuguese. For clarity, these are organized by classes, though some can pertain to multiple classes. Because of its more complex syntax and for not being prone to regular paraphrasing, time-related adverbs (class MT) [9,10], quantifiers (MQ) and focus adverbs (MF) [1], which are closed classes, will not be considered in this paper.

**PC (conjunctive adverb)** One of the most interesting paraphrasing strategies found for adverbs ending in *-mente* is the possibility of producing a prepositional phrase whose head is the noun morphologically associated to the base adjective whence the adverb was derived (noted *PrepC*). These nominal paraphrases are often constraint for the preposition and the determiner, or only allow a very limited, lexically determined, variation. Hence, many of them are already encoded in the lexicon of STRING as compound adverbs [15]. Due to the idiosyncrasies of these word combinations, these paraphrases must be directly encoded in or associated to the adverb *-mente* lexical entry. For example, besides *consequente-mente* ‘consequently’ (204 occurrences), both these two paraphrases are found: *em consequência* ‘in consequence’ (767 occurrences); and *por consequência* ‘by consequence’ (354). The different frequencies of these variants could hint for a paraphrasing strategy.

**PS (disjunctive-style adverb)** In a Harrissian framework [11, p. 91], style-disjunctive adverbs (class PS) operate as a manner adverb on a meta-linguistic, performative operator *Eu digo* ‘I say’ underlying any utterance. Hence, they could, in principle, be paraphrased by reconstructing such operator (and transforming the utterance into indirect speech). Thus, for an utterance such as: **par=ext803257-pol-95b-1**: *Especificamente, o principal motivo das consultas é a artrose do joelho, [...]* ‘Specifically, the main reason for the medical ap-

pointments is the knee arthritis . . .’ one should produce a sentence like: *Eu digo especificamente que o principal motivo das consultas é a artrose do joelho* ‘I say specifically that the main reason for the medical appointments is the knee arthritis’. Variants of these base form would be a so-called *reduced participle sub-clause* (noted *dito Adv*), especially when the adverb is modified by *mais* ‘more’: *Dito mais especificamente, o principal motivo das consultas [.]* ‘Said more specifically, the main reason for the medical appointments [.]’; or a so-called *reduced gerundive sub-clause* (noted *Adv falando*), with *falar* ‘say’: *Especificamente falando, o principal motivo das consultas [.]* ‘idem’ (notice that *dizer* ‘say’ and *falar* ‘say/talk’ are distinct operators). However, as *especificamente* ‘specifically’ is also classified as a *manner* adverb (MV) and a *focus* adverb (MF), in the cases where this ambiguity has not been adequately solved, incorrect paraphrases are expected.

**PA (disjunctive-attitude adverbs)** This class comprises several subclasses<sup>3</sup>. Sentence-modifying, *evaluative adverbs* (PA:eval): **par=ext4944-eco-97b-2**: *Surpreendentemente, o juiz nem leu mais nada [.]* ‘Surprisingly, the judge did not even read anything else’ could be paraphrase by a opinion-stating verb like *Eu acho/penso* ‘I think’ on an adjectival sentence having the utterance as its subject: *Eu acho (que é) surpreendente que o juiz nem tenha lido mais nada [.]* ‘I think (that it is) surprising that the judge did not even read anything else’.

Next, *modal adverbs* (PA:modal) attribute a specific modality to the sentence they modify: **par=ext436372-des-96a-2**: *Provavelmente, [ele] é mais inteligente do que o Jean-Jacques* ‘Probably [he] is smarter than Jean-Jacques’

Irrespective of the class, these types of adverbial constructions are often equivalent to an adjectival construction with a subject sub-clause (noted *QueF ser Adj* ‘That S be Adj’): *É provável que ele seja mais inteligente do que o Jean-Jacques* ‘It is probable/likely that he be smarter than Jean-Jacques’ However, this is a lexically constraint property, requiring explicit description, as some adverbs preclude such transformation: *Aparentemente, ele é mais inteligente do que o Jean-Jacques*; cf. *\*É aparente que ele seja/é mais inteligente do que o Jean-Jacques* ‘It is apparent/likely that he be/is smarter than Jean-Jacques’.

**MV (manner adverbs)** Quantitatively, this is the most important lexicon-syntactic class of adverbs. The typical paraphrasing structure involves a prepositional phrase with *manner operator nouns* [7] *modo, maneira, forma* and (only for Brazilian Portuguese) *jeito* ‘way/manner’. The acceptability of the paraphrase is closely dependent on the part-of-speech of the predicative element they modify (adjective or verb), their relative position and the (often) collocational status of the word combination [18]. Consider, for example, the adverb *abertamente*

<sup>3</sup> Besides those mentioned here, class PA also includes two other sub-classes: *habit adverbs* (PA:habit) e.g. *habitualmente* ‘usually’ and *subject-oriented* (PA:subj-oriented), disjunctive-attitude adverbs, e.g. *inteligentemente* ‘intelligently’. However, there are still few such adverbs in the lexicon of STRING; and, as they are often ambiguous with other classes, they will not be addressed in this paper.

‘openly’, which can combine both with verbs (1,401), either before (1,256) or after (145) them, and with adjectives, but only before them (131). In spite of the somewhat idiomatic sense of the adverb (there is no synchronic transformational relation with the verb *abrir* nor the adjective *aberto* ‘open’), it can almost always undergo the characteristic paraphrase with manner operator noun *modo* (and its variants) when combined with a verb: **par=ext559653-eco-91b-2**: *Os Verdes, o partido que mais abertamente [= de um modo mais aberto] criticou a cimeira ...* ‘The Green, the party that more openly (=in a more open way) criticized the summit ...’; **par=ext21956-pol-95b-1**: *Powell criticou abertamente [= de um modo aberto] Robert McNamara ...* ‘Powell criticized openly (=in an open way) Robert McNamara’. However, as a left modifier of an adjective, e.g. **par=ext391158-opi-97a-2**: *Sou abertamente favorável à autonomia regional, ...* ‘[I] am openly favourable to the regional autonomy ...’ the adverb can not undergo this operation, neither before nor after the adjective: *\*Sou de forma aberta favorável à autonomia regional / \*Sou favorável de forma aberta à autonomia regional*.

Finally, one should notice that, irrespective of the syntactic-semantic class, some non-MV adverbs ending in *-mente* still retain the possibility of being paraphrased by the (analytically derived?) so-called *manner operator nouns*: **par=ext1450788-nd-91a-2**: *Por esta razão e de modo paradoxal [=paradoxalmente], na década de 70, a população estrangeira aumentou em lugar de diminuir [...]* ‘For this reason and in a paradoxal way (=paradoxically), in the 70s, the foreign population augmented instead of diminishing ...’. This is often not the case with non-MV adverbs, like the ambiguous adverb *consequentemente* ‘consequently’, which is both a PC and a MV adverb: *Consequentemente = \*PC/MV De um(a) modo/maneira/forma/jeito consequente, o Pedro fez isso* ‘Consequently/In a consequent way/manner, Pedro did that’ since this paraphrase would only be interpreted as a manner adverb MV.

**MS (subject-oriented, manner adverbs)** As part of their double-scope definition, subject-oriented manner adverbs (MS), like *discretamente* ‘discreetly’: **par=ext203154-pol-92a-1**: *O dirigente socialista MS vai apoiar discretamente a candidatura de NM à liderança ...* ‘The socialist leader MS will discreetly support the candidacy of NM to the leadership ...’, besides allowing the paraphrase with manner operator noun *modo* (and its variants): *O dirigente socialista MS vai apoiar de modo discreto a candidatura de NM à liderança ...* ‘The socialist leader MS will support in a discreet way the candidacy of NM to the leadership ...’, also allow for an adjectival paraphrase that capture the relation between the adverb and the subject: *O dirigente socialista MS foi discreto a apoiar a candidatura de NM à liderança ...* ‘The socialist leader MS was discreet in supporting the candidacy of NM to the leadership ...’ (in the examples above, proper names were shortened).

**MP (point-of-view adverbs)** At the beginning of a sentence, MP adverbs can usually be paraphrased by a prepositional phrase with the compound operator

noun *ponto de vista* ‘point of view’: `par=ext1326334-eco-92a-1`: *Financeiramente* (= *de um/o ponto de vista financeiro*), *o mercado de acções foi afectado*, ... ‘Financially (= from a/the financial point of view), the stock market was affected, ...’ The framing of the main clause content by the MP adverb appeals to the speaker’s own point of view, which can partially explain the paraphrase with the gerundive sub-clause with *falar* ‘speak’: *Financeiramente falando/falando de um/o ponto de vista financeiro*, *o mercado de acções foi afectado*, ... ‘Financially speaking /Speaking from a/the financial point of view, the stock market was affected, ...’

A concluding remark on *positional variation*, another important syntactic property to characterise (and distinguish) adverbial constructions. For example, for the conjunctive adverbs PC like *consequentemente* ‘consequently’, one finds, detached by comma(s), at the beginning of sentence, 204 instances; 1,199 occurrences in the middle of the sentence; and, though theoretically possible, no instances at the end. The homograph MV adverb is rather rare (11 instances) and it only appears next to (after) a limited set of verbs, *e.g. agir* ‘act’. Positional variation, though it does not involve rewording, can be considered a special type of paraphrasing, as it entails (ortho)graphical changes in the text (i.e. upper/lower case and punctuation changes). This variation was not considered in this work.

## 5 Results

The concordances of the 14 most frequent (mostly non-ambiguous) adverbs ending in *-mente*, two from each one of the selected classes, were retrieved from the corpus, and 10 instances of each adverb were randomly selected for the evaluation. A set of finite-state transducers were built, using the information mentioned in Section 4 and encoded in the lexicon in order to replace the adverbs by the appropriate paraphrases. For lack of space these graphs can not be shown here.

Table 1 shows the information encoded for each adverb in the test set and the results (precision) obtained by assessing both the identity of meaning and the acceptability of the paraphrases produced in this way. Lexical gaps are marked ‘-’ and non-relevant properties are marked ‘x’. For clarity, results will be commented by type of paraphrase and examples are provided as follows: first the original text, then the automatically produced paraphrase and finally the correct/desired form (signalled by ‘→’).

**PrepC** The equivalence to prepositional phrase met some difficulties. When the adverb is also modified by a comparative adverb (*v.g. mais* ‘more’, *tão* ‘as much as’), which precedes the adverb, the natural word order is altered or the choice of the comparative element must undergo changes: *adaptar-se mais facilmente*/\**adaptar-se mais com facilidade* → *adaptar-se com mais facilidade* ‘to adapt more easily’; *não se entende tão facilmente*/\**não se entende tão com facilidade* → *não se entende com tanta facilidade* ‘can not be understood so easily’. In passive constructions, the prepositional phrase is more natural after the past

**Table 1.** Paraphrastic properties of selected adverbs and precision achieved

Class	Adv-mente	PrepC	Prep-C	de-modo-Adj	de-pdv-Adj	dito Adv	Adv falando	QueF ser Adj	N <sub>0</sub> <sup>hum</sup> ser Adj
PC	<i>comparativamente</i>	<i>em/por comparação</i>	0.9	x	x	x	1.0	x	x
PC	<i>finalmente</i>	<i>por fim</i>	1.0	x	x	x	x	x	x
PS	<i>especificamente</i>	-	x	0.3	x	0.1	0.2	x	x
PS	<i>literalmente</i>	-	x	0.7	x	0.0	0.7	x	x
PA:eval	<i>curiosamente</i>	<i>por curiosidade</i>	1.0	1.0	x	x	x	1.0	x
PA:eval	<i>infelizmente</i>	-	0.9	x	x	x	x	-	x
PA:modal	<i>aparentemente</i>	-	0.9	x	x	x	x	-	x
PA:modal	<i>realmente</i>	<i>na realidade</i>	1.0	x	x	x	x	-	x
MV	<i>facilmente</i>	<i>com facilidade</i>	1.0	0.6	x	x	x	x	x
MV	<i>imediatamente</i>	<i>de/no imediato</i>	0.9	0.9	x	x	x	x	x
MS	<i>cuidadosamente</i>	<i>com cuidado</i>	1.0	0.5	x	x	x	x	1.0
MS	<i>violentamente</i>	<i>com violência</i>	1.0	0.6	x	x	x	x	0.8
MP	<i>financeiramente</i>	-	x	x	1.0	x	0.9	x	x
MP	<i>judicialmente</i>	<i>na justiça</i>	1.0	x	1.0	x	0.8	x	x

participle, though the adverb can also occur before it: *A embaixada da Rússia foi também violentamente atacada pelos manifestantes* ‘The Russian embassy was also violently attacked by the protesters’ (cp. *foi atacada violentamente*), \*/?\**A embaixada da Rússia foi também com violência atacada pelos manifestantes* → *A embaixada da Rússia foi também atacada com violência pelos manifestantes*. Certain constraints on word combinations seem to be related to the collocational status of those strings (cp. [18]): *Cerqueira estava judicialmente impedido de exercer* ‘Cerqueira was judicially prevented from exercising’/\**Cerqueira estava na justiça impedido de exercer* (→ ?*Cerqueira estava impedido pela justiça de exercer*).

**de modo Adj** As expected, most instances of *manner* adverbs (classes MV), and less so the *subject-oriented manner* adverbs (class MS), allow for the paraphrase with manner operator noun (*forma*, *maneira*, and *modo*; *jeito*, for BP alone), and errors are partially due to the already mentioned combination with comparatives and the passive construction. Due to their natural ambiguity with *manner* adverbs (MV), the *style* adverbs (class PS) also allow this paraphrase. Still, as a PS, the adverb *literalmente* ‘literally’ seemed to be used more for expressing *modality* (*realis*) than *manner*, and the sentences’ acceptability is generally dubious or only keep the MV interpretation. In a clear-cut use, this modal value renders the sentence unacceptable in more evident way: [Eu] *não sei literalmente nada* ‘I do not know literally ( $\approx$  absolutely) nothing’/\*[Eu] *não sei de modo literal nada* (cp. [Eu] *não sei realmente nada*. The poor result with *es-*

*pecificamente* ‘specifically’ is due to the predominant use as a *focus* adverb (MF). Surprisingly, the PA:eval adverb *curiosamente* ‘curiously’ allows this paraphrase.

***de ponto de vista Adj*** As expected, all *point-of-view* adverbs (MP) allow this paraphrase with the operator noun *ponto de vista* (*pdv*).

The next properties are specific of sentence-modifying adverbs.

***Dito Adv-mente* ‘said Adv-ly’ and *Adv-mente falando* ‘Adv-ly speaking’** Though only PS adverbs were expected to accept these paraphrases, none of the 2 selected adverbs does it, for the same reasons explained above. It is worth mentioning that *comparativamente* ‘comparatively’ allows the equivalence with the gerundive structure: **par=ext313886-des-94a-2**: *A corrida feminina produziu, comparativamente [falando], melhores resultados [do] que a masculina* ‘The woman’s race produced, comparatively (speaking), better results than the men’s one’. Surprisingly, however, most instances of *point-of-view* adverbs (MP) can also be paraphrased in the same way.

***(Eu acho) QueF é Adj* ‘(I think) ThatS is Adj’** This property applies specifically to evaluative adverbs (class PA:eval). It is near impossible to produce paraphrases unless the sentence is very simple, or the clause on which the adverb operates has been correctly extracted. A possible example is: **par=ext1154964-pol-98a-1**: *[Ele] Não desmente, curiosamente, a citação [...]* ‘[He] does not deny, curiously, the quotation’, which would produce:  $\rightarrow$  *(Eu acho que) é curioso que [ele] não desminta a citação* ‘(I think that) it is curious that [he] does not deny the quotation’. Notice the change of tense of the verb in the sub-clause: *desmente* (indicative-present)  $\rightarrow$  *desmente* (subjunctive-present). The adverb *infelizmente* ‘unfortunately’ seems particularly resilient to this transformation, even in simple sentences: **par=ext1198599-nd-91b-2**: *A guerra, infelizmente, criou situações que nos vão dar muito material para escrever*, which does not seem to correspond naturally to:  $?*[Eu]$  *acho que é infeliz que a guerra tenha criado situações que nos vão dar muito material para escrever*.

**$N_0^{hum}$  *ser Adj*** This property corresponds to the elicitation of the double-scope of subject-oriented, manner adverbs (class *MS*), hence it presupposes the correct parsing of the verb’s subject.

## 6 Conclusion and Future Work

In short and to conclude, strictly local changes in sentence-internal modifiers (Mx classes) seem to be feasible by the tools here used, while the specific properties of sentence-modifying adverbs (Px classes) are difficult to formalize. Most paraphrastic properties are class-specific or even lexically dependent, and attention must be given to certain syntactic contexts, namely the presence of further adverbial modifiers, coordination, passive constructions and, in general, the fact



that the adverb is modifying a verb or and adjective. It is clear from the sample of adverbs here described that most properties are lexically dependent, and paraphrasing can not be addressed by just using the overall classification.

In the future, extensive coverage of the lexicon-grammar of adverbs is envisaged, with an eye on the potential use of the linguistic description of paraphrases for applications such as text simplification, language learning tutorial tools and translation. In particular, a fine-grained word-sense catalog of adverbs is still necessary, covering a larger portion of the lexicon of Portuguese adverbs ending in *-mente*. This can only be done by patiently discovery of the differences between word uses, in order to use machine-learning techniques for word-sense disambiguation.

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