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Abstract: This paper discusses the role of cognitive factors in language change; specifically, it investigates the potential impact of argument ambiguity avoidance on the emergence of one of the most well-studied syntactic alternations in English, viz. the dative alternation (*We gave them cake* vs *We gave cake to them*). Linking this development to other major changes in the history of English like the loss of case marking, I propose that morphological as well as semantic-pragmatic ambiguity between prototypical agents (subjects) and prototypical recipients (indirect objects) in ditransitive clauses plausibly gave a processing advantage to patterns with higher cue reliability such as prepositional marking, but also fixed clause-level (SVO) order. The main hypotheses are tested through a quantitative analysis of ditransitives in a corpus of Middle English, which (i) confirms that the spread of the PP-construction is impacted by argument ambiguity and (ii) demonstrates that this change reflects a complex restructuring of disambiguation strategies.

Keywords: constituent order; dative alternation; disambiguation strategies; Middle English; prepositional marking

1 Introduction

This paper presents a cognitive linguistic approach to language change, and particularly to the question how syntactic variation can come about and be maintained. Specifically, the paper focuses on the role of cognitive mechanisms such as ambiguity avoidance in the emergence and spread of the English dative alternation, illustrated in (1). For that purpose, it draws on current typological and psycholinguistic insights into semantic role distinction and argument disambiguation strategies.

(1) a. The lecturer gave the student **some cake**.
b. The lecturer gave **some cake** to the student.

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As seen in the examples, ditransitive (transfer and transfer-related) verbs such as *give*, which typically involve an agent, a recipient-like argument and a theme (Malchukov et al. 2010), can occur in different constructions in present day English.[1] On the one hand, the verbs appear in a pattern involving two nominal object arguments, commonly referred to as the double object construction (DOC; 1a). On the other hand, a prepositional construction involving *to* can be used for most ditransitive verbs (PC; 1b). The choice between the constructions correlates with preferred object order, in that the DOC typically features 'RECIPIENT before THEME' order, whereas the recipient follows the theme in the PC. The choice has also been shown to depend on a range of linguistic factors often grouped as 'prominence' features; this is summed up in the principle of 'harmonic alignment':

> animate, definite, pronominal, discourse-accessible, and shorter arguments tend to precede inanimate, indefinite, nonpronominal, less discourse-accessible, or longer arguments in both of the dative constructions. (Bresnan and Ford 2010: 181; also, e.g., Haspelmath 2007)

That is, there is robust evidence that semantic-pragmatic features such as animacy, definiteness or givenness, but also length/weight of the objects affect which member of the alternation is used – shorter recipients will tend to precede longer themes, and thus favour the DOC, while shorter themes will appear before longer recipients in the PC (Bresnan et al. 2007; among many others).

Regarding the history of the phenomenon, it is first important to note that the PC, and accordingly the alternation, was not yet present in Old English – or was at least not systematically available for prototypical giving-verbs (De Cuypere 2015c). Example (2) illustrates one of the earliest uses of the PC with *give* from early Middle English, when the pattern started to increase in frequency. The sentence furthermore reflects the fact that object order was flexible and not clearly associated with construction in earlier English – in (2), the prepositional recipient comes before the theme, contrary to present day preferences (De Cuypere 2015a, 2015b; McFadden 2002; Zehentner 2019).

(2) þu […] ȝeue to ioseph […] **hap.**
you give to Joseph happiness
'You give happiness to Joseph.'
(1225; CMJULIA, 119.390)

1 'Ditransitive' is used as a rather general cover-term for three-participant event expressions in this paper: 'ditransitive constructions' refers to both the DOC and the PC when a distinction between the two constructions is not relevant, while a 'ditransitive clause' means an instantiation of either of the two constructions. The term 'ditransitive verbs' denotes verbs typically (but not necessarily exclusively) found in ditransitive constructions, i.e., with two object arguments.

In general, constituent order in the clause was still comparatively free in earlier English, with variation in the relative position of the verb and its arguments. However, clause constituent order has since come to be fixed to categorical SVO (e.g., Hawkins 2012; Kroch and Taylor 2000b; Trips 2002). Today, position is accordingly a highly reliable strategy for argument role identification.

Finally, the history of ditransitive constructions evidences another important systemic change in the history of English, viz. a great reduction in morphological inflection in both the verbal and nominal domain (e.g., Allen 1995). This means that from Middle English onwards, arguments were increasingly difficult to differentiate based on verb agreement or nominal case. The latter, specifically the loss of formal (morphological) distinction between recipients and themes in ditransitives, also constitutes one of the main explanations for the spread of the PC and the development of the dative alternation, as the ambiguities caused by the disappearance of case presumably needed to be remedied by prepositional marking (McFadden 2002; Polo 2002). However, this account has also been criticised, as the referents of the object arguments in three-participant events typically have quite different features – for example, recipients are cross-linguistically predominantly animate in contrast to usually inanimate themes, and disambiguation between these roles should usually have presented few issues (Fischer 1992; Gast 2007).

The present paper now builds on ambiguity and ambiguity resolution as a possible factor in the emergence of the dative alternation, but is the first to empirically evaluate this question based on quantitative corpus data. What is more, the paper does not only take into account potential Recipient-Theme ambiguities, but pursues a further avenue which has to date not been explored at all. This approach is grounded in an abundance of typological, cognitive-functional and psycholinguistic research on present day stages of languages and textual as well as experimental evidence, which demonstrate that argument ambiguity is typically resolved by strategies like constituent order/position, morphosyntactic cues such as case, preposition marking and agreement or semantic-pragmatic hierarchies (e.g., Lamers et al. 2008). Absence or non-applicability of strategies typically leads to high processing costs, and trade-offs between strategies frequently occur both in synchronic language use and language acquisition, as well as in language diachrony.

Here, I place particular focus on the relation between agents and recipients in three-participant events, which are often very similar in terms of prominence features such as animacy. In situations where semantic-pragmatic asymmetries between arguments are of no avail, and morpho-syntactic contrasts were no longer or not yet available to exploit, this may have led to disambiguation issues, and patterns more transparently distinguishing agent and recipient arguments, such

as the PC, were likely to spread more rapidly. In other words, I suggest that the PC may have had a processing advantage in contexts where case and agreement had ceased to provide reliable disambiguation cues, and where cues from syntactic position were not yet fully consistent, i.e., where SVO was not yet systematically used. This proposal is tested against data from the *Penn-Helsinki Parsed Corpus of Middle English* (PPCME2; Kroch and Taylor 2000a), quantitatively analysing a set of over 1,600 annotated tokens of Middle English ditransitive constructions. The main goals of the study are (a) to assess the extent of overlap between agents, recipients and themes in terms of prominence profiles and (b) to investigate the impact of ambiguity measures on the choice of construction, including the interaction of construction and ambiguity with constituent order.

More generally, the study aims to showcase the role of factors grounded in language usage and cognition for language change. Operating on the usage-based idea that the same cognitive pressures and mechanisms constraining use in today's languages were also at play in earlier stages of languages, and guide language change (e.g., Bergs and Hoffmann 2017; also Bybee 2010; Croft 2003; Traugott 2017; Winters 2010), I demonstrate that exploring the effect of such factors – like pressures towards communicative efficiency and ambiguity avoidance – can lead to new insights about the historical emergence of cases of syntactic variation, and can put earlier assumptions on firmer theoretical and methodological standing. At the same time, I draw attention to potential difficulties in taking a usage-based/cognitive approach to questions in historical linguistics, specifically challenges in determining causal relationships in historical data (e.g., the interaction between different disambiguation strategies like constituent order and prepositional marking).

The structure of the paper is as follows: Section 2 first introduces strategies of argument disambiguation from a typological, psycholinguistic perspective (Section 2.1), before examining the history of the English dative alternation in the context of changes in role disambiguation strategies, and presenting the hypotheses of the paper (Section 2.2). Section 3 reports on the corpus study, starting with data and methodology (Section 3.1) before presenting the key results (Section 3.2). The section starts by demonstrating, by means of multiple correspondence and behavioural profile analysis, that agents and recipients very clearly cluster together against themes in terms of features such as animacy or definiteness (Section 3.2.1). This supports the assumption that prominence hierarchies or asymmetries do not provide information robust enough for disambiguation between agents and recipients. In order to investigate the extent to which such overlap impacts construction choice, especially compared to other strategies such as (lack of) case marking or fixed constituent order, I then fit a regression model to the data (Section 3.2.2). This confirms that morphological ambiguity between agents and recipients increases the likelihood of the PC to be used over

the DOC. However, AGENT-RECIPIENT ambiguity does not seem to significantly and straightforwardly interact with constituent order. The implications of these findings are discussed in Section 4: the spread of the PC, and accordingly the rise of the dative alternation can plausibly be linked to the greater argument disambiguation power of the prepositional pattern. At the same time, the results point towards redundant rather than complementary use of prepositional marking and SVO, in that one strategy is often used where the other would already disambiguate the arguments. This is interpreted as a case of 'degeneracy' as proposed in Van de Velde (2014). Finally, Section 5 considers the broader implications of the present study, focussing on the challenges and benefits of taking an approach grounded in cognitive-functional linguistics to long-standing questions in the history of English, and concludes the paper.

2 Argument disambiguation

2.1 Argument disambiguation from a typological and cognitive perspective

Argument disambiguation, viz. identifying 'who did what to whom' in a given utterance, is commonly achieved by means of one or more strategies. Most prominently, these include the following morphosyntactic cues (Lamers and de Hoop 2005; Lamers and De Swart 2012b; Malchukov et al. 2010):

(i) case or prepositional (adpositional) marking
(ii) agreement or person/number cross-referencing
(iii) constituent order (linearity constraints)

A further important factor exploited in ambiguity resolution is a range of semantic and pragmatic characteristics of the arguments, often subsumed under the term 'prominence' (e.g., de Swart et al. 2008). That is, language users frequently use the ranking of an element on hierarchies of features such as animacy, definiteness or givenness for disambiguation; these are assumed to be grounded in more general cognitive biases (e.g., Dahl 2008; Verfaillie and Daems 1996; Yamamoto 1999). For example, there is ample cross-linguistic, psycholinguistic evidence that animacy strongly correlates with semantic role and/or grammatical function assignment. Agents/subjects are prototypically associated with animate entities, while inanimates are more readily identified as patients/objects in prototypical transitive events (Bornkessel-Schlesewsky and Schlesewsky 2009; Czypionka et al. 2017).

Prominence asymmetries interact with the morphosyntactic strategies just outlined by, e.g., influencing constituent order: it is a well-attested tendency – also

reflected in the principle of harmonic alignment mentioned above – that arguments with animate and given referents are usually placed before inanimate, discourse-new elements (Branigan et al. 2008; Bresnan et al. 2007; Santesteban et al. 2012). On the other hand, the strategies interact in the sense that in the absence of one type of cue, or in contexts that violate prototypical expectations, others are drawn on to resolve ambiguities (see, e.g., the contributions in de Swart et al. 2008; Lamers and de Swart 2012a or MacWhinney et al. 2014; also Kittilä et al. 2011; Kulikov et al. 2006). This is illustrated in the examples below. In (3a), the arguments are ambiguous in both being animate, morphologically unmarked proper nouns, but can still be clearly distinguished on the basis of position, as present day English has fixed SVO order. By contrast (3b) has non-canonical constituent order in that the object is fronted, but prominence contrasts (animate person vs inanimate food item) serve to disambiguate and parse the sentence. In many languages, differential object marking, as e.g., investigated in Fedzechinka et al. (2012), Iemmolo (2013), Levshina (2020) or Tal et al. (2020), has a similar function: PPs are used to mark the objects of transitive verbs only in cases where some sort of ambiguity or non-predictable associations arise (e.g., with animate instead of inanimate themes, cf. the Spanish example in 4). As Czypionka et al. (2017: 1383) state, "[p]rocessing costs are enhanced when neither formal cues nor animacy contrasts are available".

(3) a. Sam saw **Laurie**.
b. **This cake** they will eat.

(4) *Veo* ***a*** ***la*** ***mujer*** / *Veo* ***la*** ***casa.***
I see PREP the woman / I see the house
'I see the woman/I see the house.'
(Tal et al. 2020: 2)

On a broader typological level, these interactions are relevant in that low salience or complete absence of one or more strategies often correlate with a prevalence of others. For instance, languages with fewer restrictions on constituent order, such as Modern German, typically feature more indicative morphological cues (such as case and/or agreement), while languages with less nominal or verbal inflection, like present day English, tend to rely more on fixed position (Haspelmath 2015: 31–32). Fedzechinka et al. (2016), among others, assess such cross-linguistic tendencies in an artificial language experiment, suggesting that they likely "originate in functionally motivated biases operating during language learning" (2016: 416).[2]

2 For studies of disambiguation strategies in language acquisition, see, e.g., Dittmar et al. (2008) and Lieven (2016), among many others.

Most relevantly for the present paper, such trade-offs between strategies are furthermore visible in the diachrony of languages, as the loss of one strategy tends to go hand in hand with an increasing emphasis on others (e.g., Allen 2006).

Zooming in on argument disambiguation with ditransitives specifically, we find that there are likewise clear prominence-related biases: ditransitive clauses prototypically feature animate agents and recipients, maximally opposed to the prototypically inanimate themes/direct objects (e.g., Sedlak 1975: 125; also Malchukov et al. 2010: 10). The pervasiveness of this constraint can account for the fact that in many languages, no additional strategy is used for disambiguation of the two object arguments – for instance, Kittilä (2006b: 292) states that "semantic role assignment is usually retrievable from animacy hierarchies alone, and no further marking is necessary for assuring the intended reading of canonical ditransitive clauses". Nevertheless, both prepositional encoding and position preferences are frequently found with ditransitive patterns (see Heine and König 2010; Malchukov et al. 2010; Margetts and Austin 2007: 402–403).

In contemporary English, as introduced above, ditransitive verbs participate in the so-called dative alternation, viz. they vary between two constructions which are differentiated through absence or presence of prepositional marking on the recipient-like argument, as well as object order. This means that language users can exploit strong ordering tendencies combined with systematic variation in prepositional marking as well as prominence asymmetries, suggesting that the disambiguation power of present day English regarding objects in ditransitive clauses is quite high. The following section takes a closer look at the history of ditransitives in English, highlighting that disambiguation strategies have been subject to significant change over time, and exploring ambiguity resolution as one influential factor in the emergence of the dative alternation.

2.2 Argument disambiguation in the history of the English dative alternation

The emergence of the English dative alternation as a systematic and pervasive case of variation is commonly located in Middle English. While PC uses with communication or sending verbs did exist before, they were only extended to the most prototypical ditransitive verbs, viz. verbs of transfer like *give*, at the beginning of this period (cf. De Cuypere 2015c).[3] From about 1100 onwards, the PP-construction

3 As shown elsewhere (Zehentner 2017), verbs of transfer and transfer-related senses consistently feature as the most frequent (and accordingly presumably most typical) verbs in ditransitive clauses. For discussions of the cross-linguistic prototypicality of *give* see e.g., Kittilä (2006a).

increased considerably in frequency and temporarily exceeded the DOC, before the trend was reversed again towards the later stages of Middle English (McFadden 2002; Zehentner 2019). Since then, the two patterns have relatively consistently been used in a two third DOC – one third PC distribution (e.g., Szmrecsanyi et al. 2017; Wolk et al. 2013).

Importantly, the spread of the PC and consequently the establishment of the alternation took place within a similar timeframe as other changes which characterise the history of English and are often viewed as part of a typological move from a more synthetic to a more analytic language (e.g., Baugh and Cable 1993: 60; also Hawkins 2012; Szmrecsanyi 2012). These include the decrease and eventual loss of much inflectional morphology both in the verbal and nominal domain, as well as an increasingly greater rigidity in constituent ordering. As to the former, the agents of Old English ditransitives were typically in the nominative, but the object arguments were not restricted to one particular case – recipients often appeared in the dative, by contrast to frequently accusative themes as in (5), but other combinations, also including genitives, are attested too (Allen 1995; De Cuypere 2015a).

(5) he forgeaf his geleaffullum **þa gastlican gife**
he.NOM gave his faithful.DAT the spiritual grace.ACC
'he gave his faithful the spiritual grace'
(ÆCHom_II,43:319.44.7210; De Cuypere 2015a: 231)

In present day English ditransitives, neither of the three arguments bears case inflection as such, and the two object arguments are not morphologically distinguished in any context (cf. [6], where recipient and theme are only distinguished through position). Concerning subjects and objects, by contrast, the issue is more complex. No formal contrast is maintained with noun phrases, but most pronoun forms (except for 3rd person singular neuter *it* and 2nd person plural *you*) still differ depending on syntactic function: in (7a–c), either agent or recipient or both are expressed by a 'form-changing' pronoun, and their roles can be easily identified even without drawing on position. Examples (7d–f), however, feature either NPs or 'unchanging' pronouns. In these clauses, agents and recipients are again morpho-syntactically only identifiable based on constituent order, with the agent preceding the verb, and the recipient in post-verb position (It is of course nevertheless plausible that in all examples, agent-recipient ambiguity may also be resolved by contextual, semantic-pragmatic information).

(6) They sent him **the student**. ~ They sent the student **him**.

(7) a. *They* gave them **a book**.
b. *They* gave the students **a book**.

c. *The lecturer* gave them **a book**.
d. *The lecturer* gave the students **a book**.
e. *You* gave the students **a book**.
f. *The lecturer* gave you **a book**.

In addition to this decrease in case distinctiveness, the indicativeness of verb-subject agreement in English has also been affected by a considerable reduction in verb inflections, with, e.g., no morphological person and number difference remaining in the past tense forms of lexical verbs (6–7).

As already indicated by the examples just given, changes in constituent order are relevant for ditransitives in two ways. First, up until Middle English clause-level constituent order was comparatively flexible, largely guided by information structure properties of the arguments involved (e.g., the relevant contributions in Nevalainen and Traugott 2012). The ditransitive clauses in (8) illustrate this variability: in (8a), the theme is in clause-initial place, followed by recipient, verb and agent, whereas (8b) features both agent and recipient before the verb, but the theme in post-verbal position. Since then, clause constituent order has come to be fixed to categorical SVO (Hawkins 2012; Trips 2002). For ditransitives, this means that both objects in either of the present day English dative alternation constructions have come to predominantly stand in post-verbal position, while the subject is canonically placed before the verb (Zehentner 2019).

(8) a. **þat** þe techeþ *þe spirit of wit* THEME-RECIPIENT-VERB-AGENT
that you teaches the spirit of wit
'the spirit of wit teaches you that.'
(1390; CMEDVERN,247.333)

b. *Kyng Arthure* to þe messagers ȝaf
King Arthur to the messengers gave
grete ȝiftes AGENT-RECIPIENT-VERB-THEME great gifts
'King Arthur gave great gifts to the messengers.'
(1400; CMBRUT3,83.2505)

Second, the order of objects varied considerably in earlier English, in that independently of construction and subject-verb position, the recipient could either precede or follow the theme; in the Old English DOC, both orders were used with about the same frequency (De Cuypere 2015a; Koopman 1990). In today's English, by contrast, object order is strongly associated with construction, as mentioned (for exceptions see, e.g., Gast 2007; Gerwin 2014).

In sum, argument disambiguation in earlier stages of English relied more heavily on inflectional morphology (case and agreement), whereas in present day

English ditransitives, the main (formal) disambiguation strategies are prepositional marking and constituent order. The chronological correlation of the changes in strategies in the history of English, together with typological correspondences has often been taken to imply causation. Specifically pertaining to ditransitives, one of the main explanations for the emergence and spread of the PC in previous research involves disambiguation issues between the objects.[4] For example, McFadden (2002) asserts that

> the *to*-dative was created to remedy the ambiguities caused by the collapse of case distinctions in early Middle English. The reasoning is that when dative and accusative case could no longer be distinguished overtly, the freedom of object ordering caused ambiguity. (McFadden 2002: 108; also Polo 2002)

That is, the lack of reliable constituent order cues combined with decreasing cue reliability of morphological marking results in a functional gap then filled by the innovative PC. However, this proposal is not entirely convincing – first, Old English case marking on objects of ditransitive verbs was not completely transparent and bi-unique to start with (Allen 1995, 2006). Second, as Gast (2007: 6) points out, "real misunderstandings will only rarely arise because contextual information and animacy asymmetries will usually indicate which constituent functions as a theme and which one as a recipient" (also Fischer 1992: 379). In sentences such as (5) above, semantic roles and syntactic function of the objects arguments could plausibly be identified even without unambiguous case marking, by drawing on the prototypical semantic properties of the participants as outlined above.

The present paper now takes the suggestion of ambiguity as a factor in the history of the dative alternation as well as its critique as its starting point, but takes a more elaborate and innovative approach. First, the paper provides an empirical assessment of the potential effect of RECIPIENT-THEME ambiguity, which is completely lacking to date. Second, I propose an additional, new layer which has so far not been explored at all, focussing on the role of the agent (subject) in this development. Specifically, I test the hypothesis that disambiguation between recipients and **agents** impacted the alternation. This is grounded in a large body of research on argument (subject/object) disambiguation and particularly studies on differential object marking (e.g., Fedzechkina et al. 2012; Iemmolo 2013; Levshina 2020), which investigate the connection between argument ambiguity (or 'atypicality' in Tal et al. 2020) and the use of prepositional patterns with transitives. Although subject-object ambiguity has featured heavily in discussions of related

4 Another factor proposed to have had an impact on the rise of the alternation is language contact with French (e.g., Ingham forthc.). This is only marginally addressed in this paper, but a possible (contributory) effect is not negated.

phenomena, however, no similar suggestions have been put forward for the rise of the dative alternation. In this paper, I argue that the shared features of prototypical agents and recipients in terms of prominence (e.g., animacy) may have increased ambiguity in a system which featured fewer and fewer reliable morphological cues (at least with nominal arguments). This in turn may have given an advantage to transparency-increasing strategies such as the PC; likewise, SVO with ditransitives may have been boosted as agents and recipients can be clearly distinguished based on position in this order. Ultimately, the present day English dative alternation in its current distribution can then be explained as a complex interplay of prepositional marking, constituent order and remnants of morphological distinctions.

The following sections report on the quantitative corpus study of Middle English aimed to substantiate this proposal. The precise questions that need to be addressed here are (i) the extent of functional similarity or difference between agents, recipients and themes, i.e., the extent to which functional ambiguity may be given and (ii) to what extent formal or functional ambiguity between agents and recipients on the one hand, and recipients and themes on the other hand, impacted the choice of construction. Before presenting the results of the study, the next section briefly introduces data and methodology.

3 The dative alternation in a corpus of Middle English

3.1 Data and methodology

This study uses a subset of the *Penn-Helsinki Parsed Corpus of Middle English* (PPCME2), covering about 1 million words in 43 texts produced between 1150 and 1500.[5] Using *Stanford Tregex* (Levy and Andrew 2006), I extracted all instances of verbs in a 'sister'-relation with combinations of NP-objects (NP-OB1/NP-OB2) or an NP-object (NP-OB1) and a *to*-PP from the verb-lemmatised files of the corpus (Percillier 2018). The resulting database was then manually checked to remove irrelevant instances such as resultatives (e.g., *sent the child to sleep*; following the practice in De Cuypere 2015a, 2015c). For the present purposes, the dataset was limited to actives with explicit subject arguments in the same clause, meaning that,

5 The included texts are from the four main sub-periods (M1, M2, M3 and M4). Texts whose date of composition differs from the earliest manuscript date were excluded due to their problematic position in the timeline.

e.g., passives, imperatives, non-finite clauses with implicit subject reference or (rare) null-subject clauses were excluded.

The remaining ditransitive clauses (N = 1,606) – of which 63% (998 instances) are taken up by the DOC and 37% (608 instances) by the PC – were then manually or (semi-) automatically classified according to constituent order ('SVO' vs 'other') and a number of features directly or indirectly pertaining to the three arguments, which reportedly influence the dative alternation in present day English and earlier stages. The coding follows previous synchronic and diachronic variationist studies on the topic (e.g., Bresnan et al. 2007; De Cuypere 2015a, 2015b, 2015c; Wolk et al. 2013):

- animacy: binary distinction between 'animate' entities (humans and animals, as well as spiritual beings such as god and collectives) versus 'inanimate' (locations or non-sentient entities, including body-parts).
- definiteness: binary distinction between 'definite' (personal and demonstrative pronouns, proper nouns and head nouns modified by definite articles, demonstratives or possessive pronouns) versus 'indefinite' (modification by indefinite pronouns or determiners, bare nouns).
- concreteness: three-way distinction between 'concrete' (material, tangible objects), 'abstract' (non-tangible entities, concepts) and 'concr/abstr' for elements where the distinction is not recoverable from immediate context.
- pronominality: binary distinction between personal, demonstrative, indefinite and reflexive pronouns as 'pronoun', and proper names and all full nouns as 'noun'.
- complexity: 'simple' versus 'complex', the latter labels arguments including a modifying relative clause, infinitive or gerund or a direct-speech clause.
- number: 'singular' versus 'plural' (plus 'sg/pl' for *you*).
- person: binary distinction between 'local' (1st/2nd person) and 'non-local' (3rd person).
- relative length: log-transformed, centred values of length of recipient divided by length of theme in characters (not including spaces or punctuation, and excluding the preposition in the PC).

Additional variables are 'time' (as a numerical variable based on decade of text production, scaled and centred around 1350 as the approximate mean decade; cf. Wolk et al. 2013), 'verb lemma' and 'verb origin' (native Germanic verbs vs non-native French loans). Furthermore, meta-information on the texts (such as text-file and genre) is included. For both 'verb lemma' and 'text-file', variable levels with a frequency below 5 in the total dataset were binned into a 'rest' category.

In order to assess different ambiguity-related hypotheses about the causes behind the rise of the dative alternation, I then coded the instances for different

parameters reflecting these, namely (a) agreement ambiguity, (b) noun morphology ambiguity between AGENT and RECIPIENT and (c) animacy ambiguity/atypicality between RECIPIENT and THEME:

- ambiguity of subject-verb agreement: 'ambiguous' or 'non-ambiguous', with the former referring to instances where number and/or person marking on the verb does not aid disambiguation between agent and recipient, either because marking is ambiguous/absent, or because agent and recipient have the same number/person. For instance, both *He gave me a book* and *He gives the student cake* would be classified as ambiguous due to both arguments being potential options for subject(/agent-)hood based on verb form alone. By contrast, a sentence like *He gives the students cake* would be coded as non-ambiguous since the subject is identifiable from the verb form (number/person agreement).
- ambiguity of noun morphology (AGENT vs RECIPIENT): 'ambiguous' or 'non-ambiguous'. This classification builds on observed differences in morphological form as discussed above, viz. the fact that formal contrasts between agents and recipients are only preserved with some pronouns. Specifically, combinations of NP-agents and NP-recipients are counted as ambiguous, and so are combinations of NPs plus 2nd person *you*/3rd person singular neuter *it* (which do not differ in subject and object form), as well as combinations of these two specific pronouns. Combinations including at least one pronominal argument (other than *you* or *it*) are categorised as non-ambiguous.[6]
- ambiguity of animacy (RECIPIENT vs THEME): instances labelled as 'non-ambiguous' for this variable correspond to prototypical expectations, viz. involve combinations of animate recipients and inanimate themes. Instances which violate these expectations, meaning clauses containing inanimate recipients or animate themes in any combination, are coded as 'ambiguous'. This variable accordingly conflates ambiguity with 'atypicality' in the sense of Tal et al. (2020) – I take instances with non-predictable, atypical animacy associations between referent and role as more ambiguous. Although not tested in the

6 Note that this approach is only an approximation, and may to some extent over-estimate ambiguity, in that the variable is not based on case marking in the strictest sense. It is likely that some NP-agents and NP-recipients could still be comparatively easily distinguished by means of case morphology at least in the earlier texts. However, the present classification seems justified considering that syncretism was already widespread by early Middle English (Allen 1995), and that investigating Middle English case is too thorny an issue to be addressed properly here. A further issue is the fact that different forms for the 2nd person (plural) pronoun *you* did still exist in ME; coding instances of this pronoun as potentially ambiguous is still warranted, though, as the forms are not categorically tied to one function in the data.

present study, atypicality in information-structure factors such as definiteness (as focused on in Tal et al. 2020) would be expected to show the same effects.

The findings of the analyses are presented in the following section, starting with an assessment of the semantic-functional overlap between the three arguments by means of a behavioural profile analysis, which clusters categories or patterns according to their similarity on a range of features like animacy (e.g., Gries and Divjak 2009; Levshina 2015: 301–322). This is supplemented by a *multiple correspondence analysis* (MCA), which can be used to detect relationships between values of variables (Husson et al. 2017: Ch.3; Levshina 2015: 375–385). Afterwards, the interplay between construction and clause-constituent order, as well as the influence of the given ambiguity factors on construction choice are investigated in a mixed-effects logistic regression model (Baayen 2008; Winter 2019: 232–273). All analysis and visualisation were carried out in R (R Core Team 2017); packages used include 'ggplot2' (Wickham 2016), 'ggdendro' (de Vries and Ripley 2020), 'cluster' (Mächler et al. 2019) and 'Rling' (Levshina 2015), as well as 'FactoMineR' (Lê et al. 2008) and 'ca' (Nenadic and Greenacre 2007). The regression analysis was carried out and evaluated by means of the packages 'lme4' (Bates et al. 2015) and 'jasongraf1/JGmermod' (Grafmiller 2019) and visualised using 'effects' (Fox and Weisberg 2019).

3.2 Results

3.2.1 Argument profiles: who shares what with whom

The first main assumption of this paper that needs to be tested is whether the psycholinguistic, cross-linguistic biases reported for ditransitive arguments – with agents and recipients having more common characteristics than themes – can also be observed in the Middle English corpus data. This is clearly corroborated by the analyses: agents and recipients are more similar to each other in terms of their functional profiles than either is to themes. On the top left of Figure 1, a hierarchical cluster analysis based on behavioural profiles shows the former to cluster together against the latter, and the *multiple correspondence analysis* plot on the bottom of Figure 1 indicates near-complete overlap between agents and recipients, compared to only partial overlap with themes. The additional MCA figures given in Table A1 in the Appendix indicate that most of the variance in these data (90%) can be explained by the horizontal dimension 1 alone, distinguishing the prototypes of agents and recipients (left in the plot) from themes (righthand side of the plot) on the right (cf. Greenacre 2017; Levshina 2015: 382). The second, vertical dimension

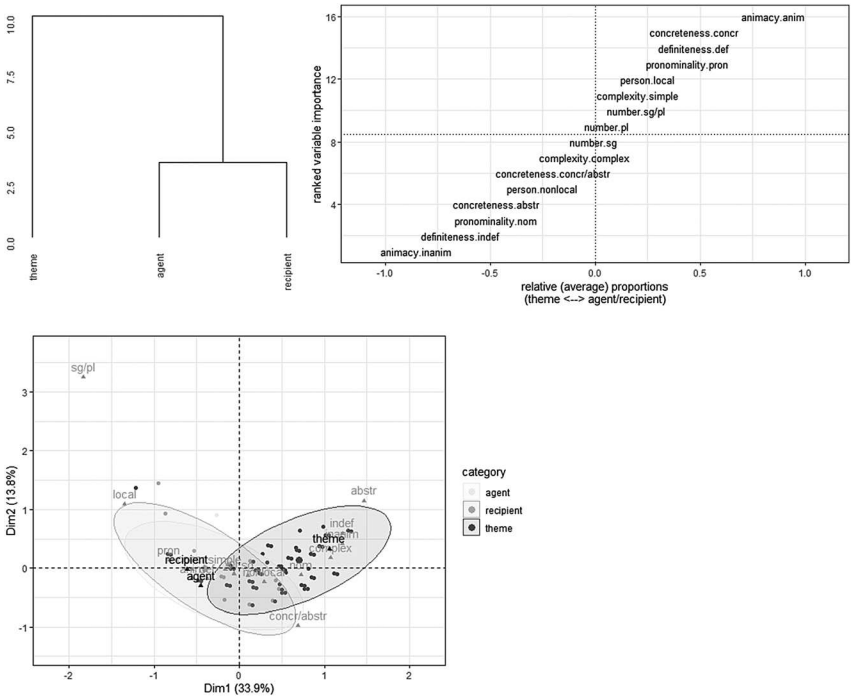

Figure 1: Hierarchical cluster dendrogram (method = ward.D2) of argument categories based on a behavioural profile analysis (top left); snake plot of relative distinctiveness of features for themes vs agents/recipients (top right); Multiple Correspondence Analysis biplot of dimension 1 and 2, with supplementary variables (arguments) in black, variables (features) in grey, individual exemplars in greyscale, and 95% confidence ellipses around exemplars of the arguments (bottom).

roughly distinguishes agents (bottom) from recipients and themes (top), but much less robustly so, and does not significantly add to the model.

Both the MCA plot as well as the snake plot on the top right of the figure furthermore give information on the ranked importance of the included features and their associations. While in the former, distinctive features are found close to the respective categories and clusters in the functional space, the snake plot ranks and sorts the features according to their distinctiveness for themes on the one side, and the cluster of agents/recipients (averaged values) on the other side (Divjak and Gries 2009; Levshina 2015). That is, the *y*-axis ranks the 16 features, such as, e.g., 'animacy: animate', according to their relative importance, with the lowest and highest endpoints indicating greatest importance for themes and agents/recipients, respectively, and the midpoint indicating little or no relevance. The *x*-axis

gives the difference between the respective (average) proportions for themes and agents/recipients for every feature; values below 0 on the left hand side of the plot mean the proportion of themes is higher with this variable value, while features to the right are more frequent with agents and recipients. The plots demonstrate that themes have a higher frequency of inanimate, indefinite, nominal and abstract, non-local referents, whereas the cluster of agents/recipients is predominantly linked to animate, concrete, definite, pronominal and local elements (see also Table A2 in the Appendix for more detailed figures on the MCA analysis). By contrast, the variables complexity and number serve less well as predictors for semantic role/category. These results accordingly suggest significant similarities between prototypical agents and recipients and clear-cut differences to prototypical themes; nevertheless, there is some overlap between the latter and recipients in particular.

3.2.2 Ambiguity effects: what impacts PC choice

Having confirmed that prominence asymmetries cannot be easily exploited for Agent-Recipient disambiguation, and that ambiguity between recipients and themes is not entirely ruled out, the next step then tests the effect of such ambiguities on choice of construction. Specifically, I expect a higher probability of the PC in contexts with higher ambiguity, viz. (i) instances with ambiguous subject-verb agreement, where the agent cannot be identified (and distinguished from the recipient) based on cues from verb morphology, (ii) instances with ambiguous noun morphology for agents and recipients and (iii) ambiguous/atypical Recipient-Theme instances which do not reflect prototypical, predictable animacy contrasts between recipients and themes. The key aim here is to substantiate that while ambiguity, or rather non-predictability, of the object role may have played some part in the spread of the PC, to-date neglected agent(subject-)related ambiguities significantly contributed as well. In addition, the connection between construction, ambiguity measures and constituent order is of interest: (iv) a higher rate of PCs is anticipated in non-SVO contexts, where agents and recipients cannot be distinguished based on position. What is more, (v) we would expect this effect to be strongest in non-SVO instances with ambiguous Agent-Recipient, where the need for disambiguation is particularly great.

To assess these hypotheses, I fitted a mixed-effect logistic regression model to the data, with 'construction' (DOC vs PC) as the response variable, and 'text file' as well as 'verb lemma' and 'genre' as random effects. Fixed main effects, as can also be seen in Table 1, consist of the variables described in Section 3.1, viz. time, clause constituent order, verb origin, agreement ambiguity, Agent-Recipient ambiguity and Recipient-Theme ambiguity. Relative length of recipient and theme was added as a

factor to make sure that any effects of ambiguity were not simply masking an underlying bias related to weight of the object arguments. Furthermore, I included interaction terms for 'time' with 'clause order' to account for a potential impact of the changing distribution of orders over time: while in the earliest decades, SVO accounts for less than half of all ditransitive instances, this number rises to about 85% in the last decades of the period. Interactions between time and the other variables (particularly agreement ambiguity and verb origin) were added initially, but removed due to neither having a significant effect nor improving model fit significantly. An interaction term between clause order and AGENT-RECIPIENT ambiguity was included and kept in order to assess hypothesis (v) mentioned above.[7]

The results of the regression model are presented in Table 1, showing the coefficient estimates of each predictor in the first column (positive values suggest a preference for the PC, while negative values point towards a preferred use of the DOC). The two rightmost columns indicate (non-)significance of the effects, following standard conventions. Model evaluation indicates that it is highly accurate (86.68%) and predictive (Somer's C-index 0.936), and unproblematic in terms of multicollinearity ($\kappa = 5.449$).

First, as also seen in the first panel in Figure 2, time has a significant effect on choice of construction, in that the likelihood of the PC increases over time. This is very much in line with earlier research, and the present dataset shows the same u-turn development observed in previous studies of the Middle English dative alternation (McFadden 2002; Zehentner 2019). The PC rises from about 10% of tokens in the beginning to over 50% mid-period, before dropping again towards the end (accounting for about 30–40% of instances in later texts). Relative length is highly influential in that longer themes (negative values in the figure) are strongly associated with DOC, whereas longer recipients have a high likelihood to be used in the PC – this fits perfectly with findings from the present day English alternation, but is notable insofar as, as pointed out above, object order is not yet categorically tied to construction type. Verb origin is moderately significant at $p < 0.05$; interestingly, the effect here goes in the opposite direction than what would be expected by contact-accounts such as Ingham (forthc.), in that non-native verbs, viz. French loanwords, increase the odds of the DOC rather than the PC.

As to the most relevant predictors for the present argument, neither agreement ambiguity nor clause order seem to significantly impact construction use, meaning that the data do not support the idea that the PC is more strongly represented in

7 Object order was deliberately not included in the analysis here (neither as a main nor interaction effect) so as to keep the model moderately simple; although earlier models show that the factor is clearly significantly tied to construction choice especially in later texts, it does not change the effects presented here.

Table 1: Main effects and interaction effects of predictors on construction choice (positive estimates indicate a preference for the PC).

Formula

construction ~ (1| text_ID.bin) + (1|V_lemma.bin) + (1|genre) + time + rel.length_RT + V_origin + order_clause + ambig_agree + ambig_AR + ambig_RT + time:order_clause + ambig_AR: order_clause

AIC	**BIC**	**logLik**	**Deviance**	**df.resid**
1,215	1,285	−594.5	1,189	1,593

Nr of observations	**DOC**	PC
1,606	998	608

Random effects	**Nr of levels**	**Variance**	**Std. deviation**
text_ID.bin	40	1.511	1.229
V_lemma.bin	39	1.744	1.321
genre	16	1.003	1.002

Fixed effects	**Levels**	**Estimate**	**Std. error**	**z-value**	**p-value**	
(intercept)		−1.336	0.527	−2.534	0.011	*
time		1.201	0.278	4.322	<0.0001	***
rel.length_RT		0.983	0.078	12.639	<0.0001	***
V_origin	native → non-native	−0.856	0.434	−1.972	0.049	*
order_clause	SVO → other	0.218	0.232	0.936	0.349	
ambig_agree	non-ambiguous → ambiguous	0.184	0.257	0.713	0.476	
ambig_AR	non-ambiguous → ambiguous	1.399	0.231	6.047	<0.0001	***
ambig_RT	non-ambiguous → ambiguous	1.364	0.264	5.173	<0.0001	***
time: order_clause	SVO → other	0.534	0.236	2.261	0.024	*
order_clause: ambig_AR	SVO → other non-ambiguous → ambiguous	−0.165	0.535	−0.309	0.758	

Summary statistics

Accuracy	**Somer's C-index**	**κ**
86.68%	0.936	5.449

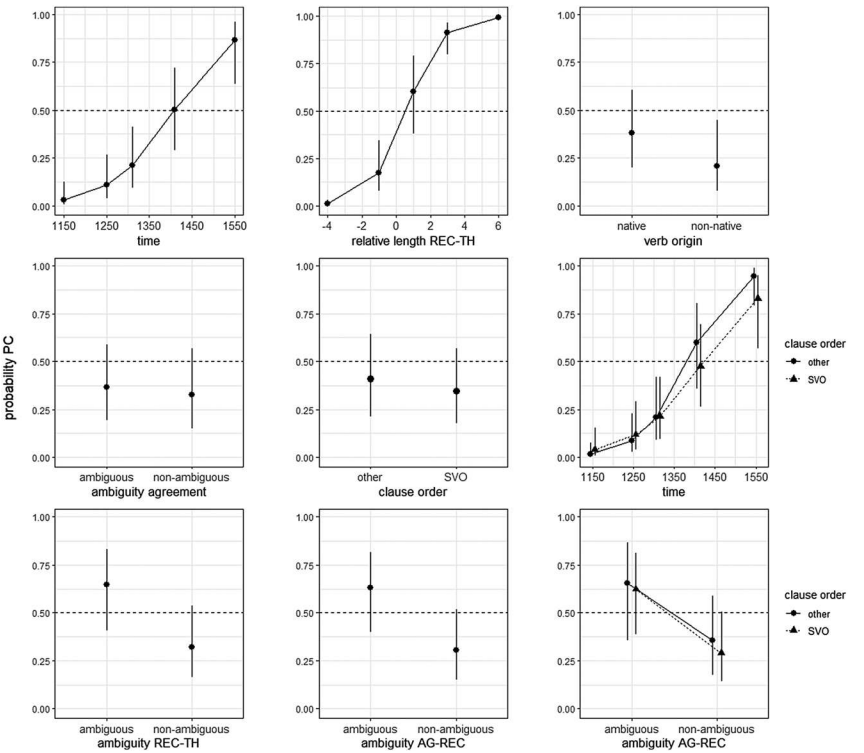

Figure 2: Main effects and interaction effects of predictors on construction choice (predicted probabilities of PC).

instances where verb form is little distinctive, nor in non-SVO ('other') contexts. However, there is a significant interaction between time and clause order: time has a stronger impact on the chances of the PC to be used over the DOC in non-SVO conditions. A significant main effect is found for both Agent-Recipient ambiguity/atypicality and Agent-Recipient ambiguity, in that both non-ambiguous instances in both cases are more likely to show DOC syntax, whereas clauses with Agent-Recipient/Recipient-Theme ambiguity boost the chances of the PC (bottom row of Figure 2). Note also that excluding either of these measures negatively affects model fit, as shown in Table A3 in the Appendix – the present model, featuring both factors, is significantly better than a model excluding Recipient-Theme ambiguity, which is in turn significantly better than a model without Agent-Recipient ambiguity. This supports the assumption that both Agent-Recipient disambiguation

as well as Recipient-Theme related factors played a (contributing) role in the rise of the dative alternation, even more so in the case of the former.

Finally, as shown in the bottom right panel, the results do not indicate a significant interaction between constituent order and Agent-Recipient ambiguity – morphologically ambiguous instances are more prone to the PC regardless of constituent order condition. It is nevertheless striking that fitting a similar model with clause order as the response variable likewise yields a significant positive effect of Agent-Recipient ambiguity on SVO order (see Table A4 in the Appendix). This suggests that neither constituent order nor prepositional marking fulfil a 'gap-filling' function for each other, in that the one is used only when the other is not applicable; instead, it seems there is some redundancy in disambiguation strategy use. This is discussed in more detail in the following section.

4 Discussion: ambiguity is a factor in the emergence of the dative alternation

The findings of the corpus study on Middle English ditransitives provide support for disambiguation as a contributing factor in the emergence of the dative alternation in various ways. On the one hand, the data put earlier suggestions on Recipient-Theme ambiguity impacting the rise of the dative alternation (McFadden 2002; Polo 2002) on firmer empirical standing. It is shown that there is some, even if not much, semantic-pragmatic overlap between these arguments, and the PC is more likely to be chosen in contexts which are less predictable based on prominence biases and thus harder to parse. At the same time, the results tie in with critical reviews of this hypothesis such as Gast (2007), in that Recipient-Theme distinction is not the only, or even main factor in this development. Furthermore, the results relate to recent experimental explorations of atypicality rather than ambiguity guiding constructional choices in comparable phenomena (see Tal et al. 2020 on differential object marking).

Most importantly, the data corroborate the main proposal of this paper that ambiguity between agents and recipients contributed to the spread of the PC. As has been demonstrated, agents and recipients in Middle English ditransitives have highly similar semantic-pragmatic profiles: this plausibly led to parsing difficulties in cases where the arguments could not be distinguished based on morphological form. In such instances, prepositional marking presents an advantage, since it reinforces a transparent opposition. I argue that the fact that (formal plus functional) ambiguity is only given in some parts of the ditransitive argument structure system, i.e., the fact that most pronouns still distinguish

subject and object forms, is not problematic for this account. Quite the contrary, it is perfectly in line with the observed development of the constructions, and offers a plausible (contributory) explanation for the maintenance of both constructions – rather than ousting of the DOC – and the emergence of an alternation relationship between them. (In morphologically non-ambiguous instances, there are no clear processing benefits incurred by using the longer and thus less economical PC instead of the DOC, resulting in co-existence.) The continued use of the DOC can furthermore be related to the fact that another disambiguation strategy, namely SVO, also greatly increases at the same time, and is likewise particularly frequent in cases of AGENT-RECIPIENT morphological ambiguity. If position already disambiguates AGENT-RECIPIENT role, the DOC is unproblematic to use even with morphologically indistinguishable elements.

Having said this, while disambiguation seems to play a role with both, the two strategies of prepositional marking and fixed constituent order do not interact as straightforwardly as expected; we cannot conclude from the results that one strategy is more often chosen when the other does not apply. Instead, even when ambiguity is resolved by syntactic position already, speakers still frequently opt for the PC when the two arguments overlap in formal and functional features. Rather than a complementary use of SVO and PC, the situation thus arguably presents one of redundant marking, or 'degeneracy' as outlined in Van de Velde (2014). This refers to "many-to-many relationships between form and meaning", and is more specific than pure redundancy, in that "the different strategies are not fully interchangeable and play a role elsewhere in the system as well" (Van de Velde 2014: 173).

Figure 3 captures the 'degenerate' systems of Old English (left) and Middle English (right) ditransitive argument disambiguation strategies, also highlighting Van de Velde's point that diachronic change rarely involves the complete loss or sudden emergence of new strategies, but rather reflects a complex restructuring in the strength and reliability of available strategies. As shown in the figure, argument disambiguation in Old English was heavily reliant on inflection (nominal and verbal), while prepositions and clause-constituent order tendencies could only be drawn on to a limited extent. From Middle English onwards, formal contrasts were only maintained with pronouns, and agreement is similarly only applicable in some contexts – by contrast, order (both SVO in the entire system, and object order with ditransitives specifically), as well as PPs come to be much more salient. Prominence asymmetries, on the other hand, cannot be easily exploited for AGENT-RECIPIENT disambiguation, but present a relatively stable strategy for RECIPIENT-THEME disambiguation throughout time. In sum, what this study thus demonstrates is that argument disambiguation plausibly played a role in the emergence of the English dative alternation, but that the history of this phenomenon constitutes a prime

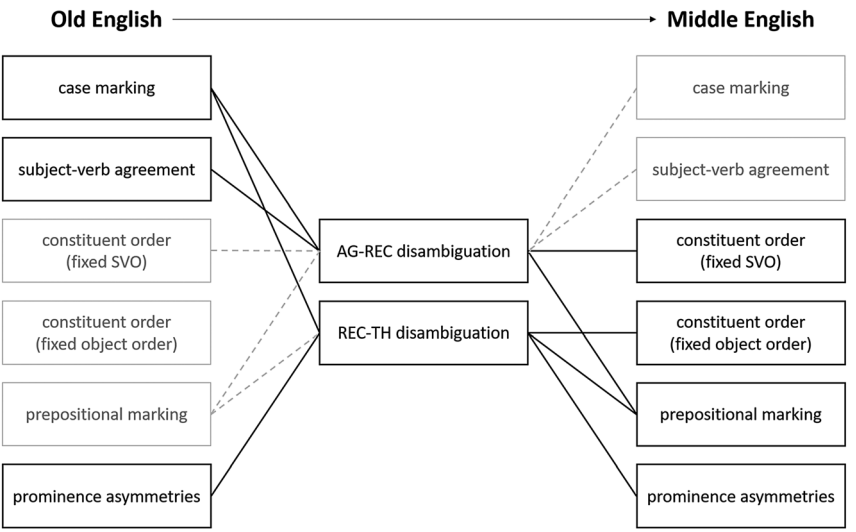

Figure 3: Degenerate argument disambiguation strategies in Old versus Middle English.

case of complex interactions and changes between multiple argument disambiguation strategies for different argument relations.

5 Conclusion

This paper has taken a usage-based, cognitive approach to the history of English ditransitive verbs and the dative alternation, which constitutes one of the most discussed cases of syntactic variation. It has revisited the still relatively uncertain causes behind the emergence of this phenomenon in Middle English, and has put forward a new proposal grounded in current cognitive, psycholinguistic and typological research into prototypes of semantic roles and strategies for argument disambiguation. Specifically, the paper has reported on a quantitative study of ditransitive clauses in a Middle English corpus designed to evaluate the impact of ambiguity-related factors on the spread of the prepositional ditransitive construction, with a focus on AGENT-RECIPIENT relations.

The analysis has substantiated the hypothesis that (a) prototypical agents and recipients in three-participant events share a range of common characteristics, which in turn distinguish them from prototypical themes and (b) that this similarity in features such as animacy may cause parsing difficulties when

formal disambiguation strategies like case marking are not applicable or reliable. Such ambiguities may provide an advantage to the more transparent PP-construction. As for Recipient-Theme overlaps, it has been shown that the likelihood of prepositional patterns also increases with ambiguous (or rather atypical) animacy combinations, providing empirical evidence for assumptions in previous research. It has, furthermore, been shown that the interplay between constituent order (SVO) and PP-marking is more complex than a clear-cut complementary distribution, and involves frequent redundant (or 'degenerate') use of both strategies in morphologically ambiguous contexts. Ultimately, the English dative alternation can be explained as the outcome of competing strategies, i.e., NP-marking/PP-marking, fixed constituent order, (remnants of) morphological argument distinctions and prominence biases, but also competing pressures such as expressivity (disambiguation) and efficiency (economy); e.g., MacWhinney et al. (2014).

The paper has illustrated that taking a theoretical and methodological approach informed by recent typological and experimental work on the cognitive underpinnings of argument roles and ambiguity resolution to diachronic phenomena allows us to more adequately assess the relevance of different argument features and different disambiguation strategies, and can put previous hypotheses about causality on more solid theoretical and empirical foundations. On a broader level, the paper has thus illustrated applications of usage-based, cognitive linguistics to long-standing questions in historical morphosyntax (Bergs and Hoffmann 2017). However, I have not discussed potential pitfalls of relying on the uniformitarian principle, viz. the assumption that cognitive pressures such as ambiguity avoidance were at play in historical English in much the same way as today. Simulation models to disambiguation in line with, e.g., van Trijp (2013) may provide additional support here, and may also be of use to address the relation between (semantic) ambiguity and (information-structure) atypicality as explored in Tal et al. (2020).

Moreover, the study has pointed at the challenges incurred by investigating a highly dynamic and multi-factorial phenomenon which involves simultaneous and interrelated changes and strategies. In particular, the present study has dealt with case marking in an approximate way only by drawing on phrase type/part-of-speech of the arguments, and has considered these changes only in a small part of the constructional network of Middle English: it is clear that all changes in strategies did not affect ditransitive constructions in isolation, but that these developments were systemic. The precise correlations and causal effects between case marking, prepositional marking and constituent order still

need to be disentangled in a more systematic, encompassing and refined way (cf. Rosemeyer and Van de Velde 2020). A final, but equally important point which would deserve more in-depth attention concerns the question to what extent disambiguation as discussed in this paper plays out in the domain of cognitive production processing or cognitive comprehension processing: while the present account has taken – at least implicitly – a more listener-centric perspective in assuming ambiguity resolution by prepositional marking to be driven by issues in comprehension processing, Pijpops et al. (2018) have, for example, shown that explicit PP-marking of objects in transitive clauses is more consistent with complexity management in language production (cf. also e.g., Grondelaers et al. 2009). Production- versus comprehension-related effects in ditransitive clauses (and their diachrony) provide promising directions for future research; likewise, the interaction between grammatical complexity and morphosyntactic and/or semantic-pragmatic ambiguity warrants further investigation.

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Data availability statement: All primary data and code used in this study are available via the Open Science Framework, and can be retrieved from https://osf.io/bwj4z/.

Appendix

Table A1: Principal inertias (eigenvalues) of Multiple Correspondence Analysis (non-adjusted/adjusted) for dimensions 1–2.

Dim	Value	% non-adjusted	% adjusted	% cumulative adjusted	Scree plot adjusted
1	0.15	33.9	88.3	88.3	**********
2	0.003	13.8	1.7	90	

Table A2: Contributions of variables and values to Multiple Correspondence Analysis dimension 1–2.

Dimension 1	R2	p-value	Dimension 2	R2	p-value
Animacy	0.668	<0.0001	Concreteness	0.390	<0.0001
Concreteness	0.642	<0.0001	Number	0.392	<0.0001
Pronominality	0.594	<0.0001	Person	0.258	<0.0001
Definiteness	0.451	<0.0001	Definiteness	0.107	<0.0001
Person	0.396	<0.0001	Animacy	0.077	<0.0001
Complexity	0.176	<0.0001	Pronominality	0.016	<0.0001
Number	0.128	<0.0001	Complexity	0.005	<0.0001
	Estimate	**p-value**		**Estimate**	**p-value**
Category = theme	0.702	<0.0001	Number = sg/pl	0.945	<0.0001
Concreteness = abstract	0.618	<0.0001	Concreteness = abstract	0.463	<0.0001
Animacy = inanimate	0.582	<0.0001	Person = local	0.279	<0.0001
Person = non-local	0.541	<0.0001	Definiteness = indefinite	0.162	<0.0001
Definiteness = indefinite	0.523	<0.0001	Category = theme	0.138	<0.0001
Pronominality = nominal	0.510	<0.0001	Animacy = inanimate	0.126	<0.0001
Number = sg	0.461	<0.0001	Pronominality = pronoun	0.053	<0.0001
Complexity = complex	0.409	<0.0001	Complexity = complex	0.042	<0.0001
Number = pl	0.353	0.034	Complexity = simple	−0.042	<0.0001
Concreteness = concr/abstr	0.102	<0.0001	Pronominality = nominal	−0.053	<0.0001
Category = agent	−0.298	<0.0001	Animacy = animate	−0.126	<0.0001
Category = recipient	−0.404	<0.0001	Category = agent	−0.127	<0.0001
Complexity = simple	−0.409	<0.0001	Definiteness = definite	−0.162	<0.0001
Pronominality = pronominal	−0.510	<0.0001	Person = non-local	−0.279	<0.0001
Definiteness = definite	−0.523	<0.0001	Concreteness = concr/abstr	−0.434	<0.0001
Person = local	−0.541	<0.0001	Number = pl	−0.466	0.001
Animacy = animate	−0.582	<0.0001	Number = sg	−0.479	<0.0001
Concreteness = concrete	−0.720	<0.0001			
Number = sg/pl	−0.814	<0.0001			

Table A3: Analysis of deviance table for different regression models (model01: model includes both Agent-Recipient and Recipient-Theme ambiguity; model01a: excludes Recipient-Theme ambiguity; model01b: excludes Agent-Recipient ambiguity and interactions with Agent-Recipient ambiguity).

Models	npar	AIC	BIC	logLik	Deviance	Chisq	Df	p-value	
model01b	11	1,254.5	1,313.7	−616.24	1,232.5				
model01a	12	1,240.4	1,305	−608.22	1,216.4	16.05	1	0.0001	***
model01	13	1,215	1,285	−594.5	1,189	27.442	1	<0.0001	***

Table A4: Main effects of variables on choice of constituent order (positive estimate values indicate SVO preference, negative estimates indicate biases towards 'other').

Formula						
order_clause ~ (1| text_ID.bin) + (1|V_lemma.bin) + (1|genre) + construction + V_origin + ambig_agree + ambig_AR + ambig_RT						
AIC	**BIC**	**logLik**		**Deviance**		**df.resid**
1,480.6	1,529	−731.3		1,462.6		1,597
Nr of observations				**SVO**		**other**
1,606				1,237		369
Random effects		**Nr of levels**		**Variance**		**Std. deviation**
text_ID.bin		40		1.412		1.188
V_lemma.bin		39		0.040		0.199
genre		16		0.166		0.407
Fixed effects	**Levels**	**Estimate**	**Std. error**	**z-value**	**p-value**	
(intercept)		1.177	0.320	3.673	0.000	***
construction	DOC → PC	−0.260	0.183	−1.424	0.154	
V_origin	native → non-native	0.585	0.297	1.969	0.049	*
ambig_agree	non-ambiguous → ambiguous	−0.048	0.197	−0.242	0.809	
ambig_AR	non-ambiguous → ambiguous	0.602	0.198	3.045	0.002	**
ambig_RT	non-ambiguous → ambiguous	0.312	0.216	1.443	0.149	
Summary statistics						
Accuracy		**Somer's C-index**				**κ**
80.88%		0.817				4.838

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