ORIGINAL RESEARCH



The metaphysics of puns

JTM Miller¹

Received: 28 August 2023 / Accepted: 28 March 2024 / Published online: 18 April 2024 © The Author(s) 2024

Abstract

In this paper, I aim to discuss what puns, metaphysically, are. I argue that the type-token view of words leads to an indeterminacy problem when we consider puns. I then outline an alternative account of puns, based on recent nominalist views of words, that does not suffer from this indeterminacy.

Keywords Words · Puns · Indeterminacy · Nominalism · Type-token

Lately, I have been selling houseboats. Sails are through the roof.¹ This is a great pun.² But what, metaphysically, is a pun? Is there anything we can learn about the metaphysics of words by considering the case of puns?

Not much has been written that explicitly takes up this question. In fact, at least to my knowledge, there has been no work that explicitly considers what, from a metaphysical perspective, a pun is.³ Perhaps this is not surprising. The metaphysics

Department of Philosophy, Durham University, 50 Old Elvet, Durham DH1 3HN, UK



¹ Thanks to Tim Blundell, Richie Hamilton, Ian Kidd, and Penelope Mackie for these excellent puns, and many more examples that I could not, unfortunately, use. Note that in many cases, the puns that I mention in this paper are limited to written or spoken form, and may not be puns if expressed in other ways. That some spoken puns are not puns when written and vice versa will make no difference to the arguments put forward in this paper.

² Or so I assert. In my experience one reliable sources of excellent puns are the names of fish and chip shops, such as 'Between a Rock and a Hard Plaice', 'The Codfather', 'Fishcotheque', 'Fry Days', and 'Codrophenia'. Truly, a wonderful catch of fishy puns.

³ A note about the scope of this paper. There are a wide range of issues of interest that arise from puns, and the linguistic literature reflects this. For example, there is scholarship that aims to produce descriptively adequate accounts of punning utterances (Attardo, 1994; Dynel, 2010; Solska, 2012a, b), attempts at establishing pun taxonomies (Heller, 1974; Yus, 2003; Dynel, 2010; Solska, 2012a, b), and research into the way punning utterances are processed (Yus, 2003, 2016; Giora, 2003; Solska, 2012a, b). The aims of

[☑] JTM Miller james.miller@durham.ac.uk

130 Page 2 of 18 Synthese (2024) 203:130

of words is still an emerging domain, and hence applying metaphysical accounts to the specific case study of puns has not yet been done by authors writing on this topic. However, in this paper, I will argue that considering puns can be useful for ongoing debates in the metaphysics of words. More specifically, I will argue that the dominant 'type-token' metaphysics of words cannot adequately handle puns as the view suffers from an indeterminacy problem. I then argue that nominalist accounts of words can avoid this indeterminacy. I conclude that this shows that the existence of puns can contribute to making a case for nominalist views in the metaphysics of words over their type-token rivals.

While this paper solely discusses an issue relating to puns, if correct, it does also raise further broader questions about the relationship between certain topics that have been traditionally been thought to be semantic (or primarily semantic) issues and the metaphysics of words. I suggest that this paper helps to show that there is a deep connection between these areas of research, and that it is likely that certain combinations of semantic theories and theories in the metaphysics of words are more (or less) easily combined. This is, in my view, an unsurprising connection. Semantic claims may rely implicitly or explicitly on certain metaphysical assumptions, and metaphysical accounts of words (and other linguistic entities) may be defended (or objected to) on the basis of their (in)ability to provide solutions to semantic puzzles.⁴ This is, of course, not to suggest that all those working in one of these fields should instantly be compelled to become an expert in the other. But it is does suggest that a greater awareness of the other domain may help each, and may lead to interesting new avenues for future research.

1 Linguistic ambiguity and type-realism

A common (non-metaphysical) answer to the question 'what are puns?' is that puns are a form of wordplay that involve a linguistic ambiguity that occurs due to an instance of (complete or partial) homonymy or polysemy. It is this that makes punning possible, and the above is a pun as we recognize the ambiguity caused by the homophonic words 'sail' and 'sale'. What this means is that when successfully interpreting a pun, we home in on two readings of the punning fragment.

For instance, Koestler states that 'in the pun, two strings of thought are tangled into one acoustic knot' (1964: 144). Attardo says that the relevant part of the utterance is 'the ambiguous element of the utterance which makes the presence of two senses possible' (1994: 134). The Encyclopedia of Humor Studies defines puns as 'a type of joke in which one sound sequence (e.g., a word) has two meanings, and this similarity in sound creates a relationship for the two meanings from which humor is derived' (Attardo, 2014, 612). Or, as Dryden, in his satirical poem 'Mac Flecknoe'

⁴ Some instances of this interaction between traditionally semantic issues and the metaphysics of words can already be found in the literature, such as in Miller (2019) and Tarnowski and Głowacki (2022).



this paper, though, are metaphysical. The issue I raise here may not be an issue at all for those engaging in those other tasks.

(1682), says: puns (and other forms of wordplay) 'torture one poor word ten thousand ways' (Dryden, 2001: 231).

I will call this the 'linguistic ambiguity thesis', or just the 'ambiguity thesis' for ease. The thesis is that when punning, a person speaks (or writes, signs, etc.) a word with multiple or ambiguous meanings. We should be clear here: the idea is that it is a single word-token that then has multiple or ambiguous meanings. I take this to be implied in the above quotes as there is 'one acoustic knot' where typically we think that an utterance of a single word is a single acoustic element, and the idea that 'the ambiguous element' (my emphasis) has 'two senses' where senses are akin to meanings. Thus, under the ambiguity thesis, when punning there is a single word uttered, and that word is ambiguous in its meaning. For example, in the line 'The other day I tried to make a chemistry joke, but got no reaction', there is a single word-token, 'reaction', that is recognized by speakers as expressing two meanings. Depending on whether you like puns, hilarity then ensues from this ambiguity of meaning. The ambiguity thesis is intuitive, simple, and attractive. It explains why puns can occur between words that sound or look alike, and coheres well with prominent theories in the philosophy of humor such as the incongruity view which holds that humor involves 'delighting in a departure from some regularity or norm' (Shaw 2010: 115).

Despite the naturalness of the ambiguity thesis, there is, I suggest, a problem if the view is combined with certain widely held views about the metaphysics of words, namely a commitment to a type-token account of words. Type-token views of words vary, but at their core, they are a family of views which hold that in order to adequately account for various features of words and language, we must posit that there are word-tokens – concrete spoken, written or signed instances of words – and word-types where word-types are taken to be abstract entities. Type-realists, unlike the nominalists discussed below, therefore posit that words are type- or kind-level entities, which at least can (and depending on further commitments, perhaps must) have instances (or tokens). While type-token views vary in terms of whether these types are created or eternal and how they might be individuated, the central idea is that the particular ink patterns in this paper are word-tokens that are tokens of some type, and at least some are tokens of the same type.⁵

Under typical type-token views of words, all word-tokens are a token of *one* word-type. This is a common view in part as the literature often draws an analogy between word-types and species.⁶ Thus, just as a single organism cannot be an instance of multiple species at the same time, a single token word cannot be tokens of multiple word-types. While I do think it is typical for the type-realist to hold that all word-



⁵ There are a myriad of views on this topic ranging from Platonic type-realist accounts to intentionalist accounts. All of them provide different answers to the question of how to individuate types, and when it is the case that two tokens are tokens of the same type. I cannot settle those ongoing arguments here but will comment on this more later in the paper. Examples of type-realist views include Gasparri (2016), Hawthrone and Lepore (2011), Irmak (2019), Juvshik (2021), Katz (1981, 2000), Lando (2019), Mallory (2020), Nefdt (2023), Stojnić (2021), and Wetzel (2002, 2009). Kaplan's stage-continuant (1990, 2011) might be thought to be type-realist (in Miller, 2020, I classified his view as type-realist for instance). For this paper, I exclude Kaplan's account as type-realist on the basis that he certainly explicitly denies that continuants are abstract objects.

⁶ See, for example, Wetzel (2009). See also discussion of this in Miller (2021b).

130 Page 4 of 18 Synthese (2024) 203:130

tokens are a token of *one* word-type, it is not *essential* to type-realism. Perhaps it is false, which would allow room for the view that in the case of puns there is one token which is a token of multiple types even if this would require a significant alteration to standard versions of type-realism currently defended in the literature. Given the limited scope possible in a single paper, I leave the development of any such views for later work and focus on typical type-token views, where any given word-token is taken to be a token of a single word-type.⁷

It most cases, which type a token is a token of is clear. The word-token 'dog' is, I take it, obviously a token of the type 'DOG'. But in the case of puns, at least if we accept the ambiguity thesis also, a metaphysical puzzle begins to emerge. While in most cases it might be clear as to which type a particular word-token is a token of, I argue that in the case of puns, it is not so clear. That is, I will argue that if we are type-token theorists, and accept the ambiguity view of puns, there is no good answer to the question of which type a word-token which is a punning element is a token of. Indeed, I will argue that it is not just that we do not know which type the word-token in a pun is a token of, but that it is metaphysically indeterminate as to which word-type is being tokened in the case of a pun. That is, I will argue that if we combine type-token views with the ambiguity thesis, at least in the case of some puns, it is indeterminate which type the token word is a token of. I will argue that this indeterminacy is not merely epistemic, but is metaphysical, and, on the assumption that we should not accept genuine metaphysical indeterminacy, means that type-token views cannot provide a good basis for a metaphysics of puns.

2 Same word and different word puns

To highlight this indeterminacy, I first need to make a further distinction between distinct types of puns. We can call the first sort of pun a 'same word' pun. These are puns where the ambiguous meanings attributed to the punned word are two (likely closely) related meanings or senses of a single word-type. Take again the line 'The other day I tried to make a chemistry joke, but got no reaction'. 'reaction', in both readings of this line, refers to some response or change in behaviour of certain relevant entities (either the audience, or the chemical substances). These meanings are

⁹ For the exposition of this distinction, I will assume for now a type-token view of words.



⁷ Yet another option might be to say that there are in fact two tokens being uttered when punning, each of their own type. Again, this would be a non-standard view in the literature on words, but it could be developed. Given my well documented nominalist sympathies (see Miller, 2021a, b, 2022a, b), I leave the development of any of these non-standard versions of type-realism to others.

⁸ Throughout, I focus on cases where the punned element is a word. This is, of course, not always the case. For example, in the case of 'The Codfather' the punning element is a morpheme. I focus on words not to deny the existence of non-word puns, but because there is an existing literature concerning the ontology (or metaphysics) of words, a large part of which is focused on the question of when is it the case that a particular word-token is a token of a particular word-type which also motivates my discussion here. At least to my knowledge, there is no existing literature asking analogous type-token questions with respect to morphemes specifically (though see Epstein, 2009 for a more general discussion of 'standard linguistic entities'). I hope, depending on the outputs of future research on the metaphysics of other sorts of linguistic entities, that the framework developed here can be applied to those other cases.

Synthese (2024) 203:130 Page 5 of 18 **130**

similar enough that, for ordinary speakers, they are associated with the same word, or they are two meanings of the same word.

Putting this another way, in this case there is a single token, 'reaction', which is a token of the type 'REACTION', which is a type that has associated with it two meanings, and the pun works due to the speakers/hearers recognition of those different but related meanings. ¹⁰

We can distinguish same-word puns from 'different-word' puns. In these cases, the token word that contributes the pun is ambiguous between two meanings, which in other circumstances would be taken to be typical of different words (or different word-types). Take the pun that I began this paper with – 'Lately, I have been selling houseboats. Sails are through the roof.' In this case, the pun plays off the typical meanings of the homophonic tokens 'sail' and 'sale'. Two meanings are attributed to the token word in the pun – 'sails' – which are typically associated with the distinct word-types 'SAIL' and 'SALE'. Hence, this is a 'different-word' pun.

This is *not* to defend the view that meaning provides a criterion of identity for words. I am defining different-word puns as involving distinct word-types, irrespective of how types are themselves individuated. Like most working on the metaphysics of words, I do not think meaning can do this due to cases where words have changed their meaning over time (e.g., the shift in meaning of the word 'egregious'), but nor do I here want to take a position on how to individuate word-types (though see some discussion of this below). All I rely on at the moment is that there is some way (whether knowable for us or not) that word-types are individuated, and that it is at least *indicative* that a particular pun is a different-word pun if the two meanings attributed to the punned element are not taken by competent speakers to be alternative meanings of the same word.

Note that there will be boundary cases where is it unclear, or even disputed, whether a pun is a same-word pun or a different-word pun. This does not discredit the distinction, just as the lack of a clear boundary between puns and other forms of wordplay does not indicate that puns do not exist. Rather, it only suggests that there will exist fuzzy cases at the boundaries between these types of puns caused by the varying intuitions we have about the sameness of words that underlies the distinction. Prima facie, the ambiguity thesis would appear to be able to explain both same-word and different-word puns through appealing to an ambiguity of meaning ascribed to a token word. However, I will argue that there is an indeterminacy problem for the view in the case of different-word puns when combined with a type-token metaphysics of words.

¹⁰ This could be denied, depending on how we individuate meanings. But in so far as we typically accept that the same word may have distinct, but related, meanings, there can be cases where a pun plays off those differing meanings of the same word. Even if 'reaction' is not such a case, this should suffice to show what I mean by a 'same-word' pun.



130 Page 6 of 18 Synthese (2024) 203:130

3 Puns and metaphysical indeterminacy

According to the ambiguity thesis, in a pun there is a single token that has (or expresses) multiple meanings. If we also accept the type-token view of words, that token, as for all tokens, must be a token of some type. But which one? That is, if the punned word is a token of some type, which type is it a token of? This, I admit, is a not a question ordinary speakers are likely to ask, and is rather one that metaphysicians will ask, but it causes a problem for the combination of the ambiguity thesis and a type-token view of words.

To see how, consider the following pun: 'desperate times call for desperate measures, so pour us each a desperate measure' (Fry, 1991). If we accept the ambiguity thesis, this pun plays off the ambiguity caused by the different meanings associated with homographic words. The punned element here is the last word-token, 'measure'. More specifically, this is a pun because there are two distinct word-types, with distinct meanings associated with tokens of those types, that the last word-token 'measure' could be a token of:

MEASURE₁: meaning a plan or course of action taken to achieve a particular purpose.

MEASURE₂: meaning a standard unit of (in this case) alcohol.

These are, I suggest, distinct word-types. Of course, some may have a different intuition from me on this and think that these are merely varying tokens of the same type. However, even if the reader's intuitions go the other way in this case, my argument will rely only on there being *some* instances of different-word puns and does not rely on this particular example. Thus, even if 'MEASURE₁' and 'MEASURE₂' are not distinct types, it seems clear that 'SAILS' and 'SALES' are distinct types, and hence that a *spoken* instance of the pun I began this paper with is a different-word pun, playing off the fact that uttered tokens of two distinct types share the same pronunciation. The argument I am about to outline can then be run, mutatis mutandis, for that (spoken) pun.

Now we can ask a question: in different-word puns, there is a token, but which type is it a token of? In the above case, there is a token, 'measure', but is it a token of 'MEASURE₁' or 'MEASURE₂'? The problem is that a type-token accounts provides no way to answer this question. It is indeterminate as to whether 'measure' is a token of 'MEASURE₁' or 'MEASURE₂'. The combination of views includes a metaphysical claim that there is *one* word with multiple meanings, but no way to allow us to know *which* type the single token is a token of. Is it a token of 'MEASURE₁', or a token of 'MEASURE₂'? I argue that it is indeterminate as to which type is being tokened.

Note that the objection here is *not* that there is a single token, 'measure', and that that token is semantically ambiguous between the two meanings, the first associated with tokens of 'MEASURE₁' and the second associated with tokens of 'MEASURE₂'. This might be the case, but the objection I want to raise concerns what word-type, 'MEASURE₁' or 'MEASURE₂', the token, 'measure', is a token of. While the issue of semantics helps bring this issue out, it is not essential to the problem I am highlighting. This is a problem arising from it being indeterminate as to whether 'measure' stands in an instantiation relation with 'MEASURE₁' or 'MEASURE₂'. We



Synthese (2024) 203:130 Page 7 of 18 **130**

might normally use the semantic properties of a word-token to help identify what type that token is a token of, but, at least in the case of a punned word, that is not available here as the token, 'measure', could be taken to express the meaning typically associated with either type (or both). The semantic properties of the token therefore cannot help here, and hence it is indeterminate whether 'measure' is a token of 'MEASURE₁' or 'MEASURE₂'.

Why is this not just epistemic indeterminacy? If it were merely epistemic indeterminacy, then we might not think it particularly problematic. However, I think we have reasons for thinking that the indeterminacy we have identified is metaphysical. First, let us say that something is metaphysically indeterminate if 'the world in itself, as opposed merely to how we represent it, is indeterminate' whilst something is epistemically indeterminate if 'we are dealing with a case where our ignorance is in a certain way principled... where there is a fact of the matter, only one that we are in principle ignorant of' (Eklund, 2011).

Another way to get at this distinction, though related to the above, concerns whether there is, even in principle, some information that could remove the perceived indeterminacy. If something is epistemically indeterminate, it seems like there is such information, even if we do not (or even cannot) know it. This is because there is some fact of the matter – some particular way that the world is. This is why for many epistemic indeterminacy is, in a sense, weaker, and why we might think that epistemic cases are not *really* indeterminate at all. In contrast, in cases of metaphysical indeterminacy, there is no fact of the matter. Reality itself is indeterminate.

Returning to puns, why think the indeterminacy identified is metaphysical? The reason is that the indeterminacy is not *only* about us not knowing which word-type is tokened. Rather, it is that there is no fact of the matter that would resolve the question of which type the token is a token of. To stress, this is *not* to say that there is no additional information that might be available to speakers to *comprehend* the pun. This is clearly not the case as a variety of contextual information will aid the listener to decipher the relevant readings. Rather, what I mean is that there is seemingly no additional information that could solve our *metaphysical* question of which type is being tokened. There is no extra piece of knowledge that we could discover, even in principle, which would resolve the indeterminacy. To see this, we can consider the properties that the token word has, and whether those properties might allow us, even in principle, to say which type is being tokened.

First, it is clearly the case that spelling and/or pronunciation properties do not help identify which type is being tokened as, in the troublesome examples, the tokens of the type are identical in spelling/pronunciation. We would be left with no way of knowing which type is being tokened. Furthermore, semantic properties also cannot help here as, by hypothesis, the token expresses (or has) multiple meanings, and so we cannot say which type the token is a token of through this route. The relevant meanings, at least in the case of different-word puns, are distinct enough to be typically associated with distinct word-types, and hence that the tokens in question have or express both meanings means that we cannot use the meaning of the token to determine which type it is a token of.

That the spelling, pronunciation, and meaning cannot help us determine what type the token is a token of will not surprise those familiar in the literature on the meta-



130 Page 8 of 18 Synthese (2024) 203:130

physics of words. In that literature, there is no substantive defence of the view that word-types are individuated by their spelling, pronunciation, or meaning. The reason for this is quite simple. Tokens of some word-type vary too much in how they are spelt, pronounced, and what they mean for us to be able to use these features to determine what type a token word is a token of. While spelling, pronunciation, and meaning might help *indicate* when two words are tokens of different types, these properties of tokens cannot be taken to provide a suitable metaphysical basis for answering the question of what type a token is a token of. Distinct word-tokens can vary in their spelling, pronunciation, and/or meaning and yet still be tokens of the same type. We cannot therefore use these properties to determine whether 'measure' is a token of 'MEASURE₁' or 'MEASURE₂'.

What about the intentions of the speaker? We might follow Kaplan (1990, 2011) in thinking that the intention to utter a token of a word is a necessary condition on tokening that word, and hence that, in the case of puns, all that we need to know is what the intentions of the speaker were. Did they intend to utter a token of 'MEASURE₁' or 'MEASURE₂'? Once we answer that question, the indeterminacy would dissolve away.

My view, following Munroe's (2016) discussion of slips-of-the-tongue, is that there are good independent reasons to think that speakers do not need to have intentions to produce a specific word in all cases. But, even if we accept a role for intentions in individuating token words, such intentions will not help in this case. This is because (at least in some cases of puns) speakers will intend to utter a pun and intend to token both words. That is, when I utter a pun, it is plausible that I intend to token 'MEASURE₁', and also intend to token 'MEASURE₂'. But, if a speaker intends both, then there seems to be no reason to think that one type takes precedence over the other. Given, as discussed above, the type-token view typically holds that there is only one token, speaker intention cannot help us work out which type is tokened in cases like those above.

Alternatively, we could try to insist that this merely a case of epistemic indeterminacy by saying that there is something as yet unknown that would determine which type it is a token of, or by positing some instantiation relation such that the token will have the property of 'being a token of type x'. Some Platonists about words already hold this view, arguing that there is no property that all tokens of a type share except that of 'being a token of type x' (e.g., Wetzel, 2009: 106-7).

By positing this property of 'being a token of type x', the Platonist admittedly can solve the problem I have raised. Continuing the example from above, the Platonist can simply hold that the relevant token 'measure' possesses *either* the property of 'being a token of type 'MEASURE₁" or 'being a token of type 'MEASURE₂". This renders the indeterminacy as being at worst epistemic. We may not (ever?) know which is being tokened, but there is a fact of the matter as to which type is being tokened.

The problem with this response is that, at least to any non-fully committed Platonist, it will feel quite ad hoc and lacking in explanatory power. The response simply promises that there is such a property of 'being an instance of type x', but this is not a property that we can directly perceive. The Platonist response leaves upon a range of possibilities that we typically would want to disallow. For example, while there



might be a fact of the matter for the Platonist about what type some token is a token of, Platonism allows the possibility that this is a completely different type than the one we thought the token was a token of. The token 'dog' might, without us knowing, in fact turn out to be a token of the type 'CAT'. As we cannot perceive directly the 'being an instance of the type x' property, this remains a metaphysical possibility. Platonism also does not provide an explanatory account in that it remains unclear how we are able to understand and interpret the speech of others. Given that we do not perceive the property of 'being an instance of type x', it is unclear how we would know what word types others are tokening when they speak. If my friend utters the token 'dog', I correctly interpret it as being a token of the type 'DOG', but this is left unexplained by the Platonist.

My own view is that these problems indicate that Platonism comes at too high a cost to pay to solve the issue raised about puns. Platonism is implausible for this (and other) reasons, but if the above does not persuade that Platonism should be rejected, then this paper can more minimally be taken to be raising a problem for non-Platonic versions of type-realism, which is increasingly the most widely defended form of type-realism in the literature today.

Another option is simply to embrace the metaphysical indeterminacy.¹¹ In response, I think there are many good reasons, well discussed elsewhere, as to why we should not embrace genuine metaphysical indeterminacy, and I am not alone in thinking that the world cannot be indeterminate in the way that would be required for this response to work.¹² Even those that are more inclined towards the view that reality can be indeterminate will be unlikely to think that we should accept genuine metaphysical indeterminacy on the basis that it allows us to maintain a type-token view of words. What would be needed then, is for supporters of the type-token view to first provide good reasons for the possibility that reality can be indeterminate, and only then might we have grounds to accept metaphysical indeterminacy in the case of puns. This at the very least burdens the supporter of the type-token view with significant additional metaphysical commitments that most would find unwelcome.

Furthermore, embracing metaphysical indeterminacy would force the type-realist into one of the non-standard versions of type-realism discussed above wherein we reject the idea that each token can only be a token of a single word-type. This is because if it is metaphysically indeterminate if a token is a token of word-types 'A' or 'B', then the token is not a token of only a single type. Combined with the additional commitment of accepting metaphysical indeterminacy, this is, I propose, not a combination of views that many would want to accept.

A (yet) further option is to respond by saying that 'measure' is actually a token of a new word, MEASURE₃, and hold that that new word is radically polysemous and perhaps only tokened once. 'measure' is therefore not a token of MEASURE₁or MEASURE₂, but is instead a token of MEASURE₃:

¹² See, inter alia, Eklund (2008), Akiba (2015), Heller (1996), Sider (2003, 2009), Horgan (1994, 1995), and Hudson (2001).



¹¹ There are some, though not many, that have defended the possibility of genuine metaphysical indeterminacy. See Rosen et al. (2004), Barnes, 2010a, b, 2013); Barnes and Williams (2011); Wilson (2017).

130 Page 10 of 18 Synthese (2024) 203:130

MEASURE₃: meaning a plan or course of action taken to achieve a particular purpose *and* meaning a standard unit of (in this case) alcohol.

However, first, this commits the type-token theorist to the view that semantic properties individuate word-types as it distinguishes the types 'MEASURE₁', 'MEASURE₂' and 'MEASURE₃' solely on the basis of the semantic properties the types (or their tokens) possess. This view, though, is widely rejected in the metaphysics of words literature as it cannot account for how words are able to change their meaning over time.

Second, again unless we accept a semantic account of how to individuate words, this response only deepens the threat of indeterminacy as we can now argue that it would be indeterminate whether the token 'measure' is a token of 'MEASURE₁' or 'MEASURE₂' or 'MEASURE₃'. Just as a type-token view fails to provide reasons as to why the token is a token of 'MEASURE₁' or 'MEASURE₂', it would also fail to provide strong reasons for thinking that the token is a token of 'MEASURE₁' or 'MEASURE₂' or 'MEASURE₃'.

And third, and even if we simply insist that 'measure' is a token of some new type MEASURE₃, this response would mean that every new punning event results in a new word being created, massively inflating the number of words that exist. Furthermore, if we were to suggest this route to solve our issue in the case of puns, it would also seem to commit us to a similar solution in other cases of semantic ambiguity. Semantic ambiguity happens frequently in language, and it would be implausible to hold that each time a speaker uses a semantically ambiguous word that they are tokening a new word-type by doing so. Ontological parsimony is not, by itself, a knockdown argument, but this does suggest that this response would have some counter-intuitive consequences.

To summarize: I have argued that the ambiguity thesis cannot be accepted in combination with a type-token ontology as it leads to an indeterminacy over which type token words are tokens of. I have argued that this occurs at least in the case of 'different word' puns where there are two word-types which the punned element might initially be thought to be a token of. I have also suggested that it is plausible that this indeterminacy is metaphysical in nature. This is because, without embracing Platonism, there is no property of the tokens that could dissolve the indeterminacy. It is not just a matter of us not knowing which type is being tokened, but rather that there is no fact of the matter as to which type is being tokened. I take it that a view that results in embracing a highly contentious metaphysical claim about reality being indeterminate is, all else considered, less plausible than a view that does not have this metaphysical consequence. It

¹⁴ A possible line of response for the supporter of type-realism would be to deny the ambiguity thesis rather than giving up on type-realism. Pending the details of what the type-realist would replace the ambi-



¹³ Indeed, there will also be more extreme cases than this, where there are three or more potential types that the token could be a token of. In such cases, the indeterminacy I have highlighted is only more pronounced, with it being just as unclear as to which type is being tokened, and why that type over the other contenders. In fact, puns across languages, which play off a speaker's knowledge of words in those distinct languages, under the type-token view leads to the conclusion that it is indeterminate whether the token is a token of a type in the same language as the other tokens in the sentence.

Synthese (2024) 203:130 Page 11 of 18 **130**

4 A nominalist account of puns

Can we maintain the ambiguity thesis on some other metaphysics of words? I think we can if we adopt a nominalist account of words. Like type-token views, nominalism is a family of views, but here, for ease of exposition, I will focus on the version of nominalism I have outlined recently in a series of papers (2021a, 2021b, 2022a). In that work, I argue that word-tokens should be analysed as bundles of properties, 'most notably semantic, phonetic, orthographic, and grammatical' (2021a: 5737) properties. Word types are then taken to be 'bundles (or sets or collections or pluralities) of tokens' (2021a: 5741).

As this is a nominalist view, it is important to stress that this account denies that these collections are themselves 'entities'. All that exists are word-tokens (analysed as being bundles of properties). Collections are mere 'ways of speaking' – a useful shorthand that allows us to talk about a range of word-tokens at the same time without listing them individually. I argue that the membership of particular collections is determined by the (exact or non-exact) resemblance relations holding between the properties that partly compose (or are instantiated by) word-tokens. 16 Thus, we can talk about the collection 'TABLE_{ORTH}' as being the collection whose members are those word-tokens that are bundles of properties which include the property of 'being spelt 't-a-b-l-e", or we might consider the collection 'TABLE_{SEM}' as the collection whose members are those word-tokens that are bundles of properties which include the semantic property of 'refers to tables'. Therefore, some (but not necessarily all; see Miller, 2022a) collections reflect genuine resemblances that hold between the properties that partly compose word-tokens, and it is those collections that speakers (and hearers) pay attention to and are what we mean when we otherwise talk about 'words' or 'word-types'.

What does this ontology mean for the ambiguity thesis? The problem for type-token views was securing why some token was a token of the relevant type, and a concern over which type the token was a token of. However, the nominalist view does not result in these issues precisely because we can hold that, in the case of a pun, the word tokens are tokens of distinct collections simultaneously. There is no indeterminacy about which type is tokened, as the nominalist can hold that a single token can be a member of more than one collection.

guity thesis with, I will explore whether other views in the metaphysics of words can accept the ambiguity thesis without leading to metaphysical indeterminacy.

¹⁶ Note that the crucial element for this paper is that types are taken to be collections of tokens. The arguments proposed here would be compatible with non-bundle views of word-tokens, so long as it is still maintained that the tokens are members of collections, the membership of which are determined by what properties the tokens instantiate. This view therefore is not a version of the 'convention' based views that Epstein (2009) argues against as at least some of the properties of word-tokens are non-conventional. I will use my language of 'bundles' (Miller, 2021a) and hence hold that properties 'partly compose' word-tokens, but if more 'objectual' views are preferred, we can instead think of the properties that word-tokens instantiate.



¹⁵ Another version of nominalism can be found in Bromberger (1989, 2011). There are other ontological views defended in the metaphysics of words (e.g., in Szabo 1989, Nefdt, 2019, Kaplan, 1990, 2011), but due to space constraints I will focus only on type-token and nominalist views in this paper.

130 Page 12 of 18 Synthese (2024) 203:130

To see this, consider the 'measure' pun again. Under the type-token view, the issue was about whether the particular word-token was a member of 'MEASURE₁' or 'MEASURE₂', where the type is an abstract entity that exists in addition to the word-token. For the nominalist, however, the question is whether the token 'measure' might be part of two (or more) collections.

For example, under the nominalist account, we might distinguish between two collections, 'MEASURE_{PLAN}' or 'MEASURE_{UNIT}'. These two collections are distinct collections in that they have distinct membership conditions:

MEASURE_{PLAN}: Word-tokens are members of this collection if they are partly composed of the semantic property 'meaning a plan or course of action taken to achieve a particular purpose'.

MEASURE_{UNIT}: Word-tokens are members of this collection if they are partly composed of the semantic property 'meaning a standard unit of (in this case) alcohol'.

'MEASURE_{PLAN}' and 'MEASURE_{UNIT}' are therefore distinct collections. Our question then becomes: is the word-token 'measure' a member of 'MEASURE_{PLAN}' or 'MEASURE_{UNIT}'? The difference between nominalist and type-token views, and the reason why nominalist views do not face the same indeterminacy issues, is that it is plausible, at least in the case of puns, that the word-token 'measure' is a member of both collections, 'MEASURE_{PLAN}' and 'MEASURE_{UNIT}'. The token is a member of each collection if it is partly composed of the suitable semantic properties, and, in the example, it is the case that 'measure' instantiates both the property of 'meaning a plan or course of action taken to achieve a particular purpose' and 'meaning a standard unit of (in this case) alcohol'.

Holding that the token has both of these semantic properties is simply a statement of the ambiguity thesis. What is important for this discussion, is that unlike type-token views, there is no requirement for the nominalist to think that the token is *only* a member of one type (or, more precisely, collection). As collections are not themselves further entities, there is no metaphysical problem in holding that a single token is a member of multiple collections, and hence we can maintain the ambiguity thesis and hold that, when punning, a person speaks (or writes, signs, etc.) a word with multiple or ambiguous meanings.

To stress, although this is a written example, the same analysis applies, mutatis mutandis, for spoken puns. If I were to *say* 'Lately, I have been selling houseboats. Sails are through the roof', then in this spoken pun, the word-token can be *both* a member of the collection 'SAILS' and the collection 'SALES' as the membership of these collections can be taken to be determined by the possession of a certain resembling phonetic property, but distinct semantic properties by the word-tokens. That is, the spoken tokens 'sails' and 'sales', at least in my accent, possess exactly resembling phonetic properties, but non-resembling semantic properties. 'SALES' is a collection whose members are those tokens that are partly composed of (or instantiate) the phonetic property of 'being pronounced ['seitz]' *and* the semantic property of 'refers to a commercial transaction', while 'SAILS' is the collection whose members are those tokens that are partly composed of (or instantiate) the phonetic property of 'being pronounced ['seitz]' *and* the semantic property of 'refers to a piece of sailing equipment'. 'SAILS' and 'SALES' are thus distinct collections – not all tokens that are members of one will be members of the other. But, as it happens, when I utter the



punned token, 'sails', I do utter a token that has the phonetic and semantic properties required for the token to be a member of both collections. In line with the ambiguity thesis, the token has the phonetic property of being pronounced ['seilz]', the semantic property of 'refers to a commercial transaction' *and* the semantic property of 'refers to a piece of sailing equipment'. By accepting a nominalist view of words, we can therefore explain both homophonic and homographic puns.¹⁷

What about unintended puns on the nominalist view? The answer here depends on whether we think that a speaker can utter a token of a word accidentally. That is, it depends on whether (and how much) we think that the intention to utter a token of a word is a necessary condition on tokening that word. My own view, as noted above, is that we should reject such a view, but nominalism can be upheld either way. ¹⁸

If we reject the intentionalist account, then a speaker can accidently (or unintentionally) produce a token of some collection. In some cases, this might lead to a pun occurring. Under the nominalist view, to accidentally pun, would be to produce some word-token which is a member of two distinct collections, only one of which the speaker intended the word-token to be a member of. There might still be some limits on accidental puns. Perhaps I cannot a token that is a member of a collection that I do not recognize or is not part of my linguistic repertoire. This would depend on further claims, outside the scope of this paper about word production and whether it is possible for a speaker to token a word that they do not know. For example, imagine a situation where in order to enter some location, a token that is a member of a certain collection must be uttered. It could be that the speaker does not know this but could be said to produce a suitable token still if they produced, perhaps even by accident, the relevant set of sounds or phonemes. The door might be opened for them because, at least in some sense, they have produced a token that others perceive to be a member of the relevant collection, even though, by stipulation, the speaker cannot intend to have produced a token that is a member of that collection. My point here is not to defend this interpretation of this sort of example, but rather to illustrate that if we reject intentional accounts of words, then the nominalist can still accommodate unintentional puns.

Alternatively, we might accept some form of an intentionalist account and deny that a speaker can ever accidently token a word. Again, this is fine for the nominalist. A speaker would produce some token. What collections that token is a member of would be determined by the intentions of the speaker.¹⁹ Furthermore, if we accept

¹⁹ This is akin to the intentionalist view combined with type-token accounts, wherein what type a token is a token of is determined by the intention of the speaker. Intentional accounts can be consistent with either



¹⁷ What about cases like 'The Codfather'? A full discussion will depend on our preferred metaphysics of morphemes as in this pun, unlike those that were the focus on this paper, the punning element – 'cod' is a morpheme not a word. (It is unimportant that this morpheme is a free morpheme and hence in other cases might be thought of as a word by itself). It is also different from the word-based puns I have focused on in that, in puns like this, there simply is no lexical ambiguity in the first place. Rather, the humour comes from one morpheme evoking another. If we were to extend our nominalist view of words to morphemes (see Miller, Ms.), this can be explained as being a case where the morpheme-token is a member of one collection, but evokes in the reader morphemes that are members of a distinct collection.

¹⁸ Note that this does not contradict the above claim that intentions cannot be invoked to save the combination of a type-token metaphysics and the ambiguity thesis. That conclusion is independent of whether we can combine an intentionalist view with nominalism about words.

130 Page 14 of 18 Synthese (2024) 203:130

this intentions-based view of words, it could still be the case that a *hearer*, mistakenly, *thinks* that someone has uttered a pun. That is, a hearer might think that some token is a member of some collection, but it is not. This would explain why a hearer might perceive the speaker to have uttered a pun even though the speaker, metaphysically speaking, has not.²⁰ Thus, I suggest that independent of what conclusions we ultimately come to about the role, if any, of intentions in word individuation, nominalism can account for unintentional puns.

5 Theories of humour

To close, although my aim was not to directly assess *why* puns are funny, it is still the case that a metaphysics of puns needs to (minimally) be consistent with theories about why puns are funny. It is beyond the scope of this paper to consider the relationship between this account of puns and all available theories in the philosophy of humour, so I will limit myself to the incongruity theory as the 'reigning theory of humor' (Smuts n.d.) and the view that is well received enough that 'no account of humor can fail to accord [incongruity] a special status' (Levinson, 1998: 566).²¹

The incongruity theory holds that humour involves 'delighting in a departure from some regularity or norm' (Shaw 2010: 115). Kant expresses it as the view that in 'everything that is to excite a lively convulsive laugh there must be something absurd' (1951: 177). Puns are a clear example of this sort of incongruity as they play off expectations around linguistic norms, and the breaking of those norms.

Prima facie, both views of puns discussed here are consistent with this account of humour, though they differ about *what* it is that departs from the norm. Under a typetoken view, it is the norms around the meanings typically associated with tokens of a given type that are undermined. Under the nominalist view, the incongruity arises

²¹ Smuts also notes that 'incongruity theories have the most to say about the object of humor', which, as this paper is about the *words* that are expressed when punning, seems to additionally make the incongruity theory a good place to start. The view has been defended by Clark (1970), Raskin (1985), Kulka (1990), LaFollette and Shanks (1993), and Hartz and Hunt (1991). See Shaw (2010), Smuts, and Morreall (2016) for wider overviews of the philosophy of humour, including for objections to the incongruity theory.



type-token or nominalist accounts of words.

²⁰ Might we employ this more generally, and hold whenever a pun occurs, this is actually a case where a hearer (and possible also the speaker) mistakenly *thinks* that a token which is a member of two collections has been uttered when it is only a member of one collection? This would be a direct objection to the nominalist view, but it would also undermine the type-token view as it would render all puns illusions as it would involve the claim that in the case of puns, hearers (and speakers) are systematically mistaken about their belief that a pun actually existed. This might even be called an 'error theory' of puns. Such a view would allow us to ignore much of what is discussed in this paper as there would be no need for a metaphysical analysis of a non-existent linguistic phenomena. My response to this is that it strikes me as a very extreme response to the topic under discussion and would go against a very strong intuition that speakers (and hearers) have that puns are a real linguistic phenomenon. It would also undermine the extensive empirical work that has been carried out on puns, which includes various forms of data strongly indicating the reality of puns. I would also worry about the potential extension of this approach to other forms of linguistic phenomena. Perhaps there are also no metaphors, or similes because these too are mere illusions. These are not knockdown arguments, and perhaps an error theory of puns could be developed, but until it is, it is hard to assess the plausibility of such an approach.

from the token being a member of two (or more) collections where tokens are not normally members of both of those collections. The nominalist account therefore is equally consistent with the incongruity theory of humour, though it locates the incongruity that gives rise to the humour in the number of collections a token is a member of, not with the typical meaning attributed to a word-type.

However, if my argument in this paper is correct, and type-realism is inconsistent with the ambiguity thesis (assuming we are unwilling to accept metaphysical indeterminacy), then this picture becomes more complex. The consequences will depend significantly on various issues that I cannot discuss in detail here, including the precise nature of the type-realism in question and what the type-realist replaces the ambiguity thesis with. One comment I will make, though, is that there does seem to be quite a close link between the ambiguity thesis and the incongruity theory of humour. A natural way to understand what is incongruous in the case of puns is that a word that is not normally ambiguous in its meaning, in the case of puns is. The incongruity arises precisely because there is ambiguity in the meaning of the wordtoken that is unexpected. If this close connection is plausible, and if I am right that we cannot accept both type-realism and the ambiguity thesis, this at least begins to put pressure on the consistency of type-realism and the incongruity theory, at least as applied to puns. This is not to say that we cannot accept type-realism and the incongruity theory, but rather that this is at least another area in the metaphysics of words that needs more attention to see what impact our metaphysics of words might have on theories of humour.

The nominalist view of puns therefore, I suggest, deserves to be more fully considered as a contender account of the metaphysics of puns, and supporters of typetoken views of words need to do more to show that their metaphysics can adequately handle phenomena such as puns. There is not the space here to discuss in this paper other phenomena, but this conclusion also raises the issue of other parts of language that may involve ambiguity, such as poetry or word play. I cannot say here whether these other phenomena lead to similar concerns for the supporter of type-realism, or if the nominalist can adequately accommodate them all. More work is needed in the metaphysics of words to see what our best ontological theories mean for a wider range of linguistic phenomena. I hope this paper is just the first to explore these sorts of issues in more depth.

Acknowledgements Many thanks to audiences at Nottingham, Durham, and Swansea for their comments on versions of this paper. Thanks also to Anna Bortolan and two anonymous reviewers for this journal for their helpful and constructive comments.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.



References

Akiba, K. (2015). How Barnes and Williams have failed to present an intelligible ontic theory of vagueness. Analysis, 75(4), 565–573.

Attardo, S. (1994). Linguistic theories of humor. Mouton.

Attardo, S. (2014). Encyclopedia of humor studies. Sage.

Barnes, E. (2010a). Arguments against metaphysical indeterminacy and vagueness. *Philosophy Compass*, 5(11), 953–964.

Barnes, E. (2010b). Ontic vagueness: A guide for the perplexed. Noûs, 44(4), 601-627.

Barnes, E. (2013). Metaphysically indeterminate existence. *Philosophical Studies*, 166(3), 495–510.

Barnes, E., & Williams, J. R. G. (2011). A theory of metaphysical indeterminacy. In K. Bennett, & D. W. Zimmerman (Eds.), *Oxford Studies in metaphysics*. Vol. 6 (pp. 103–148). Oxford University Press.

Bromberger, S. (1989). Types and tokens in linguistics. In A. George (Ed.), *Reflections on Chomsky* (pp. 58–88). Blackwell.

Bromberger, S. (2011). What are words? Comments on Kaplan (1990), on Hawthorne and Lepore, and on the issue. *The Journal of Philosophy*, 108(9), 486–503.

Clark, M. (1970). Humour and incongruity. Philosophy, 45, 20-32.

Dryden, J. (2001). In S. N. Zwicker, & D. Bywaters (Eds.), John Dryden: Selected poems. Penguin.

Dynel, M. (2010). How do puns bear relevance? In Marta Kisielewska-Krysiuk, Agnieszka Piskorska, Ewa Wałaszewska (Eds.). *Relevance studies in Poland Vol. 3. Exploring Translation and Communication Problems*. Warszawa: Wydawnictwo Uniwersytetu Warszawskiego, 105–124.

Eklund, M. (2008). Deconstructing ontological vagueness. Canadian Journal of Philosophy, 38, 117-140.

Eklund, M. (2011). Being metaphysically unsettled: Barnes and Williams on metaphysical indeterminacy and vagueness. Oxford studies in metaphysics 6.

Epstein, B. (2009). Grounds, convention, and the metaphysics of linguistic tokens. *Croatian Journal of Philosophy*, 9(1), 45–67.

Fry, S. (1991). The liar. Random House.

Gasparri, L. (2016). Originalism about word types. Thought, 5, 126-133.

Giora, R. (2003). On our mind. Salience, context, and figurative language. Oxford University Press.

Hartz, G. A., & Hunt, R. (1991). Humor: The beauty and the beast. 'American Philosophical Quarterly, 28(4), 299–309.

Hawthorne, J., & Lepore, E. (2011). On words. The Journal of Philosophy, 108(9), 447-485.

Heller, L. G. (1974). Toward a general typology of the pun. Language and Style, 7, 271-282.

Heller, M. (1996). Against metaphysical vagueness. Philosophical Perspectives, 10, 177-183.

Horgan, T. (1994). Robust vagueness and the forced march Sorites Paradox. *Philosophical Perspectives*, 8(Logic and Language), 159–188.

Horgan, T. (1995). Transvaluationism: A Dionysian approach to vagueness. Southern Journal of Philosophy, 33, 97–125.

Hudson, H. (2001). A materialist metaphysics of the human person. Cornell UP.

Irmak, N. (2019). An ontology of words. Erkenntnis, 84(5), 1139-1158.

Juvshik, T. (2021). Good 'Cat', bad 'Act'. Philosophia, 49, 1007-1019.

Kant, I. (1951). Critique of Judgment. Trans. J. H. Bernard. Hafner.

Kaplan, D. (1990). Words. Proceedings of the Aristotelian Society, 64, 93-119.

Kaplan, D. (2011). Words on words. The Journal of Philosophy, 108(9), 504-529.

Katz, J. J. (1981). Language and other abstract objects. Rowman and Littlefield.

Katz, J. J. (2000). Realistic rationalism. MIT Press.

Koestler, A. (1964). The act of creation. Macmillan.

Kulka, T. (1990). The incongruity of incongruity theories of humour. The Jerusalem Philosophical Quarterly, 39, 223–235.

LaFollette, H., & Shanks, N. (1993). Belief and the basis of humor. American Philosophical Quarterly, 30(4), 329–339.

Lando, G. (2019). A uniform, concretist metaphysics for linguistic types. Metaphysica, 20(2), 195-221.

Levinson, J. (1998). Humour. In Edward Craig (Ed.) Routledge encyclopedia of philosophy (pp. 562–567).

Mallory, F. (2020). Linguistic types are capacity-individuated action-types. *Inquiry: A Journal of Medical Care Organization, Provision and Financing*, 63, 9–10.

Miller, J. T. M. (2019). Natural name theory and linguistics kinds. The Journal of Philosophy, 116(9), 494–508.



Miller, J. T. M. (2020). The ontology of words: Realism, nominalism, and eliminativism. Philosophy Compass, 15(7), 1–13.

Miller, J. T. M. (2021a). A bundle theory of words', *Synthese. Online First*. https://doi.org/10.1007/s11229-019-02430-3.

Miller, J. T. M. (2021b). Words, species, and kinds. Metaphysics, 4(1), 18-31.

Miller, J. T. M. (2022a). Sameness of word. European Journal of Analytic Philosophy, 18(2), 2-26.

Miller, J. T. M. (2022b). 'There are no uninstantiated words', *Inquiry*, Online First. https://doi.org/10.108 0/0020174X.2022.2078405.

Miller, J. T. M., & Ms Words and other linguistic entities.

Morreall, J. (2016). 'Philosophy of humor'. In Edward N. Zalta (Ed.) The Stanford Encyclopedia of Philosophy.

Munroe, W. (2016). Words on psycholinguistics. Journal of Philosophy, 113(12), 593-616.

Nefdt, R. M. (2019). The ontology of words: A structural approach. *Inquiry: A Journal of Medical Care Organization, Provision and Financing*, 62(8), 877–911.

Nefdt, R. M. (2023). Language, science, and structure: A journey into the philosophy of linguistics. Oxford University Press.

Raskin, V. (1985). Semantic mechanisms of humor. Reidel.

Rosen, G., Nicholas, J. J., & Smith (2004). Worldly indeterminacy: A rough guide. Australasian Journal of Philosophy, 82(1), 185–198.

Sider, T. (2003). Against vague existence. Philosophical Studies, 114: 135–146.

Sider, T. (2009). Against vague and unnatural existence: Reply to Liebesman and Eklund. Nous, 43, 557–567.

Smuts, A. n.d. Humor. The Internet Encyclopedia of Philosophy.

Solska, A. (2012a). Relevance-theoretic comprehension procedure and processing multiple meanings in paradigmatic puns. In E. Walaszewska, & A. Piskorska (Eds.), *Relevance theory. More than under-standing* (pp. 167–182). Cambridge Scholars Publishing.

Solska, A. (2012b). The relevance-based model of context in processing puns. *Research in Language*, 10(4), 387–404.

Stojnić, U. (2021). Just words: Intentions, tolerance and lexical selection. *Philosophy and Phenomenological Research*, Online First. https://doi.org/10.1111/phpr.12781.

Szabò, Z. G. (1999). Expressions and their representation. *The Philosophical Quarterly*, 49(195), 145–163.
Tarnowski, M., & Głowacki, M. (2022). Words on Kripke's puzzle. *Synthese*, 200(292). Online first, https://doi.org/10.1007/s11229-022-03769-w.

Wetzel, L. (2002). On types and words. Journal of Philosophical Research, 27, 239-265.

Wetzel, L. (2009). Types and tokens: An essay on abstract objects. MIT Press.

Wilson, J. M. (2017). Are there indeterminate states of affairs? Yes. In Barnes, E. (Ed.) *Current controversies in metaphysics*, pp. 105–125.

Yus, F. (2003). Humor and the search for relevance. Journal of Pragmatics, 35, 1295–1331.

Yus, F. (2016). Humour and Relevance. John Benjamins.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

