Resonance as an applied predictor of cross-cultural diversity and a resource for AI conversational interfaces

In Dialogic syntax (cf. Du Bois 2014; Tantucci et al. 2018), naturalistic interaction is inherently grounded in resonance, viz. the catalytic activation of affinities across turns (Du Bois & Giora 2014). Resonance occurs dynamically when interlocutors creatively co-construct utterances that are formally and phonetically similar to the utterance of a prior speaker. In this study we argue that such similarity can inform the machine-learning prediction of linguistic and cross-cultural diversity. We compared two sets of 1000 exchanges involving (dis)-agreement from the two balanced Callhome corpora of naturalistic interaction in Mandarin Chinese and American English. We found a correlation of overt use of pragmatic markers with resonance, indicating that priming does not occur as an exclusively implicit mechanism (as it is commonly held in the experimental literature e.g. Bock 1986; Bock et al. 2007), but naturalistically underpins dialogic engagement and cooperation among interactants. We fitted a mixed effects linear regression and hierarchical clustering model to show that resonance occurs formally and functionally in different ways from one language to another. The applied results of this study can lead to a novel turn in AI research of conversational interfaces (McTear et al. 2016; Klopfenstein et al. 2017), as they reveal the fundamental role played cross-linguistically by resonance as a form of engagement of human-to-human interaction, and the importance to address this mechanism in machine-to-human communication.

Introduction

This paper is centred on the pragmatic and cognitive dimension of grammatical and lexical similarity across utterances in naturalistic interaction. In particular, we focus on the relationship between constructional affinities across turns of speech and whether such similarities correlate with dialogic engagement among interlocutors. This phenomenon has been defined as resonance (cf. Du Bois 2014; Tantucci et al. 2018; Tantucci & Wang 2021) and involves the on-going repetition or creative variation of a linguistic item that occurs in some previous or on-going turn of spontaneous interaction. We analysed 1000 occurrences of (dis-)agreement involving either lexical or syntactic resonance respectively in the Callhome corpora of American English and Chinese telephone conversations. A mixed effects multilinear regression (cf. Baayen et al. 2008) model indicates that resonance is a very important dimension of Mandarin conversation, as it tends to significantly correlate with intersubjectivity and dialogic engagement. Conversely, English conversation is characterised by a significantly lower degree of lexical and constructional affinity across turns, also underpinning a lower degree of association with sentence peripheral marking of intersubjectivity and dialogic

engagement. Most crucially, we fitted a hierarchical clustering model (cf. Gries 2010; Tantucci 2020) showing that resonance, in combination with sentence peripheral marking of intersubjectivity, allows to predict language diversity. This result has important implications for AI and cognitive architecture modelling, as it shows that the degree of similarity across utterances inherently defines the interactional pragmatics of different languages. This study bears a distinctively applied value, as it can inform the design of conversational interfaces (McTear et al. 2016; Klopfenstein et al. 2017) by accounting systemically for the fundamental role played by resonance in the dialogic accommodation of meaning in naturalistic conversation. Machine-to-human interaction can be enhanced by the usage-based intersection of resonance and pragmatic marking and the way this persistent concurrence contributes to dialogic engagement and on-going negotiation of meaning among interactants.

The paper is structured as follows: we first review the literature on dialogic syntax and resonance. We then move on to discussing previous and current research on (dis-)agreement, which is the specific speech act that this study is focused on. The following section is dedicated to the data retrieval, the annotation methods and the results of the present analysis. It reports results from a mixed effects linear regression and the hierarchical clustering model of the multifactorial interplay between utterance similarity and functional engagement in Mandarin and American English interaction. After a discussion hinging on language and cross-cultural diversity as dimensions that can be predicted with machine-learning methods, we then formulate the conclusions of this study by emphasising the relevance of priming and resonance as fundamental factors that can inform the AI design of machine-to-human interaction of conversational interfaces.

Resonance and engagement

Resonance is a dialogic mechanism involving the on-going activation of constructional affinities across utterances (Du Bois & Giora 2014; Tantucci et al. 2018). It occurs as the catalytic activation of analogies and similarities across turns that may occur phonetically, semantically and/or syntactically. Resonance is often driven from one interlocutor to another, yet it may also underpin self-expansion or unfold as a combined phenomenon resulting from the turns-at-talk of multiple interactants.

The recent tradition of usage-based linguistics has been mostly centred on language as an adaptive system consisting of constructs and constructions (i.a. Goldberg 1995; Tomasello 2003; Traugott & Trousdale 2013) as pairings of form and meaning that are produced by a single speaker. In the last few years, a new dialogic turn has been emerging in usage based linguistics, whereby the notion of construction has been increasingly studied as a by-product of on-going dialogic interaction, viz. as involving not just one, but both (or more) interlocutors, cooperatively contributing to the

formation of linguistic forms and functions as a joint activity. The traditional focus on formation of meaning as being independent from interactional constraints has been giving way to "interactional tools available at every turn to review, revise, and recalibrate understanding, the dynamics of human cognition in interaction diverges radically from the one-shot models assumed in many current theories" (Dingemanse 2020: 24). In this sense, cognitive processes, states of attention, intentions, inference and agency are studied as mechanisms reaching beyond individual psychological processing, viz. as distributed phenomena of dyadic or collective cognising (North 2007; Arundale 2008; Cowley 2009).

A flagship model of the on-going emergence of constructional organisation is the dialogic syntax paradigm (cf. Du Bois 2014; Zima & Brône 2015; Tantucci et al. 2018). In this view, constructions tend to emerge dialogically 'on the fly' and result from interlocutors' dynamic engagement (Du Bois, 2014; Du Bois & Giora, 2014). This entails that constructions are encoded, dis-assembled and re-assembled in the form of joint projects (cf. Clark, 1996) or co-actions (cf. Reich, 2011; Tantucci 2016a, 2016b). Interlocutors are interactionally primed to re-use the linguistic input of preceding utterances, leading to a "high degree of repetition typical of interactive language use in comparison to written texts or monologues" (Brône & Zima 2014: 466; see also Tannen 1989). Three fundamental assumptions are made for a constructional approach to dialogic interaction and the crucial role of resonance as a by-product of interactional engagement:

i.   Speakers in an ongoing interaction jointly set up local constructional routines with varying degrees of flexibility and fixedness. These ad hoc constructions at the same time produce a strong effect of structural parallelism (coherence) and allow for (creative) lexical-semantic variation between speakers.

ii. The processes involved in setting up these ad hoc constructions are comparable to the mechanisms described for the abstraction of conventional grammatical constructions from usage patterns in CxG.

iii. Ad hoc constructions are different from the form-meaning pairings traditionally described in CxG only in the scope and impact of the process. Whereas CxG focuses on community-wide conventionalizations, ad hoc constructions are temporary routines set up as part of a conceptual pact between speakers in an ongoing interaction.

(Brône & Zima 2014: 459)

The conceptual pact of dialogic engagement is an important dimension of resonance. Namely, resonance may perfectly coincide with a previous linguistic input, however it often occurs in the form of creative re-composition of structural, semantic and pragmatic features of a prime. When exact matching of the input is at stake, resonance is defined as systemic, viz. based on stable properties of

the language that are available to all members of a social group (Du Bois 2014), such as the formulaic behaviour of greetings, e.g. [A: *good morrow* B: *good morrow*] (Tantucci et al. 2018), or greetings at partying, such as the Mandarin. [A: 再见 *zàijiàn* 'good bye' B: 再见 *zàijiàn* 'god bye']. However, a previous construction is often creatively re-elaborated "on the fly in ways that may be comprehensible only to those who were present in the dialogic moment" (cf. Du Bois, 2014: 353). Those are frequent instances of what is called dynamic resonance – a phenomenon that has been previously captured as a form of message revision (cf. Sinclair & Mauranen 2006: 85) – which formally underpins parallelism and/or constructional analogy (i.a. Fischer, 2008; Gentner & Christie, 2010) and pragmatically, hinges on boosting, altering or reverting the illocutionary force of a preceding utterance (Tantucci et al. 2018). Consider the case of disagreement in the exchange below:

(1) JOANNE: […] yet he′s still healthy, he reminds me of my brother.

   LENORE: He′s still walking around I don′t know how healthy he is.

(Santa Barbara Corpus of Spoken American English, Appease the Monster, Part I)

(Brône & Zima 2014: 459)

In the case above, resonance occurs in the form of constructional analogy across turns. In Lenore's turn there is a creative extension of Joanne's original construction [*he's still healthy*] in the new form of [*he's still <u>walking around</u>*]. At a more schematic level of abstraction, both chunks correspond to the schema [Subj + BE + *still* + STATE]. This parallelism occurs on the fly across one single adjacency pair and it is used by LENORE as a pre-announcement strategy (Levinson 1983:350-3, 2013: 117; Schegloff 2007:38;) of mild disagreement, namely *I don't know how healthy he is.* In Table 1 below, this mechanism is reported in the form of a diagraph, namely "a higher-order, supra-sentential syntactic structure that emerges from the structural coupling of two or more utterances (or utterance portions), through the mapping of a structured array of resonance relations between them" (Du Bois & Giora 2014:354). The creative alteration of the original ad hoc construction is marked as underlined text (in case of <u>replacement</u>) and in brackets (in case of (addition)):

	Subj	BE	*still*	STATE
A:	he	's	still	healthy
B:	he	's	still	<u>walking around</u>

Table 1.

Diagraph [Subj + BE + *still* + STATE]

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From a pragmatic angle, this case of constructional similarity involves a contrary intensifying parallelism (cf. Tantucci et al. 2018, Tantucci & Wang 2021), whereby disagreement is achieved by means of structural subtraction. This means that the echoing of a preceding proposition p or a more schematic constructional structure, leads to an element x (*healthy*) being markedly replaced with y (*walking around*). This indicates that constructional analogy can be strictly connected with pragmatic engagement, as B formally resorts to A's construction with the per-locutionary effects (cf. Searle 1976) of disagreeing. Something similar occurs in the excerpt below, as A's original construct [*it's gonna be boring*] is altered by B in the form of [*it's gonna be really good*]. The latter depends on analogy that hinges on a more schematic structure [Subj *'s* + *gonna be* + AP]. In this case, dynamic resonance is achieved both through <u>replacement</u> and (addition):

(2)　　A:　　I just don't wanna go it's gonna be boring, I think.

　　　　B:　　No it's gonna be really good.

<div align="right">(Ogden 2006: 1764)</div>

	Subj	*'s*	*gonna be*	AP
A:	it	's	gonna be	boring
B:	it	's	gonna be	<u>(really)</u> <u>good</u>

<div align="center">Table 2.</div>

<div align="center">Diagraph [Subj *'s* + *gonna be* + Adj]</div>

Agreement can also be pursued in the form of constructional similarity across utterances. The Mandarin exchange below is from our dataset. Here, B resonates with A's original structure by boosting the degree what is said and therefore producing a speech act of hyper-agreement with the preceding turn:

(3)　　A:　　太冷清了是吧？

　　　　　　tài lěngqīng le ba

　　　　　　too cheerless PF be BA

　　　　　　'That's too cheerless isn't it?'

　　　　B:　　唉，就是很冷清的, 唉。

ai，jiùshì hěn lěngqīng de，ai

AI, absolutely very cheerless PF be DE, AI

Yeah, absolutely cheerless for sure, yes.

The original construction [太 *tài* 'so' + 冷清 *lěngqīng* 'cheerless' + 了 le MOD[1] 是吧 *shìba* SFP[2]] is creatively re-elaborated in the form of [就是 *jiùshì* 'absolutely' 很 *hěn* 'very' 冷清 *lěngqīng* 'cheerless' + 的 *de* 'DE' + 唉 *ai* 'AI']. The analogy from one chunk to the other is based on the more schematic structure [INT[3] + Adj + MOD + SFP]:

	INT	Adj	MOD	SFP
A:	太	冷清	了	是吧
B:	(就是) 很	冷清	的	唉

Table 2.

Diagraph [INT + Adj + MOD + SFP]

There is here a clear correlation between constructional structure and dialogic engagement, as the hyper-agreement in (3) is achieved via scalar implicature deriving from the exclusive meaning of 就是 *jiùshì* 'absolutely/nothing but' being used as a replacement of the original intensifying function 太 *tài* 'so' within the same schema adopted by A. Similarly, while the sentence final 是吧 *shìba* is a pragmatic marker of invited agreement (cf. Tantucci 2017b, 2018, 2020) comparable to the English *isn't it*, while the clause final 的 *de* (cf. Chao 1968:800; Huang & Liao 2011:32; Paul 2014:99) acts as a peripheral marker of certainty (Li 2007:270; Lü 2016:162).

Goldberg (2019) recently discussed three important dimensions underpinning the relationship between constructional organisation of utterances, the degree of creativity involved and speakers' social engagement:

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[1] Modal particle.
[2] Sentence final particle.
[3] Intensifier.

i.   Expressiveness: Linguistic options must be sufficient for conveying speakers' thoughts, beliefs, and attitudes in ways that listeners are able to understand.

ii. Efficiency: Fewer and shorter constructions are easier to learn and produce than more or longer constructions.

iii. Obeying conventions: [speakers] attempt to use language in the ways that others in the language communities do.

(Goldberg 2019: 8)

Priming and resonance are persistently at play in the dialogic formation of constructional pairings of form and meaning. This clearly suggests that constructional similarity is far from being an exclusively implicit mechanism, but is rather likely to correlate with dialogic engagement and interactional coordination, viz. as a by-product of interactive sense-making in context (cf. Linell 2009:432). This is a fundamental assumption of the dialogic syntax paradigm, clearly suggesting that both socio-cognitive mechanisms of obeying interactional conventions of a community of speakers (iii) and efficiency of meaning transmission (ii) are arguably involved in the persistent pursuit of analogy and similarity across turns. At the same time, expressiveness (i) is at play as a crucial source of creativity and the realisation of ad hoc constructions, with effects on dynamic resonance and on-going constructional alteration as a mechanism competing with systemic and repetitive linguistic behaviour (see also Tantucci & Di Cristofaro 2019).

Structural vs constructional priming

In this section we argue that resonance correlates with priming both formally and functionally. We first discuss the literature on priming as a mechanism that has been traditionally treated as a structural mechanism. We then suggest the desiderata for a reassessment of priming as a constructional phenomenon involving constructional pairs of form and meaning, therefore extending its scope from a merely formal to an additionally functional dimension.

Research on priming originates from cognitive psychology and has been developing over the last 30 years. Its main research strand is centred on structural similarity, with a special emphasis on how speakers tend to repeat syntactic structures they have just encountered, produced or comprehended (Gries 2005: 365). Pickering & Ferreira (2008) define priming as a persistent tendency "to repeat or better process a current sentence because of its structural similarity to a previously experienced ("prime") sentence" (2008: 1). Levelt & Kelter (1982) were the first who discovered that in a number of naturalistic interaction of merchants in the Netherlands the syntactic structure of answers to questions was remarkably similar, or even identical, to that of the preceding questions:

(4) a. Hoe laat gaat uw winkel dicht?

'At what time does your shop close?'

b. Om hoe laat gaat uw winkel dicht?

'What time does your shop close?'

(5) a. Om vijf uur.

'At five o′clock.'

b. Vijf uur"

'Five o′clock.'

(Levelt & Kelter 1982: 89; Gries 2005: 366)

This tendency was also confirmed in a later study by Weiner & Labov (1983) who found that the passive utterances occurring at some point of a sociolinguistic interview tended to be significantly correlated with the presence of another passive utterance in the previous five sentences. Bock (1986) subsequently designed a picture-based memory task whereby subjects were to repeat prime sentences with transitivity alternation and dative alternation. Subjects were then given a picture to describe and showed a significant preference for the syntactic structure that matched the prime sentence. During the following decade, experimental work has been centred on spoken English and written English, but also extended to Dutch (cf. Hartsuiker & Kolk 1998; Hartsuiker et al. 1999; Hartsuiker & Westenberg 2000) and German (cf Scheepers & Corley 2000). Hartsuiker et al. (2002) also reported syntactic priming from comprehending Spanish to producing English. Salamoura (2002) enquired priming from Greek (L1) structures to English (L2) structures, while Gries & Wulff (2005) showed that German learners of English as a foreign language exhibit priming in an English sentence completion task. Word-form encoding of disyllabic words has been shown to have a stronger effect on priming than monosyllabic words in Mandarin Chinese (Chen et al. 2002). Offline experimental paradigms have also become increasingly popular, such as sentence completion tasks (i.a. Pickering & Branigan 1998; Hartsuiker & Westenberg 2000), sentence recall tasks (Potter & Lombardi 1998), and picture descriptions from dialogues (cf. Branigan et al. 2000).

The distinctively structural persistence of priming is argued by Bock et al. (2007), who emphasise that priming occurs regardless of the modality in which language structures are experienced, viz. as an implicit, and specifically syntactic learning mechanism (2007:438). This view is aligned with a number of studies centred on structural persistence (Bock, 1986; Bock & Loebell 1990; Hartsuiker & Kolk 1998) as a tendency to echo syntactic structures from recent experience, despite changes in the meaning, in the wording, even in the language embodying the persistent structure (Pickering & Branigan 1998; Loebell & Bock 2003; Hartsuikern Pickering & Veltkamp

2004). Priming has obvious correlations with working memory and the discursive/temporal distance between a prime and a subsequent output (Potter & Lombardi 1998; Chen et al. 2013). Smith & Wheeldon (2001) and Corley & Scheepers (2002) conducted on-going studies where priming effects were measured in terms of production latencies. Levelt and Kelter (1982) and Branigan et al. (1999) report that priming is relatively short-lived in both spoken and written registers. In some other cases, priming effects are shown to persist across longer time interval or intervening material (cf. Bock & Griffin 2000; Pickering et al. 2000; Chang et al. 2000; Reitter et al. 201; Chen et al 2013).

Somewhat surprisingly, the experimental literature on priming has rarely been taking into account potential functional and pragmatic dimensions. Pickering & Ferreira (2008) hold the view that priming and repetition are inversely related to creativity. This is based on the argument that primed speakers merely repeat a previous behaviour, and therefore forgo the opportunity to create a novel behaviour instead. In this study we hold a different position, as we support the idea that priming in spontaneous interaction occurs as both cooperative and creative (and not merely structural) mechanism, whereby formal resemblance correlates with pragmatic coordination among interlocutors. This is especially true for cases of dynamic resonance, whereby interactants rely on the ability to creatively re-use previously encountered items to achieve new per-locutionary effects (see also Playfoot et al. 2016 on the primacy of non-creative, stereotypical association in tasks involving non-naturalistic interaction).

Pragmatic cooperation was at stake in a study on priming conducted by Garrod & Anderson (1987) who found that similar behaviour was replicated by pairs of participants playing a cooperative maze game. Something similar emerged from Brennan & Clark's study (1996). In this case interlocutors described pictures with a clear tendency to imitate one another′s choice of referring expressions. Interlocutors in other cases have been shown to interpret the spatial expressions such as left and right in the same way (Schober 1993; Watson, Pickering & Branigan 2004). Similarly, it has also been found that interlocutors often align on accent and speech rate (Giles, Coupland & Coupland 1991) and on phonetic realisations of repeated words (Pardo 2006). Haywood, Pickering and Branigan (2005) took cooperation and engagement into account as they found that participants tended to use locally disambiguated instructions when they had just been instructed to perform a similar act with a prime containing a particular item, rather than when the prime was not present. Apart from the cases above, one of the reasons of the stronger emphasis that traditionally has been placed on the exclusively structural and implicit dimensions of priming might be that data in experimental environments is normally collected in very narrowly defined and artificial settings. As Gries (2005: 385) notes, this may be desirable to control error variance, however it prevents from capturing the relationship between spontaneous interaction and context. Corpus data, by contrast has the potential to reveal whether priming is significantly associated with semantic-pragmatic dimensions that arise

'on the fly' through spontaneous conversation, and not as the result of artificially designed stimuli (cf. Tantucci & Wang 2021). In this sense, the present study is designed to account for all forms of syntactic and phonological priming across turn-takings throughout two balanced corpora of dialogic interaction. With this method we aim at the total accountability of priming as an emergent property of naturalist interaction, with a special concern to whether it occurs a joint production of dialogic pairings of form and meaning. For this reason, this paper favours the notion of constructional priming, as it better captures the speakers' capacity to co-construct formal and functional pairings of form and meaning. Consider the naturalistic example (6) below from our dataset:

(6)   A: Because I don't have anyone to talk to.
        B: oh, come on, you're kidding, right?
        A: No, I'm not kidding.

<div align="right">Callhome / Eng / 4485</div>

Example (6) is a case of constructional priming, whereby formal similarity is paired with specific rhetoric strategies and per-locutionary effects. Here B's construction [*you're kidding*] is re-used by B in the negative form to further stress the importance of her original statement on record: *I don't have anyone to talk to*.

	Subj	BE	PROG
A:	you	're	kidding
B:	I	am (not)	kidding

Table 2.

Diagraph [Subj + BE + PROG]

In the case above, structural resemblance across turns is based on the schematic structure [Subj + BE + PROG] and clearly extends beyond mere syntactical similarity. The utterance occurs in the form of an intensifying parallelism, whereby syntactic analogy is used as a booster of the expressive illocutionary force of B's speech act. Engagement here is a crucial dimension of constructional similarity, as a simple *no* as a response to B's question may lead to a reciprocity mismatch and result in un-cooperative behaviour (cf. Tantucci et al. 2018; Culpeper & Tantucci 2021; Tantucci 2021).

One may wonder if priming hinges exclusively on the basic cognitive ability of imitation. Imitation and its underlying mechanisms of mirror systems are argued to be a cardinal feature of human language (Arbib 2012) and are studied from how children learn language through imitative use (Ledin & Samuelsson, 2017), to more adult-like forms of linguistic mimicking (e.g. Arbib 2012).

If evidence on priming would be exclusively limited to mere imitation of a preceding stimulus, a distinctively implicit-structural account could suffice to explain behavioural and dialogic similarity after the input. On the other hand, we take the stance that priming often involves creativity and the on-going re-elaboration of a preceding construct. This is where dynamic resonance is at play, viz. as a phenomenon that is ubiquitous in naturalistic interaction which may either occur in the form of replacement or addition.

(Dis-)agreement

In this section we revise the current literature on (dis-)agreement and we discuss how the illocutionary dimension combines with constructional similarity across turns. Research on the pragmatics of (dis-)agreement started with Pomerantz (1984), with the original assumption that agreement is the preferred response to a statement (Greatbach 1992). Leech (1983, 2005) similarly argued that in response to opinions or judgements of interlocutors, agreement is preferred while disagreement is dispreferred in both Eastern and Western contexts. He noted that disagreement is often mitigated by speakers by means of adding delay, hesitation or temporising expressions. However, in a number of cultures and context-specific instantiations, disagreement has also been argued to be socially 'expected' or even a sociable form of rapport enhancement (cf. Spencer Oatey 2008). A distinction is traditionally made between strong disagreement and mitigated disagreement (Pomerantz 1984; Rees-Miller 2000; Angouri & Locher 201), with disagreements being considered "strong in as much as they occur in turns containing exclusively disagreement components, and not in combination with agreement components" (Pomerantz 1984: 74). From a discourse analytical perspective (Watts 2003; Locher 2004; Mills 2005), it was then found that strong disagreement tends to be employed as form of engagement in Jewish culture (Tannen 1984; Blum-Kulka et al. 2002; Ben-Menachem & Livnat 2018). From a cross-cultural angle (i.a. Goodwin & Goodwin 1990) much research has been conducted for Greek naturalistic interaction (Tannen & Kakavá 1992; Georgakopoulou 2001; Koutsantoni 2005). Converging evidence indicates that disagreement shows a tendency to become highly conventionalised and scripted (Schank & Abelson 1977) in a number of institutionalised contexts. Context and 'situatedness' are at the centre of studies of (dis-)agreement in Kotthoff (1993), Myers (1998), Yaeger-Dror (2002), Clayman & Heritage (2002), Tannen (2002), and Netz (2014), among others. Disagreement has also been found to play a relatively conventional role in contemporary on-going political discourse as a practice with a context-specific function of entertainment (i.a. Kleinke 2010; Dori-Hacohen & Shavit 2013; Livnat & Kohn 2018).

The inherent relationship between disagreement and dialogic engagement is particularly salient in cases of word meaning negotiation (WMN). Myrendal (2019) argues that WMN underpins

sequences that regard the way a particular word is used in context. This leads to a rhetoric negotiation of the formal and functional status of the lexeme or construction with effects on resonance and ad hoc pairings of form and meaning. (Dis)-agreement has also been object of enquiry in strategies for politeness between American English and Chinese (Liang & Han 2005) with a positive correlation between rates of disagreement and change of social distance among Chinese speakers. Chu (2016) designed a contrastive study on politeness strategies and social distance in connection with disagreement among native speakers of English and Chinese EFL. A similar study on Mandarin mundane conversations carried out by Zhu (2014a) reveals that non-familial, equal-status native speakers often rely on strong disagreement as a strategy of facework and rapport mantainment. Sentence peripheral pragmatic marking and intersubjectivity have also been shown to intersect with speech acts of disagreement in the Chinese context. Cases in points are the adverbials 其实 *qíshí* 'actually' and 事实上 *shìshí shàng* 'in fact', with the function of mitigating the threatening of recipients' face (Hsieh & Huang 2005, Wang et al 2010, Wang et al 2011). Zhu (2014b) investigated naturally occurring conversations produced by Chinese speakers of English with strong disagreement in spontaneous English conversations among non-familial, equal-status Chinese native speakers was similarly characterised by predominantly face-enhancing and face-maintaining acts (see also Zhu & Boxer 2013 on strong disagreement in Mandarin and English as a Lingua Franca).

The present analysis is centred on the cross-linguistic variation agreement and disagreement as forms of dialogic engagement which both functionally underpin various degrees of resonance and constructional priming. Consider the Mandarin exchange below from our dataset:

(7)   A: **京都大学是好学校**。他现在在什么学校?

        jīngdū dàxué shì hǎoxuéxiào。 tā xiànzài zài shénme xuéxiào

        Kyoto University is good university. He now stay what university

        'Kyoto University is a good institution. In which school is he studying right now?'

    B: **京都大学是**绝对名牌啦。

        jīngdū dàxué shì juéduì míngpái la

        Kyoto University is absolute brand LA

        'Kyoto University is an absolute brand isn't.'

    A: 绝对名牌哦。

        juéduì míngpái o

        absolute brand O

'An absolute brand surely.'

B: 哎，绝对名牌啦。

ai，juéduì míngpái la

AI, absolute brand LA

'Yeah, an absolute brand isn′t.'

In (7) above, agreement across turns is pursued in the form of constructional analogy based on the priming assertive construction [京都大学 *jīngdū dàxué* 'Kyoto University' + 是 *shì* 'is'+ 好学校 *hǎo* 'good' *xuéxiào* 'university']. B first resonates with A's schema [Subj + 是 *shì* + NP] in the form of hyper-agreement with the absolute intensifier 绝对 *juéduì* 'absolutely' in the place of 好 *hǎo* 'good', with the overt addition of the sentence final particle 啦 *la*, functioning as a marker of intersubjectivity and assertive reinforcement (cf. Tantucci 2018, 2020).:

	Subj	是	NP
A:	京都大学	是	好学校
B:	京都大学	是	绝对名牌（啦）

Table 3.

Diagraph [Subj + 是 *shì* + NP]

This new pattern is then reciprocated by A in the following turn, and re-asserted once again by B, with the ellipsis of the subject and the main verb, but the persistent parallelism with the schema [NP + SFP]:

	Subj	是	NP	SFP
B:	京都大学	是	绝对名牌	啦
A:	/	/	绝对名牌	哦
B:	/	/	绝对名牌	啦

Table 4.

Diagraph [(Subj + 是 *shi*) + NP + SFP]

In the exchange above, resonance and constructional priming intersect with the overt deployment of sentence final particles (SFP) of marked intersubjectivity (cf. Tantucci 2017a, 2017b; 2020, 2021). Mandarin SFPs constitute overt forms of interactional engagement, occurring as non-obligatory markers that are distinctively used to address potential reactions to what is being said, marking the utterance as a co-act proposal. As we emphasised in the previous sections, we not endorse the view that formal similarity across turns is exclusively implicit, i.e. detached from functional and dialogic engagement. This assumption is tackled empirically in the ensuing corpus-based analysis. In particular it will be shown that the intersection of overt employment of sentence peripheral pragmatic marking and resonance can be fitted in an unbiased model to predict language diversity.

Data retrieval

The data of this project was retrieved from the Callhome corpora of spontaneous interaction of Mandarin Chinese and American English, each of them consisting of 120 unscripted telephone conversations between native speakers, comprising 250,000 words[4]. The Callhome corpora are exclusively based on phone-calls data, hence elements hinging on embodied interactional experience such as proxemics were excluded a-priori from the current analysis. It is important to remark that speakers of the Chinese and American English version of the Callhome were all aware that they were being recorded and they were given no guidelines concerning what they should talk about[5]. Despite this context being quite specific and situated, it is also one that allows the analyst to primarily concentrate on the textual dimension of verbal interaction. This means that multimodal effects that may at play in other conversational settings are necessarily excluded both from interlocutors' interactional expectations. Most crucially, this paper aims at shedding light on how human-to-human interaction can inform the design of machine-to-human conversational interfaces. The selection of a dataset that is exclusively centred on the textual and phonetic dimension of naturalistic interaction was a clear advantage for this project.

Two different annotators manually retrieved 1000 cases of turn-takings of agreement and disagreement from each corpus. The operational criteria for the selection of turn takings of (dis-)agreement were based on whether the utterance would constitute an adjacency pair with a previous turn and whether it would either collocate or be acceptable with a preceding pragmatic

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[4] https://talkbank.org/access/CABank/CallHome/zho.html; https://talkbank.org/access/CABank/CallHome/eng.html (Last accessed 03/06/20).
[5] https://ca.talkbank.org/access/CallHome/eng.html (Last accessed 25/10/2020).

marker *shì de* 是的 'it is so' / 对 *duì* 'correct' vs 不是 *bùshì* 'it is not (the case)' / 不一定 *bù yīdìng* 'not necessarily' for Mandarin, while the opposition between *I agree / absolutely* vs *I don't agree / not necessarily* was used for the English data (cf. examples (1-7) in sections 2 and 3). The retrieval of the data was based on the principle of total accountability (Leech 1992), with the manual selection of all the turns of (dis-)agreement displaying resonance from the beginning up to the 1000th occurrence of each corpus. This led to the analysis of 83 different conversations for the Chinese Callhome, amounting to 67312 tokens, while it required 105 dialogues in the English Callhome with 227032 tokens in total. The retrieval of the data already led to a preliminary result, namely, that resonance is significantly more frequent in Mandarin naturalistic telephone conversation involving (dis-)agreement than English (X^2 (1, $N = 2000$) = 822.87, $p<.0005$.).

Annotation and methods

The multifactorial annotation of this study took into account whether the utterance was one of agreement or disagreement, the language (Chinese, English), whether peripheral pragmatic markers were present (PM) and which ones they were (PMs), it included the source of resonance (i.e. whether speaker B would resonate with speaker A, with him/herself or with both)[6], the degree of resonance occurring lexically, the one of resonance occurring syntactically and finally the distance from the prime and the stage throughout the exchange where resonance occurred. A sample row (out of 2000 for the two corpora) of the input of these dimensions is given in table 5 below:

(Dis-)agreement	Language	PM	PMs	Source	Phon Resonance	Synt Resonance	Distance
Agr	*En*	*Yes*	*you know*	*Other*	*4*	*3*	*2*

Table 5.[7]

Input for the annotation

The count of lexical resonance was based on the number of words or interjections that were reiterated or re-used by the interlocutors. Syntactic resonance was measured with reference to the internal

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[6] The notion of source of resonance here accounts for whether the priming stimulus originates from the interlocutor, the speaker him/herself or whether it occurs as a combination of both. Importantly, the idea that priming stimuli lead to resonance in naturalistic interaction does not entail intentionality. This means that – different from experimental tasks – in spontaneous interaction priming often occurs un-intentionally, i.e. without the speakers' aim to lead to a response that would include some formal or functional similarity with the original stimulus.

[7] PM here is a categorical variable accounting for presence vs absence of pragmatic markers. On the other hand, PMs is a factor accounting for all the specific pragmatic markers that we found in our dataset.

constituency of resonating ad hoc constructions. In this latter case, the annotation reached beyond the mere repetition of words, as it took the internal constituents of schematic constructions displaying structural similarity. Finally, we measured the dimension of distance based on the number of intonation units (IU) (cf. Chafe 1994) occurring from the prime up to the resonating construction. Intonation units are defined in terms of a single intonation contour (Chafe 1994; Croft 1995; Du Bois et al. 1993; Tao 1996). They tend to end with continuing or falling intonation contour and are typically separated by at least a brief pause, they tend to consist of a single clause, which contains one verb plus commonly known phrases that are associated with it (Chafe 1994:14). We can first look at example (8) as an illustration of the annotation procedure:

(8) A: I mean he would just have a miserable time.

     B: Oh, this would be a great time, even Norman…

<div align="right">Callhome / Eng / 4790</div>

In (8), the priming construction [*he + would + just have + a + miserable + time*] is re-assembled by B in the form of [*this + would + be + a + great + time*], based on the more schematic structure [Subj + *would* + Verb + *a* + Adj + *time*]:

	Subj	*Would*	Verb	*a*	Adj	*time*
A:	he	would	just have	a	miserable	time
B:	this	would	be	a	great	time

Table 6.

Diagraph: [Subj + would + Pred + a + Adj + time]

B's utterance is one of disagreement, as it would be inconsistent if preceded by *I agree.* B's turn includes the left peripheral interjection *oh*, which was included respectively in the two columns for pragmatic marking PM and PMs (cf. table 5). The source of resonance was marked as *other*, as B is not self-primed by her own utterance (that would be a case of self-expansion, to be tagged as *self*)[8], nor does resonance result from a combination of both interlocutors utterances (which would be tagged as *combined*). In B's turn, lexical resonance has a value of 3, due to the words *would, a* and *time* being re-used by B after A's utterance. Quite differently, a higher value is to be ascribed to syntactic resonance, as the latter is based on the internal constituents of the ad hoc schematic construction that

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[8] In adult and ontogenetic and research on priming and dialogic syntax, self-expansion and self-priming constitute important mechanisms of interactional engagement (e.g. Köymen & Kyratzis 2014).

resonates in B's turn. In this case the value is 5, amounting to the sum of Subj + *would* + Verb + *a* + *time*. A possible objection could be that, at a high level of schematicity, constructional similarity is extremely common in dialogic conversation, which may result in an extremely challenging annotation task for the dimension of syntactic resonance. We tackled this issue by positing lexical resonance as a condition for the annotation of syntactic resonance. This entailed the occurrence of at least one priming lexical item, particle or interjection as one of the internal constituents of the resonating construct, e.g. the presence of respectively *would*, *a* and *time* as necessary conditions for the annotation of the construct [Subj + *would* + Pred + *a* + Adj + *time*] in the Syntactic resonance column[9]. Finally, the value of distance is 2, as it includes the first IU *oh*, followed by the resonating chunk, *this would be a great time*. A second example of the present annotation is given in (9) below:

(9)　　　A:　　给寄了，他没收到，不知道怎么回事儿。

gěi jì le，tā méi shōudào，bù zhīdào zénme huí shì'r

give send PF, he not receive, not know how CLAS[10] thing

'I sent it, he didn't receive it, I don't know why.'

　　　　B:　　哦，也不一定没收到呢 。

ò，yě bù yīdìng méi shōudào ne

O, also not certain receive NE

'Oh, it might be not the case that he didn't receive it actually.'

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In the diagraph above, the construction [□ *tā* 'he' + □ *méi* 'not ' + □ □ *shōudào* 'receive'] is the

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prime for the resonating [也 *yě* 'also' + 不一定 *bù yīdìng* 'not necessarily' + 没 *méi* 'not', 收到 *shōudào* 'receive' 呢 *ne* NE]. Both of these are specific instantiations of the more schematic past tense negative construction [Subj + PastNeg + Verb]:

	Subj	PastNeg	Verb
A:	他	没	收到
B:	/	(也不一定) 没	收到（呢)

Table 7.

Diagraph [Subj + PastN + Verb]

B's turn is one of disagreement, as it is compatible with the pragmatic marker 不一定 *bù yìdìng* 'not necessarily' and mutually exclusive with its negative counterpart 是的 *shìde* 'it is so'. Importantly, B's utterance is marked with pragmatic markers occurring at both left and right sentence periphery, 哦 *ó* and 呢 *ne*. These are both aimed at dialogic engagement and rapport maintenance despite the illocutionary force of utterance hinging on disagreement (cf. Tantucci 2017b, 2018, 2020b). The source of B's resonance is exclusively A's turn, which is marked as *other*. The construct has a lexical resonance value of 2, with the replication of the items 没 *méi* + 收到 *shōudào* from A's to B's turn. The syntactic value is 3, as it corresponds to the three constituents of the [Subj + PastN + Verb] construction. Finally, distance here corresponds to 2, as it involves the occurrence of the first IU 哦 *ó*, followed by B's resonating construct, counting as the second IU.

The present model of analysis was exclusively based on formal criteria of annotation, without positing the problem of subjective judgement of qualitative diagnostics. Nonetheless, it was still necessary to resort to a three staged process of inter-rater reliability among three different annotators. This was done to capture all the quantitative variation of both lexical and syntactic resonance throughout all the 2000 dialogic exchanges. The rate of accuracy among the annotators at each stage of analysis was respectively 68%, 78% and finally 96%.

Analysis and results

This section is divided in two parts. We first provide a mixed effects linear regression analysis centred on resonance occurring constructionally. We then report the machine learning results of a hierarchical clustering model that allows to predict language diversity based on behavioural cues such as resonance and pragmatic marking. The latter bear an important applied value, as it can inform the design of naturalistic elements of engagement and cooperation for conversational interfaces.

Linear and mixed effect's regression of degrees of resonance

We first compared the degree of syntactic and lexical resonance in Chinese and English interaction, the distance from the initial prime to the new resonating construct and the source of resonance. In figure 1 below are plotted these three dimensions, indicating a remarkably higher value of syntactic resonance, lexical resonance and distance in Chinese in comparison with American English interaction:
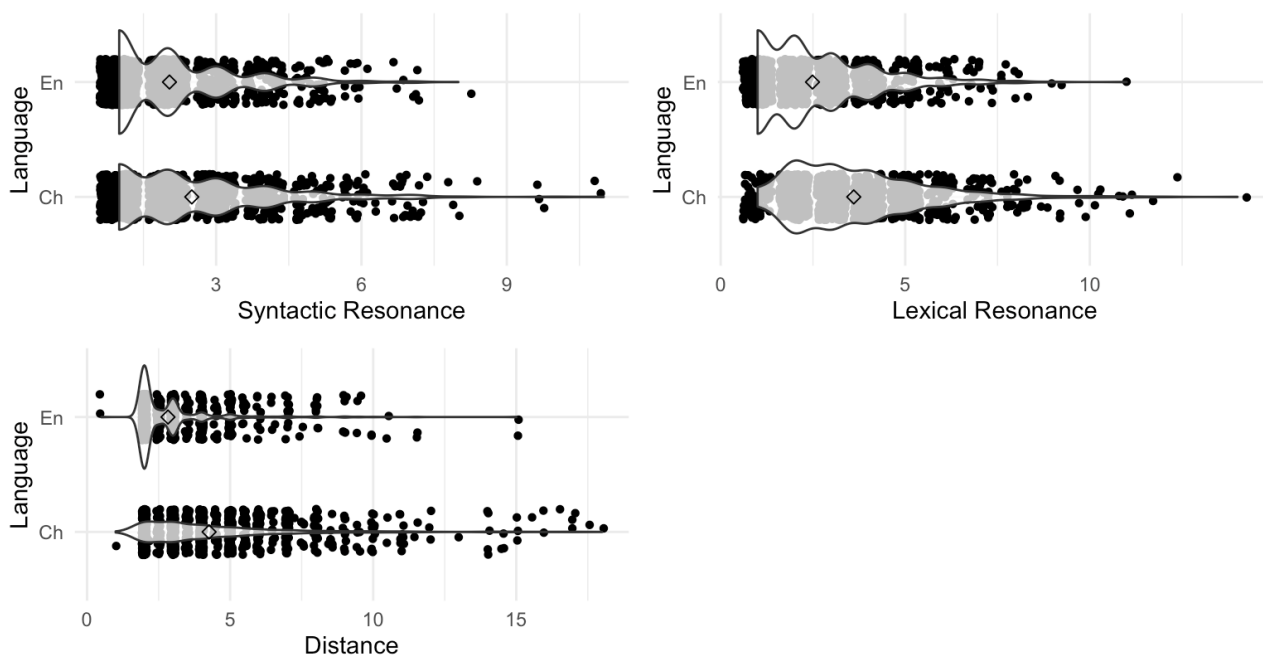
Figure 1.

Syntactic resonance, lexical resonance and distance in Chinese vs American English interaction[11]

Figure 1 includes three violin plots. This type of visualisation eases the interpretation of the data distribution as it displays the probability density of the observations at different values, which are smoothed by a kernel estimator. In all three cases we can see a much longer kernel density distribution for the Chinese data, with comparatively higher means, indicated by a diamond-shaped point (◇) at

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[11] In order to get a holistic visualization of the three plots, the steps on the x axis vary in magnitude depending on the predictor.

the centre of each plot. A linear regression indicates that Chinese interaction is characterised by significantly higher degree of syntactic resonance (df=1 on 1998, R^2 =.024, F= 50.84 $p<.0005$; β=-7.131, $p<.0005$), lexical resonance (df=1 on 1998, R^2 =.0954, F= 211.8 $p<.0005$; β=-14.55, $p<.0005$) and distance (df=1 on 1998, R^2 =.099, F= 222.2 $p<.0005$; β=-14.91, $p<.0005$). This entails that resonance has a stronger weight in Chinese with respect to how interlocutors re-use both words/interjections and more schematic constructions that they heard in a preceding turn. Similarly, it also crucially reveals a longer persistence of the prime across Chinese turns, as distance (measured in intonational units, IU) is also significantly higher in Mandarin Chinese interaction. This is particularly evident in the third visualisation of figure 1, as we can see a much more elongated kernel shape in the case of the Chinese data, with a mean distance above 4 IUs, in contrast with the value around 2.6 IUs of the English data. One possible explanation for longer persistence of the prime in Chinese conversation may arguably regard the Chinese focus structure (Lapolla 1995; Lambrecht 1996) and assertive illocutionary force being strongly geared towards the right periphery of the utterance:

(10)　　A:　　你要订的话，也可以去订啊？

　　　　　　　nǐ yào dìng de huà yě kěyǐ qù dìng a

　　　　　　　you must book DE word, also can go book A

　　　　　　　'If you want to book, you could also physically go to do so come on.'

　　　　B:　　不行，不行，你没有签证你怎么订啊？

　　　　　　　bù xíng，bù xíng，nǐ méi yǒu qiānzhèng nǐ zénme dìng a

　　　　　　　not go, not go, you not have visa you how book A

　　　　　　　'This can't work, it can't work, how can you book if you don't have your visa?'

<div align="right">Callhome / Chin / 0774</div>

In the diagraph above, the construct [订 *dìng* 'book' 啊 *a* A] resonates in the form of a rhetorical question, yet bearing assertive illocutionary force. The resonating construct occurs at the right periphery of B's turn of disagreement, with a distance of 4 IUs from the original prime. Crucially, word order in B's turn is relatively fixed and not as flexible as it would be in English, whereby B may reverse the order between protasis and the assertive force of the apodosis, e.g. *how can you book if you don't have your visa*? This would clearly entail a shorter distance from the priming structure and the resonating construct. This point further suggests a correlation between engagement and priming,

as the fixed right-peripheral focus of Mandarin utterance tends to coincide with resonating lexemes and constructs.

A further step of our analysis was to reveal the factors that contribute to the increase of resonance as a schematic mechanism. We therefore fitted a mixed effect linear regression model (cf. Baayen & Davidson 2008) with syntactic resonance as a response variable, distance as a random effect, and source of resonance, lexical resonance and pragmatic marking as fixed effects. It was then possible to reveal holistically the correlation between the degree of resonance occurring syntactically and whether the prime originates from the speaker (*self*), the addressee (*other*) or both (*combined*). The model similarly tackled the effect-size of the relationship between resonance occurring lexically and grammatically. It finally took into account possible correlations between schematic similarity across utterances and presence of pragmatic markers at sentence periphery. The results of our model for the Chinese dataset are reported in table 5:

Random Effects

Groups	Name	Variance	Std. Deviation	
Distance	(Intercept)	7.582E-02	0.008707	

Fixed Effects

	Estimate	Std. Error	T value	Pr(>|t|)
(Intercept)	-0.09540	0.07368	-1.295	0.19587
Disagreement	0.04944	0.05912	0.836	0.40316
Source_other	-0.30274	0.05351	-5.658	3.69e-08 ***
Source_self	-0.23288	0.08710	-2.674	0.00763 **
Lexical resonance	0.73432	0.01365	53.789	< 2e-16 ***
PM	0.15651	0.04930	3.175	0.00155 **

Table 8.

Mixed effects linear regression of the factors contributing to Syntactic resonance in Chinese

In table 8 above, the random effects section includes the standard deviation, showing the variability from the predicted values due to the random effects added to the model, which in this case is the number of IUs occurring from one diagraph to another. In the fixed effects section, the Estimate column shows the coefficients of the slope for the fixed effects on the degree of syntactic resonance, namely disagreement, source of resonance, degree of lexical resonance and presence of pragmatic markers at sentence periphery.

From the table, we can first notice that whether interlocutors agree or not does not significantly correlate with syntactic resonance. On the other hand, we can clearly see that resonance tends to significantly occur as a combined phenomenon among interlocutors, as both *other* and *self* show negative coefficients and T values (Source_other, $\beta(288)=-.3$, $T=-5.66$, $p<.0001$; Source_self, $\beta(950)=-.23$, $T=-2.67$, $p<.0001$). Expectedly, there is a very strong correlation between resonance occurring as a lexical phenomenon and as a syntactical one (Lexical resonance, $\beta(990)=-.73$, $T=53.79$, $p<.0001$), entailing that acoustic similarity across turns is significantly combined with grammatical analogy. Finally, and most crucially, there is a positive correlation between syntactic resonance and occurrence of sentence peripheral pragmatic marking (this was indeed the case in all the Chinese examples provided throughout the paper (3,7,9,10)). This is a fundamental result as it shows that in Mandarin, structural similarity is significantly associated with intersubjectivity and dialogic engagement. We can now compare these results with the English dataset in table 9:

Random Effects			
Groups	Name	Variance	Std. Deviation
Distance	(Intercept)	0.001949	0.04415
Fixed Effects			
	Estimate	Std. Error	T value	Pr(>|t|)
(Intercept)	0.44762	0.07736	5.786	2.77e-08 ***
Disagreement	0.07092	0.11908	0.596	0.5516
Source_other	-0.14547	0.07423	-1.960	0.0558 .
Source_self	-0.06974	0.07446	-0.937	0.3513
Lexical resonance	0.04326	0.01502	44.098	< 2e-16 ***
PM	0.157	0.04957	873	0.3830

Table 9.

Mixed effects linear regression of the factors contributing to Syntactic resonance in American English

Table 9 shows that syntactic resonance is less affected by the fixed effects in American English interaction. The only value that is strongly correlated with the outcome variable is lexical resonance, which, similar to what was at stake for the Mandarin data, indicates a clear interplay between syntactic and lexical similarity across turns. Conversely, the source of resonance as a combined phenomenon does not play as crucial a role as it does in Mandarin interaction. Most crucially, presence of pragmatic

marking shows positive coeffcients and T values, yet not quite significantly so, as in the case of the Chinese Callhome data. This is a crucial point of discussion of the present study, as it underpins the cross-linguistic relationship between constructional similarity and dialogic engagement across turns. Put simply, dynamic resonance and structural similarity is a fundamental element of creative engagement in Chinese naturalistic interaction. American English exchanges are also characterised by dynamic resonance, but to a far lesser degree.

Resonance and pragmatic marking as predictors of language diversity

In the usage-based literature, there is general consensus about the relationship between sentence peripheral presence of pragmatic markers and intersubjectivity (i.a. Traugott 2012, 2016; Haselow 2012; Tantucci 2017b, 2020, 2021; Tantucci & Wang 2018, 2020a, 2020b). Interlocutors resort to intersubjectivity when they overtly signal their awareness of the addressee's potential reactions to what is being said (Tantucci 2020, 2021). An operational way to test the degree to which resonance is a functional (and not exclusively structural) mechanism, is therefore to assess whether there is a large-scale correlation between presence of sentence peripheral pragmatic markers of intersubjectivity and degrees of resonance. More specifically, in the present analysis we assessed whether this interaction allows to predict language diversity and interactional behaviours cross-culturally. To do so, we fitted a hierarchical clustering model (Steinbach et al., 2000), which in cognitive corpus linguistics has been used as a multivariate exploratory model to differentiate senses and forms of a lexeme (cf. Gries, 2010; Jansegers and Gries, 2017: 3). A similar approach has been adopted in pragmatics research, viz. in so-called illocutional concurrences (IC) analysis (Tantucci & Wang 2018, 2020a, 2020b). In the IC approach, pragmatic and contextual dimensions cluster with formal and textual features of specific speech acts as a data-driven mechanism. The assumption of this approach is that contextually situated patterns of behaviour are characterised by the convergence of both illocutionary and textual features. In the fitting of this model, we retrieved all the sentence peripheral PMs that were present in resonating turns of the two languages. We then took into account all the illocutionary and formal dimensions listed in table 5, except from 'language'. We therefore fitted a model which could produce unbiased clusters of similarity among those variables, based on the hypothesis that language diversity would emerge as a result (viz. American English vs Chinese). In figure 2 below are reported the results of this analysis:
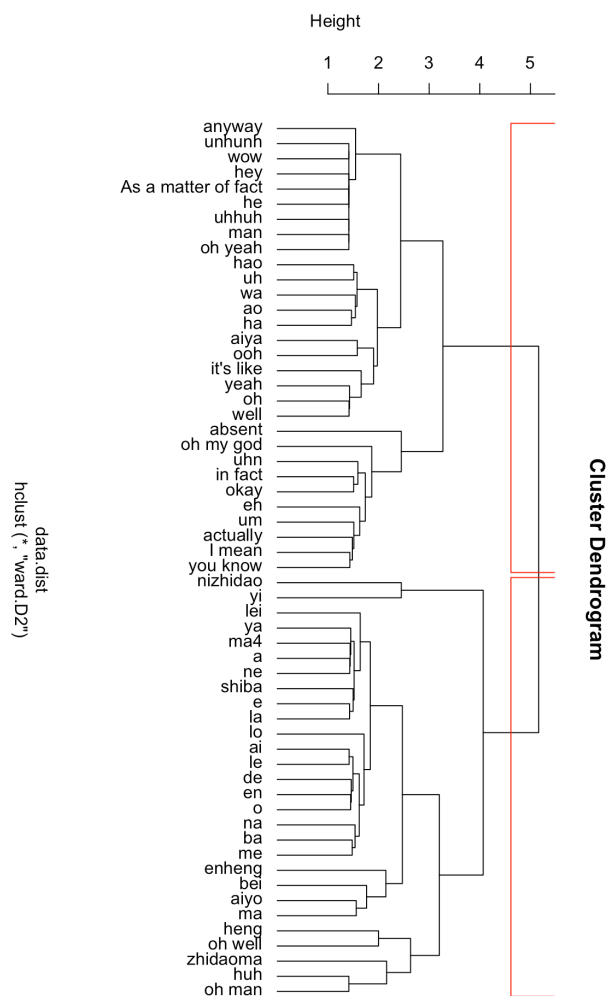
Figure 2.

Hierarchical clustering of based on structural and pragmatic similarity of PMs usage.

The plot above is called a dendrogram. Groups of behavioural profiles of the pragmatic markers appearing at the left hand-side of the plot (e.g. *Oh man, okay, e, la* and so on) are clustered together based on degrees of dialogic similarity and resonance features[12]. The higher the partition of the clusters, the stronger the division of interactional patterns among the pragmatic markers, which in this case was 2, as marked by the red sections at the righthand side of the plot.

The results of this model remarkably indicate the machine learning potential to differentiate languages based on resonance and pragmatic marking. More specifically, we can see how the cluster on top includes pragmatic markers that are almost entirely exclusive of English interaction (e.g. *anyway, as a matter of fact*), while almost only Chinese PMs appear in the second cluster at the bottom (e.g. *la, lo, ne*). This partition can be better visualised on a two-dimensional plane, which was

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[12] Similarity was measured as Ward distances (cf. Murtagh et al. 2011) which was reflected by the length of each split.

obtained after a multidimensional scaling transposition (e.g. Jansegers & Gries 2020; Tantucci 2021):
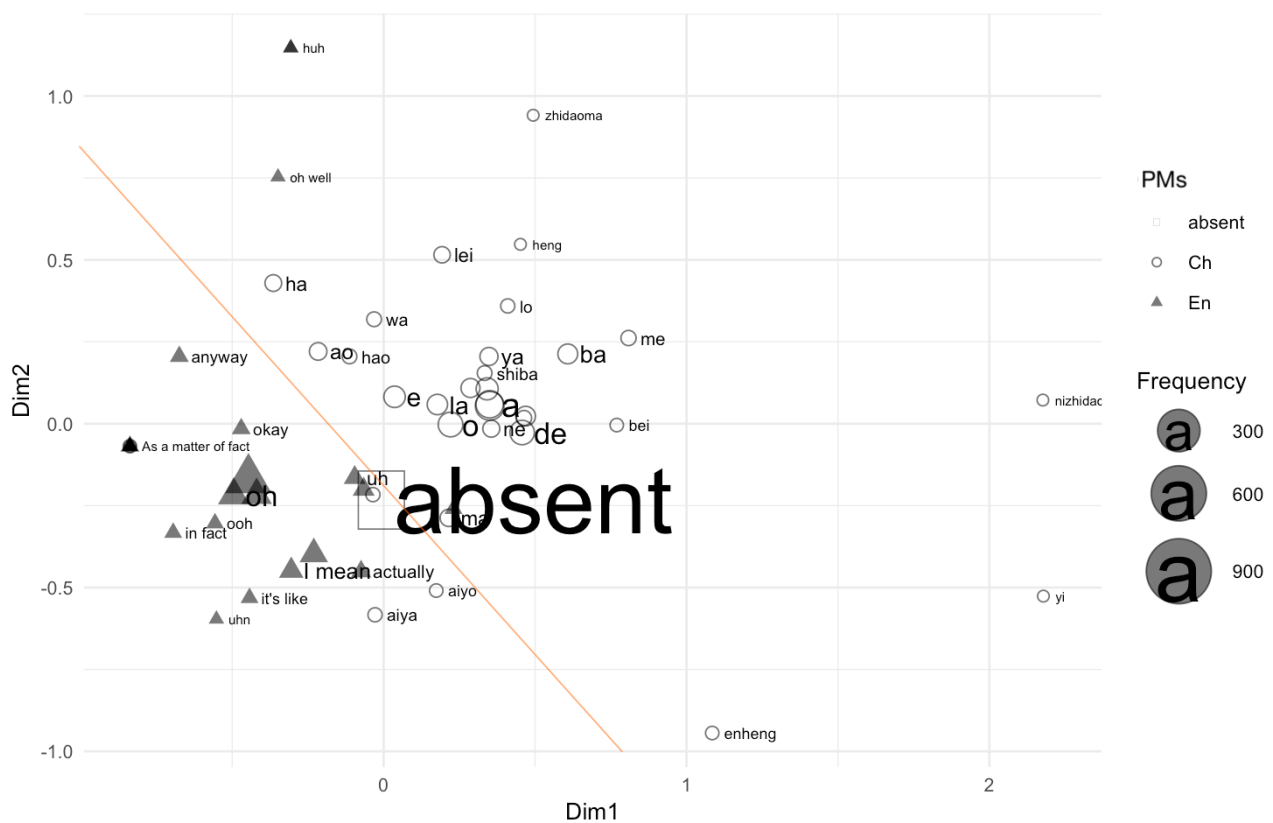

Figure 3

Multidimensional scaling of structural and pragmatic similarity of PMs usage.

In figure 3, increasing distances across Dim1 and Dim2 express interactional dissimilarity, while the size of each label accounts for frequency. All the PMs from the first cluster in figure 2 are represented by a triangular shape (▲), while the second cluster is visualised with empty circles (○), finally, absence of PMs is signalled by an empty square (□). Apart from a few outliers (e.g. *huh, oh well, aiyo, aiya*), we can see an accurate partition the PMs in the two languages, with Chinese PMs clustering around the centre of the plot and English PMs converging towards the bottom left hand side. Absence of PMs is finally located in between the two groups. The two clusters are divided by a red diagonal line, clearly showing a remarkable accuracy in the prediction of language diversity based on illocutionary force, and most importantly, degree, distance and source of resonance. In order to get a more fine-grained insight about which dimensions led to the partition of the two clusters, we fitted a snake plot, representing the effect-size differences between the average values in both clusters (cf. Levshina, 2015: 313) and positioning them in relation to either the first or the second cluster.
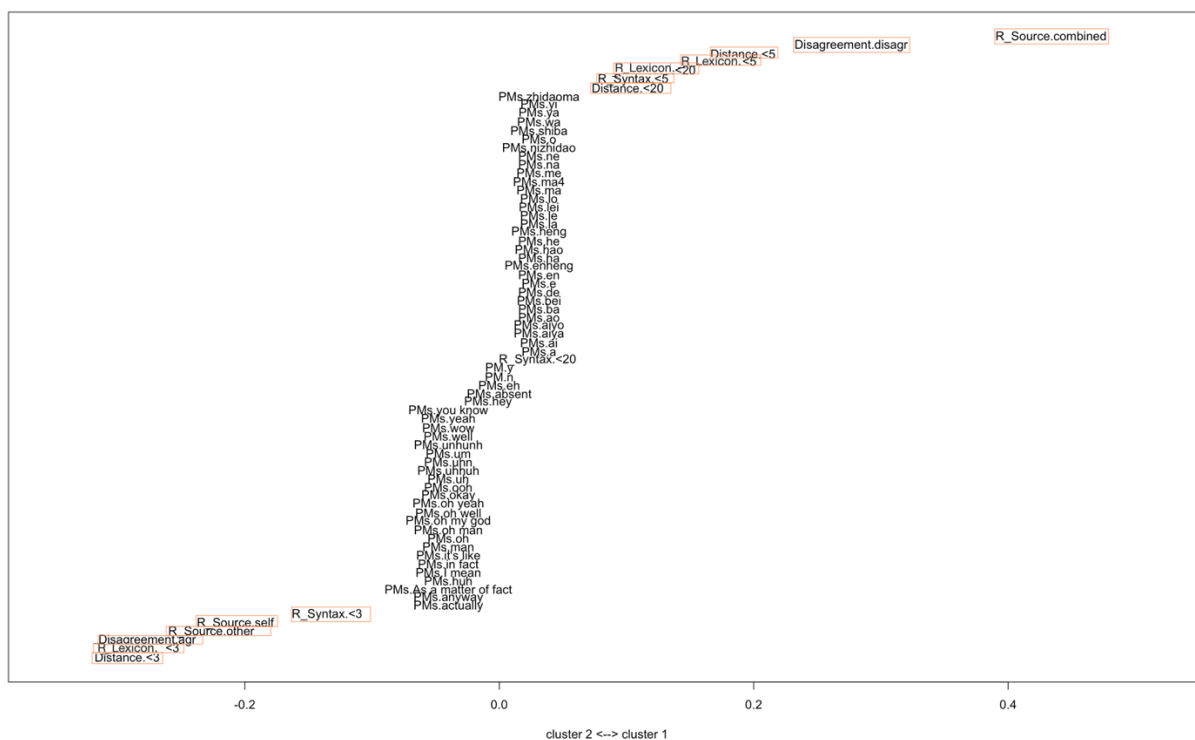
Figure 4.

Inner variables contributing to the classification of PMs in Chinese and English naturalistic interaction.[13]

The first thing to be noted is that language is absent among the variables in figure 4, as the aim of this study was indeed to make language diversity emerge as a data-driven result. Crucially, from the dimensions that are highlighted at the bottom left of figure 4, it is clear that English pragmatic marking tends to combine with relatively low values of both syntactic and lexical resonance, namely lower than 3. American English interaction is also comparatively geared towards agreement and utterances either resonating in the form of self-expansion, or specifically originating from the addressee[14]. Finally, distance is also distinctively short, i.e. less than 3 IUs.

Things are different for Mandarin pragmatic markers. In this case, values above 3 and 5 for syntactic, lexical resonance and distance 'pull' Chinese PMs towards the top right-hand side of the plot. Similarly, disagreement and source of resonance, resulting from the combination of turns of both

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[13] The labels appearing on the plot are the ones used for the annotation. They are therefore given in a contracted form to easy the holistic visualization of the results. Namely, Disagreement.agr = Agreement; Disagreement.disagr = Disagreement; R_Lexicon = Lexical resonance; R_Syntax = Syntactic resonance; R_Source.combined = the source of resonance is Combined; R_Source.other = the source of resonance is Other; R_Source.self = the source of resonance is Self; <3 indicates values that are less than 3; <5 indicates values that are between 3 and 4; <20 indicates values that are between 5 and 19].

[14] Concerning English data, it would be reasonable to expect disagreements being structurally marked by pragmatic markers (e.g., Levinson 1983) with agreements being the default or preferred response action. However, our results indicate that, when resonance is at play, pragmatic marking seems to both encompass speech acts of agreement and disagreement (cf. Tantucci & Wang 2021).

interlocutors, are also among the dimensions that led to accurately predicting of language diversity and cross-cultural pragmatic mismatching. Consider example (11) below:

(11)   A: Good for the soul.

          B: Yeah, really good for the soul.

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In (11) above, resonance occurs in a very short stretch of interaction, namely 2 IUs. B's turn is initiated by the peripheral pragmatic marker *yeah,* with agreement being pursued through intensifying parallelism, viz. from [*good for the soul*] to [(*really) good for the soul*]. A is the exclusive source of B's resonating turn, which has a value of 4 both for lexical and syntactic resonance. This tendency is statistically different from what is illustrated in the Mandarin example (10) (section 4.2.1), whereby longer IU distance intersect with combined resonance, with B both resonating with A's construct [订 *dìng* 'book' 啊 *a* A] and self-expanding his own speech act of disagreement [不行 *bùxíng* 'it can't work', 不行 *bùxíng* 'it can't work'], therefore leading to higher resonance values.

Conclusions

In this study we have shown that formal and functional similarity across utterances can be a predictor of language diversity and cross-cultural behaviour. Priming is therefore not an exclusively implicit mechanism, but correlates with dialogic engagement in naturalistic interaction. Our results indicate that resonance occurs in Chinese and American English as a form of dialogic engagement that is equally present in speech acts of agreement and disagreement. However, it appears to be at play to larger degree in Chinese interaction, encompassing longer stretches of discourse and both underpinning constructional similarity across utterances at the schematic and the lexical level. A fundamental result of the present analysis is the correlation between structural similarity across utterances and dialogic engagement, as shown by the significant interplay of sentence peripheral pragmatic marking and both syntactic and lexical resonance. The convergence of these two dimensions varies cross-linguistically and can aid the machine-learning prediction of language diversity and cross-cultural mismatches of interactional behaviour. One the limitations of the present analysis is the relatively specific nature of the dataset, hinging exclusively on naturalistic telephone conversation, yet not addressing the way resonance may occur multi-modally, rather than an exclusively textual phenomenon. On the other hand, the controlled environment of such interactional setting provided important results that may inform human-machine interaction. In fact, one profound

implication of this study is the crucial importance of incorporating usage-based insights from naturalistic interaction and pragmatics into the design of cognitive architecture and conversational interfaces. The applied impact of this endeavour can be the one of devising increasingly sophisticated ability of AI to simulate empathy and engagement, i.e. through conversational strategies and dialogic patterns that underpin human naturalistic conversation at the interactional pragmatic level, and not merely at the propositional one. One of the major advances in AI have been made through convolutional neural networks, which use highly constrained wiring to exploit that the visual world is translation invariant. The inspiration for this revolutionary technology was centred on the structure of visual receptive fields. This is the kind of innate constraint that in (human) animals would be expected to arise through evolution, yet there might be many others yet to be discovered (Zador 2019:6), e.g. hinging on mirror neurones (Arbib 2012) or Theory of Mind (Tomasello 2008; Tantucci forthcoming) abilities. The present paper argued that human ability to re-use a prime as a form of creative engagement throughout naturalistic interaction could be one of them and may constitute a powerful resource for future development of conversational interfaces in human-machine interaction.

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