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Speech acts in professional maritime discourse: A pragmatic risk analysis of bridge team communication directives and commissives in full-mission simulation

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ABSTRACT

The paper studies verbal maritime communication by categorising spontaneous professional discourse observed in co-operative full-mission simulation exercises into the illocutionary points of commissives and directives according to Searle's original classification. The research adopts a Corpus Pragmatics approach by combining vertical Corpus Linguistics methods with horizontal Pragmatics analyses. Between-group analyses of speech acts by native and non-native speakers of English are carried out and possible risks of miscommunication classified and compared. On the basis of the circular Osgood-Schramm communication model the sender–receiver interaction is investigated for either speaker group. Findings include both quantitative and qualitative between-group differences in locutionary, illocutionary and perlocutionary speech acts. These differences are evaluated as causal factors in effective communicative acts and as contributory factors for miscommunication in the maritime domain.

1. Introduction

Team communication in the workplace plays a decisive role in human performance. Whilst professional team discourse fulfils a range of social functions (Holmes, 2005; Kraut et al., 1990; Li, 2000; Lynch, 2002) its main purpose is to contribute to a successful completion of work-related tasks. In this respect, the specific linguistic patterns employed by the discourse community of any professional domain can be expected to pursue the goal of effective communication as a means of task accomplishment (cf. Hoover, 2002).

In the safety-critical environment on board sea-going ships, effective team communication is of vital importance to safety as it prevents damage to vessels, injuries to their crews and environmental pollution (Bocanegra-Valle, 2011; de la Campa Portela, 2005; Jurkovič, 2015; Pritchard and Kalogjera, 2000). Conversely, miscommunication in the maritime domain has been identified as a major contributory factor to shipping accidents (cf. John et al., 2013; McCallum et al., 2000; McCrae, 2009; Pyne and Koester, 2005). For this reason, the International Maritime Organization (IMO), the United Nations body charged with maritime regulation, has made substantial efforts to reduce ambiguous language patterns by first developing the Standard Marine Navigational Vocabulary (International Maritime Organization, 1978) and later the Standard Marine

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Communication Phrases (SMCP, International Maritime Organization 2002). The SMCP were adopted by the IMO in the year 2001 for use by officers in charge of a watch on ships of 500 gross tonnage or more and were published in 2002. By simplifying and removing any ambiguities from natural language, the SMCP constitute a coded English language variety to be used by seafarers internationally (cf. Gustafsson, 2004; John et al., 2017; Noble, 2015).

Bridge team communication can be considered a sub-genre of Maritime English which relates to the verbal exchange of information by the navigating crew (on the bridge) of a ship.[1] It helps nautical officers to develop a shared understanding required to navigate a ship safely. A disruption of this information exchange due to an error in encoding or decoding a verbal message causes an incongruent mental representation of the navigational situation which potentially leads to erroneous and possibly dangerous decision-making processes (Balmat et al., 2011; Horck, 2004; Velasquez and Hester, 2013).

Verbal team communication can be visualised by means of the well-known Osgood & Schramm communication model (1954), whereby a message is transmitted successfully if it has been encoded appropriately by the transmitter and decoded correctly by the receiver. Following this model, a message (i.e. a communicative act) can be assumed to have been effective if encoded, transmitted and decoded correctly. Accordingly, communication can be deemed to have been ineffective if errors occur in any of its three phases of language production, language transmission or language reception (cf. Lent, 2013; McQuail and Windahl, 1993).

The Osgood & Schramm model of communication allows for a suitable framework to study speech acts in a maritime setting. The term "speech act" has been referred to by Davies (2005, p122-123) as the "smallest unit of analysis in conversational interaction". Baker and Ellece (2011, p138) refer to speech acts as "utterances which perform various social functions such as requesting, greeting, advising, complaining, warning and so on". Speech acts are an integral part of the speech act theory defined by Austin (1962) and developed further by Searle (1969). Davies (2005, p122-123) summarises the theory's underlying principle as follows: "[T]here are three types of speech act: the locutionary act (the basic literal meaning of an utterance), the illocutionary act (what the speaker intends by the utterance) and the perlocutionary act (the actual effect the utterance has on the hearer)".

In theory, the coded English language variety promulgated by the IMO aims to remove any discrepancies between locutionary and illocutionary speech acts in bridge team communication. This means, that on the language production side of the Osgood & Schramm model speakers are expected to produce utterances without any ambiguities so that their locutionary language production and illocutionary meaning be identical. On the receiving end of the information exchange, nautical officers shall confirm perlocutionary acts by using a closed-loop communication whereby the receiver repeats the message uttered by the transmitter (hence closing the communicative loop). This affirmative communication method is commonplace in shipping (cf. Chauvin et al., 2013; Chawla, 2015) and practised intensively in Bridge Resource Management courses which aim to improve the interaction of team members.[2]

The question arises as to what extent the theoretical construct outlined above can actually be observed in spontaneous speech acts by bridge team members. Preliminary research on bridge team communication introduced "a quantitative methodology to calculate and weight utterances for evaluating [the] information content" of maritime discourse based on lexical and key word densities (John et al., 2013, p242). The research approach was in line with the linguistics field of Semantics, by which locutionary acts were investigated in a literal manner, thus assuming no differences between locutionary and illocutionary speech acts.

This research sets out to study speech acts from the perspective of Pragmatics, which according to Paltridge (2006, p3) "is interested in what people mean by what they say, rather than what words in their most literal sense might mean by themselves". The research undertakes to identify possible miscommunication by singling out differences between locutionary and illocutionary speech acts. It also verifies if the "perlocutionary effect" of the corresponding speech acts corresponds to their "perlocutionary intention" (Bach, 1990, p397; Bach and Harnish, 1979). Communication patterns of two sociolinguistic groups, namely native and non-native speakers of English, are analysed and differences and similarities between these two groups are quantified.

2. Methodology

This paper investigates speech acts of naturalistic maritime communication recorded in full-mission simulation exercises. These exercises simulate the socio-technical work environment of a real ship's bridge. The analysis is carried out on a spoken corpus of bridge team discourse including native (L1) and non-native (L2) speakers of Maritime English. The spoken corpus contains verbatim transcripts of authentic, synchronic language use in standard navigation exercises. It consists of 43,019 word tokens produced by twenty German (L2) students of Nautical Sciences during a total recording time of 10 h, and of 63,871 word tokens produced by twenty Irish (L1) students of Nautical Sciences during an identical total recording time. The special spoken corpus is limited to standard team work tasks and has been studied in previous Corpus Linguistics research for

[1] Bocanegra-Valle divides Maritime English into "five different subvarities according to the specific purpose they serve within the maritime context" (2013, p3580). Bridge Team Communication belongs to the subvariety of "[i]nternal (intra-ship or onboard) communication" (Bocanegra-Valle, 2013, p3580).

[2] At this point it is worth mentioning that the Standard Marine Communication Phrases (SMCP) have been paramount in introducing a communicative form which team members also adopt in situations not specifically covered by the SMCP.

lexical and key word densities, vocabulary growth and part-of-speech diversity (John et al., 2017). The empirical speech data was audio-recorded in the years 2013 and 2014 at Jade University of Applied Sciences in Germany and at the National Maritime College of Ireland (cf. John et al., 2016 for a detailed description of the data collection process and meta-data of exercise participants).

Corpus Linguistics traditionally pursues a "vertical-reading methodology" (Rühlemann and Aijmer, 2015, p8) on "authentic language data, stored in extensive computer corpora, as the basis for linguistic research" (Rühlemann and Aijmer, 2015, p*i*). This vertical approach in Corpus Linguistics enables researchers to establish frequencies of linguistic features which can subsequently be analysed by means of quantitative methods. To the contrary, Pragmatics most often adopts a "horizontal-reading methodology" Rühlemann and Aijmer, 2015, p3) in order to engage in "the art of the analysis of the unsaid" (Mey, 2001, p245). As Pragmatics research intends to infer the "meaning-in-context" (Bublitz and Norrick, 2011, p*v*) of utterances rather than studying their surface structure, research focuses on speaker–listener interaction which usually covers several utterances (cf. Bublitz and Norrick, 2011; Fasold, 1990; Leech, 1983; Levinson, 1983).

For the investigation of speech acts included in a spoken corpus on bridge team discourse a Corpus Pragmatics methodology has been applied. Corpus Pragmatics employs a vertical Corpus Linguistics approach to identify locutionary speech acts which are subsequently studied horizontally for their illocutionary meaning and perlocutionary reception.

The horizontal analysis follows a "pragmatic perspective, [whereby] language use and language users in interaction are primary, as opposed to language as a system of signs or a set of rules. The pragmatic perspective scrutinises neither just individual words nor sentences nor even isolated texts, but rather hold speech events or language games in real social contexts, considering both the present state of affairs and its connectedness with prior and succeeding action", according to Bublitz and Norrick (2011, p4).

Following the terminology introduced by Rühlemann and Aijmer (2015), the authors employ the term "*vertical*" to refer to occurrences of node words identified across the studied dialogues in a vertical direction and the term "*horizontal*" when several lines of text are analysed for their pragmatic function.

Fig. 1 depicts the different approach in vertical and horizontal corpus analyses.

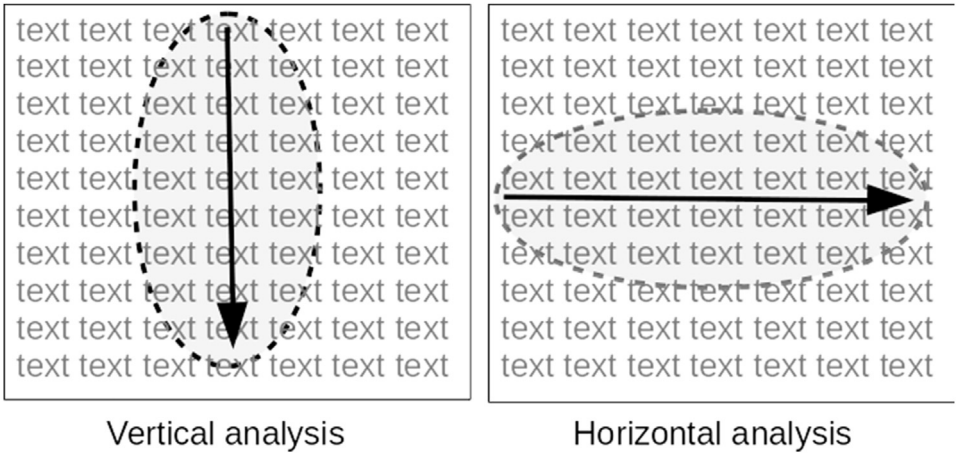

Fig. 1. Vertical and horizontal text analysis (Rühlemann and Aijmer, 2015).

Rühleman and Aijmer (2015, p55) refer to a number of researchers who have carried out "[c]orpus-based speech act studies […] in which words and phrases, predetermined by the researcher to have pragmatic meaning, are searched in a corpus to identify speech acts (e.g., Adolphs, 2008; Aijmer, 1996, 2008; Jiang, 2006; Butler, 2008; Cheng, 2010)".

This research combines the search for predetermined words with a search for specific syntactic structures to classify speech acts as directives and commissives according to Searle's taxonomy of illocutionary acts (1975).

3. Identification of locutionary speech acts

In reference to Austin's original classification of speech acts (1962), Searle (1976, p10) proposed an alternative taxonomy with "basic categories of illocutionary acts". He defines the constructs of directives and commissives as follows:

- directives: "they are attempts […] by the speaker to get the hearer to do something" (Searle, 1976, p11),
- commissives: they "commit the speaker (again in varying degrees) to some future course of action" (Searle, 1976, p11).

After publishing his theoretical framework and stating examples of illocutionary acts, Searle provided his own semantic analysis for identifying speech acts (Searle and Vanderveken, 1985, pp179-217) on the basis of predefined lexical items, and although his taxonomy has since been used extensively by linguists (cf. Garcia McAllister, 2015, p34) no conclusive

methodology has been developed for identifying speech acts classifiers. In the year 1996, Cohen (p385) saw a paradigm shift in that "although the process of defining and identifying speech acts has been going on since the 1960s, the last 15 years have marked a shift from intuitively based anecdotal approach to speech acts description to an empirical one [,…] encompassing both quantitative and qualitative approaches".

This research follows the more recent approach outlined by Qadir and Riloff (2011) who use "Lexical and Syntactic (LexSyn) Features, Speech Act Clue Features, and Semantic Features" to extract speech acts from a text corpus containing message board posts.

Upon applying the methodology proposed by Qadir and Riloff to the spoken corpus of bridge team communication and combining a number of "classifiers that can identify whether a sentence contains a speech act" (ibid, p748), a total of 3,172 speech acts clues for directives and commissives were identified in 2,218 utterances, leading to an overall speech act clue frequency of 29.7 clues per 1,000 tokens for the entire text corpus. The observed redundancy in the occurrence of speech acts clues (i.e. more than one clue per utterance) is based on the fact that speech acts clues are identified in the mixed-method manner described above.

The clues were subsequently annotated in the spoken corpus with pragmatic markers in line with research carried out by Garcia (2007), Rühlemann & O'Donnell (2012) and Stiles (1992) to allow for a vertical, quantitative analysis of the identified locutionary speech acts.

4. Results of the vertical analysis of locutionary speech acts

The annotated corpus was analysed for native and non-native speakers separately leading to significant differences between the number of speech act clues observed in L1 and L2 utterances. A Pearson's chi-squared test of association ($\chi 2$) carried out on these raw figures leads to $p < 0.001$ so that the null hypothesis of no difference between the two frequencies must be rejected. The magnitude of the measured effect was computed using the phi coefficient (Φ) which has been recommended by Grissom and Kim (2005) for naturalistic research on dichotomous variables (p249). On a scale from -1 to $+1$, phi results in 0.05 for directives and 0.04 for commissives where a value of 0 would denote no difference between the native and non-native speakers. Table 1 displays the individual clue values for both sub-corpora.

Table 1
Occurrences of speech act clues for directives and commissives.

	Native speakers (L1)	Non-native speakers (L2)	Effect size
Speech act clue frequency per 1000 word tokens	23.23	39.23	
Directives frequency	7.49 (479 clues)	13.48 (580 clues)	$\Phi = 0.05$[a]
Commissives frequency	15.73 (1005 clues)	25.75 (1108 clues)	$\Phi = 0.04$[a]

[a] Findings significant in $\chi 2$ test, $\alpha = 0.01$.

This vertical, corpus-based analysis on speech act clue frequencies has proved to be suitable for identifying a series of commissives and directives to be analysed horizontally. A between-group comparison of native and non-native speakers delivers divergent clue frequencies. Although the hypothesis testing leads to significant differences between native and non-native speakers, the phi coefficient points to rather marginal differences in the distribution of directives and commissives across both sub-corpora. It can thus be argued that at surface level, native and non-native speakers produce speech acts, including commissives and directives, at a similar rate.[3]

5. Categorising locutionary and illocutionary speech acts

After isolating a series of locutionary speech acts from the text corpus by means of a vertical text analysis, these speech acts are subsequently investigated for discrepancies between their locutionary and illocutionary meaning. It is understood that no difference between their locutionary and illocutionary meaning avoids ambiguities in the delivered message whereas a possible discrepancy puts more strain on the receiver to decode the message correctly.

For a qualitative analysis of possible differences between the literal meaning of an utterance and its illocutionary meaning, a dichotomous system has been chosen. This system grants a value of 0 to unambiguous utterances and a value of 1 to those utterances which can possibly lead to miscommunication due to a discrepancy between the locutionary act and its illocutionary meaning. Table 2 lists the number of possibly ambiguous directives and commissives uttered by native (L1) and non-native speakers (L2).

[3] In their research on Speech Acts in Message Board Posts, Qadir and Riloff (2011) identify 159 directives and 261 commissives for each 1000 word tokens. Although the communicative setting is totally different, their findings coincide in a clear prevalence of directives over commissives.

Table 2
Possibly ambiguous directives and commissives uttered by L1 and L2 speakers.

	L1	L2	Effect size
Possibly ambiguous utterances including directives (locutionary ≠ illocutionary act)	76 (15.8%[b])	157 (27.0%[b])	$\Phi = 0.15$[a]
Possibly ambiguous utterances including commissives (locutionary ≠ illocutionary act)	153 (15.2%[b])	335 (30.0%[b])	$\Phi = 0.20$[a]

[a] Findings significant in $\chi 2$ tests, $\alpha = 0.01$.
[b] Percentage of the clues listed in Table 1.

The quantitative analysis of potentially ambiguous speech acts summarised in Table 2 reveals that language production by non-native speakers bears a much higher risk than messages uttered by native speakers. A calculation of the ratio of potentially ambiguous speech act production to the total number of clues leads to L2 figures which are approximately twice as high as for L1 speakers. With reference to the Osgood & Schramm communication model this means that in L2 communication, the effort to be made by the messages' receivers to decode them correctly can be assumed to cause a substantially higher risk of communicative disruptions.

Table 3 provides some examples for unambiguous and potentially ambiguous utterances. The lexical elements which can possibly lead to a misunderstanding are marked in *italics*.

Table 3
Dichotomous system for differentiating utterances.

Unambiguous utterances (locutionary act = illocutionary meaning)	Utterances with a risk of ambiguity (locutionary act ≠ illocutionary meaning)
(15_{L2}) Slow ahead, forty percent[a,c].	(64_{L2}) *Can* you take over for a moment here?[c]
(112_{L2}) I will call him.[b]	(108_{L2}) *Can* you please call him to make *it* a *little bit* more?[c]
(1426_{L2}) So, I will tell you now our position.[b]	(1348_{L2}) But you know, you, you *should* use two radars.[c]
(5475_{L2}) Here then, please do the new waypoints, er, again.[c]	(1346_{L2}) I *only have to* switch the radar here on port side but so far it's ready, yeah.[b]
(10120_{L1}) Let's have a countdown now every half cable as opposed to every cable.[d]	(1355_{L2}) You're *gonna make sure* that you can start.[c]
(10258_{L1}) Shall I take a bearing now that she is stable?[b]	(10030_{L1}) When you are working this *I suppose you have to* keep because we are heading further south.[c]
(10720_{L1}) I will pull away.[b]	(10161_{L1}) I *have to* grab that now.[b]
(12250_{L1}) I tell you to get the bosun and tell him to get the anchors cleared away.[c]	(10424_{L1}) Let's stay *about there*, over.[d]

[a] Standardised nautical command.
[b] Commissive.
[c] Directive.
[d] Both commissive and directive.

The examples listed in Table 3 include lexical and syntactic features, speech act clue features, and semantic features, according to Qadir and Riloff (2011) classification categories as stated above. Lexical and syntactic feature include the use of personal pronouns (e.g. 112_{L2}, 1246_{L2}, 10258_{L2}), future tense (e.g. 112_{L2}, 1246_{L2}, 10720_{L1}), modals (10258_{L1}, 64_{L2}, 1348_{L2}), infinitive verb phrases (e.g. 12250_{L1}, 1346_{L2}, 10161_{L1}), plan phrases (e.g. 1355_{L2}) and sentences beginning with modals or verbs, or with question words (e.g. 64_{L2}, 10258_{L1}, 10030_{L1}). Speech act clue words make use of the terms identified by Searle (1976) and Wierzbicka (1987), e.g. *I suppose* (10030_{L1}), and semantic features, e.g. to identify standardised nautical commands (as in utterance 15_{L2}).

The examples listed in the right column also include the typical use of *hedging* (Hyland, 1998; Lakoff, 1972; Markkanen and Schröder, 1997) as a means of politeness to mitigate criticism (e.g. in utterances 1348_{L2}, 1355_{L2}, 10030_{L1}). Table 4 lists the most frequent *hedges* according to Diani (2015, p180). It can be seen that modal verbs (*may, might, would*) occupy a prominent position in bridge team communication whilst premodifying adverbs (*perhaps, somewhat, rather*) only play a minor role with the exception of *probably* which is predominantly used for hedging purposes by the observed L1 speakers.

Table 4
Most frequent hedges in English as used by bridge teams.

	L1	L2	*Effect size*
seem	15	3	$\Phi = 0.06$[a]
perhaps	0	1	[b]
may	4	31	$\Phi = 0.07$[a]
might	29	4	$\Phi = 0.08$[a]
probably	52	5	$\Phi = 0.12$[a]
would	95	68	$\Phi = 0.05$[a]
somewhat	0	1	[b]
rather	0	1	[b]

[a] Findings significant in $\chi 2$ tests, $\alpha = 0.01$.
[b] Findings not significant in $\chi 2$ tests, $\alpha = 0.01$.

The total number of identified hedges is significantly higher in native speakers ($n_{L1} = 195$; $frequency_{L1} = 0.13$) than in non-native speakers ($n_{L2} = 114$; $frequency_{L2} = 0.06$). The latter tend to use a more direct wording in directives, as shown by the examples listed in Table 5. Here, non-native speakers use the simple present (2961_{L2}) and future tense (140_{L2}, 5835_{L2}) to direct team members in a matter-of-fact fashion whereas native speakers tend to use a more cautious wording which apparently leaves the decision with the communication partner: *you might have to* (7236_{L1}), *would you very quickly* (14261_{L1}).

Table 5
Directives uttered by native and non-native speakers.

Directives by native speakers (L1)	Directives by non-native speakers (L2)
(8587_{L1}) Now could you call me on the working channel, please, working channel please?	(108_{L2}) Can you please call him to make it a little bit more.
(7236_{L1}) You clear off these lads here, […] you might have to pass astern this guy.	(140_{L2}) So now you will ship away from the, here, at first, we will use the bow thruster, move to port.
(12169_{L1}) So you need to potentially remove that offset when that error or perceived error is removed.	(2961_{L2}) Okay, we move a little bit forward, and then you should start up.
(14261_{L1}) Would you very quickly get me the position on the radar, give me the range and bearing?	(5835_{L2}) After this you will send the sailing plan and the position report where we are now and where we are bound to.

In directives, the use of hedging may cause misunderstanding as it apparently leaves the listener (i.e. receiver) with a choice which might not have been intended at all by the speaker (i.e. sender). Examples for this ambiguity can be seen in Table 5 in utterances 2961_{L2}, 7236_{L1} and 12169_{L1}.

6. Results of the horizontal analysis of perlocutionary acts

So far, a vertical analysis has been carried out to isolate speech acts which potentially cause misunderstanding due to a discrepancy between their locutionary and illocutionary points. In the following, horizontal analyses are undertaken to determine if the communicative purpose of the isolated speech acts can be deemed to have been successful because the corresponding perlocutionary effect gives evidence of the fact that a message has been received and decoded correctly. For this purpose, all perlocutionary acts are categorised as follows: If the receiver closes the communicative loop by repeating substantial parts of the original message,[4] the speech act is considered successful and without any risk of miscommunication. If, on the other hand, the receiver confirms the message without repeating parts of the original message, a residual risk of miscommunication exists as it is not clear whether the receiver has actually understood the message (i.e. decoded it correctly). The third category is formed by answers which clearly indicate that a communicative disruption has taken place. Table 6 lists the three categories including the clues used for their identification. It also states some examples for a better illustration of the used categories.

Table 6
Examples for risk categories identified in perlocutionary acts.

Assigned value	Risk description	Clues for risk assessment
0	no risk of miscommunication	closing the communicative loop by partially repeating the original message *(27_{L2}) I stop the thrusters?* *(28_{L2}) Yeah, thruster stop please.* – *(4850_{L2}) Okay, so we will alter course to this, position approximately and also informate (sic.) the other two vessels about this, er, Ems and Jade.* *(4851_{L2}) That they can alter their course to this position.* – *(4947_{L2}) I suggest to decrease our speed.* *(4948_{L2}) Decrease, I will go to half ahead.* – *(11805_{L1}) Yeah, yeah, we will go for three hundred.*

(*continued on next page*)

[4] The loop is typically considered as closed when contents words and numbers are repeated by the receiver.

Table 6 (*continued*)

Assigned value	Risk description	Clues for risk assessment
		(11806$_{L1}$) Three hundred? *(11807$_{L1}$) Yeah.*
1	residual risk of miscommunication	answers limited to confirmation: yes, OK, good, I know, etc. *(15$_{L2}$) Slow ahead, forty percent.* *(16$_{L2}$) Yes.* – *(10718$_{L1}$) Yeah, I am not in the position back yet.* *(10719$_{L1}$) Okay.* *(10720$_{L1}$) I will pull away.* *(10721$_{L1}$) Do it.* – *(11964$_{L1}$) Let's come to 310.* *(11965$_{L1}$) Okay.* – *(15019$_{L1}$) We want to come around to port.* *(15020$_{L1}$) Good.*
2	high risk of miscommunication	no response, incorrect response or incoherent response *(6290$_{L2}$) I think you can use autopilot. [no response] (6291$_{L2}$) How often do you like the position?* *(6292$_{L2}$) Yeah, we can do, every six minutes.* – *(4905$_{L2}$) And where we have to go here?* *(4906$_{L2}$) Just a minute now, this chart. [incoherent response]* – *(4983$_{L2}$) Now, let's go.* *(4984$_{L2}$) So, I think, this is. [incoherent response]* – *(15009$_{L1}$) You can increase the engine slightly there too.* *(15010$_{L1}$) That is their plan, is it? [no response, refers to own observation instead]*

The assessment of possible risks in perlocutionary acts by means of the three discretionary categories of “no risk”, “residual risk” and “high risk” provides six pairs of observation for responses to directives and commissives. Given that the total word production (in tokens) varies between the two groups over an identical total recording time of 600 min each, the ratios of the identified risks to the occurrences of speech act clues are also given. Table 7 lists both the raw counts and the ratios (in percent). It also includes the results of the hypothesis testing on differences between native and non-native speakers by means of Pearson's chi-squared tests of association.[5]

Table 7
Risk assessment in perlocutionary acts.

	Number of clues		X^2
	(L1)	(L2)	
Directives: no risk	37 (7.72[a])	27 (4.66[a])	$p = 0.05$
Directives: residual risk	31 (6.47[a])	44 (7.59[a])	$p = 0.51$
Directives: high risk	43 (8.98[a])	63 (10.86[a])	$p = 0.36$
Commissives: no risk	85 (8.46[a])	71 (6.41[a])	$p = 0.09$
Commissives: residual risk	114 (11.34[a])	127 (11.46[a])	$p = 0.94$
Commissives: high risk	98 (9.75[a])	130 (11.73[a])	$p = 0.19$

No findings significant in $\chi 2$ test, $\alpha = 0.01$.
[a] Percentage of the clues listed in Table 1.

The data in Table 7 leads to the conclusion that no significant differences must be assumed between the native and non-native speaker groups across any of the six risk categories. In other words, the likelihood of observing the categories of “no risk”, “residual risk” or “high risk” in the perlocutionary acts following directives and commissives is independent of the speakers' mother tongue. The acceptance of the null hypothesis is corroborated by robust statistical results with a median X^2 test probability of $p = 0.27$ on a sufficiently big sample size of n = 3,172 speech acts clues.

Even if both speaker groups present a similar distribution in their responses the risk of miscommunication remains quite high. In speech acts including directives, only 64 responses (L1 + L2) are given as an unambiguous closed-loop feedback whilst a total of 181 responses have a residual or high risk of misunderstanding. This means, that regardless of their mother tongue participants close the communicative loop in 35 percent of all speech acts only. According to Searle, by using directives the speaker “attempts […] to get the hearer to do something” (1976, p11). A risk-minimising confirmation of a directive by the hearer in roughly one third of all responses is definitely not enough in the safety-critical environment on board a sea-going ship.

[5] In Table 7 the total number of directives and commissives differs from the values in Table 1 because some directives and commissives uttered by the sender did not receive any response from the receiver (e.g. in utterances 6290$_{L2}$ and 15010$_{L1}$) while others are replied to more than once.

A similar situation can be ascertained for speech acts including commissives where a total of 156 closed-loop responses are opposed to 469 responses which include an inherent residual or high risk. As in the case of directives, just one third of all perlocutionary acts can be confirmed through a repetition of the original locutionary act. Here, it might be argued that commissives only "commit the speaker […] to some future course of action" (ibid, p11) without obliging the hearer to this particular future action. However, one important aim in using commissives at all is to inform other bridge team members about one's own thoughts to develop a shared mental model of the navigational situation. This is the very reason why Bridge Team Management training encourages participants to "think aloud" (Benedict et al., 2015; Hederström et al., 2012). Again, observing closed-loop feedback in one third of all speech acts including commissives has to be considered a rather worrying ratio for a safety-critical work environment.

7. Findings and discussion

In her research on "performance of speech acts in workplace conversations and the teaching of communicative functions", Koester (2002, p167) refers to the complex nature of studying naturalistic speech acts: "Performing speech acts is a fairly complex phenomenon, which involves, according to Cohen (1996), sociocultural knowledge about when to perform a speech act and which one is appropriate in a given circumstance, as well as sociolinguistic knowledge regarding the actual linguistic realization of each speech act appropriate to the particular situation" (ibid, p168).

In bridge team communication the performance of speech acts fulfils the main purpose of providing an effective, task-related communication with the overall objective to provide team members with sufficient information to steer a ship safely. Mariners shall use a coded language variety of English which aims to eliminate ambiguities by reducing lexical items and simplifying natural language structures. Theoretically, the "linguistic realization" (Koester, 2002, p168) of socio-linguistically appropriate speech acts in this domain should thus lead to a complete convergence of the illocutionary meaning with its corresponding locutionary act. On the other hand, adequate perlocutionary effects should be verified by using a closed-loop communication strategy. With reference to the Osgood & Schramm model (1954), risk-minimising maritime communication is achieved when messages are encoded correctly by senders, i.e. without discrepancies between their locutionary and illocutionary acts, and perlocutionary effects of decoded messages are verified by means of a closed-loop feedback strategy.

The intention of this research has been to determine to what extent native and non-native speakers of English actually employ the disambiguation approach stated above and in how far they are different from each other in this employment. Therefore, speech acts have firstly been identified in a vertical, corpus-based manner. This first step leads to markedly significant differences between directives and commissives produced by native and non-native speakers (see Table 1). After isolating directives and commissives vertically, a horizontal, pragmatic analysis of possible ambiguities has revealed that out of a total 2,218 utterances, 721 presented a difference between their locutionary and illocutionary points (see Table 2), thus causing an increased effort to decode the messages correctly with the inherent risk of misunderstanding.[6] Following the analysis of message *senders*, the responses by the message *receivers* has been scrutinised. Here, no significant differences were found between L1 and L2 participants. The analysis has revealed that only one third of all perlocutionary effects can be verified through closed-loop communication, while two thirds present a residual risk due to affirmative answers (e.g. yes, good, okay, etc.) or plainly incoherent responses (see Table 6).

According to Bublitz & Norrick "[p]ragmatics is fundamentally concerned with communicative action in any kind of context" (2011, p4). This *communicative action* is clearly visible in the maritime domain where work teams target specific professional issues to ensure the smooth operation of ships. The pragmatic analysis presented in this paper has studied naturalistic language *performance* in full-mission simulation exercises. Risks of miscommunication have been identified on both sides of the Osgood & Schramm communication model, and interestingly, significant differences between native and non-native speakers of English could only be ascertained in locutionary acts while responses to these resulted in non-significant results. The very similar risk patterns observed in L1 and L2 participants highlight the importance of a dedicated communication training once a sufficient language proficiency level has been achieved.

The Corpus Pragmatics approach has proved to be a valid tool for quantifying possible risks of miscommunication. The methodology and the research findings can be used to make bridge team communication more efficient and shipping safer by identifying inherent risks of miscommunication and raising future nautical officers' awareness in education and training sessions.

8. Limitations of the adopted methodology

The research was carried out on a special spoken corpus developed by the authors on the basis of recorded simulation exercises. Although exercises in full-mission simulation are highly realistic, an assumption of equality (Habermas, 1979) might be felt by participants which may not reflect the hierarchical structures on board real ships. Other variables leading to differences between simulations and real-life situations may include the multicultural nature of ship crews or their different language competence levels.

[6] The authors assume a model whereby indirect speech acts are typically harder to process than direct speech acts.

On the other hand, discretionary categorical variables have been assigned to the observed speech acts. By their very nature, the use of categorical variables for discrete values implies a simplification of the complex reality of speech acts.

To the authors' knowledge no ideal statistical test exists yet for measuring a dependent variable that consists of multiple categorical outcomes from speakers who contribute multiple data points (as is the case in this corpus). In this respect, the chosen chi-square test must be deemed anti-conservative because it assumes that all observations in the dataset are independent, which may give the analysis more power than is technically warranted by the dependence between data points from the same speaker or the same dialogue.

Lastly, the research has only considered verbal communication, thus disregarding any non-verbal communication like gestures which might have contributed to a disambiguation of possibly ambiguous speech acts.

9. Future research

Future research might look at the identified risks in more detail. Typical linguistic patterns might arise in highly risky speech acts which can be used for an improved communication training of future nautical officers. The applied methodology can also be used to study real-life situations on board sea-going ship and examine the differences among speakers in accordance with their general language competence levels and nationalities.

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Appendix A. Supplementary data

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