

Good call!

Grounding in a Directory Enquiries Corpus

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Abstract

This paper describes the collection of a corpus of telephone directory enquiries conversations. We analyse the feedback used in the corpus and discuss implications for dialogue systems.

1 Introduction

Effective communication requires collaboration between all participants, with dialogue co-constructed by speakers and hearers. Even in contexts such as lectures or storytelling, which are largely monological (Rühlemann, 2007), listeners provide frequent feedback. This feedback demonstrates whether or not they have *grounded* the conversation thus far (Clark, 1996), i.e. whether something said can be taken to be understood, and comes in the form of relevant next turns, or backchannels (e.g. ‘yes’, ‘yeah’, Example 1; lines 6 and 8¹ or ‘mm’).² Other responses, such as clarification requests (e.g. Example 1; lines 10 and 17) indicate processing difficulties or lack of coordination and signal a need for repair (Purver, 2004; Bavelas et al., 2012).

These communicative grounding strategies (Clark and Brennan, 1991; Traum, 1994) enable dialogue participants to manage the characteristic divergence and convergence that is key to moving dialogue forward (Clark and Schaefer, 1987, 1989), and are therefore crucial for dialogue agents. Importantly, feedback is known to occur subsententially (Howes and Eshghi, 2017), but most dialogue models do not operate in an incremental fashion that would allow them to produce or interpret feedback in a timely fashion.

¹Examples are all taken from our Directory Enquiries Corpus (DEC), described below.

²In face-to-face dialogue this includes non-linguistic cues (e.g. nods), but as our corpus is telephone conversations, we do not consider these here.

(1) DEC07:1–32

1 Caller hello
2 Operator hello
3 Caller hello
4 Operator how may i help you?
5 Caller oh hi i'm uh looking for some phone
 numbers
6 Operator yes
7 Caller er here in london
8 Operator yeah
9 Caller and the first
10 one is rowans tenpin bowl
11 Operator can you repeat that for me?
12 Caller rowans tenpin bowl
13 so it's rowan
14 R O W A N S
15 Operator yes
16 Caller tenpin
17 Operator tenpin?
18 Caller yeah
19 Operator the number ten
20 Operator and pin?
21 Caller yes
22 Caller yes
23 Operator tenpin
24 Operator road?
25 Caller bowl
26 Operator th- like the bird?
27 Caller uh like bowling
28 Operator uh bowling
29 Caller bowl
30 Operator yes
31 the thing you eat from right?
32 okay here we go

While it is difficult to compare corpus studies of feedback, as terms such as backchannels and repair have not been used consistently in the literature (see Fujimoto, 2007, for review), there are a number of quantificational studies of feedback that bear mentioning. One of the earliest is that described in Duncan (1972, 1974), which presents a detailed multimodal annotation of backchannel responses, and finds that in 885 ‘units’ (roughly corresponding to utterances) there are a total of 71 instances of feedback (8%). Corpus studies that cover aspects of feedback include (Fernández, 2006), whose annotations of non-sentential utterances (NSUs) in a subcorpus of the British

National Corpus (BNC; Burnard, 2000) include the classes ‘acknowledgements’ (5% of all utterances), and ‘clarification ellipsis’ (1%). However, as her focus is on NSUs, Fernández (2006) deliberately excludes cases in overlap, which means many genuine feedback utterances will be missed (Rühlemann, 2007). For clarification requests, the numbers reported in (Fernández, 2006) are also an underestimate, as she is not concerned with sentential cases (e.g. “what do you mean?”). In another BNC study, Purver (2004) found that CRs made up just under 3% of utterances, whilst Colman and Healey (2011) found different levels of CRs in different dialogue domains, with more in the task oriented Map Task (Anderson et al., 1991). Interestingly, this varied significantly depending on role; route followers produced significantly more CRs than route givers. Additionally, and importantly for phone conversations, participants in the Map Task also produce more backchannels when they are not visible to one another (Boyle et al., 1994)

Although using low-level features (Cathcart et al., 2003; Gravano and Hirschberg, 2009) may allow a dialogue model to sound ‘more human’, it can’t provide any insight into why feedback occurs where it does, or whether there are different appropriate responses to feedback dependent on its positioning and other characteristics. It is also unclear whether models in which feedback incorporates reasoning about the intentions or goals of one’s interlocutor (Visser et al., 2014; Buschmeier and Kopp, 2013; Wang et al., 2011) presuppose a level of complexity that is unnecessary in natural conversation (Gregoromichelaki et al., 2011).

Here, we focus on feedback in an extremely restricted domain – that of telephone directory enquiries (see also Clark and Schaefer, 1987; Bangerter et al., 2004), which can be seen as a good test case for dialogue systems. Directory enquiries is a real world application for dialogue systems (e.g. Chang, 2007) that has particular features that can be problematic for a speech recogniser, such as understanding names which are not present in an existing lexicon over a noisy channel. As we argue below, this is a particularly good domain for studying feedback, as feedback should be more frequent and necessary than in less restricted domains. The reasons for this are two-fold. Firstly, in task-oriented dialogue, where information transfer is crucial for success, and

avoiding miscommunication is vital, feedback is more common than in less goal-directed conversations (Colman and Healey, 2011). Secondly, verbal feedback is more frequent in dialogues where participants cannot see each other, and therefore do not have the ability to employ non-verbal feedback (Boyle et al., 1994), such as telephone conversations. In addition, the specific task of a directory enquiries call is less asymmetric than many tasks used to study dialogue, such as the Map Task (Anderson et al., 1991), because both participants act as ‘information giver’ (caller for name to be looked up; operator for phone number) and ‘information receiver’ (the reverse) at different stages in the dialogue. Additionally, in contrast to corpora which have similar features (such as SRI’s Amex Travel Agent Data, Kowtko and Price, 1989), relevant parts of the dialogue (names and numbers, see below) do not require anonymisation.

In this paper, we present a new corpus of human-human telephone directory enquiries dialogues, and explore the strategies for feedback that human participants use, especially in cases where misunderstandings arise. We suggest that dialogue models need to be able to perform incremental grounding, particularly in the context of spelling out words and dictating number sequences, with a number of increasingly specific strategies available for both acknowledgements and clarifications. The complete corpus (transcriptions, audio and annotations) is freely available on the Open Science Framework (osf.io/2vjkh; Bondarenko et al., 2019) thus aiding in the development of spoken dialogue systems that need to both acquire and offer accurate information to the user (e.g. directory enquiries, travel agents etc).

2 Method

2.1 Data collection

The data was collected with the help of 14 volunteers who were paired up for each recording session. Eight of the volunteers were male and six were female. The participants were native speakers of a number of different languages and had various levels of English proficiency.

Each pair of participants was instructed that they were to take turns playing the roles of a directory service enquiries caller and operator. Each caller was provided with a list of three businesses located in London, and told that their task was to find out the phone numbers of the businesses on

their list through a telephone conversation with the operator. The operators task in turn was to provide the caller with the phone numbers using the on-line Phone Book service (thephonebook.bt.com). Each caller made two calls to the operator who was situated in the studio. The recording sessions resulted in 4 dialogues per pair (28 in total) with the shortest dialogue duration being 2 minutes 31 seconds and the longest one being 10 minutes 46 seconds.

2.2 Transcription

The audio recordings were transcribed using ELAN (Brugman and Russel, 2004).

2.3 Annotation

All of the transcripts were manually annotated, with the overview of annotations used shown in Table 1. Two dialogues (281 utterances) were annotated by two coders to ensure inter-rater reliability. Cohen’s kappa tests showed good agreement for all tags: `turn-type (ack/CR/C)` $\kappa = 0.635$; `AckType` $\kappa = 0.625$; `CRType` $\kappa = 0.689$.

2.4 Feedback subtypes annotation

Following observations of the data, we further annotated our feedback utterances into subtype. For acknowledgements these are:

Continuer acknowledgement/backchannel words like “okay”, “yeah”, “yes”, “mmhm” (e.g. Example 1; line 8).

Verbatim verbatim repetitions of (parts of) previous utterances (e.g. Example 1; line 27)

Paraphrase paraphrased repetitions of (parts of) previous utterances

Confirm confirmation phrases like “correct”, “exactly”, “thats correct”

Appreciate appreciative response to the previous utterance: “great”, “good”, “perfect”.

For clarification requests these are:³

General request indicates a non-specific lack of perception/understanding of other speaker’s previous utterance (e.g. “sorry?”, “what?”)

³As pointed out by an anonymous reviewer, the categories for acknowledgements may conflate form and function, whilst those for CRs do not consider the form. This may mean that we miss important parallels or differences between acknowledgements and clarification requests and we intend to address this in future work.

Repeat request asks other speaker to repeat a previous utterance (e.g. Example 1; line 11)

Confirmation request asks other speaker to provide a confirmation (e.g. Example 1; line 17)

Spelling request asks other speaker to spell out the name of the queried business or its address (e.g. “could you spell that for me please?”, “is that a W?”)

2.5 Content annotation

Since the main purpose of the data collection was to investigate the domain of telephone directory enquiries each of the the utterances was also labelled according to its content: namely, whether it includes any information about the names, addresses and phone numbers of businesses. Each utterance labelled with any of these was then labelled according to the form such information was conveyed in:

Word (part) speaker mentions the name of a business or its address in full or in part

Spelling installment (part) speaker provides a spelling for the name or the address of a business in full or in part, usually in installments of one or more letters

Dictation installment (part) speaker dictates a phone number in full or in part, usually in installments of one or more digits

PreviousWord/spelling/dictation, PreviousContent each utterance is also annotated with the content and form labels of the previous utterance.

3 Results

In our 28 dialogues, there were a total of 4165 utterances, or 3002 speaker turns (for our purposes a turn constitutes multiple consecutive utterances by the same speaker with no intervening material from the other participant). The shortest dialogue consists of 64 utterances (48 turns) and the longest consists of 246 utterances (190 turns). 1285 of these utterances are acknowledgements, which constitutes 31% of utterances or 43% of turns. There are also 277 clarification requests, i.e. 7% of utterances and 9% of turns.⁴ This is higher than found in previous studies (Purver,

⁴As the pattern of results is consistent over turns or utterances, for the remainder of this paper we focus on the by utterance numbers.

Tag	Value	Explanation
acknowledge (Ack)	y/n	For all utterances: does this sentence contain a backchannel (e.g. ‘yeah’, ‘mhm’, ‘right’) or a repeated word or phrase acknowledging the proposition or speech act of a previous utterance? (Note this category does not include direct answers to yes/no questions)
clarification request (CR)	y/n	For all utterances: does this utterance contain a clarification request, indicating misunderstanding of the proposition or speech act of a previous utterance
clarify (C)	y/n	For utterances following a clarification request: does this utterance contain a response to a clarification request, clarifying the proposition or speech act of a previous utterance?

Table 1: Annotation Tags

2004; Fernández, 2006; Boyle et al., 1994, a.o.), and, as discussed in the introduction, is probably due to the nature of the task.

As shown in Table 2, operators produce more acknowledgements and clarification requests than callers (Acks: 36% vs 26% $\chi_1^2 = 48.466, p < 0.001$; CRs: 9% vs 4% $\chi_1^2 = 36.961, p < 0.001$). This result stems from the greater possibility for error in the understanding of names compared to numbers (see section 3.1 below).

	Role					
	Caller		Operator		Total	
Ack	559	26%	726	36%	1285	31%
C	189	9%	64	3%	253	6%
CR	94	4%	183	9%	277	7%
(blank)	1306	61%	1044	52%	2350	56%
Total	2148	100%	2017	100%	4165	100%

Table 2: Summary of results by speaker role

3.1 Asymmetry of information

As shown in Tables 3 and 4, as in Colman and Healey (2011), the pattern of feedback mirrors the asymmetry of roles, with information receiver (i.e. operator for the business name, and the caller for the phone number) providing the majority of acknowledgements and clarification requests.

	Role					
	Caller		Operator		Total	
Ack	50	11%	441	68%	491	44%
C	78	16%	1	0%	79	7%
CR	3	1%	100	15%	103	9%
(blank)	342	72%	105	16%	447	40%
Total	473	100%	647	100%	1120	100%

Table 3: Results by speaker role where the previous utterance is about a business name

	Role					
	Caller		Operator		Total	
Ack	364	73%	92	28%	456	55%
C	0	0%	30	9%	30	4%
CR	60	12%	0	0%	60	7%
(blank)	75	15%	210	63%	285	34%
Total	499	100%	332	100%	831	100%

Table 4: Results by speaker role where the previous utterance is about a business phone number

3.2 Feedback subtypes

As shown in Table 5, most of the acknowledgements in our corpus consist of continuers, with 772 (60%) acknowledgements containing at least one continuer. The next most common type of acknowledgement is a verbatim repeat of material from a prior utterance, with 492 (38%) acknowledgements. For a dialogue system, this is good news: simple utterances of just a continuer or repeated material accounts for 91% of all acknowledgements, suggesting that these may be the only two strategies that need to be implemented for both production and comprehension.

For clarification requests (Table 6), the majority (48%) are confirmation requests – checking that something has been understood by offering a provisional interpretation. These serve to pinpoint the (potential) source of miscommunication in a way that the more general types do not (see also Ginzburg, 2012). In practice, they are very similar to the verbatim acknowledgements, as in example 1 line 17, but with questioning intonation suggesting that they are more tentative. These ought to therefore be generatable in the same way as verbatim acknowledgements. The data suggest a scale of feedback, analogous to Clark and colleagues’ levels of evidence of understanding

(Clark and Brennan, 1991; Clark and Schaefer, 1989; Clark, 1996), with listener confidence being a key component of which type of feedback is appropriate.

Type(s)	Number	%
Appreciate	5	0.4%
Confirm	21	1.6%
Confirm, Continuer	1	0.1%
Continuer	718	55.9%
Continuer, Appreciate	9	0.7%
Continuer, Appreciate, Continuer	1	0.1%
Continuer, Confirm	9	0.7%
Continuer, Paraphrase	2	0.2%
Continuer, Verbatim	3	0.2%
Paraphrase	25	1.9%
Paraphrase, Continuer	2	0.2%
Verbatim	456	35.5%
Verbatim, Appreciate	1	0.1%
Verbatim, Continuer	25	1.9%
Verbatim, Continuer, Appreciate	2	0.2%
Verbatim, Paraphrase	1	0.1%
Verbatim, Verbatim	4	0.3%
Total	1285	100%

Table 5: Types of acknowledgement

Type	Number	%
Confirmation request	134	48.4%
General request	28	10.1%
Repeat request	64	23.1%
Spelling request	51	18.4%
Total	277	100%

Table 6: Types of clarification request

3.3 Strategies

As there is greater scope for miscommunication in the transmission of names than numbers, we now focus on the examples where the feedback follows an utterance whose content is about a name.⁵ For these cases, there is large variability in how easily the names are conveyed, with the number of turns taken from the first mention of any part of the name to the operator confirming that they have found the number ranging from 2 utterances to 82 utterances, with 3 (of 84) cases unresolved.

Table 7 shows that of the turns following an utterance about a business name, 45% contain a spelling installment, or part of one, with similar proportions for acknowledgements (36%) and clarification requests (41%), with only 15% (acks 12%, CRs 21%) relating to the word level. This

⁵Note that row totals in Tables 7, 8 and 9 do not add up to 100% as some turns contain more than one strategy.

shows that models of dialogue need to be able to produce and interpret increments of different sizes – potentially of a single letter, as people do when they are pinpointing sources of (potential) trouble within an unfamiliar name.

Tables 8 and 9 demonstrate that feedback strategies are highly dependent on the information giving strategy employed in the preceding utterance. While generic strategies (continuers or non-specific repairs such as “what?”) are common and always available, participants are also likely to match the prior strategy used in their feedback – it is, for example, rare to acknowledge or clarify a spelling installment with a word, and vice versa.

3.4 Qualitative results

Examples 2–9 show a variety of these strategies in action. In Example 2, the Operator relies on continuer acknowledgements, which, according to Clark and colleagues’ model of levels of evidence of understanding, are weaker signals of understanding than e.g. verbatim repeats and might be therefore more likely to allow misunderstandings to occur. Example 3 from another pair shows the same business name split into different increments (with the first half of the name “bistro” treated as an independent word and the rest spelled out in increments of 3 letters; see also section 3.5, below), with different feedback techniques for different subparts of the utterance – a continuer at line 126, a verbatim acknowledgement at line 128.

(2) DEC11:88–98

88 Operator er can you spell bistrotheque for me?
 89 Caller abs-
 90 Caller sure er it’s
 91 Caller B I S
 92 Operator yes
 93 Caller T R O
 94 Operator mmhm
 95 Caller T H E
 96 Operator okay
 97 Caller Q U E
 98 Operator er yes i have it here for you

(3) DEC3:123–128

123 Caller so bistro
 124 Caller T
 125 Caller H E
 126 Operator yeah
 127 Caller Q U E
 128 Operator Q U E

Example 4 splits the business name into two increments of 3 and 4 letters respectively, and is acknowledged by verbatim repeats in each case.

	Ack		CR		Total	
Spelling installment	137	28%	31	30%	394	35%
Spelling installment part	41	8%	11	11%	107	10%
Word	21	4%	5	5%	47	4%
Word part	40	8%	16	16%	127	11%
Other	253	52%	42	41%	452	40%
Total	491	100%	103	100%	1120	100%

Table 7: Strategies for feedback following an utterance about a business name

	Previous utterance content type								Total
	Spelling installment	Spelling instmt part	Word	Word part					
Spelling installment	127	40%	9	20%	0	0%	1	1%	137
Spelling installment part	23	7%	18	39%	0	0%	4	6%	41
Word	3	1%	2	4%	10	20%	6	9%	21
Word part	3	1%	0	0%	15	30%	22	32%	40
(continuer/confirm/appreciate)	171	54%	18	39%	25	50%	42	62%	253
Total	319	100%	46	100%	50	100%	68	100%	491

Table 8: Strategies for acknowledgements about a business name by previous utterance content type

A common strategy for avoiding miscommunications in spellings is developed in Example 5: namely using unambiguous words which start with the same letter. This strategy is prompted by the operator’s clarification request in line 19. Note that the acknowledgements provided by the operator here are sometimes only the word (e.g. line 23 “america”) but sometimes include the letter in a direct repeat of the whole utterance (e.g. line 35 “R for Russia”). In our corpus, different pairs come up with different sets of words for spelling out the letters (e.g. country/city names, as here, or people’s first names – note that this choice can also be the source of miscommunication, as in Example 12). This strategy can be initiated by either participant, or in co-constructions (as in Example 7), and, after repeated interactions, participants may use this strategy productively – even dropping the letter with the country name standing in for the whole, as in Example 6 (this mirrors the way participants strategically align in tasks such as the Maze Game; Mills and Healey, 2006).

(4) DEC16:54–61

54 Caller the next place i’m looking for is called
55 Caller er tayyabs which is spelled
56 Caller T A Y
57 Operator T A Y
58 Caller Y A B S
59 Operator Y A B S
60 Caller it’s a restaurant
61 Operator okay

(5) DEC28:17–35

17 Caller okay so it starts with a
18 Caller L
19 Operator L?
20 Caller as in london
21 Operator yes
22 Caller A as in america
23 Operator america
24 Caller er U
25 Caller as in er
26 Caller er under
27 Caller <laugh>
28 Operator under yes
29 Caller er D as in denmark
30 Operator denmark
31 Caller E as in england
32 Operator england
33 Caller and R
34 Caller for russia
35 Operator R for russia

(6) DEC26:61–69

61 Caller it’s it’s a restaurant by name tayyabs
62 Operator okay can you spell that for me please?
63 Caller should i
64 Caller yes it’s a thailand
65 Operator yes
66 Caller america
67 Operator yes
68 Caller yugoslavia
69 Operator yes
: : :

(7) DEC28:138–141 Co-construction

138 Caller and K for er
139 Caller <laugh>
140 Operator as in king?
141 Caller k- king <laugh> yeah

3.5 Increments

People often break the names into increments to aid understanding, but what counts as an incre-

	Previous utterance content type								Total
	Spelling installment		Spelling instmt part		Word		Word part		
Spelling installment	24	52%	3	43%	1	4%	4	19%	31
Spelling installment part	8	17%	3	43%		0%		0%	11
Word		0%		0%	4	16%		0%	5
Word part	2	4%	1	14%	5	20%	10	48%	16
(generic repair)	17	37%		0%	16	64%	12	57%	42
Total	46	100%	7	100%	25	100%	21	100%	103

Table 9: Strategies for clarification requests about a business name by previous utterance content type

ment is not fixed, and may be further subdivided in case of failure. Examples 8 and 9 show two different ways in which the same name was divided into increments, with Example 9 having many more utterances, including several verbatim acknowledgements to convey the same information.

(8) DEC7:89–98

89 Caller phoenicia mediterranean food
 90 Operator can you repeat that for me?
 91 Operator tenicia?
 92 Caller yeah
 93 Caller it's P H
 94 Caller O E N
 95 Operator mmhm
 96 Operator co- continue please
 97 Caller I C I A
 98 Operator I C I A

(9) DEC23:101–117

101 Caller yeah it's phoenicia
 102 Operator clomissia?
 103 Caller mediterranean food
 104 Caller yes you spell it with a P
 105 Operator P
 106 Caller H
 107 Caller O
 108 Operator H O
 109 Caller E
 110 Operator yes P H O E
 111 Caller E N
 112 Operator N
 113 Caller A C
 114 Operator A C
 115 Caller A-
 116 Caller I A
 117 Operator I A

3.6 Repair Strategies

In our data there is some indication that participants are generally good at predicting potentially problematic elements and further specifying those before they lead to miscommunication, such as non-conventional spellings of words as in Examples 10 and 11.

(10) DEC20:4–9

4 Caller the first one being first one being one called cittie of yorke which is C I T T I E of
 5 Caller yorke spelled with an E at the end
 6 Operator cittie of yorke with two Ts?
 7 Caller cittie of yorke where cittie isn't
 8 Caller C I T Y it's C I T T I E
 9 Operator yeah

(11) DEC10:59–9

59 Caller it's called lyle's
 60 Caller with a Y
 61 Operator lyle's

In general, misunderstandings are resolved quickly and locally, however, there are also interesting cases where misunderstandings persist, such as Example 12, with the specific problematic letter in the name taking 57 utterances to resolve. In this case, as in 13, the participants started by trying to just spell out the names (which can be ambiguous, especially in noisy settings) and then switch strategy to a more specific method (here using the initial letter of a name or place) when the initial strategy fails.

(12) DEC22:82–139

82 Caller with a - filip with an F
 83 Operator filip
 84 Operator yeah
 : :
 107 Caller er
 108 Operator pilip
 109 Caller fanny
 110 Operator mmhm
 111 Caller fanny
 : :
 113 Operator P
 114 Operator P as in panda
 115 Operator right?
 116 Caller sorry i didn't hear you
 117 Operator P
 118 Operator the next one is a P
 119 Operator as in panda
 120 Caller P?

121 Operator or okay
 122 Operator then
 123 Caller no
 124 Caller it's er
 : :
 133 Caller uh fanny
 134 Operator <unclear> I don't know that name
 funny?
 135 Caller yeah or like filip but with an F
 136 Caller or if you say fruits
 137 Operator with an F?
 138 Operator okay
 139 Caller F yeah

(13) DEC25:67–112 Change of strategy

67 Caller yes and the business i was looking
 for hot- it's a hotel it's called hotel
 wardonia
 : : <lines 68–94 spell out the name >
 95 Operator er i'm sorry i couldn't find any re-
 sult for
 96 Operator hotel swarbonia maybe i spelled
 97 Operator wrong
 98 Caller yes i can spell that once again
 99 Operator yes please
 100 Caller it's er W for wales
 101 Operator er so it's hotel first?
 102 Caller yes it's hotel and W for washington
 yeah
 103 Operator W for washington
 104 Caller yeah then A for er
 105 Caller atlanta
 106 Operator yeah

In Example 14, one of the few cases where mis-
 understandings did not get resolved, it is clear that
 the participants are unable to align due to the sim-
 ilarity in sound of a 'B' and a 'V' (especially for
 the native Spanish caller). Note that this pair did
 not manage to ascertain the source of the trouble,
 which a letter + name using the initial letter strat-
 egy may have resolved. A dialogue model should
 therefore be able to generate this type of strategy
 for disambiguating letter sounds, even where the
 human user does not do so.

(14) DEC14:4–112 Complete failure

4 Caller er one is a pub
 5 Caller it's called the star tavern
 6 Operator can you repeat please?
 7 Caller the star
 8 Caller tavern
 : :
 16 Caller yeah the well the place is called
 the star tavern
 17 Operator the star
 18 Caller tavern
 19 Caller yeah
 : :
 29 Operator i'm not sure if i heard the name
 of the place correctly

30 Operator can you repeat?
 31 Caller yeah the the name of the place
 the
 32 Operator yes
 33 Caller the tavern it's the star
 34 Caller star like a star in the sky you
 know <laugh>
 35 Operator yes
 36 Caller the night
 37 Operator mmhm
 38 Caller er tavern
 39 Operator can you spell it er please ta-?
 40 Caller the address you say?
 41 Operator er the star ta- what?
 42 Caller the star tavern
 : :
 58 Caller and it's tavern it's T A
 59 Operator and then
 60 Caller V E er <R> un <N>
 61 Caller N
 62 Caller sorry
 : :
 72 Operator T A B E R N
 73 Operator is that correct?
 74 Caller yeah
 : :
 94 Caller okay you have the name of the
 place correct?
 95 Caller right?
 96 Operator star tabern right?
 97 Caller yeah
 : :
 112 Operator website still says we're sorry we
 co- couldn't find any results

4 Discussion and future work

We have presented a new corpus of telephone di-
 rectory enquiries that is freely available, and a pre-
 liminary exploration of the feedback used in these
 dialogues.

In future work, we hope to provide a formal
 model of incremental grounding incorporat-
 ing the phenomena observed in our corpus includ-
 ing spelling and dictation installments, as well as a
 comparison with previous work (e.g. Purver, 2004;
 Fernández, 2006; Rieser and Moore, 2005). Work
 on formal modelling of grounding (e.g. Traum,
 1994; Larsson, 2002; Visser et al., 2014) has often
 assumed that the minimal units being grounded are
 words. In a complete model, this needs to be com-
 plemented by the grounding of subparts of words,
 including single letters. Work in this direction in-
 cludes Skantze and Schlagen (2009), where dic-
 tation of number sequences is used as a test case
 “micro-domain” for an implemented model of in-
 cremental grounding. However, this system works
 exclusively on the level of single digits (or se-
 quences thereof). A challenge for a general model
 of grounding is to combine grounding of whole
 words/utterances with grounding of sub-parts of
 words, using the many strategies that people do.

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References

- Anne Anderson, Miles Bader, Ellen Bard, Elizabeth Boyle, Gwyneth Doherty, Simon Garrod, Stephen Isard, Jacqueline Kowtko, Jan McAllister, Jim Miller, Catherine Sotillo, Henry Thompson, and Regina Weinert. 1991. The HCRC map task data. *Language and Speech*, 34(4):351–366.
- Adrian Bangerter, Herbert H Clark, and Anna R Katz. 2004. Navigating joint projects in telephone conversations. *Discourse Processes*, 37(1):1–23.
- Janet Beavin Bavelas, Peter De Jong, Harry Korman, and Sara Smock Jordan. 2012. Beyond backchannels: A three-step model of grounding in face-to-face dialogue. In *Proceedings of Interdisciplinary Workshop on Feedback Behaviors in Dialog*.
- Anastasia Bondarenko, Christine Howes, and Staffan Larsson. 2019. [Directory enquiries corpus](https://osf.io/2vjkh). Available at osf.io/2vjkh.
- Elizabeth A Boyle, Anne H Anderson, and Alison Newlands. 1994. The effects of visibility on dialogue and performance in a cooperative problem solving task. *Language and speech*, 37(1):1–20.
- Hennie Brugman and Albert Russel. 2004. Annotating multi-media/multi-modal resources with ELAN. In *4th International Conference on Language Resources and Evaluation (LREC 2004)*, pages 2065–2068. European Language Resources Association.
- Lou Burnard. 2000. *Reference Guide for the British National Corpus (World Edition)*. Oxford University Computing Services.
- Hendrik Buschmeier and Stefan Kopp. 2013. Co-constructing grounded symbols–feedback and incremental adaptation in human-agent dialogue. *KI-Künstliche Intelligenz*, 27(2):137–143.
- Nicola Cathcart, Jean Carletta, and Ewan Klein. 2003. A shallow model of backchannel continuers in spoken dialogue. In *Proceedings of the tenth EACL conference*, pages 51–58. Association for Computational Linguistics.
- Harry M Chang. 2007. Comparing machine and human performance for callers directory assistance requests. *International Journal of Speech Technology*, 10(2-3):75–87.
- Herbert H. Clark. 1996. *Using Language*. Cambridge University Press.
- Herbert H. Clark and Susan A. Brennan. 1991. *Grounding in communication*, pages 127–149. Washington: APA Books.
- Herbert H. Clark and Edward A. Schaefer. 1989. Contributing to discourse. *Cognitive Science*, 13:259–294.
- Herbert H Clark and Edward F Schaefer. 1987. Collaborating on contributions to conversations. *Language and cognitive processes*, 2(1):19–41.
- Marcus Colman and Patrick G. T. Healey. 2011. The distribution of repair in dialogue. In *Proceedings of the 33rd Annual Meeting of the Cognitive Science Society*, pages 1563–1568, Boston, MA.
- Starkey Duncan. 1972. Some signals and rules for taking speaking turns in conversations. *Journal of Personality and Social Psychology*, 23(2):283 – 292.
- Starkey Duncan. 1974. On the structure of speaker–auditor interaction during speaking turns. *Language in society*, 3(2):161–180.
- Raquel Fernández. 2006. *Non-Sentential Utterances in Dialogue: Classification, Resolution and Use*. Ph.D. thesis, King’s College London, University of London.
- Donna T Fujimoto. 2007. Listener responses in interaction: A case for abandoning the term, backchannel. *Journal of Osaka Jogakuin College*, 37:35–54.
- Jonathan Ginzburg. 2012. *The Interactive Stance: Meaning for Conversation*. Oxford University Press.
- Agustín Gravano and Julia Hirschberg. 2009. Backchannel-inviting cues in task-oriented dialogue. In *INTERSPEECH*, pages 1019–22.
- Eleni Gregoromichelaki, Ruth Kempson, Matthew Purver, Greg J. Mills, Ronnie Cann, Wilfried Meyer-Viol, and Patrick G. T. Healey. 2011. Incrementality and intention-recognition in utterance processing. *Dialogue and Discourse*, 2(1):199–233.
- Christine Howes and Arash Eshghi. 2017. Feedback relevance spaces: The organisation of increments in conversation. In *Proceedings of the 12th International Conference on Computational Semantics (IWCS 2017)*. Association for Computational Linguistics.
- Jacqueline C Kowtko and Patti J Price. 1989. Data collection and analysis in the air travel planning domain. In *Proceedings of the workshop on Speech and Natural Language*, pages 119–125. Association for Computational Linguistics.
- Staffan Larsson. 2002. *Issue-based Dialogue Management*. Ph.D. thesis, Göteborg University. Also published as Gothenburg Monographs in Linguistics 21.

- Gregory Mills and Patrick G. T. Healey. 2006. Clarifying spatial descriptions: Local and global effects on semantic co-ordination. In *Proceedings of the 10th Workshop on the Semantics and Pragmatics of Dialogue (SEMDIAL)*, Potsdam, Germany.
- Matthew Purver. 2004. *The Theory and Use of Clarification Requests in Dialogue*. Ph.D. thesis, University of London.
- Verena Rieser and Johanna Moore. 2005. Implications for generating clarification requests in task-oriented dialogues. In *Proceedings of the 43rd Annual Meeting of the ACL*, pages 239–246, Ann Arbor. Association for Computational Linguistics.
- Christoph Rühlemann. 2007. *Conversation in Context: A Corpus-Driven Approach*. Continuum.
- Gabriel Skantze and David Schlangen. 2009. **Incremental dialogue processing in a micro-domain**. In *Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics, EACL '09*, pages 745–753, Stroudsburg, PA, USA. Association for Computational Linguistics.
- David Traum. 1994. *A Computational Theory of Grounding in Natural Language Conversation*. Ph.D. thesis, University of Rochester.
- Thomas Visser, David Traum, David DeVault, and Rieks op den Akker. 2014. A model for incremental grounding in spoken dialogue systems. *Journal on Multimodal User Interfaces*, 8(1):61–73.
- Zhiyang Wang, Jina Lee, and Stacy Marsella. 2011. Towards more comprehensive listening behavior: beyond the bobble head. In *Intelligent Virtual Agents*, pages 216–227. Springer.