Towards a corpus-based description of speech-gesture units of meaning

The case of the circular gesture

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The theories and methods in corpus linguistics (CL) have had an impact on numerous areas in applied linguistics. However, the interface between CL and multimodal speech-gesture studies remains underexplored. One fundamental question is whether it is possible, and even appropriate, to apply the theories and paradigms established based on textual data to multimodal data. To explore this, we examine how CL can assist investigating lexico-grammatical patterns of speech co-occurring with a recurrent gesture (i.e. the circular gesture). Sinclair's (1996) unit of meaning model is used to describe the co-gestural speech patterns. The study draws on a subset of the Nottingham Multimodal Corpus, in which 570 instances of circular gestures and their co-occurring speech are identified and analysed. We argue that Sinclair's unit of meaning model can be extended to include speech-gesture patterns, and that those descriptions enable a more nuanced understanding of meaning in context.

Keywords: circular gestures, multimodal corpus analysis, co-gestural speech patterns, unit of meaning model

1. Introduction

The temporal, semantic and cognitive relationship between speech and gesture has been widely explored in the broad, interdisciplinary field of gesture studies, encompassing areas such as psycholinguistics (Kita, 2009), pragmatics (Kendon, 2004), metaphor (Cienki & Müller, 2008) and language acquisition (Gullberg & McCafferty, 2008). In the last decade, there have been a growing number of studies exploring the ways in which the theories and/or methods developed in corpus linguistics can lend support to the investigation of the speech-gesture relation-

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ship (Chen et al., 2021; Debras, 2017, 2021; Zima, 2017). Uncovering such synergies will undoubtedly benefit both corpus linguistics and speech-gesture studies. The analyses of emerging patterns based on large datasets in corpus linguistics can help gesture researchers to generate more robust findings. At the same time, applying corpus linguistic theories and paradigms to gesture studies can help extend and deepen our understanding of the strengths and limitations of corpus linguistics, hence surfacing key implications for our description of meaning.

However, there are significant challenges of doing corpus-based research with a focus on speech and gesture. Some issues are more practical and technical in nature, such as the extremely time-consuming nature of gesture analysis, and the lack of large-scale multimodal corpora and technology to support automatic speech-gesture analysis. Other issues are more theoretical and methodological, and rather complex to address, e.g. the development of theoretical frameworks that can be used for speech-gesture analysis and form the basis for automatic gesture recognition. A fundamental question is whether it is possible, and even appropriate, to apply the concepts and approaches established on the basis of textual data in corpus linguistics to multimodal data.

To address some of the theoretical challenges for both corpus linguistics and gesture researchers, this article presents an exploration of a new approach to using existing textual-based corpus linguistic theories and methods to investigate the meaning variations of a recurrent gesture: the circular gesture. We apply one of the pioneering theories in corpus linguistics, Sinclair's (1996) unit of meaning framework, to describe the speech patterns aligned with the recurrent gesture. During this process, basic corpus techniques (e.g. concordance analysis) are applied to assist a variety of pattern analyses, and this provides valuable insights into the ways in which software designed for textual analysis can also be useful for multimodal research on gesture. Our research is distinct and novel in terms of applying Sinclair's unit of meaning model to describe the speech patterns co-occurring with a recurrent gesture (i.e. using a gesture-first rather than speech-first approach). This allows for an evaluation of a new multimodal unit of meaning in the context of the parameters outlined by Sinclair (1996) that were based solely on textual data.

We illustrate this approach by drawing on the supervision meetings in the Nottingham Multimodal Corpus (NMMC) from which we have identified 570 instances of circular gestures emerging from eight videos (totalling more than 400 mins, approximately 100,000 running words). Although the primary goal of this article is to explore a multimodal corpus-based approach for examining the unit of meaning of the circular gesture, it is also worth highlighting that we are doing so by drawing on one of the largest datasets used to investigate the meaning variations of a recurrent gesture. Whereas traditional gesture research tends

to focus on much smaller datasets, our research is among many works that mark the shift of conducting multimodal corpus-based research on speech and gesture. They include studies based on the Red Hen corpus (e.g. Cánovas et al., 2020), the Bielefeld Speech and Gesture Alignment Corpus (SaGA) (e.g. Kok, 2017) and the British Sign Language Corpus Project (https://bslcorpusproject.org/).

2. Recurrent gestures

To distinguish gestures from other bodily movements, gestures are usually defined as meaningful spontaneous hand-and-arm movements (Kendon, 2004; McNeill, 2005). The meanings of most gestures tend to be closely associated with their co-occurring speech, which is termed the 'lexical affiliate' (Schegloff, 1984), or the 'idea units' (Kendon, 2004). For instance, when a speaker is describing the size of an object as *big* or *large* (i.e. the lexical affiliate), these words tend to co-occur with a gesture where the hands are extending outwards.

While the movements of most gestures tend to be idiosyncratic, some gestures share with each other at least one kinesic element (e.g. movements, space, hand-shapes, etc.), and, more importantly, these gestures are usually coupled with the same meaning. One of the terms often used for this type of gestures is 'gesture family' proposed by Kendon (2004), whose research is based on video recordings of conversations among Southern Italians.

Kendon (2004) conducted discourse analyses of the meanings of four gesture families based on naturally occurring conversations between Italian speakers, among which the most well-known are the Open Hand Supine family (OHS, informally the "palm up" family) and the Open Hand Prone family (OHP, informally the "palm down" family). For instance, the palm up gesture, also known as the Palm Up Open Hand gesture (PUOH) (McNeill, 2005; Müller, 2004), is usually associated with a semantic theme such as presenting, offering or waiting for something to be received. Such a form-meaning association has also been observed by other researchers in the field (Calbris, 2011; Streeck, 2009).

More recently, some scholars have studied 'recurrent gestures' (Ladewig, 2014), which describe frequently occurring gestures with certain meaning associations. The recurrent gestures and gesture families are essentially the same as they both describe the form-meaning associations of gestures that occur frequently in daily life. The researchers working on recurrent gestures propose 14 such gestures with certain meanings associated with them, such as movements of throwing something away, sweeping away, and rotating, etc. (Müller et al., 2013).

Whereas most recurrent gestures outlined above have yet to be investigated based on large corpora, one of the earliest and most systematic studies of recur-

rent gestures explores the cyclic gesture used by German speakers (Ladewig, 2011). With the same cyclic movement, the two parameters including the position and size can contribute to three variations of uses in the corresponding contexts: (i) in the context of expressing the notion of on-going activities (i.e. the referential meaning of continuity) with the hand positioned in the peripheral space; (ii) in the context of non-fluent speech (i.e. co-occurring with pauses) signifying searching for words/concepts with the hand in the central gestural space (i.e. a cognitive function); (iii) in the context of encouraging or requesting the other party to continue an action with a large-size cyclic gesture by rotating the elbow rather than the wrist (i.e. a pragmatic function).

However, since Ladewig's research is qualitative in nature, no statistics are reported in terms of the number of instances in each category. Also, the referential, pragmatic and cognitive framework developed by the research is necessarily a simplified version of the breadth of the observed variation. In addition, no information is given regarding the coding schemes used for measuring the size and space of the gestures, both of which are very difficult to measure. To date, no agreed standard for coding the size of gestures exists, and in the absence of an agreed standard such decisions can only ever be relative and subjective. Although there is a scheme for coding the space of a gesture (McNeill, 2005), such analyses are difficult to carry out manually as the researcher has to segment the space in front of the speaker's body, which may not always be captured accurately by the camera in naturally occurring discourse that forms the basis of corpus research.

While attempts to propose and investigate recurrent gestures (including gesture families) are valuable for various applications, the empirical scope of most previous research on the meanings of recurrent gestures is too narrow as it is often limited to a few instances only. It therefore seems to be premature to determine the meanings of those recurrent gestures without further empirical evidence derived from larger corpora. Furthermore, although the main meanings of most recurrent gestures proposed by previous researchers appear intuitively valid, a comprehensive and fine-grained analysis of the exact lexical and grammatical speech patterns co-occurring with the gestures is currently not available.

A corpus-based approach for establishing a lexico-grammatical framework for a recurrent gesture also helps us address the issue of identifying the lexical affiliate of a recurrent gesture. Although the method of using the co-occurring discourse context to interpret the meaning of a recurrent gesture is widely accepted, it is very difficult to identify a lexical affiliate or idea unit (i.e. the exact words with which the gestures are co-expressive) for all recurrent gestures. For iconic gestures (i.e. gestures describing concrete objects or actions), it is easier to identify their lexical affiliates, which are usually the lexis describing the objects or actions in speech. Nonetheless, the meanings embodied in many recurrent gestures men-

tioned above such as the PUOH and the cyclic gesture tend to be abstract and metaphoric. Hence, although it is possible to identify the discourse context in which a recurrent gesture tends to occur, the exact speech co-occurring with the gesture may vary greatly. This means that our interpretation of the meaning of such recurrent gestures can only be approximate. However, the problem of identifying the lexical affiliate is less relevant once our goal is to establish a framework to describe the speech patterns co-occurring with recurrent gestures, rather than the exact lexical affiliates.

To address the gaps in the current descriptive framework outlined above, our article sets out to apply a lexico-grammatical theory used in corpus linguistics, Sinclair's (1996) unit of meaning model, to the analysis of the lexico-grammatical patterns of co-gestural speech. In principle, this approach can be explored using any recurrent gesture, but we chose the circular gesture as our target gesture due to its particularly high frequency in the NMMC. A preliminary observation of the NMMC shows that most other recurrent gestures are not as frequent as the circular gesture. A large dataset is essential for demonstrating a corpus-based approach in order for patterns to emerge, as well as for generating robust patterns of meaning.

3. The unit of meaning model

As one of the pioneers in corpus linguistics, Sinclair (e.g. 2004) demonstrated the tendency of certain words to co-occur with certain other words. In his work, Sinclair correctly foresaw a need for the analysis of the unit of meaning of any word to be extended from the word itself to its surrounding words. In accordance with his corpus-based findings, he established a model for analysing the unit of meaning, illustrating the relationship between a search term, or a node, and the words co-occurring with it.

Sinclair's (1996) unit of meaning model contains four parameters that can be used for linguistic description, namely collocation, colligation, semantic preference and semantic prosody. The concept of collocation refers to those words that frequently co-occur with the search word, underpinning the premise that words rarely exist independently of other words. The concept of colligation describes the tendency of a node to co-occur with a group of words that belong to a particular grammatical structure/class. Semantic preference is relevant to the co-occurrence of a specific item with a general notion (e.g. visibility) expressed by different but semantically related words (e.g. *see*, *detect*, *obvious*). Distinct from the other three concepts in the model, semantic prosody, initially proposed by Louw (1993), is associated with the function, the attitude, or the pragmatic aspect expressed by the discourse environment of the node (e.g. the attitude of reluctance associated

with *true feelings*) (Sinclair, 2004). As a word tends to co-occur with certain collocates (usually in a span of around five words in corpus collocation analysis), it takes on the connotation (e.g. negative, positive connotation) afforded by such a context. The definition of semantic prosody has been extensively discussed and extended (Hunston, 2007).

The unit of meaning model continues to be used by corpus-based text analysts as a vital tool for linguistic and sociolinguistic analysis (Atkins & Harvey, 2010; Mahlberg, 2013), and is also commonly used to inform dictionary entries (Sinclair, 2004). While the unit of meaning model has been used to describe spoken discourse (Adolphs et al., 2004), it crucially leaves out the importance of gestures in the spoken mode. Given the role of gestures in the meaning making process in spoken discourse, we may expect that they form an integral part of the unit of meaning in this context.

Research on gestures shows that the interpretation of the meanings of most gestures primarily relies on their co-occurring speech, except for emblems (Kendon, 2004; McNeill, 2005) whose meanings tend to be conventionalised with a relatively stable form-meaning associations across contexts in a socio-cultural speech community. From this perspective, it seems reasonable to use the unit of meaning model to describe the unit of meaning in a broadened-out gesture context.

In addition, the unit of meaning model is expected to be robust in describing speech patterns co-occurring with recurrent gestures as it involves different aspects of meaning including grammatical structure, semantic meaning and pragmatic function. Such flexibility and inclusiveness in the analysis of meaning are crucial as the speech co-occurring with recurrent gestures may well vary. The following sections provide an overview of the procedures of exploring the unit of meaning of the circular gesture in relation to the emerging speech patterns co-occurring with this gesture.

4. Corpus and methods

Our research draws on a sub-corpus of the NMMC (Adolphs & Carter, 2013; Knight, 2011), the video recordings of supervision meetings, as the basis for analysis. This section explains the selection of the sub-corpus data (4.1), and the procedures for analysing patterns in this multimodal corpus.

4.1 Data selection

The sub-corpus used for this study includes naturally occurring interactions between PhD students and their supervisors. Eight videos of more than 400 min-

utes in total were selected with the length ranging from 35 minutes to 88 minutes. Five videos were excluded from analysis as the speakers are mainly working with a laptop so that there are fewer gestures available for analysis. The total number of running words is 92,754 with an average number of 11,594 per supervision recording.

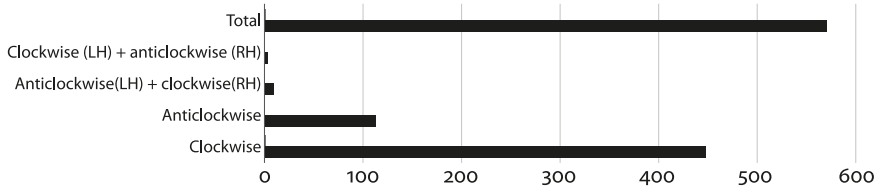
The term 'circular gesture' adopted here is based on previous research of the cyclic gesture in view of having the same core (i.e. rotational movement) (Ladewig, 2011). However, our research allows for many more variations of movement for the purpose of capturing all types of speech patterns aligned with rotational movements. We identified 570 instances of circular gestures for further analysis.

Specifically, for cyclic gestures, Ladewig (2011) only selected those continuous, outward rotational gestures that remain in the same position; however, our study uses a more inclusive approach in data selection. It targets all the rotational movements regardless of other parameters such as the hand shape, space, trajectory, etc. This means that, except for the essential continuous, rotational movements, there are no other restrictive criteria in terms of the physical forms of these gestures. The decision of taking an inclusive approach was made because (i) little is known about the actual meanings of the circular movements at this preliminary stage of investigation, and (ii) the limited dataset of the NMMC. That is, we need to include as many instances as possible to identify the meaning variations of the rotational movements.

The decision of adopting an inclusive approach in data selection is also based on the preliminary observations of the data. It has been observed in the NMMC that many circular gestures that would not have been included by using Ladewig's (2011) narrow definition of the cyclic gesture also have the same functions as other cyclic gestures. This is indeed within our expectation. Calbris' (2011) study of the parameters of the circular gestures does not find a significant impact on the meanings of the gestures from the chosen parameters (e.g. number of the circles, body parts, and symmetry). Her research, therefore, indicates that the parameters of the circular gestures tend not to lead to very distinctive meaning variations.

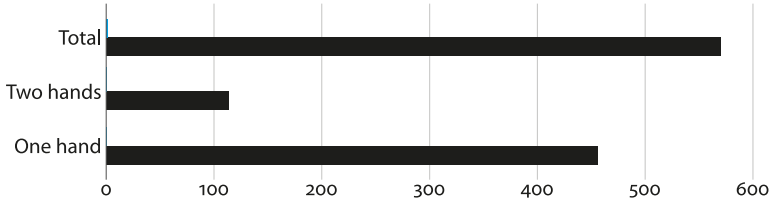
Figures 1 to 3 provide useful information of the variations of circular gestures in terms of the rotational directions, one or two handedness, and movement trajectories. The numbers and percentages of those variations show that the 570 instances of circular gestures identified tend to have clockwise rotations (448 out of 570, 78.60%, see Figure 1), predominantly performed by one hand (456 out of 570, 80.00%, see Figure 2) remaining in the same position or space (490 out of 570, 85.96%, see Figure 3). The images in Figure 4 from a to d show some examples of the circular gestures with the ones in a and b being the most typical. The speakers often rotate their hands even while holding a pen. When rotating both

hands, they either rotate them in the same direction simultaneously or in an interlocking way.



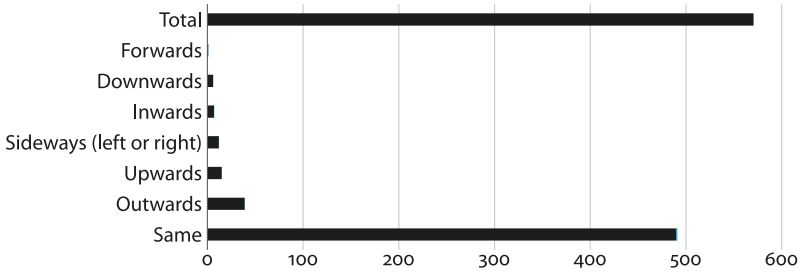
	Clockwise	Anticlockwise	Anticlockwise(LH) + clockwise(RH)	Clockwise (LH) + anticlockwise (RH)	Total
Percentage	78.60%	19.65%	1.40%	0.35%	100.00%
Number	448	112	8	2	570

Figure 1. The number and percentage of variations in direction



	One hand	Two hands	Total
Percentage	80.00%	20.00%	100.00%
Number	456	114	570

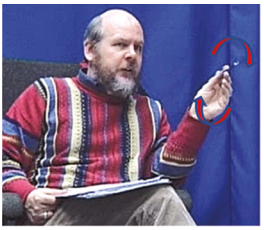
Figure 2. The number and percentage of variations in handedness



	Same	Outwards	Upwards	Sideways (left or right)	Inwards	Downwards	Forwards	Total
Number	490	39	15	12	7	6	1	570
Percentage	85.96%	6.84%	2.63%	2.11%	1.23%	1.05%	0.18%	100.00%

Figure 3. The number and percentage of variations in movement trajectories

a. One hand (left hand) rotates clockwise



b. One hand (left hand) holding a pen rotates clockwise

c. Both hands rotate clockwise, interlocking with each other

d. One hand (right hand) rotates clockwise

Figure 4. Examples of the circular gestures

In addition to being particularly careful when identifying the circular gestures, such as distinguishing a wrist turn from a full rotation, there are two important principles or decisions concerning the selection and segmentation. Firstly, as in Ladewig's (2011) study, the feature of 'continuity' in the rotational motions remains an essential criterion for selecting circular gestures. Thus, if a series of circles are interrupted by pauses, they were coded as separate circular gestures. The second decision concerns the resemblance between those one-circle circular gestures ending with an open-hand-palm-up hand and the well-known PUOH gesture (see Section 2). There are many instances of PUOH gestures in which the hand is not fully rotated and/or the latter halves of which are performed at a higher speed. These instances were not coded as circular gestures. However, it seems not unusual for a circular gesture to end with a palm-up handshape after being fully rotated (e.g. the instance in Figure 5), and such instances were included in the analysis.

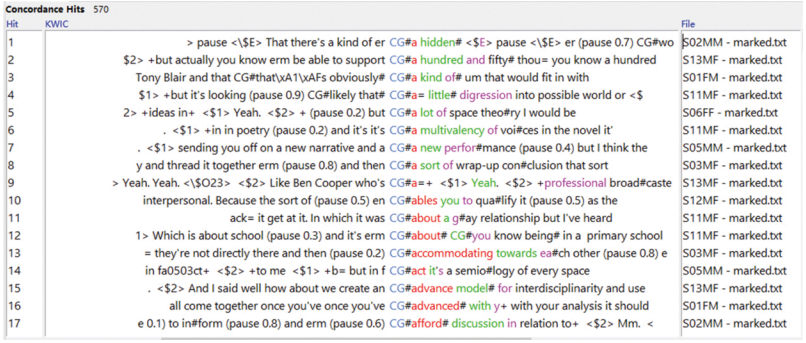
Figure 5. An instance of a circular gesture ending with the palm facing up

4.2 Speech-gesture annotations and concordance

After deciding on the criteria for selecting the circular gesture, the next step is to segment the 'stroke phase' of each circular gesture. The stroke phase is not only the most laborious part of the gesture where the movement appears to have more strength than at other times, but also the phase where the meaning of a gesture resides (Kendon, 2004; Kita et al., 1998; McNeill, 2005). For circular gestures, the stroke phases are where the rotational movements are performed, or where the circles are most clearly outlined. This is also the approach taken in research on cyclic gestures (Ladewig, 2011). Sometimes the hand may hold for a while before or after the stroke phase, which are termed the 'pre-stroke' and 'post-stroke' phases, respectively, and they can also be regarded as a part of the stroke phase (McNeill, 2005). However, in this study, the pre-stroke and post-stroke phases were not coded as our research interest is the circular movement. Since there is currently no reliable technology that can support automatic segmentation of gesture phases, the circular gestures and their co-occurring speech were segmented and annotated manually with the aid of the multimodal analytical software *ELAN* (2020).

After segmenting all the speech co-occurring with the circular gestures in *ELAN* (Lausberg & Sloetjes, 2009), we then annotated each occurrence using the marker *CG# #* in the speech transcripts for further analyses using *AntConc* (Anthony, 2019). The hashtags # mark the onset and end of each gesture. The purpose of using this very short marker rather than other SGML-conformant schemes (Standard Generalized Markup Language) with angle brackets is to show as many words and contexts as possible in each concordance line. This is especially relevant as circular gestures can sometimes co-occur with long multiword expressions, the number of which can reach up to 10 words. This way of annotation is crucial for enhancing the efficiency of pattern analysis as all of the co-

gestural speech is now ready for automatic search in the corpus software, which is not currently possible for the majority of existing multimodal tools. For instance, simply by searching the node *CG*, we can automatically generate a key word in context (KWIC), or rather a key gesture in context (KGIC), concordance of all the speech co-occurring with the circular gestures. Figure 6 is a screenshot of the *AntConc* results which show the first 17 instances of the concordance list of all the co-gestural speech in the transcripts of the eight videos with all instances sorted alphabetically. As can be seen from the data, the concordance includes instances of similar lexical and grammatical structures, and therefore significantly facilitates the identification and description of the emerging speech patterns.



Concordance Hits 570

Hit	KWIC	File
1	> pause <\$E> That there's a kind of er CG#a hidden# <$E> pause <\$E> er (pause 0.7) CG#wo	S02MM - marked.txt
2	$2> +but actually you know erm be able to support CG#a hundred and fifty# thou= you know a hundred	S13MF - marked.txt
3	Tony Blair and that CG#that\xA1\xAFs obviously# CG#a kind of# um that would fit in with	S01FM - marked.txt
4	$1> +but it's looking (pause 0.9) CG#likely that# CG#a= little# digression into possible world or <$	S11MF - marked.txt
5	2> +ideas in+ <$1> Yeah. <$2> + (pause 0.2) but CG#a lot of space theo#ry I would be	S06FF - marked.txt
6	. <$1> +in in poetry (pause 0.2) and it's it's CG#a multivalency of voi#ces in the novel it'	S11MF - marked.txt
7	. <$1> sending you off on a new narrative and a CG#a new perfor#mance (pause 0.4) but I think the	S05MM - marked.txt
8	y and thread it together erm (pause 0.8) and then CG#a sort of wrap-up con#clusion that sort	S03MF - marked.txt
9	> Yeah. Yeah. <\$O23> <$2> Like Ben Cooper who's CG#a=+ <$1> Yeah. <$2> +professional broad#caste	S13MF - marked.txt
10	interpersonal. Because the sort of (pause 0.5) en CG#ables you to qua#lify it (pause 0.5) as the	S12MF - marked.txt
11	ack= it get at it. In which it was CG#about a g#ay relationship but I've heard	S11MF - marked.txt
12	1> Which is about school (pause 0.3) and it's erm CG#about# CG#you know being# in a primary school	S11MF - marked.txt
13	= they're not directly there and then (pause 0.2) CG#accommodating towards ea#ch other (pause 0.8) e	S03MF - marked.txt
14	in fa0503ct+ <$2> +to me <$1> +b= but in f CG#act it's a semio#logy of every space	S05MM - marked.txt
15	. <$2> And I said well how about we create an CG#advance model# for interdisciplinarity and use	S13MF - marked.txt
16	all come together once you've once you've CG#advanced# with y+ with your analysis it should	S01FM - marked.txt
17	e 0.1) to in#form (pause 0.8) and erm (pause 0.6) CG#afford# discussion in relation to+ <$2> Mm. <	S02MM - marked.txt

Figure 6. A screenshot of the concordance list of *CG* in *AntConc* (alphabetically sorted)

4.3 Cluster analysis

Whereas the concordance list of the circular gestures enables the discovery of similar linguistic patterns in alphabetical order, cluster analyses highlight patterns within the words to the left or right of the node *CG*. This can then help foreground recurrent words that co-occur with circular gestures. For instance, the results of the 2-word cluster analysis in Figure 7 show that a salient number of instances of co-gestural speech starting with pauses (pausing in speech), *and*, *you*, *the* and *I*. Based on this, further discourse analysis of these frequently occurring items in conversation can then assist or confirm the analyses of certain emerging speech patterns, such as clause and dysfluent speech (see Section 5.2 for details).

In addition to the basic cluster analysis, there are further analyses that can be conducted. For instance, with the aid of wild cards, which can stand for any character(s) or word(s), most corpus tools allow for a search of a node in relation to certain words in a set span. This can then be used to explore any item of interest co-occurring with, or adjacent to, the circular gestures. For example, if the symbol *$* is set as the wildcard in *AntConc*, a search for the cluster *CG$pause* would show

#Total No. of Cluster Types: 310											
#Total No. of Cluster Tokens: 570											
Rank	**Freq**	**Range**	**Cluster**	**Rank**	**Freq**	**Range**	**Cluster**	**Rank**	**Freq**	**Range**	**Cluster**
1	52	8	cg#(pause	6	10	6	cg#so	11	7	5	cg#what
2	21	8	cg#and	7	9	7	cg#a	12	6	4	cg#in
3	20	7	cg#you	8	9	5	cg#that	13	6	4	cg#is
4	15	6	cg#the	9	8	6	cg#it	14	6	6	cg#ly
5	12	7	cg#i	10	7	5	cg#to	15	6	3	cg#they

Figure 7. The first 15 most frequent clusters to the right of *CG* (Cluster range = 2)

all the instances co-occurring with the circular gestures with the word *pause* in the second or third or fourth position, depending on how many times *$* is inserted. Such analyses can then help the researcher to compare the main patterning of co-occurrence between circular gestures and pauses, and hence assist the building of the lexico-grammatical framework.

4.4 Concordance plot

The concordance plot function has been used to examine the number and distribution of individual instances of the circular gestures in each video, and, therefore, helps evaluate the distribution of the results. Each horizontal line represents the occurrence and location of each instance in each corpus file. Figure 8 below shows that a fairly large number of instances is found in each video, ranging from 39 instances in Video 3 to 116 in Video 6.

However, considering the variations of the length of the supervision meetings, a more valid analysis of the frequency of occurrence of circular gestures in each supervision meeting involves counting the average number of circular gestures per minute (see Table 1). In general, circular gestures tend to occur frequently with an average of at least once per minute in almost all the videos, except for Video 4. However, due to the unequal number of the total instances from each video, caution is needed when drawing conclusions based on the current datasets. A more useful analysis of the plot function is to examine the frequencies of the circular gestures at the different stages of supervision meetings such as opening and closing discussions. However, we did not do that as that is irrelevant to the present research.

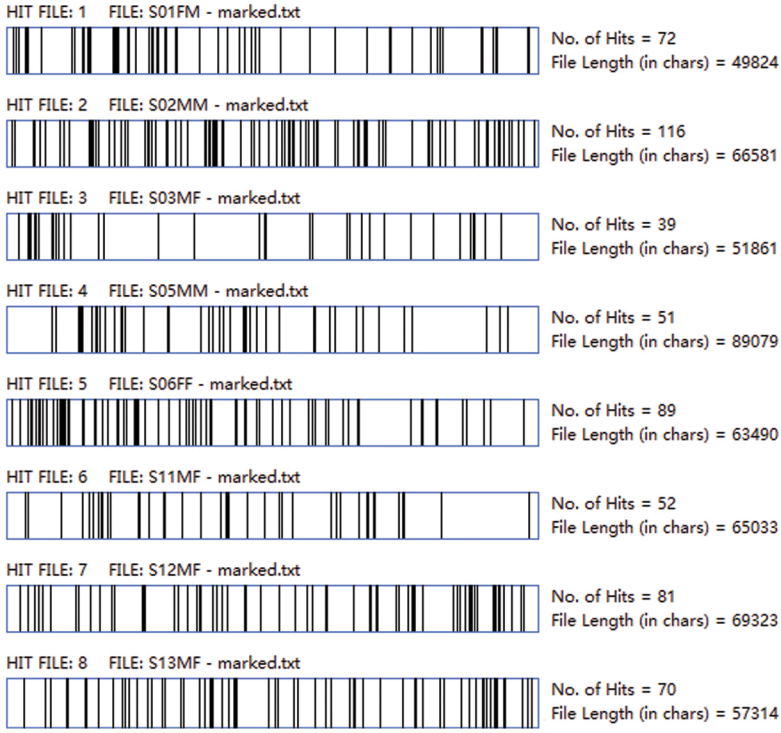


Figure 8. The concordance plot of the circular gestures

Table 1. The number of circular gestures per minute

Item	Video	Minute	Occurrence	Occurrence/Min
1	1	35	72	2.06
2	2	60	116	1.93
3	3	41	39	0.95
4	5	88	51	0.58
5	6	47	89	1.89
6	11	43	52	1.21
7	12	55	81	1.47
8	13	37	70	1.89
	Average	51	71	1.50

4.5 Sampling techniques to develop a lexico-grammatical framework

As illustrated above, concordance and cluster analysis can be applied to explore the lexico-grammatical patterns of speech. Although we used all the 570 instances, to develop a preliminary framework, a sampling technique is designed and applied. This is because, when dealing with an extremely long list of instances, the human eye can only manage to observe a limited number of instances. This number might be approximately 100 instances for observing general patterns and 30 for exploring details (Hunston, 2002). For this reason, sampling techniques, such as a random selection of 30 instances (Sinclair, 1996), have been proposed in textual analysis. That is, we randomly select 30 concordance lines and analyse patterns, then select another 30 for any new patterns and so on, until no new patterns can be identified.

Similarly, it is very difficult to explore speech patterns in all the 570 concordance lines without adopting any sampling technique. Therefore, a sampling approach was specifically designed for the current study in order to build a descriptive framework for categorising speech components that co-occur with all the circular gestures. The sampling process began with a pilot analysis of the first instance from the eight videos and this process was repeated several times by selecting the following instances in each video until no new pattern emerged. This then led to the establishment of a preliminary lexico-grammatical framework. This initial framework was then tested and adopted to categorise all the instances in the concordance list, during which process revisions were made in order to make the final framework as inclusive as possible. Ultimately, lexico-grammatical patterns fell into 15 main categories and one sub-category as an added layer of analysis within the 15 main categories. Definitions of the speech patterns and relevant details concerning their coding will be provided in the analysis. All manual analyses, including all manual annotations and categorisation, are carried out in *Microsoft Excel*.

4.6 Cross-checking and inter-rater reliability tests of speech patterns

Two research assistants were recruited to cross-check the analyses of the 15 main categories of the speech patterns to ensure and examine their validity and reliability. Both coders graduated with an MA degree in English Applied Linguistics and have some knowledge of corpus linguistics and gesture studies, but they were unaware of the purpose of the research. Prior to the tests, the goals of the research and the reliability test were explained in detail. Both coders were provided with a coding scheme (see Appendix 1) and noted whether or not they agreed with the coding decisions of each instance (see original documents in the appendices).

A high rate of agreement was reached in both tests: one coder agreed with the coding of the speech patterns of 565 instances out of 570 (99.12%), and the other agreed with 557 out of 570 (97.72%).

In addition, two different research assistants were recruited to conduct inter-rater reliability tests in which they were required decide independently (without the original coding decisions) on the categorization of the first 120 instances (21%) of all 570 instances (see Appendices 2 and 3). Prior to the tests, both coders were carefully trained with other instances to ensure accurate understanding of the coding scheme. The rates of agreement in the final tests reached 92.50% and 89.16%. Considering the complex nature of the speech patterns, these results show a high degree of inter-rater reliability.

5. Analysis

Section 5.1 provides an overview of the multimodal unit of meaning of the circular gesture. The definition and analysis of each category is then presented in Sections 5.2 to 5.5. All instances in each category are available in the online appendices.

5.1 The multimodal unit of meaning of the circular gesture: Overall distribution

Drawing on Sinclair's unit of meaning model and the speech patterns, a profile for the unit of meaning of the circular gesture was constructed including the 15 main categories in Table 2 and one sub-category identified in four main categories in Table 3. Among the four aspects (i.e. collocation, colligation, semantic preference, semantic prosody) in Sinclair's unit of meaning model, we are focusing on the last three. Since collocation refers to certain words that tend to co-occur with the node, this concept is unsuitable for describing the speech-gesture relationship as the circular gestures tend to co-occur with a variety of words. In other words, although we can identify co-gestural speech patterns that belong to similar grammatical structures (i.e. colligation), notions (i.e. semantic preference) or functions (i.e. semantic prosody), there are no emerging words that appear to be the collocates of the circular gestures. In the future, when we have access to multimodal corpora that are fully annotated for all gestures that occur, it will be interesting to explore the collocational relationships between different gestures.

Table 2. Distribution of frequency of the 15 main categories

Rank	Unit of meaning components	Speech pattern	Number of occurrences	Percentage
1	Colligation	clause	150	26.32%
2	Colligation	verb phrase (+ _____)	116	20.35%
3	Colligation	noun phrase (+ _____)	75	13.16%
4	Colligation	modification (+ noun phase)	55	9.65%
5	Colligation	dysfluent speech	54	9.47%
6	Semantic preference	deixis	36	6.32%
7	Colligation	preposition phrase	19	3.33%
8	Colligation	predictive (+____)	15	2.63%
9	Semantic prosody	intensification	14	2.46%
10	Semantic prosody	vagueness	10	1.75%
11	Semantic prosody	monitoring mutual ground	9	1.58%
12	Colligation	discourse marker	6	1.05%
13	Semantic preference	negation	6	1.05%
14	Colligation	conjunction	3	0.53%
15	Semantic preference	confirmation	2	0.35%
	Total		570	100.00%

As shown in Table 2, 10 speech patterns were identified and assigned to the concept of colligation (i.e. grammatical patterns) as they contain similar grammatical features. Colligation accounts for the majority of examples, totalling 493 out of the 570 instances (86%). Clause and verb phrase (+ ___) are the most frequent structures, followed by the next three categories, ranking 3, 4 and 5. The instances in the remaining five categories are minor, ranking 7, 9, 12 and 14.

The number of patterns and instances in the semantic preference category is considerably smaller compared to colligation with only 44 instances (7%), which rank 6, 13 and 15 in all the main categories. Three categories were identified with each category having a similar semantic meaning but composed of different lexis and grammatical structures. For instance, the utterances in the category of deixis (ranking 6) do not have the same grammatical structure, but all specify the meaning of object, location, time and direction. Deixis has a relatively large number of instances compared to the other two patterns in semantic preference (i.e. negation in 13 and confirmation in 15).

The smallest number of instances in the 15 main categories were identified in semantic prosody (33, 5%), which were classified into three speech patterns serving certain functions, including intensifying speech (i.e. intensification, ranking 8), mitigating attitude with vague language (i.e. vagueness, ranking 10) and monitoring mutual ground (ranking 11). The number of instances in each category is minimal.

Table 3. Tokens of the sub-category of on-going process in the main categories

Speech pattern	Token of on-going processes
verb phrase (+ ____)	35
clause	22
noun phrase (+ _____)	5
modification (+noun phrase)	4
Total	66

Table 3 presents the number of instances in the only sub-category that have a semantic preference for describing on-going action (i.e. continuity) identified in four main categories, mostly in clause and verb phrase (+ ___). No such instances were found in the remaining 11 main categories. The reason for creating this sub-category is that, consistent with previous research (e.g. Calbris, 2011; Ladewig, 2011), many instances synchronised with the circular gesture in our data contain the meaning of continuity. However, as such meaning can be realised by different grammatical features, especially clauses and verb phrases, coding them as a main category would lead to many overlaps in the categorisation. Hence, adding such a sub-category not only resolves the issue of overlap, but also makes the coding scheme more fine-grained and comprehensive.

5.2 Main category: Colligation

This section introduces the results related to colligation. The following sub-sections introduce the co-gestural speech patterns for colligation in the corpus.

5.2.1 *Clause*

The speech pattern of clause is the most frequent among the 15 main categories (150 out of 570, 26.32%, Appendix 4). The circular gestures in this category mainly co-occur with part of main or subordinate clauses headed by pronouns (e.g. *you*, *it*, *I*), *wh*-clauses (e.g. *how*, *what*, *which*) and other subjects (e.g. *people*, *arguments*). Table 4 presents the tokens and percentages of all the subjects leading the

clauses, among which *you*, *it*, *other subjects*, *I*, *that* rank in the top five. Preceding those subjects, we find discourse markers such as *and* and *so*, and other conjunctions such as *if*, *as* and *but*.

Table 4. The number of subjects leading the clauses

Subject	Token	Percentage	Subject	Token	Percentage	Subject	Token	Percentage
you	32	21.33%	how	9	6.00%	where	4	2.67%
it	18	12.00%	what	8	5.33%	why	4	2.67%
others	15	10.00%	which	7	4.67%	this	3	2.00%
I	11	7.33%	we	6	4.00%	he	1	0.67%
that	11	7.33%	there	5	3.33%	she	1	0.67%
they	10	6.67%	when	4	2.67%	who	1	0.67%

The number of instances led by the top-5 subjects accounts for 58% of all the 150 instances in this category. By observing the start and end of the marker, the hashtag (#), it is noticeable that the circular gestures can be synchronous with clauses of various lengths. Also, they tend to start at the beginning of the clauses (including the discourse markers and conjunctions if there are any) and do not end until the verb phrases are uttered, though the gestures usually do not last long. Another important observation is the high frequency of personal pronouns *you* and *I* that lead the clauses. This may well reflect the dialogic nature of the NMMC supervision meeting sub-corpus. A corpus of a different nature may generate different results.

5.2.2 *Verb phrase (+ ___)*

This category ranks as the second highest in the main categories, totalling 116 instances (20.35%, Appendix 5). 27 of them were coded as 'verb phase' (see the 'speech pattern' column in Appendix 5) as they are predominantly composed of linking verbs (e.g. *be*) or action verb phases of different forms (e.g. *-ing*, *-ed*), which may be preceded by other auxiliary verbs (e.g. *have*, *be*) and/or modal verbs (e.g. *may*). In those instances, the circular gestures tend to start with or right before the verb phrases and stop the moment the verb phrases are uttered. The rest of the 89 instances were coded as 'verb phase + ___' as they not only contain the main verb phrases, but also a short part of the utterance following them, which are mostly the objects of the verb phrases.

To examine any possibility of recurrent verbs in this speech pattern, all the verb lemmas were counted and those occurring more than twice are listed in Table 5. The linking verb lemma *be* (including *is*, *are*, and *be*.) occurs nine times

and ranks top, followed by four action verbs *do*, *get*, *give* and *go*. However, the slightly higher frequencies of those verbs do not necessarily suggest a particularly close association between them and the circular gestures. Verb lemmas such as *be*, *do*, and *get* are among the most frequently occurring verbs in spoken language.

Table 5. Verb lemmas occur more than twice

Verb lemma	Freq	Verb lemma	Freq	Verb lemma	Freq	Verb lemma	Freq
be	9	describe	3	follow	2	read	2
do	5	on	3	formulate	2	talk	2
get	5	use	3	keep	2	try	2
give	4	advance	2	modify	2	work	2
go	4	afford	2	move	2		
construct	3	explore	2	perform	2		

In the coding of the first two speech patterns just discussed, the main distinction between the speech pattern of the verb phrase (+ ____) and the previous pattern of the clause lies in the fact that the instances in the latter category do not involve the subjects of verb phrases. In other words, the circular gestures in this category only co-occur with the verb phrases, or the verb phrases and a few following words.

5.2.3 *Noun phrase (+ ___)*

This speech pattern of noun phrase (+ ___) also has a high frequency with 75 instances (13.16%, Appendix 6), which ranks third among the main categories. The majority of instances (59 out of 75) in this category were coded as 'noun phrase'. They are noun phrases, which can be preceded by a (in)definitive article (i.e. *a, the*) or a conjunction (e.g. *and*), and/or followed by a preposition (e.g. *of*). As can be seen from the concordance in Appendix 6, they can be single nouns (e.g. instances 26, 28, 40), complex nouns (instance 49), or the combination of two nouns (e.g. instances 61, 95). The circular gestures tend to start right before or at the beginning of the noun phrases and end when they are at least partially uttered. In addition to the 59 instances predominantly composed of noun phrases, the remaining 16 instances in this category are formulated by noun phrases and their complements (i.e. 'noun phrase + ___'), which can be introduced by words such as *that* (instances 69, 541) and *of* (e.g. instances 102, 145, 456, etc.). The circular gestures tend not to last longer than a few words after the noun phrases, except for 464. Instances such as 459 were not included in this sub-category as the gesture does not co-occur with the words after *of*.

5.2.4 *Modification (+ noun phrase)*

55 instances out of the 570 (9.64%, Appendix 7) were identified in this category, in which the circular gestures mainly co-occur with expressions that are used to modify noun phrases. The gestures only co-occur with the modifications, or with both the modifications and the following noun phrases. Referring to the instances in Appendix 7, the main modifying part can be a single adjective (e.g. instances 1, 52, 123, 132,137, etc.) or a noun phrase (e.g. 25, 113, etc.), which might be preceded by a (in)definitive article, conjunction or adverb. 36 out of all the 55 instances only entail the modifying part and hence were coded as 'modification'. The rest of the 19 instances in this category not only contain the modifying part, but also the noun phrases that are being modified (i.e. 'modification + noun phase'). As can be observed from the data, these instances differ from those in the subcategory of 'modification' in that the circular gestures do not end until the noun phrases are at least partially uttered (e.g. 5, 6, 7, etc.).

5.2.5 *Dysfluent speech*

Among the 54 instances (9.47%, Appendix 8) of dysfluent speech, the circular gestures mainly co-occur with dysfluent utterances indicated by features such as *erm*, *er*, pauses (longer than 0.2 seconds), sound stretching (marked by =), repetitions, false starts, incomplete speech, etc. Among the many challenges during the development of the coding scheme is the prevalence of pauses in spoken language. Using pauses as the only indicator of dysfluent speech may lead to an unusually large number of instances in this category. Hence, it was decided that utterances with only one pause of any length need to have at least one other dysfluent indicator (e.g. a different pause, repetition, etc.) in order to be coded as dysfluent speech. For example, the instance 286 (*CG#obesity being (pause 0.2)#*) is coded as a noun phrase + ____ even though it contains a 0.2-second pause. However, this principle does not apply to the instances only co-occurring with a pause. There are eight circular gestures aligned with pauses of different lengths (e.g. instances 318, 324, 326, etc. in Appendix 8). An additional 14 instances of dysfluent speech contain at least one pause.

Repetition is also a frequent dysfluent indicator: 20 out of 53 instances co-occur with a repetition (e.g. instances 37, 41, 64, etc.). In addition, 13 instances contain more than one dysfluent feature (e.g. 142, 152, 193, etc.). For example, instance 142 has a latching speech (*for=*) and a 0.3-second pause.

5.2.6 *Prepositional phrase*

Among all the 19 instances in this category (Appendix 9), 14 share a similar patterning, which is constructed of a single preposition followed by a noun phrase or

a verb in a *–ing* form. For instance, *about* ___ occurs four times (instances 11, 12, 70, 218); *for* ___, four times (141, 143, 144, 440); *with* ___, twice (539, 540). Other than the 14 single prepositions, the remaining six examples form part of prepositional phrases. For example, there are two instances in the form of *on an/a* ___ *basis* (293, 294). The others three are instances 85 (*in comparison to* ___), 194 (*in* ___ *respect*), 259 (*on* ___ *side*) and 289 (*of and in the process of*).

In terms of the temporal relationship between the circular gestures and the prepositional phrases, it can be observed that the start of the gestures tends to co-occur with the beginning of prepositions. The end of the gestures often coincides with the point when the phrases are approaching the end, usually a few words after the prepositions.

5.2.7 *Predictive (+___)*

Only 15 instances were identified in this category (Appendix 10). As is shown in the data, seven instances of this type are constructed by adjective predictives that follow copulas or linking verbs (e.g. *be*) (i.e. the sub-category of 'predictive'). The circular gestures end the moment the predictives are uttered. The other eight instances not only contain the predictives, but also a few words following them such as prepositions (i.e. 'predictive +___').

5.2.8 *Discourse marker*

Among the very small number of instances (6, 1.05%, Appendix 11) where circular gestures co-occur with discourse markers, *I mean* occurs four times (instances 126, 177, 178, 179). The other two are *for example* (instance 140) and *you know* (555). As discourse markers are generally highly frequent in spoken language, we only categorised instances as discourse markers where they predominantly co-occurred with spoken discourse markers (e.g. *CG#I mean# you know it's worth chasing that*). For instance, instances 46 (*CG#and you know that's# a very fair*) and 47 (*CG#And you know they're# very depressed*) were coded as clauses with a *you know* inserted in them; instance 82 (*spaCG#ces and you know city scapes# and CG#(pause 0.1)*), noun phrase; instance 32 (*CG#and I mean obviously# it's you're doing*), intensification.

5.2.9 *Conjunction*

Only three circular gestures co-occur with conjunctions (Appendix 12), which are *as* (instance 55), *and* (instances 80, 250) *or* (instance 263). An instance has to be predominantly aligned with a conjunction in order to be assigned to this category. For example, instance 40 (*CG#and theme#s*) is coded as noun phrase rather than a conjunction, and instance 45 (*CG#and work on# that*) as verb phrase.

5.3 Main category: Semantic preference

The category of semantic preference includes three types of speech patterns: deixis, negation and confirmation.

5.3.1 *Deixis*

The instances of deixis mainly clarify the meanings of object, location, time and direction with the help of pronouns (e.g. *this/these*, *that*), verbs (e.g. *come* and *go*) and prepositions (e.g. *to*, *out of*, *in*). Among the 36 instances in this category (Appendix 13), 15 specify objects (see the "further analysis" column in the appendix), 11 refer to locations, nine clarify directions and only one relates to time.

One noteworthy characteristic of those deictic expressions is that, overall, they tend to refer to abstract rather than concrete concepts. For example, the wider discourse context shows that 14 out of the 15 instances referring to objects are abstract ones, except for instance 63, and eight out of nine are abstract directions (except for instance 182). Additionally, five out of 11 instances clarify abstract locations (instances 127, 192, 195, 290, 303). In total, 27 out of 36 instances of deixis refer to abstract concepts. This may also relate to the nature of the supervision meetings corpus as speakers are usually talking about abstract, academic content rather than describing something concrete. It should be noted that instances of deixis can overlap with others, such as clauses, prepositional phrases, verb phrases (+ ____). However, they are coded as deixis due to their primary meaning.

5.3.2 *Negation*

Among the six instances in this category (Appendix 14), the meaning of negation is expressed by different lexico-grammatical features such as *not* (*can't* in instance 79 and *aren't* in 443), *not just* (instances 279, 419) and *no* (instances 275, 275). As both *not* and *no* are commonly used in clauses, some instances in the category of clause are not coded as negation, even though they contain *not* or *no*, because they do not primarily co-occur with them. Examples include 96 (*CG#'cos it doesn't ex#ist*) and 215 (*CG#it's not made e#xplicit (pause 0.4)*. Others include *CG#there's no= forecasting there's no=#* (instance 472), *CG#there's no interfering fa#ctor then* (instance 475) and *CG#there's no kind of# democratic (pause 0.4)* (instance 471).

5.3.3 *Confirmation*

Only two instances emerged in this category (Appendix 15). In these cases, the circular gestures predominantly co-occur with *yes*, indicating the meaning of confirmation from the speaker.

5.4 Main category: Semantic prosody

This section introduces speech patterns for the final main category, semantic prosody: intensification, vagueness and monitoring mutual ground.

5.4.1 *Intensification*

The 14 instances of intensification co-occurring with circular gestures mainly serve the function of intensifying speech with adverb intensifiers such as *obviously*, *just*, *particularly*, etc. (see Appendix 16). The circular gestures in those instances are primarily aligned with the adverb intensifiers. This feature differentiates the instances in this category from others that may also contain an intensifier, but do not primarily co-occur with them. For example, in instances 87 (*it is CG#completely you you saw this y#ou did this*) and 210 (*it CG#it becomes much# more complicated*), although they contain adverb intensifiers, they also co-occur with the beginning of main or subordinate clauses including a subject and a verb. Hence, such instances are assigned to the speech pattern of clause.

5.4.2 *Vagueness*

All 10 instances of vagueness in Appendix 17 have the function of mitigating the force of utterances, using a variety of vague language such as *kind of* (instances 226, 227, 228, 554), *sort of* (569, 570), *in general* (190), *likely* (235), *maybe* (314) and *some* (424). Similar to the intensifications, vague language frequently occurs in spoken language. Thus, instances of vagueness have to be predominantly constructed of vague language to be included in this category. For example, instance 225 (*it's CG#kind of a mixed mo#de*) is not coded as vagueness, but as a modifier + noun phrase. One could also argue that instance 235 can be categorised as a predictive and 424 as a modifier; however, they were coded as vagueness due to their apparent pragmatic function of toning down the language and hence weakening the commitment of the speaker.

5.4.3 *Monitoring mutual ground*

In the nine instances in this category (Appendix 18), two patterns have been identified for the circular gestures emerging in the context of monitoring mutual ground on the part of the speaker: with and without speech. With speech, there are five instances using the sequence of *do you know what I mean* 119, 120, 323, 380, 520. For the remaining four instances (60, 388, 433, 502), the circular movements are aligned with the end of a turn (i.e. the last word), followed by a pause and/or a response from the listener. The pause seems to indicate the intention of checking understanding of the speakers in this particular discourse context and such a communicative goal is usually decoded and responded to by the listener. That is,

circular gestures in those instances continue until a confirmation of understanding has been expressed by the listener.

To illustrate this, an episode of such a context is presented below, although, in this instance, the circular gesture occurs in the middle of an utterance, co-occurring with *CG#reflective (pause 0.3) + <$ 2> Mm#*. Here, the supervisor is talking about the importance of being critical and reflective about one's own research at this stage of PhD study. The 0.3-second pause seems to suggest the supervisor's intention of checking the mutual ground between her and the student as the pause offers a chance for the other party to confirm understanding.

Speech transcript (S02MM):

<$ 1> You know y= <$E> pause <\$E> in some in some ways too much confidence <$E> pause <\$E> <$=> is a is a bad thing here.
<$ 2> Yes.
<$ 1> Because you know that kind of <$E> pause <\$E> level of well I'm sorted. It's sorted.+
<$ 2> Mm.
<$ 1> +I know exactly where everything is where we're going" <$E> pause <\$E>+
<$ 2> Mm.
<$ 1> +wouldn't er suggest to me that you're being critical <$E> pause <\$E>+
<$ 2> Mm.
<$ 1> +and and **CG#reflective (pause 0.3)#+**
<$ 2> Mm.
<$ 1> +about what you+
<$ 2> Mm.
<$ 1> +your work.
<$ 2> Sure.

5.5 Sub-category: Semantic preference ('on-going process')

Previous research (Calbris, 2011; Ladewig, 2011, 2014) suggests that circular gestures tend to have the meaning of continuity as they are often synchronous with speech describing on-going actions or events. However, the coding of this meaning has not been specified with regard to its particular lexico-grammatical features. The present study only counts those instances that contain a verb in the *-ing* form or lexis that explicitly have the meaning of continuity. The number of instances of on-going process identified in the four main categories are presented Appendix 18, totalling 66 instances.

Among all the 35 instances of on-going process identified in the main category of verb phrase (+ ___), almost all co-occur with a verb in the *-ing* form, indicating

the meaning of continuity or cycle, except for 89 (*consistently*), 93 (*continue*), 156 (*go round*) and 160 (*you've CG#got cycle#s of*). Similarly, only one instance out of the 22 of on-going process identified in clause does not contain the *verb-ing* form, which is *CG#so you're a c= consistently respon#sive* (423); others include 379 (*CG#rather than sort of continuous# prose*) and 409 (*CG#series of# little performances*) in modification and 102 in noun phrase (+ ____) (*CG#cycles of abuse I think#*).

6. Towards a multimodal unit of meaning

One of the contributions of the current research is to demonstrate how corpus linguistic methods can lend support to the exploration of the emerging patterns of meaning co-occurring with recurrent gestures. With careful sampling and the aid of automatic concordance analyses, we have identified 15 main lexico-grammatical categories and one sub-category that allow for a more nuanced description of the meaning of the circular gesture in its linguistic and discourse context. Compared to previous research on the circular gesture, only two categories share some similarities to the existing findings (Calbris, 2011; Ladewig, 2011). One is the meaning of on-going process as the only sub-category in the framework. The other pattern that has been highlighted in previous studies is that of dysfluent speech, corresponding to the cognitive function (i.e. assisting lexical retrieval) in Ladewig's (2011) framework. All other categories offer a new lens on the nuanced meaning of the circular gesture and thus add to the current body of work in this area.

Another contribution of our research is the use of Sinclair's unit of meaning model to describe emerging lexical and grammatical patterns co-occurring with circular gestures. Although differing from their original uses, three of the four concepts (i.e. colligation, semantic preference, semantic prosody) have been applied to describe the co-occurring speech patterns of the 570 circular gestures in our corpus. Thus, our research highlights the feasibility and usefulness of adopting Sinclair's unit of meaning model in examining recurrent speech-gesture associations. As mentioned in Section 2, the approach outlined in this article can helps us resolve the issue of identifying the lexical affiliate of a recurrent gesture. For many circular gestures, such as those co-occurring with clauses, modification (+ noun phrase) and preposition (phrase), etc., it is unclear which part of the utterance is the lexical affiliate. However, this is no longer an issue when taking a lexico-grammatical approach to describing the meaning of the target gesture. Sinclair's (1996) unit of meaning consists of a set of dimensions or components, namely colligation, collocation, semantic preference and semantic prosody. In this

article, we have discussed these individually rather than as part of a unit including all of these components. However, if we extend our analysis beyond the speech strictly co-occurring with the circular gesture, it becomes possible to consider an integrated unit of meaning of the kind described by Sinclair. For example, where a circular gesture co-occurs with speech in a colligational pattern that suggests prediction, the semantic prosody tends to be positive or neutral where the semantic preference relates to a comparison of some kind. Future analysis will need to show whether a change in the type of circular gesture effects a change in colligation, semantic preference and semantic prosody, and whether these components lead to an altogether change in the function of the gesture following the change in function of its form.

Adopting a corpus-based approach requires a focus on the most frequently occurring patterns in language use and a recognition that not all meaning variations occur with the same degree of frequency and significance (Sinclair, 1991). Not many studies have adopted a corpus-based approach to generate findings of the frequencies of meaning variations of recurrent gestures, and new evidence may well emerge if we do so. Using the current investigation of circular gestures as an example, corpus results of the 16 speech patterns suggest the distinctive frequency of occurrence of each variation. Among all the meaning variations of circular gestures, those with higher frequencies include, in the main categories, clause (150), verb phrase (+ ___) (116), noun phrase (+ _____) (75), modification (+ noun phrase) (55) and dysfluent speech (53), all belonging to the concept of colligation. The semantic preference of the on-going process also has a high frequency with 66 instances.

In a broader sense, the current research also contributes to a growing body of multimodal research on patterns of multimodal meaning making and construction based on large corpora such as the Red Hen corpus (Hinnell, 2018; Zima, 2017). They represent a recent shift to multimodal corpus research that adopts a mixed methods approach (Lin & Chen, 2020). Whereas numerous qualitative studies from various fields such as pragmatics (Kendon, 2004) and conversation analysis (Clift, 2020) have convincingly demonstrated that language and communication are inherently multimodal rather than monomodal, systematic multimodal corpus research provides statistical evidence of the patterned uses of speech and other modes of expression, such as hand gestures, gaze and facial expressions (Feyaerts et al., 2022). The present study adds further evidence to this research agenda by establishing the lexico-grammatical patterns associated with the circular gesture. Furthermore, our study also suggests that traditional corpus linguistic theories such as Sinclair's (2004) unit of meaning model can and should be further extended to the description and analysis of multimodal data.

We have to acknowledge that our framework is limited in many ways, especially with regards to the potential overlaps of linguistic features between categories that have been mentioned throughout the article. The coding is not always clear cut due to the complex and dynamic nature of the utterances co-occurring with the circular gesture. However, the framework can serve as a starting point for further refinement drawing on different sets of data, and for establishing a more comprehensive and reliable profile of the pragmatic functions of the circular gesture based on speech patterns. Despite the limited availability of multimodal corpus data of naturally occurring discourse, we believe that the approach outlined in this article has significant theoretical and methodological implications for future research on recurrent gestures. We also believe that the methodological framework outlined above will not only lead to more robust descriptions of meaning in context, but also to better applications based on those descriptions.

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Appendix

The appendices are available from https://osf.io/sy9r6/.

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