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研究ノート

Communicating with gaze in emergency care: a multimodal analysis

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Abstract

This study examines *joint attention* between health care professionals (HCPs) in interaction in emergency care training, using a multimodal corpus analysis with a conversation analytic approach. On the basis of Kidwell & Zimmerman (2007), which analysed young children's use of gaze to lead joint attention, three research principles are addressed here, although the primary aim is to assess the feasibility of the research method: 1) what do HCPs look at in emergency care training?, 2) how do HCPs achieve joint attention?, and 3) how does a recipient respond to a shower's show-action in the context? An emergency care training session with a simulated patient, Ken (KSP), was video-recorded, and annotations were added to the gazes of three HCPs, Mike (doctor, medical student) and two nurses, Helen and David, using a multimodal annotation tool, ELAN (all names anonymised). The results show that Mike gazed at KSP most of the time, while David was engaged in medical procedures, gazing mostly at KSP's arm. Helen spent about half the time out of view of the camera to find equipment/medicines for treatment. *Joint attention* seemed to be led by practices of showing or gazing at an object, and vocalisation, which made the shower's understanding of the situation observable and also prompted a recipient's action. Thus, this preliminary study indicates that nonverbal communication, especially gazing, affects interactions in emergency care, which should be further investigated with a larger data set using the method established through the study.

Keywords： emergency care simulation, gaze, multimodal analysis, joint attention

1 Introduction

It is common practice to treat a patient with a team of several health care professionals (HCPs) in emergency care. This differs from a dyad medical consultation between a doctor and a patient, where a relatively linear consulting process is observed, i.e. data gathering (history taking and examination) > explanations > discussion of treatment (diagnosis) (Roberts, Atkins, & Hawthorne, 2014). HCPs as a team need to collaborate to deal with multiple events which are happening simultaneously, monitoring

others' action to decide the orientation of the diagnosis. This preliminary study examines *joint attention* between HCPs in interaction in emergency care training, using a multimodal corpus based approach. Here, *joint attention* is defined as "a social exchange organized around the jointly attended matter" (Kidwell & Zimmerman, 2007, p.594).

The importance of nonverbal communication and the relationship between nonverbal/verbal dimensions in clinical settings have been recognised (Martin & DiMatteo, 2013). In health communication, gaze is recognised as "the primary nonverbal behavior that persons use to communicate their immediately current engagement in (or disengagement from) collaborative social action" (Thompson, Robinson, & Brashers, 2011, p. 647). Montague et al. (2011) also identified that clinicians' gaze affects patients' gaze in their study of two party primary care consultations, i.e. a patient looks at what a doctor is watching. Szulewski & Howes (2014) analysed HCPs' gaze in emergency care in Canada with an eye-tracking device and highlighted potential areas for research:

1. Prioritization of information gathering: where do subjects look first upon entering a medical crisis situation?
2. Devalued information: where did the subject not look?
3. Dwell time analysis: Specific target times (e.g., total time with gaze focused on a specific area)
4. Specific gaze behaviours: scanning, confirmation, checking-in, perching
5. Cognitive load and stress indicators: pupil dilation

(Adapted from: Szulewski & Howes, 2014,p.3)

The current study will fit into their fourth category although joint attention was not a particular focus in their study.

Gaze in interaction has been investigated in healthcare communication research as well as other areas. In his studies in dyad medical consultations in 1980s, Heath identified doctors' use of eye gaze to encourage patients to talk (Heath, 1984), and a patient's eye gaze in the physical examination, which avoided mutual gaze with a doctor, presented their body as an object of inspection (Heath, 1986). Some studies in different areas from healthcare communication also focused on eye gazing of interlocutors in interaction, e.g. the practice of *joint attention* among viewers at an exhibition or a poster session (Bono & Katagiri, 2005; Sumi, Ito, Matsuguchi, Fels, & Mase, 2003).

Investigating young children's use of gaze, Kidwell and Zimmerman (2007) identified children's attempts to lead *joint attention* with a carer, which they call *show action*, describing a pattern in attention organising practices: child's show action > recipient's response > child's treatment of the response. Figure 1 is an example of *show action,* where a child (J) was approaching the camera person, showing her shoe. Responding to her *show-action*, the camera person looked at the shoe (*joint attention*) and uttered, 'that's your

shoe' although the body movements of the camera person were not captured in the video framework. J nodded and smiled, and then left the camera person.

Figure 1: J's show action (Kidwell & Zimmerman 2007, p. 596)

These studies are valuable since they suggest the effects of nonverbal actions of gaze in social interactions. However, joint attention between HCPs in emergency care has not been investigated in existing studies. To fill the gap, three research principles are addressed here, although the primary aim is to assess the feasibility of the research method: 1) what do HCPs look at in emergency care training?, 2) how do HCPs achieve joint attention?, and 3) how does a recipient respond to a shower's show-action in the context?

2 Research Data and Method

For this preliminary study of gaze in emergency care interaction, the first ten minutes of a simulated training session (about 20 mins in total) was analysed. The corpus includes more than 1500 annotations of HCPs' gaze behaviours. This particular data set was chosen because the HCPs finished the initial diagnosis within the first ten minutes, and then two of them left the bed area: one called for help and the other tried to find some medical equipment so that they were out of sight of the camera for a while. A relatively small scale corpus was examined here since the aim of the study is to assess the feasibility of the multimodal corpus analysis method .

A multimodal corpus is defined in Foster & Oberlander (2007, p. 4) as "an annotated collection of coordinated content on communication channels such as speech, gaze, hand gesture, and body language, and is generally based on recorded human behaviour". Knight (2011, p. 2) describes that multimodal corpus linguistics looks at not only " the 'abstract' element in discourse - the process of 'meaning making' […] - but also the 'media', the physical mode(s) in which these abstract elements are conveyed". A time-aligned corpus analysis (Tsuchiya, 2013) is an approach of multimodal corpus linguistics and applied to the current study, together with a conversation analytic approach (Drew, Chatwin, & Collins, 2001), which focuses on "the dynamic processes through which connected sequences of actions are built up" (ibid, p. 59):

(1) First, the transcribed data of the participants' utterances and eye gaze were stored in a multimodal corpus for quantitative analysis (i.e. objects and time lengths of gaze). Using the time-aligned script, the temporality of the participants' gaze was visualised in a timeline on the second time scale, which enabled researchers

to identify interesting areas for micro level investigation.

(2) After creating the overview of gaze behaviours, the targeted instances identified in the previous stage, i.e. joint attention between HCPs in this study, were extracted and analysed with video images, applying a conversation analytic approach.

Both approaches are necessary to see the global pattern of the HCPs' gaze behaviours and the micro level interaction with nonverbal/verbal features. In studies of eye gaze, three features, *mutual gaze*, *gaze duration*, and *glancing*, are often investigated (Harrigan, 2013). In the current study, however, we decided to focus on *joint attention* between HCPs.

A medical student (Mike) and two experienced nurses (Helen and David) performed a scenario involved a simulated patient, Ken (KSP) (a 62 year old male) who presented with chest pain. The recording took place at a simulation centre in the UK as part of training for final year medical students. The video-recording was stored in a miniature multimodal corpus, which included transcribed data sets of all the participants' verbal utterances. Using a multimodal annotation tool, ELAN (2001-2015), eye gazing of three HCPs was annotated in timeline and analysed, focusing on *show action* and *joint attention* between HCPs. The video data and ELAN were used for the coding of eye gaze rather than live annotations "because of advantages of re-play, slow motion viewing, and resolution of measurement errors" (Harrigan, 2013, p.49).

3 Results

3.1. Objects and total time lengths of gazing

Objects and total time lengths of the three HCPs' gazes were summarised in Table 1. Mike gazed at KSP's face (2 mins 39 secs) and his body (2 mins 6 secs) for half of the time in total, sometimes looking at equipment and medicines used for the treatment, i.e. a monitor and epinephrine (2 mins and 52 secs at

	KSP	KSP's body	Helen	Mike	David	Equip-ment	Out	Un-known
Mike (Doctor)	02:39	02:06	00:40	-	00:21	02:52	01:10	00:12
Helen (Nurse)	00:49	00:10	-	00:44	00:14	02:58	04:22	00:43
David (Nurse)	00:50	03:09	00:20	00:05	-	03:00	02:23	00:13

Table 1: Objects and total time lengths of HCPs' gazes

Figure 2: Objects and time of HCPs' gazes on timeline

Equipment).David, on the other hand, was engaged in medical procedures, i.e. blood pressure measurement and cannulation, gazing mostly at KSP's arm (3 mins 9 secs at KSP's body and another 3 mins at Equipment). Helen spent more than four minutes out of the camera to find equipment/medicines (Out, 4 mins 22 secs).

The objects and time lengths of the three HCPs' gazing are also illustrated in timeline in Figure 2. The X axis is the timeline in seconds (600 secs in total), and the Y axis is the objects they gazed at. Mike's gazing is shown in blue, Helen yellow and David green. Mike looked at KSP's face from time to time throughout the duration. In the middle of the duration, David was gazing at KSP's body for medical procedures, which is described with several long green lines in 'KSP's body' in Figure 2. The co-occurrences of the yellow dots in Mike and blue dots in Helen indicate that they sometimes looked at each other. The following section qualitatively analyses practices of *joint attention* between HCPs.

3.2. Joint interaction between HCPs

Three patterns in practices of *joint attention* between HCPs were observed in the ten-minutes of data. In Excerpt 1, Mike was gathering information from the KSP. While listening to their talk, David first picked up a tray with an IV line from the table (Figure 3-1). David was then walking towards Mike, who was standing on the left side and talking to KSP, trying to insert the IV line on KSP's left arm, where a cannulation simulator was attached. This is David's *show action*. Mike was looking at the tray when David was approaching, which is *joint attention* (Figure 3-2). Then, Mike asked David in line 7, 'Are you putting a cannula in there?',

which was followed by David's confirmation, 'yeah' in line 8. Thus, David's nonverbal action led the verbal interaction with Mike, which confirmed the medical procedure, cannulation, David was going to do. Mike was then walking from the left side to the right side of Ken to make enough space for David to cannulate KSP. This is an instance where David's *show-action* led *joint attention* on a tray with the recipient, Mike.

Figure 3-1: David's show action

Figure 3-2: Joint attention on the tray

Figure 3-3: Mutual gaze (David and Mike)

Excerpt 1: David's Show Action at 00:02:33

1	Mike	Have you got any allergies at all sir?
2	KSP	er erm no, no, not that I know of.
3	Mike	No?
4	KSP	No.
5	Mike	Pain still going down your arm and chest?
		<$E> David's show action (Fig. 3-1) </$E>
6	KSP	<$G?> chest.
		<$E> *Joint attention* → *Mutual gaze* (Fig.3-2, 3-3) </$E>
7	Mike	Are you putting a cannula in there?
8	David	Yeah.
9	Mike	Fantastic.

The second example in Excerpt 2 is *joint attention* after Helen's gazing at an object, a

monitor. While Helen was putting an oxygen mask on KSP, Mike was explaining medical procedures to KSP in lines 1 to 9, and then said in line 11, 'and hopefully that will help to get rid of some the= help get rid of some of the pain'. Helen used her eye gazing at the monitor placed near Mike, which seemed to indicate that he should watch the monitor without disturbing Mike's talk to KSP (Figure 4-1). Then, Mike noticed her *show action* and looked at the monitor, which completed their *joint attention*.

Excerpt 2: Helen's Show Action at 00:02:57

1	Mike	what we're gonna do now is put a little, little needle into your arm and give you some morphine for the pain.
2	KSP	oh yeah
3	Mike	the nurses are just giving you some oxygen, so we'll probably=
4	KSP	yeah
5	Mike	take over your face.
6	KSP	argh
7	Mike	+ don't want your glasses to get in the way.
8	KSP	yeah
9	Mike	Okay, and we are going to give you some aspirin as well +
10	KSP	okay <$E> Helen's *Show action* (Fig. 4-1) </$E>
11	Mike	=+ and hopefully that will help to get rid of some the= help get rid of some of the pain.
12	KSP	Argh will it take long? <$E> *Joint attention* (Fig.4-2) </$E>
13	Mike	Er no not long at all.

Figure 4-1：Helen's show action by gaze

Figure 4-2: Joint attention on the monitor

In Extract 2, Helen's show action led Mike's nonverbal action, looking at the monitor, while he kept talking to KSP. Here, Mike engaged in communications in two channels simultaneously, one with KSP verbally and another with Helen nonverbally, which enabled

Mike to be aware of KSP's saturation level on the monitor, while at the same time maintaining his talk with KSP's inquiries.

The other case was joint attention between Helen and Mike, which was led by Mike's utterance. In Excerpt 3, Mike was reading the dosage of morphine which was written on the small bottle, trying to give it to KSP. However, he did not know the dose, so he asked Helen for help in line 1, uttering 'Ten milligrams 1 mil I don't know the dose of morphine that we should give him' (Figure 5-1). Responding to Mike's utterance, Helen came to Mike, looking at the morphine together with Mike, and then answered in line 2, 'It should be erm= <$H> water injection </$H> nine in one' (Figure 5-2). This is the third pattern where joint attention was accomplished by the shower's utterance.

Excerpt 3: Mike and Helen's Joint Attention at 00:05:45

1	→	Mike	Ten milligrams 1 mil I don't know the dose of morphine that we should give him. <$E> *Show action* (Fig. 5-1) </$E>
2	→	Helen	It should be erm= <$E> *Joint attention* (Fig.5-2) </$E> water injection nine in one.
3		Pause	(1.0)
4		Mike	okay

Figure 5-1:
Mike's show action with an utterance

Figure 5-2:
Joint attention on the morphine

In Extract 3, Mike's verbal action (mentioning his not knowing the dose) led Helen's nonverbal action, looking at the bottle, then eventually confirming the dose. In this case, an HCP's verbal action prompted the other HCP's nonverbal response.

4 Conclusion

This preliminary study focused on practices of *join attention* in HCPs in emergency care training. In the data, *joint attention* was led

by three preceding practices: (1) shower's *show-action*, (2) shower's gazing at an object, and (3) shower's vocalisation to draw a recipient's attention to an object. Through HCPs' use of *show-action*, the shower's understanding of the situation became observable to others, simultaneously prompting a recipient's action. By so doing, HCPs seem to confirm the medical procedures they are going to perform and raise awareness of the patient's conditions. This could be a crucial area for the assessment of team quality in emergency care, as Zheng, Taylor, & Swanstrom (2009) suggest that eye gaze and anticipatory movement are two 'valuable behavioural markers' to assess term performance in the operating theatre (also cited in Weldon, Korkiakangas, Bezemer, & Kneebone, 2013). Although the data in this study was collected in the UK, the method developed here could be applicable to the analysis of emergency care interaction in Japan and other places. Further research on gaze analysis in emergency care with a larger data set is necessary using the research method established here, which has potential for adding finer descriptions of the interaction.

Notes

[1] All names are pseudonyms.

[2] The annotation system of the Cambridge and Nottingham Corpus of Discourse in English (CANCODE) (Adolphs, 2006, pp. 134-135) was applied to the transcript. The plus symbol + indicates a continuous sentence and the equal symbol = signals an unfinished sentence. <$G?> indicates inaudible sounds and <$E>…</$E> shows extralinguistic information. (2.0) indicates an interval between utterances (2 seconds in this case).

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Ethics approval

The Ethics Committee of the University of Nottingham approved the study.

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