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The Cancode interaction analysis system in the oncological setting: reliability and validity of video and audio tape coding

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Abstract

Cancode is a computerized interaction analysis system developed for cancer consultations. This paper assesses its reliability and validity, and compares the use of audio versus video tape; by assessing 30 consultations between an actor and 10 oncologists. Weighted Kappa inter- and intra-rater scores ranged from 0.5 to 1.0 and 0.58–1.0, respectively, and use of video tape did not alter verbal coding. Factor analysis of verbal codes revealed two factors, 'verbal control' and 'verbal support'. Verbal and non-verbal doctor behavior differed by patient type ('verbal support' $P = 0.007$, 'verbal control' $P = 0.004$, 'Responsiveness' $P = 0.000$, and 'Immediacy' $P = 0.000$). Inter-doctor variation was noted for 'verbal support' ($P = 0.000$) and 'Relaxation' ($P = 0.000$). 'Responsiveness' was negatively correlated with 'verbal support' (-0.58) and 'verbal control' (-0.65). Cancode is reliable, valid and sensitive to doctors behavioral changes. For a more passive patient, the doctor may switch from a 'cure' to 'care' oriented consult, responding to psycho-social instead of informational needs.

Keywords: Verbal; Non-verbal; Communication; Interaction analysis; Coding; Oncology

1. Introduction

The importance of good communication in the medical consultation arises from strong associations with patient and doctor outcomes. Patient satisfaction, psychological well-being [1], adherence to treatment [2], recall and understanding of information, and health outcomes have all been linked to doctor communication [3–8]. Aspects of communication have also been linked to prescribing practice, doctor 'burnout', and malpractice claims [9–11]. Communication may be particularly important in cancer consultations, which involve complex and emotive issues.

Doctors vary in their ability to recognize and respond appropriately to patients' needs. Communication skills do not improve with experience, and require appropriate training [12]. Current and ideal practice in the clinical encounter, and what constitutes effective communication training, are growing research areas [13–15]. Research and clinical application in this area require ways of accurately/reproducibly documenting doctor–patient interaction. This paper reports on the development of a cancer-specific consultation interaction analysis system (Cancode) and presents data on its reliability and validity.

1.1. Interaction analysis systems for communication analysis

Several interaction analysis systems (IASs) have been developed to analyze the medical encounter. Two types of IAS can be identified: 'cure' systems, which describe task oriented behavior, and 'care' systems, measuring socio-emotional behavior. Observation instruments also differ with regard to clinical relevance to a particular specialty, coding technique, and behavior encoded (verbal, non-verbal or both) [16].

Ong et al. [16] conducted a systematic review identifying 12 IAS. Recent literature revealed only two new systems: CN-LOGIT [17] and The Medical Interaction Process System (MIPS) [18]. The most commonly applied system is the Roter Interaction Analysis System (RIAS) [19]. Seven of the interaction analysis systems have been applied in the cancer setting [17–24]. Only the RIAS, MIPS and CN-LOGIT have been assessed for both reliability and validity.

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In the RIAS each statement made is coded under a number of mutually exclusive categories, covering several dimensions. The RIAS incorporates instrumental (giving information, asking questions and counseling, asking clarifications, giving directions) as well as socio-emotional information (verbal attentiveness, showing concern, social behavior and disagreement). Additionally, global ratings of anger, anxiety, dominance, interest, responsiveness and warmth are allocated [25,26]. It is a reliable and valid IAS [19]. This system was first applied in the general practice environment [11,27–29], then in other areas such as diabetes management [30], women's health [31], prenatal care [32], nursing [33], and more recently in the oncological setting [19,34]. It has proven flexible in comprehensive analysis of communication content in various settings [25].

The MIPS is a coding system adapted from the RIAS, designed specifically for the cancer setting. It has good convergent validity, and good inter-rater reliability [18].

CN-LOGIT is composed of three parts: (1) micro-level analysis in real time, retaining the sequence of events, (2) event counts, and (3) macro-level analysis of consultation style and affect. The consultation is divided into units of speech, which change when a person stops speaking or changes speech content. The coder gives each unit of speech four codes (marked on the transcript) whilst listening to the audio tape and looking at the transcript. The first is 'source' (doctor, patient or third party), the second 'process' (open and closed questions, initiated statements and responses to questions), the third 'content' (diagnosis, prognosis, treatment, medical history and presenting symptoms, other medical matters, social matters, and other), and the fourth, emotional tone (friendly/warm, tense/ anxious, sad/depressed, frustrated/angry or matter of fact). The coder enters the codes by keyboard into a specially designed software package while listening to the audio tape in real time. The space bar marks the end of each speech segment. The software is easily installed onto most computers. The computer calculates the time spent for each individual code, combination of codes, and the total consultation, as well as the number of times each code or combination of codes appears. Thus the computer sums the data into higher order categories (e.g. all codes for diagnosis regardless of process). The CN-LOGIT system is able to process the resultant data sheet automatically to a spreadsheet in the Statistical Package for the Social Sciences (SPSS) for further analysis. A number of consultations can be coded under a project name and then transferred to the same large database. An advantage of CN-LOGIT is the recording of information as frequency of speech segments, as well as time length for a particular code. Given that event sequence is retained, information about sequence patterns could be utilized in interaction analysis, however, this has not yet been attempted. This interaction analysis system was shown to be valid and to have good inter- and intra-rater reliability [17,24].

Table 1
Cancode structure

Dimension 1: Source
1 Doctor
2 Patient
3 Other (eg. family member)
4 Other health professional
5 Physical exam (no speaker)
Dimension 2: Content
1 History/symptoms
2 Diagnosis
3 Prognosis
4 Treatment
5 Other medical
6 Psycho-social issues
7 Social support/counseling/stress management
8 Social exchange
9 Other/non-specific
Dimension 3: Function
1 Disclose
2 Advise/recommend/influence
3 Question (open)
4 Question (closed)
5 Question (leading)
6 Question (multiple)
7 Label/judge/criticize
8 Express feelings/seek reassurance
9 Inform/educate
10 Actively support/empathize/reflect/reassure
11 Partnership build: confirm/agree/socialize
12 Check patient understanding
Dimension 4: Emotion
1 Positive/friendly/warm
2 Tense/anxious/afraid
3 Sad/depressed
4 Matter of fact
5 Frustrated
6 Angry/annoyed

CN-LOGIT has been adapted into a more reliable and valid system called Cancode, which provides a more comprehensive view of the interaction, encompassing more coding possibilities within the same four categories, source, content, function and emotion (see Table 1). Cancode is otherwise coded and operated in the same way as CN-LOGIT. While CN-LOGIT has been shown to be a reliable and valid IAS, the reliability and validity of Cancode has not yet been formally assessed.

1.2. The impact of visual input on communication coding

All IAS require considerable resources to code large study samples. Using audio tape is less expensive than video recordings. It is also well known that audio tapes are a useful source of information for the patient following their cancer consultation [35]. However, visual cues may increase the sensitivity and validity of verbal codes, and non-verbal behavior itself is known to play a highly significant role in communication. Only 7% of emotional communication is thought to be conveyed verbally, 22% to be provided by

voice tone and 55% by visual cues like eye contact and body positioning [36]. Several studies have reported that emotional information is the dimension of communication most related to the patient outcomes of satisfaction and quality of life [7,36,37]. The cancer consultation is particularly strong in emotionally laden information, and anxiety, promoting for many patients [38]. As a consequence, patients may look for cues to find out what they ought to be feeling or thinking. Also, most patients are active in searching for information about their disease, and non-verbal communication 'leaks' can transport information that is not meant to be transmitted [39]. Patients are very sensitive to these issues, and to inconsistencies between physician's verbal and non-verbal communication [40]. Thus non-verbal behavior, including visual cues is likely to be significant in this context.

Using audio tape, an IAS is capable of assessing the emotional content conveyed verbally and by voice tone, by the above percentages possibly missing up to 55% of emotional information. With Cancode, some difficulty has been encountered recording emotional content expressed by a doctor and to a lesser degree by the patient. Across a sample of some 300 consultations with 10 doctors, emotional tone was most commonly coded as emotion category 'matter of fact', likely reflecting the doctor's consistent clinical manner and the patient's attempt to behave in a socially acceptable, formal manner. The RIAS codes affect, based on voice tone, in global ratings [25,26], which may be more sensitive and valid.

Previous studies using visual information have focused on one or two aspects of non-verbal communication, e.g. physical proximity, time spent chart reviewing [41], time looking at patient, showing interest [27], sitting down while talking, or touching patient [42]. Further, these non-verbal behavioral assessments are sometimes restricted to observations of patients' and not doctors' behavior [16]. With a view to investigate sensitive methods of assessing the emotional content so important to the cancer consultation, it was considered important to further explore non-verbal communication.

The contribution of non-verbal stimuli to analysis of doctor patient communication should be assessed for two reasons. Firstly, it needs to be determined if visual cues alter standard verbal communication codes. This has previously been addressed by Weingarten et al., who found that when coding for patient centredness, $<5\%$ of information was lost when using audio tape [43]; however, it is not known to what extent other codes (such as process codes) are influenced by visual cues.

Secondly, it is important to establish what unique information can be gained from visual cues, and whether this increases the sensitivity of the IAS. The contribution of non-verbal stimuli to the analysis of doctor–patient communication should be assessed, so that informed decisions can be made about the cost-effectiveness of including videotaped material and more extensive coding of non-verbal elements.

2. Aims

The goals of this study were to (a) establish the reliability and validity of Cancode, (b) explore whether verbal coding differs using video tapes versus audio tapes, and (c) investigate the additional information provided by non-verbal coding. To cover these aims three hypotheses were developed:

1. Doctors' verbal behavior (doctor centredness, doctor provision of medical information and psycho-social exchange) will change in response to controlled patient conditions (active, passive, intermediate) and Cancode will be sensitive to these predicted changes.
2. Verbal coding of audio tapes using Cancode will not differ to verbal coding obtained by using video tapes.
3. Non-verbal coding can be applied to the same consultations, providing an additional element of coding to that gathered by Cancode.

3. Methodology

3.1. Sample population

Ten Oncologists with minimum 10 years specialist experience were recruited from the Sydney region. See Table 2 for a summary of their demographics.

3.2. Procedure

Consultations between a single actor–patient and 10 clinicians were videotaped as well as audio taped. The actor was trained to play the role of a patient with early stage breast cancer, who had recently undergone surgical treatment. She enacted in random sequence, three different participation styles:

(a) An active patient, who asked many questions and wanted to make the final decision about treatment. The actor attempted to seize verbal control, constantly restated her agenda, interrupted the doctor, and exhibited a 'tight lipped' manner with crossed arms and legs to reflect her anxious and controlling nature. She also expressed her verbal distress and raised emotional issues.

Table 2
Demographics of Doctors involved

Dr	Sex	Age	Occupation
1	Female	<50	Radiation oncologist
2	Female	<50	Radiation oncologist
3	Male	>50	Surgeon
4	Male	>50	Surgeon
5	Male	<50	Surgeon
6	Male	<50	Radiation oncologist
7	Male	<50	Radiation oncologist
8	Male	<50	Medical oncologist
9	Male	<50	Surgeon
10	Male	>50	Radiation oncologist

(b) A passive patient, who did not ask questions, happy to leave all the decisions to the doctor. This condition was enacted by adopting a restricted body movement and posture, along with little spontaneous speech, provision of yes/no answers, not stating agenda, not interrupting, not indicating treatment preference, and attempting to defer the decision to the doctor. She was also visibly anxious and weepy and not able to freely verbalize emotional distress.
(c) A patient who asked some questions and wanted the final treatment decision to be made jointly. The actor played this role as intermediate to the passive and active patients.

These patient typologies were developed based on a literature review and a consensus process with a panel of medical oncologists and psychologists [44]. The range of patient types was selected to establish whether Cancode is sensitive to a range of doctor behavioral responses. The doctor was blinded to the condition the patient was enacting, which was presented in random order, however, there was an obvious distinction between the three roles played by the actor, identifiable by multiple behavioral/language cues.

Doctors were provided with a referral letter the day prior to the video taping. This outlined the patient's medical history, results of her pathology report, and the outcome of her surgery. Doctors were advised to discuss adjuvant therapy with the patient, and these consultations took place in their clinic room. The doctors were asked to discuss diagnosis, then treatment, then prognostic information, for approximately 5 min each, after which time the consultation would end. If doctors had not moved to discussion of treatment after 5 min they were asked to begin this aspect. Similarly, if after 10 min they had not moved on to discussion of prognosis they were again asked to move on. Following the first patient participation style, doctors relaxed for a few minutes and then the second consultation was recorded. The third was recorded in a similar fashion. This process produced thirty standardized consultations of approximately equal length and content break up, with 10 in each condition.

3.3. Coding

The consultations were transcribed, then a single coder applied Cancode using the standard procedure of listening to audio tapes whilst reading and marking codes onto the transcripts. After 3 months, 10 of the 30 consultations, randomly selected, were recoded by the same coder, using unmarked transcripts while watching video recordings. This was done to see whether the additional input of the video altered the coding in any way. Audio coding always preceded video coding, as it was felt likely that visual stimuli would be retained in memory longer than audio stimuli and would therefore be more likely to influence subsequent coding. It was hoped a 3-month gap would be sufficient to ensure the coder had forgotten codes given based on audio coding, and thus minimize ordering bias.

To establish intra-rater reliability of audio tape coding, after another time lag of 3 months, the first coder recoded 10, unmarked transcribed consultations, randomly selected from the remaining 20, while listening to the audio tape. In a similar fashion, to establish inter-rater reliability of audio tape coding, a second coder coded 10 randomly selected unmarked transcribed consultations using audio tapes. Finally, to establish intra-rater reliability of Cancode using video, the first coder recorded the 10 transcripts that had been previously coded from video, again, while watching the video. Video inter-rater reliability was not planned, as the major part of the study was conducted using audio tapes, and Cancode is designed for audio tape.

The possible bias introduced by not blinding the coder is acknowledged, however, in order to analyze differences in doctor behavior between the three patient conditions, it was deemed important to have a consistent coder. The coder was experienced in using the system, having previously coded a sample of 300 oncological consultations of half-an-hour length using Cancode. It is hoped that the method of coding, which focuses on the content and function of each speech segment, would minimize bias introduced by coder awareness of global differences between consultations.

To explore the unique features added by visual stimuli, all 30 consultations were coded while watching videos according to Mehrabian's classification of non-verbal communication/behavior. Mehrabian's coding system appears to be the most comprehensive non-verbal coding system, involving the assessment of behavior along three domains; 'immediacy', the degree of closeness between the persons engaged, 'relaxation', the degree of postural relaxation/tension exhibited by the communicator, and 'responsiveness', the extent of awareness and reaction to the other person [45]. An empirical study by Larsen and Smith utilized Mehrabian's approach in the most systematic fashion of any non-verbal analysis thus far [37]. Scores are assigned on a coding sheet in 40-s intervals for each of 15 criterion (see Table 3). An average score across 10 intervals is then obtained to provide a separate score for immediacy, relaxation and responsiveness.

3.4. Analysis

To investigate inter- and intra-rater reliability all codes in a consultation were tallied and compared via cross tabulation in each of the three domains. Weighted Kappa scores were calculated for original and re-coding separately for both audio and video coding.

To investigate doctor behavior in response to the three study conditions, 10 Cancode summary variables of particular interest were selected for analysis. With two people present, a total number of codes of 2 by 9 by 12 by 6, or 1296 coding combinations, are possible in Cancode (although not all combinations occur often or would be

Table 3
Coding Schema for Non verbal information adapted from Mehrabian's system [45]

Immediacy	Relaxation	Responsiveness
Touching	**Asymmetry in arm position**	**Facial Activity**
5 Touch	3 Arms draped over desk/asymmetric	3 Over expressive movements/exaggerated expression
0 No touch	2 Moderate asymmetry	2 Expressive face
	1 Both arms in lap/slight asymmetry	1 Diminished facial movements
Distance	0 Arms symmetrical and midline	
4 < 2 feet		**Vocal Activity**
3 2–3 feet	**Sideways lean**	On a scale of 1–5 where 1 is a flat voice and 5 has great tonal variation.
2 3–6 feet	4 61–90 degrees	
1 6–10 feet	2 31–60 degrees	**Speech rate**
0 >10 feet	1 1–30 degrees	Recorded as the number of words spoken during a forty second segment and then averaged across ten segments.
Observation	0 No sideways lean	
2 Observes face directly	**Leg position asymmetry**	**Speech Volume**
0 Does not observe face directly	3 Legs crossed	3 Raised voice
	2 One foot forward on floor	2 Neutral volume
Body Orientation	0 Insteps touching on floor	1 Lowered voice
4 Directly facing		
2 0–45 degrees away	**Relaxation of hands**	
1 45–89 degrees away	2 Very relaxed	
0 90 degrees away	1 Moderately relaxed/ loose	
−1 91–135 degrees away	0 Tense	
−2 136–179 degrees away		
−4 180 degrees away	**Relaxation of neck**	
	2 Chin in hands	
	1 Not supported, gaze ahead	
	0 Not supported, gaze elevated	
	Backward lean (reclining angle) This score is the negative of that recorded for forward lean.	

Note: Scores are given for each sub category, and then added for the three measures as a summary score.

meaningful). Given the limited sample size, hypotheses derived from the doctor–patient communication literature were formed to provide a narrower framework. These hypotheses proposed that doctor centredness, doctor provision of medical information and psycho-social exchange may vary between different patients. Indicator variables were created to test these hypotheses, which included:

1. *Doctor centredness ratio* (*time*): The ratio between the total amount of time the doctor speaks and the patient speaks.
2. *Doctor centredness ratio* (*number of events*): The ratio between the number of utterances the doctor makes compared to the patient.
3. *Number of changeovers*: The number of times the speaker changes.
4. *Information about diagnosis*: Time the doctor spends informing about diagnosis.
5. *Information about prognosis*: Time the doctor spends informing about prognosis.
6. *Information about treatment*: Time the doctor spends informing about treatment.
7. *Discussion of psycho-social issues*: Time spent discussing psycho-social issues.
8. *Provision of social support*: Time spent discussing available social supports.
9. *Active support*: Time spent verbalizing active support to the patient.
10. *Checking of understanding*: Time spent actively making sure the patient understands the content of the consultation.

Scores 1–3 provide information about doctor centredness. While conceptually linked, each provides unique information. The ratio of doctor to patient speech may be 1 as measured by events and 3 as measured by time, if the doctor is spending three times as long speaking, but the patient is regularly making short statements/questions. The number of changeovers indicates how interactive the consultation is. These variables were correlated in this sample (0.8497, −0.747 and −0.836 between Dr./pt ratios for time and events, Dr./pt ratio for time and number of changeovers and Dr./ pt ratio for number of events and number of changeovers, respectively). However, these correlations were not perfect and variables are conceptually different, so it was deemed important to include them all in the factor analysis. Scores 4–6 provide information about the provision of medical information, while Scores 7–10 are indicators of a psycho-social focus.

A factor analysis of these 10 variables was conducted. Analyses of variance were carried out to compare verbal and non-verbal doctor behavior (factor scores) within the three

Table 4
Weighted kappa scores

	Content	Function
Audio Inter-rater	0.59	0.50
Audio Intra-rater	0.86	0.80
Video Intra-rater	0.79	0.58
Video vs Audio	0.77	0.72

Note: Fleiss Kappa Benchmark [46], 0.75 and above = excellent, 0.4–0.75 = fair to good, below 0.4 = poor/recode.

conditions. Verbal and non-verbal scores were correlated to determine whether non-verbal scoring was measuring something similar to verbal scoring.

4. Results

4.1. Comparison between audio tape and video tape verbal analysis

Weighted Kappa scores for inter-rater reliability in audio tape coding were 0.50 for function and 0.59 for content. Intra-rater reliability using audio tapes was 0.86 for content and 0.80 for function. Intra-rater reliability for video tape coding was 0.79 for content and 0.58 for function. Comparing video tape coding to audio coding weighted Kappa scores within the same coder were 0.77 for content and 0.72 for function (see Table 4). Source was universally agreed upon, as there were only ever two speakers present and it was never unclear which was which.

4.2. Results of verbal and non-verbal quantitative analysis for different patient types

4.2.1. Analysis of doctor's verbal scores

The 10 verbal scores were standardized since they were originally expressed in different units. For example, some variables measured time, others a ratio of time, while still others reflected frequency with which a communication variable occurred. Standardization was achieved by expressing each score for each of the 30 cases as a percentage of the average score for that variable across all cases. Thus a high score indicates a greater frequency/time for that behavior than was average for the group, while a low score indicates a lower frequency/time than the average. This ensured that factor scores reflected all of the contributing variables equally rather than being dominated by those with higher raw scores. Standardized scores were subjected to a principal component analysis with oblimin rotation to explore the underlying factor structure and decrease the number of variables tested. Two components were extracted, explaining 63% of the total variance. The first, termed "verbal control of the consultation", explained 40.51% of the variance; the second, termed "verbal support in the consultation", explained a further 22.96% of the variance (see Table 5). The first factor describes a more doctor centered consultation with fewer changeovers, and less information provided by the doctor about diagnosis and prognosis. The second factor describes a more socially supportive consultation with more active support of the patient, provision of more psycho-social information and less information about treatment. A summary score for each of these two factors was generated for each of the 30 cases by adding standardized scores. Descriptive statistics for verbal as well as non-verbal summary scores are shown in Table 6.

Table 5
Factor analysis of verbal doctor communication variables, revealing two components

	Verbal control	Verbal support
1. Dr. centredness ratio (time)	+0.898	
2. Dr. centredness ratio (no. events)	+0.922	
3. Number changeovers	–0.914	
4. Inform about diagnosis	–0.699	
5. Inform about prognosis	–0.414	
6. Inform about treatment		–0.710
7. Actively support		+0.784
8. Discuss psychosocial		+0.732
9. Provides social support		+0.884
10. Checks understanding	+0.733	

Significant differences were found between patient types for both "total verbal control" ($F(2, 29) = 33.22$, $P = 0.000$) and "total verbal support" ($F(2, 29) = 9.58$, $P = 0.001$). There was also a significant difference between doctors for "total verbal support" ($F(9, 29) = 8.84$, $P = 0.000$). For both variables assessing differences between patients, linear contrasts showed differences on passive and active patient group comparisons, passive and intermediate patient comparisons, but not the intermediate and active patient comparisons. See Table 7 for results.

Table 6
Descriptive Statistics for analysis of summary scores in verbal and non verbal analysis

	N	Min.	Max.	Mean *Passive*	Mean *Intermediate*	Mean *Active*	Mean *Overall*	Standard Deviation
Total verbal support[a]	30	−162	2098	442	141	10	197	447
Total verbal control[a]	29	−418	674	390	−134	−240	−8	321
Immediacy	27	45	105	74	67	67	69	15
Relaxation	27	23	69	38	40	39	39	12
Responsiveness	27	84	111	92	103	105	100	8

[a] These are the descriptive statistics for standardized scores, adding variables according to factors described in Table 5. Where the factor analysis described a negative loading scores were subtracted thus explaining the possibility of negative scores.

Table 7
Results of Analysis of Variance comparing "verbal control" and "verbal support", as well as non verbal measures, between (a) doctors and (b) patient conditions, including effect size and significance of contrasts for patient groups

Source	Variable	df	MS	F	p[a]	Power	Effect size [b]	Contrasts[c]		
								3 vs 1	3 vs 2	1 vs 2
Doctor	Verbal control	9	30358	1.040	0.45	0.346				
	Verbal support	**9**	**433599**	**8.482**	**0.000**	**1.000**	**1.6**			
	Immediacy	**8**	**507.2**	**7.09**	**0.000**	**0.997**	**1.45**			
	Relaxation	**8**	**419.7**	**16.71**	**0.000**	**1.000**	**2.22**			
	Responsiveness	8	34.9	1.56	0.214	0.485				
Patient	**Verbal control**	**2**	**969640**	**33.222**	**0.000**	**1.000**	**1.51**	**0.000**	0.180	**0.000**
	Verbal support	**2**	**489903**	**9.584**	**0.000**	**0.958**	**0.75**	**0.000**	0.213	0.008
	Immediacy	2	133.4	1.87	0.187	0.331				
	Relaxation	2	8.4	0.336	0.719	0.095				
	Responsiveness	**2**	**470.4**	**20.99**	**0.000**	**1.000**	**1.247**	**0.000**	**0.000**	0.347

[a] Significant results are highlighted in bold.
[b] These effect sizes are high, thus strengthen the results despite small sample size
[c] 1 represents an active patient that asks lots of questions, 2 an intermediate, and 3 a passive patient. Contrasts were only performed on significant results for the patient group, since this was the controlled variable, and doctors were fairly homogenous, thus do not have groups to compare.

4.2.2. Analysis of doctor's non-verbal scores

The three components of non-verbal communication were compared using analysis of variance. Video recording failed for one doctor, hence results were obtained for nine doctors across the three groups on these variables. Immediacy was significantly different between doctors ($F(8, 26) = 7.09$, $P = 0.000$) as was relaxation ($F(8, 26) = 16.71$, $P = 0.000$). Neither of these were significantly different between conditions. Doctors responsiveness was significantly different between condition ($F(2, 26) = 20.99$, $P = 0.000$), but not between doctors. Linear contrasts on responsiveness showed significant differences between the active and passive, and intermediate and passive conditions, but not the intermediate and active comparisons. See Table 7 for a summary of results.

4.2.3. Correlation between verbal and non-verbal measures

Verbal control and support were both negatively correlated with responsiveness, at −0.65 and −0.58, respectively. Correlations are shown in Table 8.

4.2.4. Power analysis

We conducted a power analysis to determine effect size. Power for the study was good, despite relatively small sample size. For differences between conditions, effect sizes were 1.51 for verbal control, 0.75 for verbal support, and 1.247 for responsiveness. For variation among doctors, effect size was 1.6 for verbal support, 1.45 for immediacy and 2.22 for relaxation.

Table 8
Correlations between verbal/ non verbal scores

Comparison Variables	Correlations
Verbal control/ Verbal support	0.26
Verbal control/ Immediacy	0.08
Verbal control/ Relaxation	0.01
Verbal control/ Responsiveness	−0.65
Verbal support/ Immediacy	0.44
Verbal support/ Relaxation	−0.23
Verbal support/ Responsiveness	−0.58

5. Discussion

5.1. Reliability of Cancode

Weighted Kappa scores indicate that the coding system is reliable. Reliability statistics were fair to excellent across all domains. While satisfactory, neither inter- nor intra-rater reliabilities were perfect. It appears the function category is more difficult to code reliably, possibly due to overlap between codes. For example, the difference between disclosing and informing was at times interpreted differently even by the same coder. Video coding had not previously been used with Cancode, and it is likely the visual information provided a distraction, even to the experienced coder, increasing the difficulty of coding verbal behavior. Indeed the coder reported that coding was more difficult and time consuming with video.

5.2. Validity of Cancode

Cancode was sensitive to doctor behavioral changes in response to controlled patient types. The verbal support and the verbal control measures obtained by factor analysis differed between active and passive, as well as intermediate and passive conditions. Thus the validity of the system is supported. In the process of illustrating that Cancode is sensitive to a range of behavior, interesting data was collected concerning the way doctors react to different patient types.

In interpretation it is important to remember the study intent. This is a small sample of doctors, behaving in response to three controlled scenarios with the same actor. It can be stated that these doctors were sensitive to the difference between patient conditions, and altered their behavior as described below. However, they were not responding to actual patients, so one cannot generalize the results to the clinical setting (although doctors did report that patient types were realistic). Furthermore, while the actor was instructed to vary her degree of activity in the consultation, affect also varied between conditions, and it is likely this influenced doctors as much or more than patient activity. Thus it is difficult to assess exactly what triggered changes in doctor behavior.

For the passive patient, doctors tended to provide both more 'verbal support', that is, more discussion of psycho-social information, more emotional support, and less time informing about treatment; and more 'verbal control'; that is, doctors spoke more, with less changeovers between doctor and patient speaking, less time informing about prognosis and diagnosis, and more time checking patient understanding. There were also non-verbal differences in doctor responses to different patient types. Doctors were more "responsive" to the passive patient; they tended to slow down their speech, speak more softly, and have less active facial movements than for the active patient.

The reverse was true for the active patient, where more time was spent talking about treatment, diagnosis and prognosis. The patient spent more time talking, and there were more speaker changeovers. Doctors who spoke to the active patient spent less time checking understanding and providing social support, and spoke more quickly, louder, and with more active facial and vocal movements than those speaking to the passive patient.

5.3. Verbal coding using audio and video stimuli

The second aim of the study was to ascertain whether verbal information would be assessed differently given the input of visual information. Intra-rater reliability scores for audio to audio coding were very similar to those for audio to video coding (see Table 4). This suggests that video tape did not substantially change coding of verbal elements. This is consistent with research by Weingarten et al. [43]. In comparison of patient centredness scores between audio and video coding, Weingarten et al. used Bland and Altmans method, of comparing the mean differences of two scores [43]. This method would be inappropriate for Cancode, which does not record a single score, but multiple scoring possibilities. Weighted Kappas enabled a comparison that showed good to excellent reliability (and hence not much difference between coding scores). When the focus is verbal information, expensive video tape analysis may be unnecessary. This is important with regards to the use of IAS, especially where cost is a priority.

5.4. Additional information provided by non-verbal coding

This is not to deny the potential importance of coding non-verbal behavior via video tape analysis. Effect size for the non-verbal aspect "responsiveness" was on par with the effect size for the verbal measure "total verbal support", and greater than that for "total verbal control". This suggests that non-verbal codes are as sensitive, if not more sensitive to doctor response to different patient types, as verbal measures.

To investigate this further, correlations between verbal and non-verbal measures were explored. Of note are the correlations between verbal scores and responsiveness. These were negative correlations, suggesting that in consultations which were more doctor centered and featured more support, the doctors affect is flattened, with softer speech, less tonal variation, slower speech rate and diminished facial movement. Looking at mean variations between conditions, it is clear that this is what happens in a consultation with a more passive patient. These correlations are high, but not very high, suggesting there are additional elements at play here, which have been recorded by video non-verbal coding. However, many of these elements (tonal variation, speech rate and loudness) could be assessed from an audio tape. Where other non-verbal elements are of interest (such as those elements included in immediacy and relaxation) separate video-based coding may need to be introduced.

5.5. Limitations of Cancode

Cancode is reliable and valid in the context of the cancer patient consultation, however, it is not without problems. Coding is time consuming, although speed improves with practice. Experience shows that five times the consultation length is required to get to the stage of entered data. A training manual has been produced, describing Cancode, and giving examples of how to code different speech segments. The training process may take several weeks.

In addition to logistics, reliability for the domain, 'function', was only fair to good, suggesting a need for refinement. Despite these problems, Cancode has the potential to be useful in widespread application of communication analyses.

5.6. Practice implications

This study provides further evidence for the qualitative results outlined by Brown et al., which indicated that oncologists are responsive and flexible to different patient types [44]. In the latter study, negotiation skills facilitated a shared decision with the active patient, whereas for the passive patient, the response to emotional cues was helpful.

Passive patients may receive more 'care-oriented' information. With these patients doctors more commonly checked

understanding, slowed speech and spoke more softly. In response to an active patient, the doctors' communication behaviors were more 'cure' (treatment) oriented, with less time spent on psycho-social information and more on treatment, diagnosis and prognosis. This responsiveness of clinicians, here quantitatively described may or may not meet the emotional and informational needs of different patients. Further research is necessary to establish which responses to different types of actual patients are most helpful in promoting good patient outcomes.

Individual doctors varied in immediacy, body orientation as well as relaxation. These non-verbal behaviors appear to be trait styles. It is interesting to note that immediacy has been previously linked with patient understanding and satisfaction [37]. Verbal support varied between doctors as well as in response to patient condition, and may be a response to patient behavior, trait style, or a combination of both. Communication skills courses could assess doctors' characteristic trait styles prior to training, in order to tailor teaching more effectively.

6. Summary

This study provides further evidence of the ways in which interaction analysis systems can supply information about the cancer patient consultation. Seeing non-verbal elements whilst coding doctor behavior does not significantly alter coding of verbal information using Cancode, supporting previous findings that audio taped material is adequate for analysis of verbal content of a consultation. In validating Cancode this study has noted differences in behavioral responses by oncologists in response to varying patient scenarios as depicted by an actress. It appears that the more passive/depressed patient triggers in the doctor a reduced affect, and a more care-oriented consultation.

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